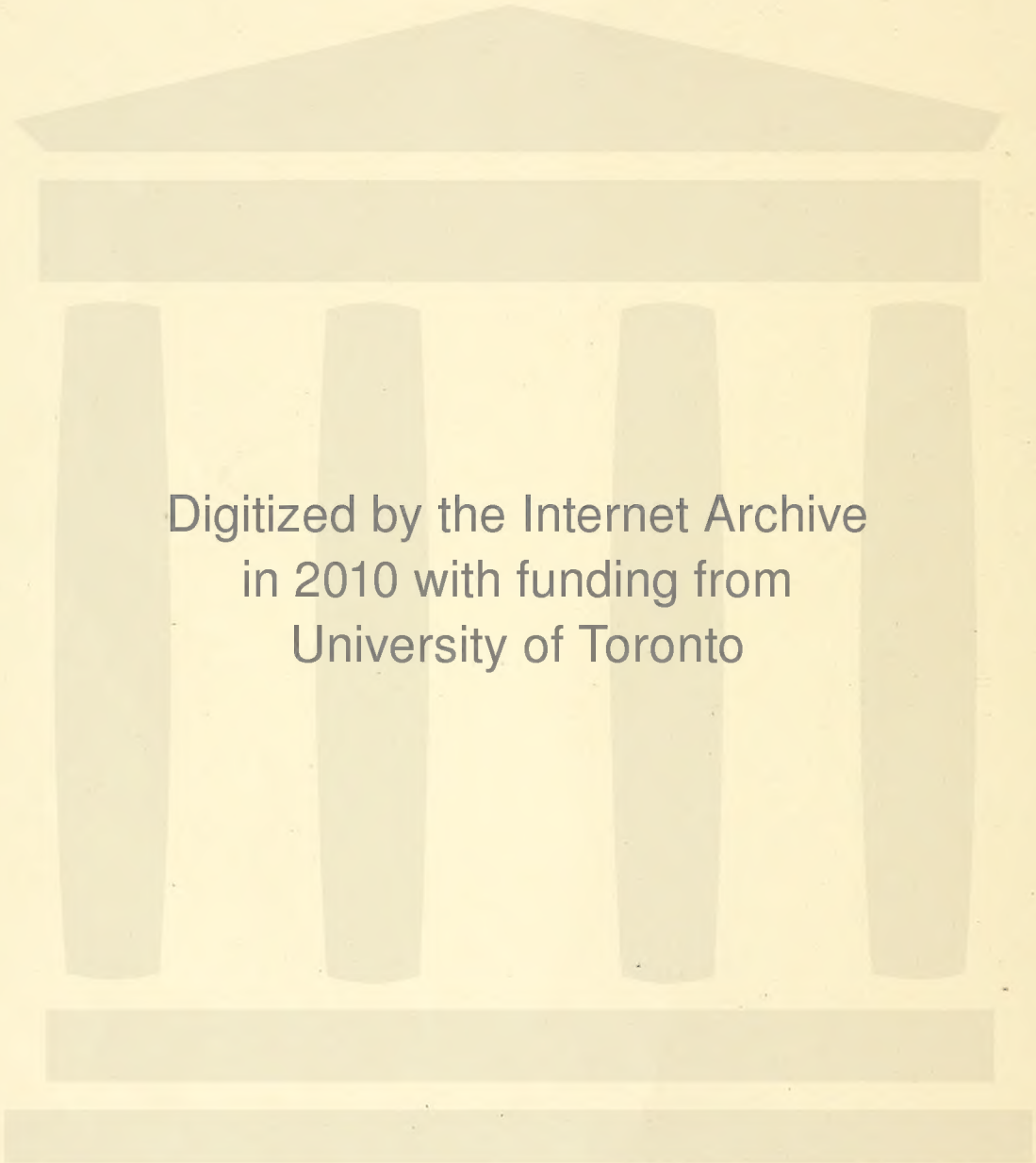
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and Its Practical Applications

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Outstanding Aspects of the Industry

PREDICTIONS and predilections for 1920 have in most cases merely served to confound the prophets and cast doubt on the wisdom of the economists. Starting out happily and heavily laden, with bunkers filled to overflowing and with every prospect of a successful voyage, the ship, badly battered, was just about able to make port. In a wide range of industries deflation has set in, and there have been perceptible slumps in the wool, cotton, grain, iron, leather, sugar, rubber, coffee, lumber and other markets. The electrical industry has not shared their fate and has hardly felt the hand of depression, chiefly for the reason that it has never been in the hands of opportunists. As one manufacturer has aptly expressed it, "Furnishing both material and brains, it has sold the material and given away the brains. Seemingly satisfied with the creation of great wealth for the community, it has reserved for itself but a fraction of what it created." It has therefore enjoyed a gradual growth with medium prosperity, which gives it a position of stability and renders it more or less panic-proof.

ENGINEERING developments during 1920 kept pace with the needs of the country. It is difficult to improve the already high efficiency of most electrical apparatus. Improvements, therefore, have for the most part been along economic rather than technical lines, except in the radio-telegraph field. Interconnections of electric generating and distribution systems continue to grow, and transmission voltages as high as 220,000 are planned. Recent legislation has given impetus to water-power development, and high-pressure steam stations established at mines, wherever feasible, are coming into vogue. Official studies are also under way for super-power zones which are fraught with great economic possibilities. These developments, however, are evolutionary rather than revolutionary. There is growing appreciation on the part of engineers of their duty to the public, and this has led to the formation of the council of the Federated American Engineering Societies, whose function it is to develop this national sense of engineering and its relations to our great human problems.

THE constant growth in output of the electric light and power companies of the country despite the many and serious obstacles which have confronted them during the past year is the best evidence of the proficiency which characterizes the operation of these public utilities. Of itself this should be a matter of pride to the entire engineering profession; yet, great as is the accomplishment, greater still is the fact that the average cost of electricity remains, as it has remained during the past decade, almost constant. This is phenomenal and indicates the immense possibilities within the industry when better regulatory policies and practices shall unshackle and stimulate the genius and ability of all public utility men.

FINANCIAL problems still overshadow the electrical central stations. The needs for new capital are exceedingly great and the acquisition of it is difficult. Permits for water-power development alone, if they are granted, will tax the ingenuity and skill of manufacturers, executives and operators alike, for they involve 12,000,000 hp. and the expenditure of approximately $2,000,000,000 over and above the normal outlay for improvements and betterments to existing generating and distributing systems. During 1920 about $400,000,000 of new money was raised by electric public utility companies for refunding and other purposes incident to the well-being and expansion of the business. That the amount was insufficient goes without saying—twice that sum could have been used. The outlook for an easier money market, however, is bright, and with the inducements which low-priced public utility securities offer for a fairly high yield more funds will be available.

THE country is suffering somewhat from an embarrassment of riches. We have been blessed with crops of wheat, corn, cotton and other staples more abundant than ever. The best record of the feverish war days has been surpassed by the steam railroads. Our foreign trade has reached an enormous total, establishing not only a new record for the nation but constituting the greatest volume of trade ever attained by any country in any age. What though there be stagnation here and there, it is not symptomatic of the country or of the electrical industry. The world is short of material, and, considering the industrial dislocation occasioned by the war, the derangement of finance, the colossal government debt and other disturbing influences, the natural forces now in operation are not only reassuring in their reactions but are conducive to business stability. It would have been too much to expect that the electrical industry would not respond sympathetically to the fluctuations occurring in other basic industries. Even with the declining business of the past four months the record for the year exceeds by at least 25 per cent the business of 1919 and our factories are still working on unfilled orders. However, the period of readjustment has about run its course and within the next few months it is reasonable to expect an expansion of business that will make all past predictions seem conservative. Factors in this coming expansion are already beginning to appear.



Guy Eastman Tripp

One of the outstanding captains of the electrical industry, an organizer and administrator whose leadership and judgment are frequently sought

SOME men contribute to the advancement of an industry through their research, others through their engineering skill, but there is one small group that makes it possible for the public to enjoy fully the benefits of the vision, skill and brains of the others. To this group belong the executives who direct and guide industrial progress. On such men rests the responsibility for the future development of the electrical industry. No matter how carefully a motor has been designed nor how substantially a dam has been built, the necessary confidence of the public is wanting unless there is a leader at the head of the enterprise. Such a man is Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company. With the Stone & Webster organization, later in the almost hopeless task of reorganizing the badly muddled affairs of the Metropolitan Street Railway system, then as chairman of the board of the Westinghouse interests, and during the war chief in charge of production of ordnance, he has always been able to shake off details, get at the meat of the problem and arrive at a solution which assures success.

As a traveling auditor with Stone & Webster Mr. Tripp attracted such attention that he was soon managing utility properties and divisions and finally became a vice-president. While with Stone & Webster he was appointed chairman of a committee of three to operate the New York City railways, then under receivership. His conspicuous work in that capacity came to the attention of the directors of the Westinghouse company, and after the death of Mr. Mather Mr. Tripp was appointed to his present position. He went to that company while it was emerging from the trials of its receivership at a time when it needed a financier and a student of human nature, with a firm hand and a clear insight, to keep its course straight in the channel of healthy business. How well he has succeeded can be judged from the strong financial position of the company, which in the current fiscal year expects to bill in the neighborhood of one hundred and seventy-five million dollars' worth of goods.

Mr. Tripp was born April 22, 1865, at Wells, Maine, and started to work when a boy. He has achieved success wherever his endeavors have led him because he has mastered the job and stuck to the essentials. When he became an executive he left the details to others, placing responsibility on subordinates and expecting and getting results. He has the faculty of harmonizing conflicting interests and of getting to the heart of things by the most direct route. In the Ordnance Department, where he attained the rank of brigadier-general, he astonished all by the ease with which he cut red tape, decentralized the department and produced results. For his services in this connection the General has been decorated with the distinguished service medal of the United States government.

The Electric Public Utility Outlook

Necessity of Raising Huge Amounts of New Capital Still a Pressing Problem—Millions of Water Horsepower Awaiting Development—Spirit of Good Will Toward the Industry Manifested

By MARTIN J. INSULL
President of the National Electric Light Association

THE year just begun is full of promise for the electric light and power industry. The possibilities will be markedly determined by the degree to which we are able to finance ourselves. For the public good it is expedient that light and power companies be made to function efficiently and be put on a paying basis. They must have adequate equipment and funds for expansion to meet the growing needs of the communities they serve, and their securities must be made attractive to the small investor.

SMALLER INVESTORS DESIRABLE

Large investors, that is to say people with wealth, are not in the market at the present time by reason of the fact that, owing to the very heavy supertaxes on incomes, they feel they can better afford to buy tax-free securities paying a low rate than to take on investments yielding a higher rate but actually producing less on account of taxes. Therefore the investors that we as utility men must rely on more and more are the smaller ones. We must interest them not only as possible suppliers of funds but also as a matter of sound public policy. For that reason the campaigns of good will entered into most generously by the manufacturers of electrical apparatus and supplies and by the National Electric Light Association and other kindred utility organizations ought to go far in building up faith in public utilities and in establishing the indispensability of their service.

NEED OF FURTHER DEVELOPMENTS

Any electric light and power company is worth to the community what it can give it in service. If the utilities are short of equipment or otherwise crippled in distributing electricity the problem is the community's as well as ours. The cost of our inability to render adequate service falls directly on the public.

The electric light and power companies of the country would like to buy more equipment. They need it just as really as the thousands of industries in communities they serve require the electricity that would be generated by it. In addition, vast water powers made available for development by congressional action will require millions of horsepower of apparatus, costing billions of dollars, before the energy of the falling water can be made serviceable to mankind. But with the money market as it is at present, and with existing credit restrictions, the industry is not in a position now to command the funds with which to buy all the equipment it needs unless the public service commissions of the several states permit it to earn more on its present investment.

Of course, public utility managers must show inherent ability and must breathe the spirit of service, but they cannot accomplish the impossible. What they have done in conjunction with their efficient and loyal organizations against heavy odds has been nothing short of marvelous, and it is only just that the public be apprised of the accomplishment.

SERVICE ESSENTIAL TO INDUSTRY

Electric utilities today are vitally essential to the industrial world. Once they were developed beyond the demands on them, but now they cannot meet the offered loads. It is unthinkable, however, that industrial expansion should be checked by lack of electrical facilities. Our power systems will be improved and increased to be adequate to the growing demands of industry. With all the handicaps that have confronted us during 1920, the electric public utilities have produced eight billion kilowatt-hours more energy than they did in 1919 and raised almost half a billion dollars of new money. I submit, therefore, that the electric light and power industry has done, as it will continue to do, its best in serving the country. However, it will need more than ever before the co-operation of the public and the unanimous support of the other branches of the industry.

PUBLIC UTILITY SECURITIES SOUND

The job before us is to educate the smaller investor to put some of his savings into public utility securities. This is ethically just and practically wise from every angle. The movement is, moreover, timely, for never so much as now has there been need of disabusing the American people of their old notions concerning capital generally, and particularly concerning capital invested in the securities of electric light and power companies, regulated as they are by public service commissions and conducted for the public good by men of broad experience and technical skill.

SPIRIT OF GOOD WILL MANIFEST

Already a new spirit toward the electric public utilities is manifesting itself on the part of bankers, public service commissions, business men and the public, and I cannot urge too strongly that we as utility men acquit ourselves as deserving of the confidence and trust thus reposed in us, and that we be imbued and animated by the spirit of service, sufficient and unsurpassable, so that ours shall be the model public utility—young, lusty, enterprising, intrepid, daring and resourceful. That has been our heritage and the basis of our marvelous growth. The least we can do is to pass it on with added honors and luster.

APPEAL TO PUBLIC OPINION

Our appeal lies in a dignified submission of the case to the public will. Provided that that public is properly informed and enlightened, either through our own efforts or the efforts of our friends, our future is secure. That consummation, I am reasonably certain, we shall experience in large measure in 1921.

Interconnection Power-Contract Principles

Contracts Should Not Be Entered Into Except as New Investment Is Made, and Then There Should Be Provision for a Fair Division of Revenue

BY R. S. HALE

Superintendent Special Research Department, Edison Electric Illuminating Company of Boston, Mass.

ELECTRIC power is sold over transmission lines connecting the systems of different companies in two cases. The first case is where the lines are built and ready so that there is no problem of capital expenditure. This condition may be brought about in several ways. Sometimes an old contract has expired, sometimes the capital expenditure is so small that it is disregarded, and sometimes the two companies have got together and said: "Let us make this connection. One of us will build so much and the other will build so much, and then after we have made the connection we will see what we will do about buying or selling energy."

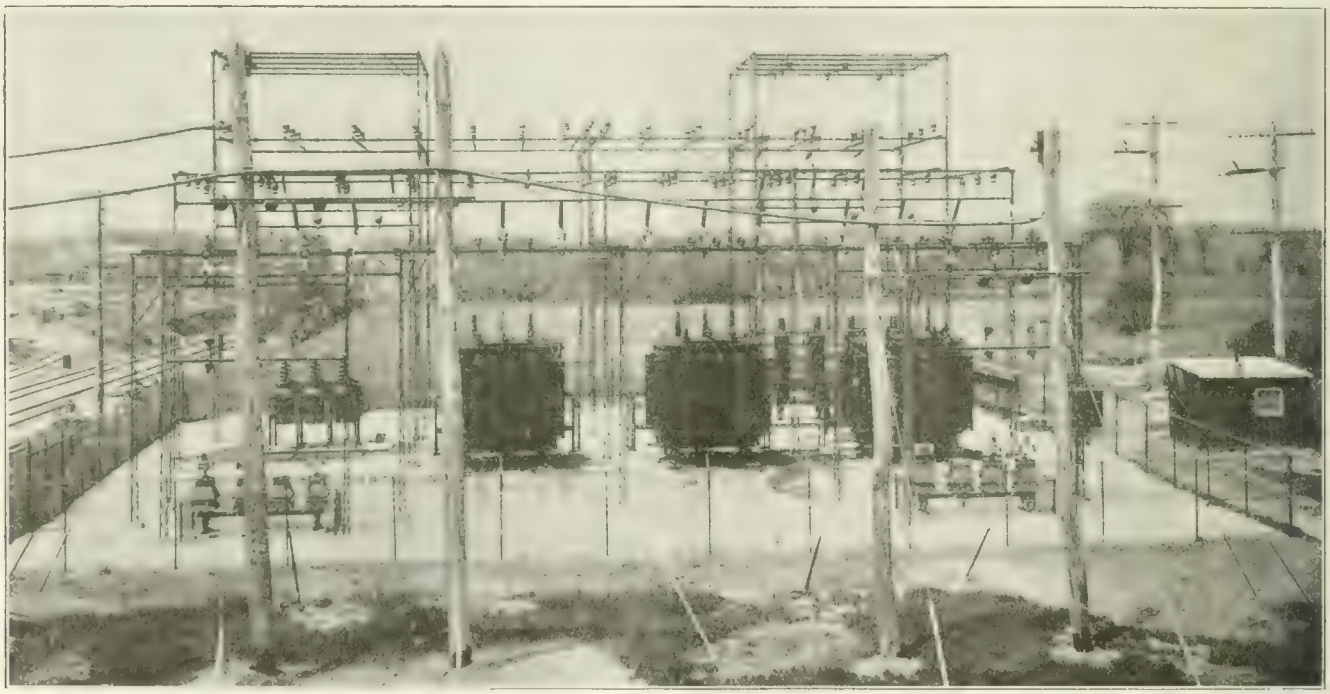
In all these circumstances the best advice in regard to making a contract is the same as the advice of *Punch* to those about to marry: "Don't." The best contract is no contract at all. Let each company state the price at which it will sell, the statement of the price also including the time at which the supply will be available, the amount, and any further requirements as to power factor, load factor or anything else. The price, however, would be subject to change at any time, or perhaps the selling company would say: "This price will stand for a week or a month or a year so that the purchasing company can plan ahead." The prices and conditions, however, would be settled by the selling company and would not be a contract in the ordinary sense of the word, but would be a rate or set of rates.

For instance, the selling company might say:

"The rate is 1 cent, and we can supply up to 5,000 kw. except between 2 p.m. and 6 p.m. If you take only 500,000 kw.-hr. per month or less, there will be no reduction, but for more than 500,000 kw.-hr. per month the rate for the excess will be 9 mills. If you want energy between 2 p.m. and 6 p.m. we can give you 1,000 kw., but you must give us two days' notice so that we can get the boilers ready, must pay us $50 per day extra and must pay an extra half cent for energy taken during those hours."

The selling company could put out rates like these or others with more or less complications and could change them from time to time; but unless there is involved an expenditure for other than operating expenses, what is the need of a contract?

If, however, and this the second case, an expenditure of new money for capital account is involved, then the investing company may feel it necessary to have some agreement so that it may not be left with an idle investment. The principle and practice involved here is much the same as with ordinary sales of power in the cases when an investment is needed. One company makes an investment in hope of selling enough energy to make it a paying one. The company may be and often is willing to "take a chance" without a contract; but, if unwilling to take the risk, what form of contract should it make?



TRANSFORMER STATION WHICH CONNECTS BOSTON EDISON AND NEW ENGLAND POWER COMPANY'S SYSTEMS
During year ended June 30, 1920, the former company sold to the latter 11,560,822 kw.-hr. and purchased in exchange 7,125,257 kw.-hr.

A committee of the National Electric Light Association once made a report on this subject and suggested the following scheme as fully protecting both parties:

Let the purchasing company advance the money and let the investment made with that money become the property of the selling company but be earmarked during the term of the contract for the use of the purchasing company. In the ordinary case of sales of primary power this is accomplished by specifying a number of kilowatts (or kilovolt-amperes) always to be available. In the case of secondary power it would be accomplished by specifying a number of kilowatts to be available for the use of the purchasing company during all except peak hours, which would be defined by the clock or

might be defined by permitting the selling company to shut off, say, 500 or 800 or some other number of hours per year as chosen by itself.

The rate paid for energy taken should be the regular rate that the selling company would charge for energy delivered with its own investment in its own territory, but the money thus paid should be separated into two portions in some defined way, the first portion corresponding to operating expenses and to be retained by the selling company, and the other portion corresponding to the return on the investment and profit, to be returned by the selling company to the purchasing company until the money advanced for the investment shall have been returned with interest. The agreement should be subject to arbitration if circumstances change, and the rate for the power, which would not be in the contract but would be established by the selling company, should also be subject to arbitration.

Such an arrangement absolutely protects both companies, because if no energy is used the selling company has not had to expend any of its own funds since the purchasing company advanced all the money for investment, and as no energy is used there are no operating expenses.

If, on the other hand, energy is used, the selling company has to provide money for operating expenses, but this is covered by the portion of the bill retained, while the balance is returned to the purchasing company until the money advanced is returned with interest.

Theoretically such a contract might be for an indefinite time, since even if the investment was never returned the selling company would in theory still be safe. Practically, however, it seems more reasonable to provide that at the end of say seven years no further return of investment shall be made, but thereafter all the money paid for power shall be retained by the selling company. In any case the total rate for the power should be the regular rate of the selling company, the same as charged in other cases under similar conditions, and should be subject to change by arbitration and not be a part of the contract.

If it is a question of financing, the purchasing company, instead of advancing cash, can provide notes or bonds, which the selling company would place in its treasury. The money returned by the selling company to the purchasing company would then be available for paying the interest and principal on these bonds.

While this is a perfect method, it is not yet in use. Instead, most contracts call for a guarantee, either in dollars or in kilowatt-hours, and such contracts usually work well. If, however, there is any real danger that the purchasing company will not use enough to fulfill its guarantee, then there should be a provision so that the penalty or price paid for the amount not taken under the guarantee would be less than the full rate for energy actually taken, since the selling company would save operating expense on all energy not taken.

In any case the rate for energy should not be part of the contract, but should be subject to change from time to time, with provisions for arbitration—or, what is the same thing, subject to appeal to a utility commission.

In any case contracts should be for as short a term as is considered safe. Short contracts make for long friendships, and even if a capital expenditure is involved, both parties should look forward to getting as soon as possible on the basis of no contract, but selling and buying power at rates according to the existing conditions and subject to revision when conditions change.

Tendencies in the Design of Power Stations

Economies Resulting from the Skillful Arrangement of Station and Layout of Equipment and Operating Tendencies in Boiler and Turbine Rooms

By Peter Junkersfeld
Engineering Manager Stone & Webster, Inc., Boston

THE present and probable future economic condition of the world indicates that greater advances in the field of power-station design are to be expected in the coming years than in those just past. During the last few months the necessity of avoiding waste has been brought home to everybody, and it is not unlikely that economy will be a virtue for some years to come. The public service industry, in which the production of power has reached its highest development, has been restricted in the growth of its normal power supply owing to financial conditions and war-time activities. With the improved conditions, from the central-station point of view, which are undoubtedly soon to prevail, it is to be expected that many additions will be made to present power stations and that a number of new plants will be built. There will then exist the great stimulus to progress—the need for improvement and the opportunity to get it.

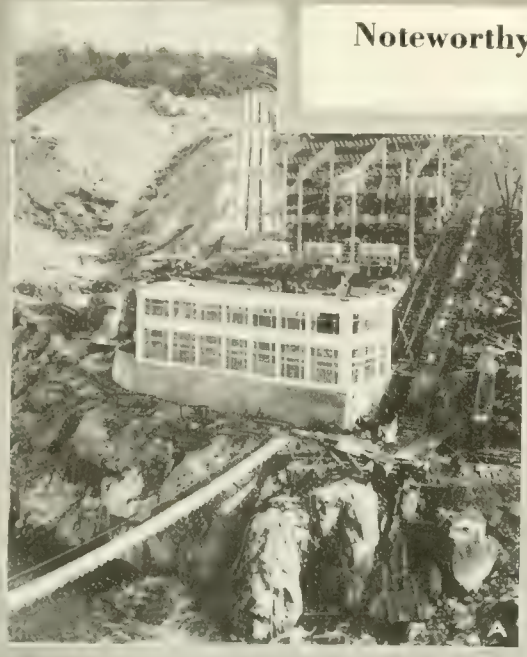
I do not wish to imply that the past year or two have been entirely devoid of progress, for there has been a steady advance to better practice and much thinking as to what will be done when the opportunity offers. There has also been a severe test of equipment to furnish a basis for further progress.

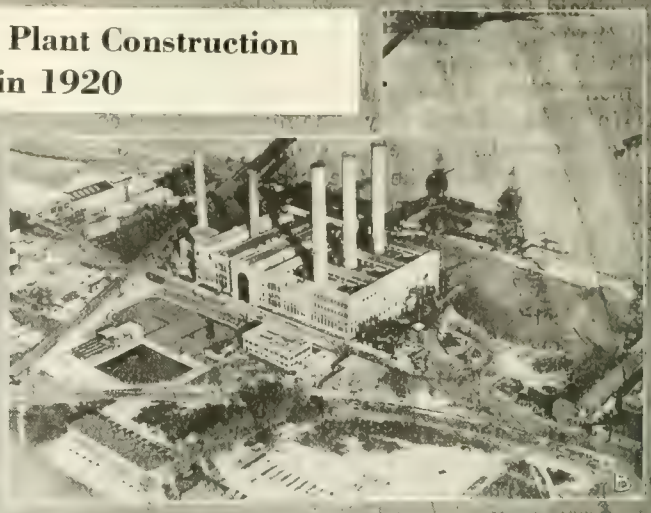
Efficiency Versus First Cost

In the pursuit of the maximum of efficiency designing engineers are always held in check by the cost of reaching it. The recent extremely high price of coal has seemed to justify construction expenditures that would not be permissible with cheap fuel. However, there is always danger of regarding the present as a "normal" period and of going to great lengths to obtain low operating cost without sufficient regard to the possibility of burdening the plant throughout the future with excessive fixed charges. It is, therefore, most important that during the design period a close study of probable operating costs for a long period be made and that these be carefully balanced against the fixed charges. Low operating expense, especially in operating and maintenance labor, can frequently be obtained without additional cost by skillful arrangement of suitable building and equipment. This is something which is always in order and is receiving a great deal of attention.

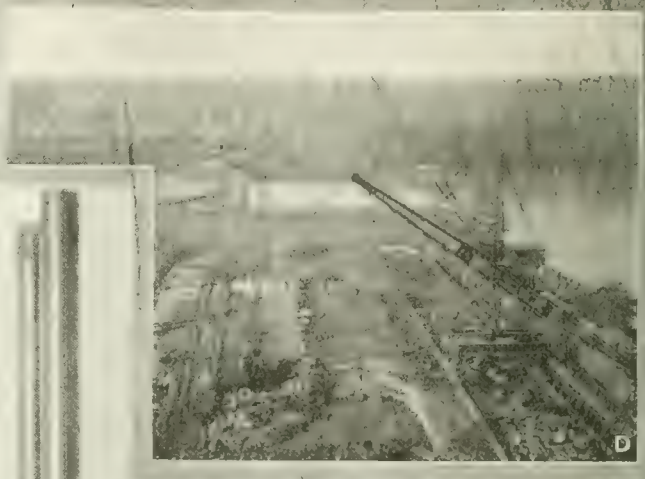
As fuel cost usually represents nearly 80 per cent of the station operating and maintenance expense, efficient boiler operation deserves great consideration. Education of the firemen, an all-important factor, is, of course, outside the province of the plant designer. He can, however, give serious study to the selection of the stoker and the design of the furnace, and he can provide suitable instruments to permit operation of the boilers on a continuous-test basis. The drift toward more general use of large boilers permits the use of instruments on individual units without seemingly prohibitive cost, and it is now becoming common to see coal actually weighed into the stoker hoppers, the feed water input and the

Noteworthy Plant Construction in 1920











A—The 60,000 hp. Kerckhoff plant of San Joaquin Light & Power Corporation, near Fresno, Cal., started Aug. 15, 1920, and completed in fifteen months at cost of about $6,000,000. B—Westport steam generating station of the Consolidated Gas, Electric Light & Power Company of Baltimore, which will have 140,000 kw. installed rating by March 1, 1921. C—Skowhegan 12,750-hp. hydro-electric plant of Central Maine Power Company, formally started Dec. 1, 1920. D—Muscle Shoals (Ala.) dam from the power-house end. The power station will have an initial installation of four 30,000-hp. I. P. Morris waterwheels driving four 20,000-kva. Westinghouse generators. The ultimate rating will be 612,000 hp. E—The Colfax station of the Duquesne Light Company, Pittsburgh. Two 60,000-kw. generating sets are installed, and four more will be added as the load increases.

steam delivery metered, and other instruments and automatic controls installed.

The design of boiler settings now receives much more study in detail than has been the practice in the past. Boilers now are usually set very high. There are several recent instances of the B. & W. type of boilers being set with the bottom of the front header nearly 20 ft. (6 m.) above the floor and the Stirling type of boilers with the center of mud drums 12 ft. and 13 ft. (3.6 m. and 3.9 m.) above the floor. The settings are constructed entirely of firebrick, and provision is made for expansion in all four walls so as to prevent cracking of the brickwork.

Underfeed Stokers of Standard Types Hold Prominent Place

Underfeed stokers of the standard types continue to hold their prominent place. In localities, however, where high-ash coals of high volatility have been burned principally in natural-draft chain grates, as in the Middle West, the demand for high capacities has led to the use of traveling grates arranged for forced draft. The Coxe stoker was already available for this service, with a successful record of many years behind it, and several other types are now on the market. There has also been a marked disposition to use forced-draft traveling grates for small-sized anthracite in regions well outside the normal anthracite area.

A decided advance has been made within the last year in the practice of burning oil fuel. The mechanical atomizing oil burner has been adapted to the needs of stationary plants, and very high capacities and efficiencies are being obtained. As much as 1,300 lb. (590 kg.) of oil can be burned per hour in an individual burner using forced draft. The intimate and exact mixture of air and oil at their point of entrance into the furnace which is required for both efficiency and capacity can be maintained over the entire range of output with much less difficulty than when steam atomizing burners are used.

Although recent conditions have been more favorable to the economizer, there has been some hesitancy about using it. Cast-iron construction under high pressure is not generally desirable, and corrosion trouble with steel tubes has been considerable. Station designers have shown a disposition to avoid these difficulties as well as much of the cost incident to a straight economizer installation by using deeper tube banks on boilers of the B. & W. type and integral economizers on boilers of the Stirling and Bigelow-Hornsby types. These devices admittedly do not recover so much heat as a true economizer, but appear to be very satisfactory compromises.

Station Heat Balance

Obtaining a satisfactory heat balance in a steam-power station is always an important problem. It is just as important, however, that considerable flexibility be permitted so that the operator may maintain the balance under wide variation of load. Much ingenuity has been displayed in the various solutions of this problem. The use of house turbines and alternate steam and motor drives is well known. Plans have lately been devised for bleeding steam from the lower stages of the main unit, after it has done a maximum of work, and using it for primary heating of the condensate returns. This has the effect of retaining within the heat cycle of the plant some of the heat otherwise wasted in the condensing water with corresponding gain in plant efficiency. Heating of the water is completed by the exhaust from a house turbine or other auxiliaries.

Power-Station Buildings

In the design of power-station buildings there have been noticeable tendencies toward deeper basements in both turbine and boiler rooms. In the former the turbine floor partakes of the nature of a gallery around the turbine, permitting the access of light and air to the condenser floor and an easy view of all operating equipment. The high boiler-room basement permits discharging ash directly from the hopper into standard railroad cars or motor trucks and greatly simplifies the problem of ash removal. In the boiler room coal bunkers are now frequently built at one end or in the center, the stoker hoppers being filled by traveling weigh lorries. This leaves the space over the firing aisle free and permits natural lighting and ventilation.

Condensation in the winter time on the underside of the turbine-room roof, which has long been a cause of trouble to plant operators, is also receiving further attention.

Station Electric Equipment

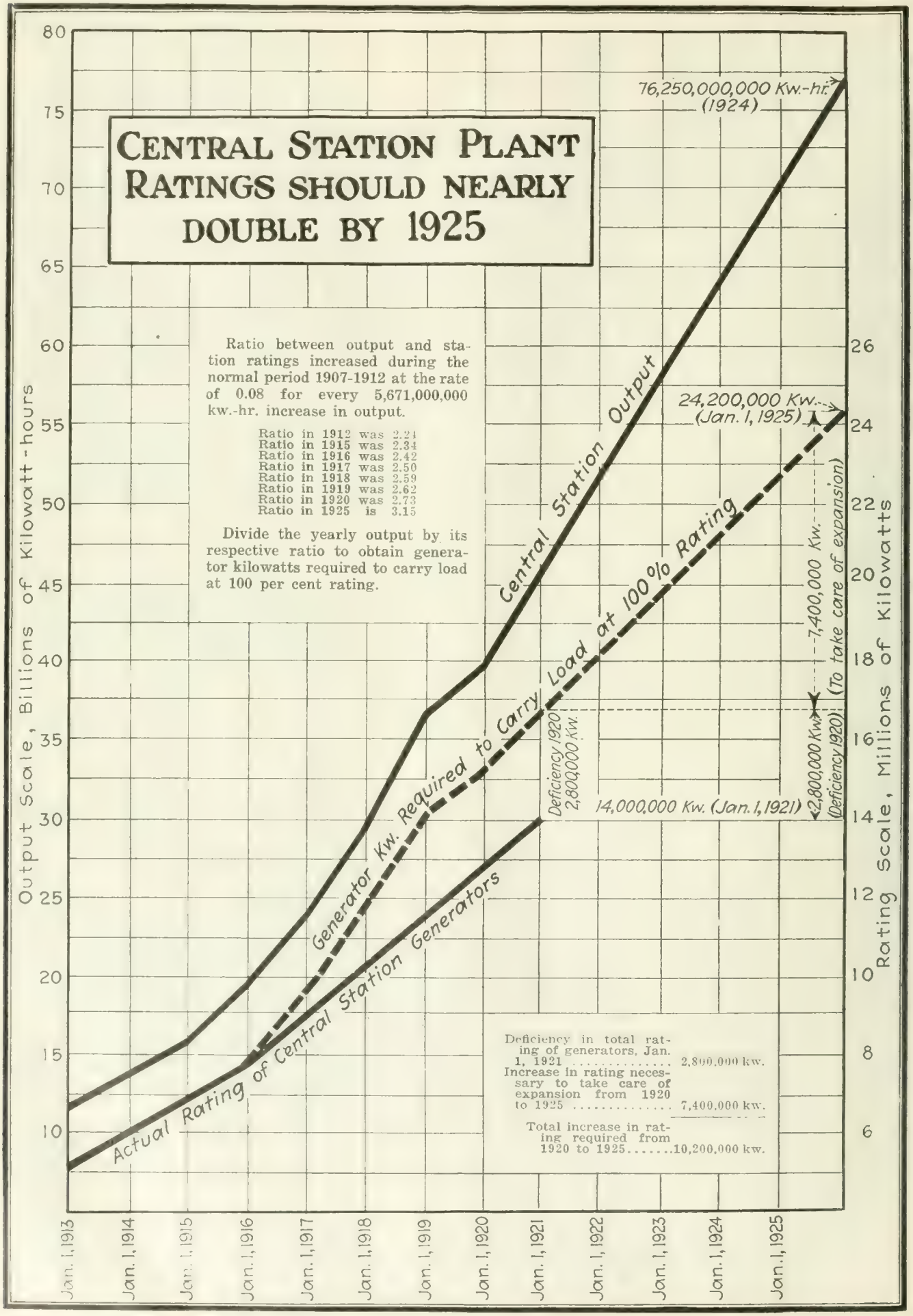
In the layout of the electrical side of the modern plant the tendency is toward simplification and increased reliability. Switchboards are arranged more logically in order to prevent trouble due to mental errors on the part of operators. Bus structures are made more rigid, and the tendency is toward the greater separation of the phases, to reduce the possibility of short circuits as well as the mechanical stresses arising from them. With these ends in view bus insulators are placed so that they will be in compression instead of tension or bending, and a wider spacing of conductors and the use of heavier barriers have been adopted. In one or two cases each of the three phases is being housed in an entirely separate room with the single-pole switches of each circuit tied together mechanically.

Avoidance of the destructive effect of short circuits is one of the things uppermost in the minds of designing electrical engineers. Switches of higher current-carrying and rupturing capacity are being employed. Various weak points of the electrical system within the station are being strengthened, resistance is being placed in series with potential transformers to limit flow of current to a short circuit within the transformer, single-turn current transformers are being employed to avoid the failures common with other types, and more care is being exercised in the selection of taps and connections on account of the frequency with which they have been destroyed by short circuits.

The use of reactors in generator leads, between bus sections and in outgoing feeders, is receiving much more attention to insure their satisfactory functioning under short-circuit conditions without interference with normal operation.

There is a tendency to return to automatic switches in generator leads but with the relays so arranged as to open the switch only in case of a short circuit within the generator, thus cutting the disturbance off the system.

All equipment that will operate satisfactorily in the open is being placed outdoors for the sake of safety and reduction in building costs. This includes power and instrument transformers, oil switches, lightning arresters and high-tension buses.


CENTRAL STATION PLANT RATINGS SHOULD NEARLY DOUBLE BY 1925
Ratio between output and station ratings increased during the normal period 1907-1912 at the rate of 0.08 for every 5,671,000,000 kw.-hr. increase in output.
Ratio in 1912 was 2.24
Ratio in 1915 was 2.34
Ratio in 1916 was 2.42
Ratio in 1917 was 2.50
Ratio in 1918 was 2.59
Ratio in 1919 was 2.62
Ratio in 1920 was 2.73
Ratio in 1925 is 3.15
Divide the yearly output by its respective ratio to obtain generator kilowatts required to carry load at 100 per cent rating.
76,250,000,000 Kw.-hr. (1924)
24,200,000 Kw. (Jan. 1, 1925)
Central Station Output
Generator Kw. Required to Carry Load at 100% Rating
7,400,000 Kw. (To take care of expansion)
2,800,000 Kw. (Deficiency 1920)
Deficiency 1920 2,800,000 Kw.
14,000,000 Kw. (Jan. 1, 1921)
Actual Rating of Central Station Generators
Deficiency in total rating of generators, Jan. 1, 1921 ..... 2,800,000 kw.
Increase in rating necessary to take care of expansion from 1920 to 1925 ..... 7,400,000 kw.
Total increase in rating required from 1920 to 1925.....10,200,000 kw.
Output Scale, Billions of Kilowatt-hours
Rating Scale, Millions of Kilowatts
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
26
24
22
20
18
16
14
12
10
8
6
Jan. 1, 1913
Jan. 1, 1914
Jan. 1, 1915
Jan. 1, 1916
Jan. 1, 1917
Jan. 1, 1918
Jan. 1, 1919
Jan. 1, 1920
Jan. 1, 1921
Jan. 1, 1922
Jan. 1, 1923
Jan. 1, 1924
Jan. 1, 1925

Electrical Industry Will Require $10,371,000,000 for New Plants and Appliances by 1925*

PROBABLE INCREASE IN GENERATOR RATING OF WATER-POWER PLANTS

	Kw.
Water-power development probable on government land, navigable streams and boundary waters (present Federal Power Commission Applications), between the years 1920 and 1925	7,500,000
Water-power development probable on non-navigable streams not on government land (assumed as 10 per cent of that under Federal Power Commission)	750,000
Total water-power development probable between 1920 and 1925	8,250,000

The total power applications at present before the Federal Power Commission total about 10,000,000 hp., or 7,500,000 kw., and this figure has been taken as the probable hydro-electric development in the next four years. In plotting the "central-station output" curve to be found on the opposite page no account has been taken of possible large consumption of electrical energy by industries not now existant, such as new irrigation projects and electrochemical developments, practically all the energy for which will be produced by hydraulic plants. The estimated consumption and the generator rating by 1925 are believed to be conservative.

* * *

PROBABLE INCREASE IN GENERATOR RATING OF STEAM-POWER PLANTS

	Kw.
Total increase in central-station generator rating required by 1925 (see curves)	10,200,000
Central-station probable hydro-electric development by 1925	7,750,000
Probable increase in central-station steam and gas plants by 1925	2,450,000
Private hydro-electric developments by 1925	500,000
About one-third of private plants assumed hydraulic; therefore private steam electric developments by 1925	1,000,000
New central-station steam plants plus new private steam plants	3,450,000

Although the number of water-power permits under consideration indicates that hydro-electric development for the next five years will be of the order given in our estimate, a definite ratio between steam rating and hydro-electric rating has been found essential. Therefore, if the water-power rating which is tabulated is installed, more steam rating will have to be provided as reserve. However, increasing interconnection of electric service systems may reduce the ratio of steam reserve to hydro-electric rating below what is now considered necessary.

* * *

HYDRO-ELECTRIC DEVELOPMENT COSTS

Cost of new generating-plant capacity—8,250,000 × $200	$1,650,000,000
Cost of transmission equipment—8,250,000 × $110	907,000,000
Cost of distribution installation—6,120,000 × $100	612,000,000
Cost of customers' lamps, motors and appliances and of wiring houses and factories—6,120,000 × ($125 × 6)	4,580,000,000
Total capital required for probable hydro-electric developments and resulting service costs	$7,749,000,000

Since 2,800,000 kw. of the 10,200,000 kw. (required new installation for central stations) is to displace present generator overload, that amount will not call for additional transmission or distribution systems and will not supply energy for additional motors, lamps or appliances. Therefore, only 5,620,000 kw. of new central-station hydraulic-plant installation will call for additional distribution system or will supply energy for additional motors, lamps or appliances, and only 1,780,000 kw. of new central-station steam-plant installation will call for additional distribution system or will supply energy for additional motors, lamps or appliances

* * *

STEAM-ELECTRIC DEVELOPMENT COSTS

Cost of new generating-plant capacity—3,450,000 × $75	$259,000,000
Cost of distribution system—2,780,000 × $100	278,000,000
Cost of customers' lamps, motors and appliances and of wiring houses and factories—2,780,000 × (125 × 6)	2,085,000,000
Total capital required for probable steam-electric developments and resulting service costs	$2,622,000,000

As a basis of arriving at costs pre-war or 1912 prices have been used in the following computations.

A study of cost data available indicates that the cost of steam-electric generating plants under 10,000 kw. rating in 1912 averaged about $102 per kilowatt and that plants over 50,000 kw. averaged about $70 per kilowatt. The figure of $75 per kilowatt has therefore been adopted in these computations for steam-electric plants, since most new plants will probably be of large capacity. Cost of hydro-electric plants varies over a wide range. The small plants of this type averaged in 1912 from about $150 to $300 per kilowatt, and the large plants averaged around $140 per kilowatt, although large plants without dam and reservoir construction ranged as low as $85 per kilowatt. The figure of $200 per kilowatt has been adopted in these computations for hydro-electric plants. These plant costs have been, as far as possible, based on rock-bottom prices and do not include highly developed architectural plants. Cost of transmission equipment has been assumed as $110 per kilowatt, and cost of distribution installation has been assumed as $100 per kilowatt. The cost of wiring houses and factories and the cost of motors, lamps and appliances needed by customers has been assumed in the aggregate as $125 per kilowatt, with a diversity factor of six, giving the capital required to supply customers' needs as $725 per generator kilowatt.

* * *

SUMMARY OF NEW CAPITAL NEEDED (1920 TO 1925)

Capital for new generating-plant capacity—$1,650,000,000 + $259,000,000	$1,909,000,000
Capital for new transmission equipment (hydraulic plants only)	907,000,000
Capital for new distribution equipment—$612,000,000 + $278,000,000	890,000,000
Capital for customers' lamps, motors and appliances and for wiring houses and factories—$4,580,000,000 + $2,085,000,000	6,665,000,000
Total new capital required by electrical industry, 1920 to 1925*	$10,371,000,000

*Exclusive of electric railroads, street railways, telephones and telegraphs.

Automatic Financing

A New Form of Public Ownership, Sustained and Encouraged by Self-Interest, Enables Electrical Utilities to Obtain Required Funds as Needed

By R. H. Ballard
Vice-President and General Manager Southern California Edison Company

BEHIND the new financing of electrical utilities is the ever-broadening knowledge of the American people that their present prosperity and the future achievement of their children and their children's children are absolutely dependent upon the development of the electrical resources of the nation. It is well that this is so, because with the rapid depletion of the reserve of timber and mineral fuels a climax in the world's history has been reached and a change is foreshadowed in the prime mover of industry, agriculture and transportation which is so comprehensive as to require enthusiastic and patriotic co-operation in its financing.

The conditions under which an electric light and power company can operate approach the ideal in almost exact ratio with the proportion of the company's equity owned by its consumers. This view, carried to its logical conclusion, would place the ownership and control of the company in the hands of those who depend upon it for service and look to it for the development of their lands, for the growth in population of their towns and cities and for increase in their own business. It stimulates the self-interest thought of community expansion and individual profit and makes it possible for the operating company to finance 25 per cent of its development by the sale of junior securities to its patrons, and then go into the recognized money market for 75 per cent on bonds and mortgages.

State regulation has taken the securities of public utility companies out of the speculative class, and they are gradually taking their place in a class with municipal securities. They can be issued only by an order of the regulating body, upon a basis of actual plant investment. There is, however, a growing belief that regulation, if carried to the extreme of limiting return to a point below the market price of money and forbidding any possibility of profit as a reward for enterprise, economy and efficiency, would become a steam roller, crushing out that vital thing in all human endeavor—initiative—and reducing investment and effort to a dead level. In the human equation there is no such thing as the status quo. There must be room for hope and optimism, else the stagnation and apathy which result from bureaucratic management such as obtains in Europe will produce the natural fruitage of apathy and sullenness, which we have seen break forth in insurrection, revolution and anarchy.

Five hundred million dollars will be needed in California within the next ten years for new power development. Basing its opinion upon the reports of the several companies operating in the state, the Railroad Commission finds that this great sum will be needed for producing and distributing 1,750,000 hp. of additional electrical energy.

While the financing of electric public utilities during the past year or two has been difficult because of enforced competition in the money market with large industrial offerings and foreign securities, development has gone forward in California which will result in bringing in 250,000 hp. of additional hydro-electric energy during the year 1921. Through the summer of 1920 a serious power shortage was threatened, but the great hydro-electric development of the past year seems sufficient to avert a recurrence of the shortage in 1921, and it is believed that with better financial conditions water-power resources can be developed with sufficient rapidity to meet the requirements.

The gasoline shortage, the fact that coal is not commercially available in California, the diminishing oil supply with the consequent increase of price, and the necessity of devoting the entire natural-gas supply to domestic uses, have brought home to the people the imminent necessity of developing the water-power resources of the mountain ranges. The need for co-operative effort along this line is being expressed by the press and on the platform in the manner characteristic of a great public movement. The methods followed by operating companies in financing these large developments are generally similar. Bonds are issued for approximately 75 per cent of the cost, and these bonds are sold to large banking syndicates for resale and distribution to the public at large throughout the whole country. The remaining part of the cost is provided by the sale of junior securities to the California public, and these stocks are being rapidly absorbed by investors, consumers and by officers and employees of the operating companies themselves. They form a splendid basis for accumulated savings. Success in distributing this form of securities among the people of the state has already been phenomenal, but a well-founded belief prevails that the movement is only in the stage of inception and still wider distribution is anticipated.

Opportunity for Consumer to Become Owner of Securities

It is an ownership by the people in the securities of their own regulated companies, and it not only retains the ownership of utilities in the community but insures to the enterprise the trained experience of those eminently fitted to perform the task. As contrasted with the old and now virtually defunct theory of public ownership based on taxation and controlled and operated by politicians, the plan is proving satisfactory both in providing the highest type of service and in giving to the individual consumer an opportunity to become an owner of the securities which his patronage maintains.

It is not to board room financiers that I am addressing these remarks, because they are grounded in the fundamental principles of safe investment and have at their disposal abundance of accurate information on which to base their decisions. It is rather to those of our own electrical profession that I wish to pass the word, that they may pass it again to the hundreds of thousands of men who turn the switches in our great factories and to the millions of women who push the buttons in the flats and cottages when the lights go on, so that all these may understand the opportunity to take part in the great movement to electrify America and make production and prosperity continue even though the fuel supplies of the earth become exhausted. They are the same people who constituted the twenty-nine million buyers of Liberty bonds. If they were to become owners of the equity money in our electrical public utilities, the question of developing our resources to the utmost limit and by interconnection making each kilowatt work to its full capacity would be solved and the question of electrical financing would become automatic.

Co-operation for the Central Station and Isolated Plant

Interconnection Is Economically Sound and Is Shown to Hold Mutual Advantages Where Isolated Plants Can Be Justified

(By a Prominent Engineer and Central-Station Executive)

TOO MUCH intolerant prejudice and not enough good engineering judgment have fostered the appearance of irreconcilable conflict or antagonistic competition between central stations and isolated plants, when each really has functions to perform and there are unquestionably some situations in which an isolated steam electric plant can show advantages over the use of purchased electric power service. This is particularly true in cases where requirements for heating the premises may be satisfied by the use of exhaust steam. The point which has been most frequently ignored is that in nearly all cases where an isolated plant is economically justifiable important additional economies for that plant and for the central station can be obtained by interconnection and co-operation.

The installation of power-producing equipment in large office buildings, department stores and similar places was a general practice some years ago, but changes in price levels and other conditions have narrowed the field of the isolated building plant. From the viewpoint of fuel conservation alone there is some apparent saving in producing by-product energy from a heating plant when the heating requirements for exhaust steam balance the simultaneous requirements for electric power. However, such ideal correspondence between heating and power requirements seldom or never occurs, and even if it is approximated the value of the fuel saved is seldom sufficient to carry the additional operating expense and the investment charges for engines and generators.

Interchange of Energy Offers Economical Solution of Problem

The most economical solution of the problem can be effected in favorable situations through an interchange of energy with a central station. The isolated plant should be operated only as required by the demand for heat. The electrical energy made available as a by-product of the heating varies in quantity in quite a different way from the power required by the building in which the plant is installed, but with the scheme outlined the surplus or deficiency of that plant's electrical output can be delivered to or taken from the general distribution circuits of the central station. The considerable saving in fuel made possible by such interconnection may enable the small plant to sell energy at some profit to the distributing system and with advantage to the central station, which would supply all energy during the non-heating period each year. The isolated-plant fixed charges for the whole year must be earned during the heating season, but even so the gross operating costs can be lower for a plant designed for operation in connection with the central station than for a plant designed for isolated operation. If these practices were more generally adopted they would reduce the discreditable evidence of waste exhibited by the numerous "white feathers" of exhaust steam which crown so many skyscrapers.

The working out of the details of an agreement for interconnected operation is apt to be tedious and difficult unless both parties to the negotiation keep clearly in mind the simple purpose to utilize their respective facilities jointly to save fuel economically. The proportion of such saving to be received by the respective parties should not be difficult to negotiate. That the problem can be solved satisfactorily is indicated by experiences of several of the larger central stations in different sections of the country.

In at least one of our largest cities the local central station has supplied electric service to every new office building erected during the last five years. It can also be stated in general that no small isolated steam plants are being installed solely for producing power where central-station service is available and fewer power plants of any size are being installed in office buildings and similar places. When fuel became scarce and expensive isolated plants were shut down with alacrity and their load was transferred to the central stations, whose rates had not been correspondingly increased. Much coal has been saved during the last three years by this shifting of load, but it has not made it any easier for the central stations to finance plant additions and extensions.

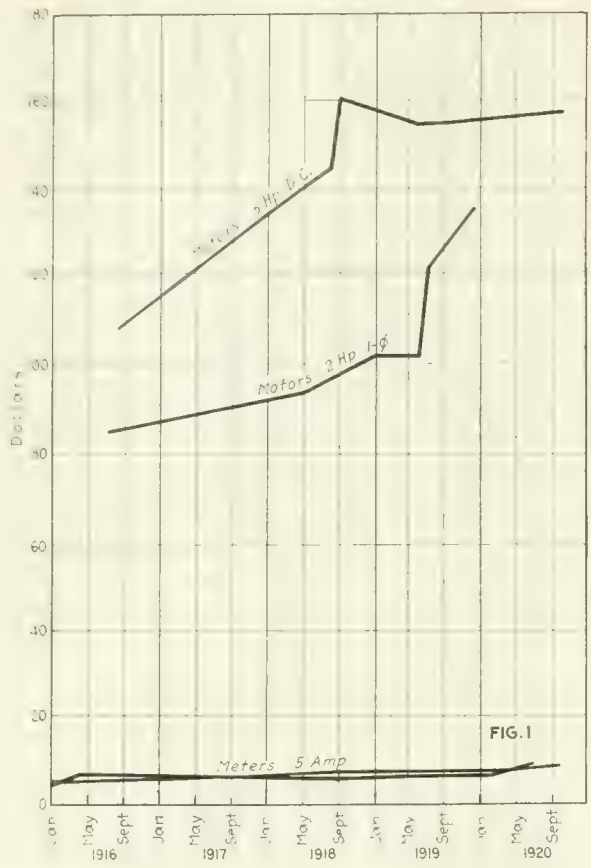
Ease of Financing a Factor in Plant Ownership

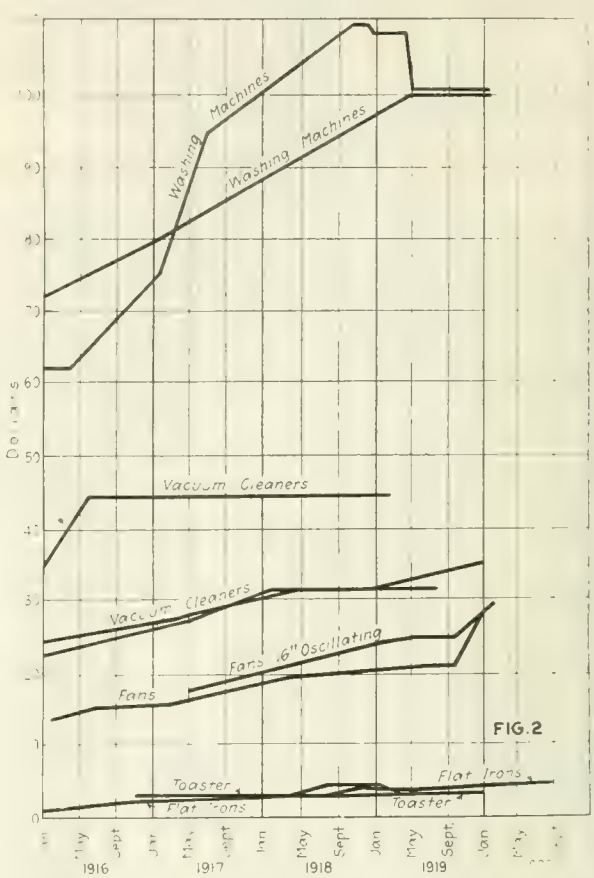
Some observers have expected a tendency among large industrial companies to discontinue central-station service. The reason for this expectation is that numbers of manufacturers have been very prosperous and could finance a power plant on more advantageous terms than could a central station at the present time. Such a course may be justified when the factory load warrants the use of generating equipment which approaches closely the fuel economy of the central station's plant, when the factory has an advantageous site, and when there is need for steam in the factory process or there is waste heat from the process. However, even under such favorable factory conditions an isolated plant can attain greater economies if operated in connection with the general system of the central station.

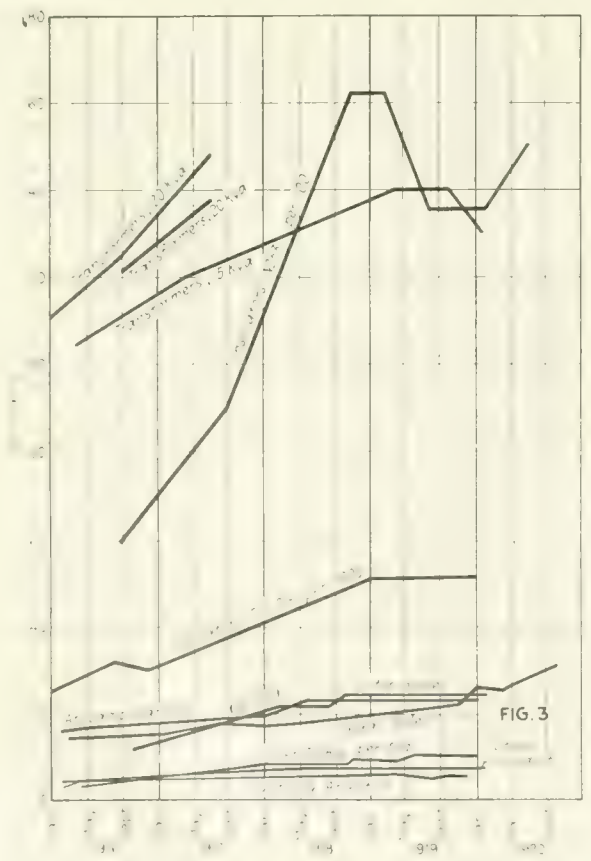
In several localities progress has been made toward co-ordinating the operation of the central-station system and the economical plants of large factories. The arrangements are usually similar to the more familiar interchange agreements between two central stations. In some cases the central station purchases a stated amount of power; in others the central station takes whatever the factory plant can spare to the extent that the central station then desires to receive energy. Further co-operation is to be expected between central-station and isolated plants as a result of a more general recognition of the interconnection benefits which were given emphasis by the several government boards and officials during the war and by the prominent examples in California, New England, Pennsylvania and elsewhere in this country and abroad.

The most noteworthy benefits obtained from utility-industrial interconnections are those relating to saving in aggregate rated capacity through the diversity factor of the loads, saving in reserve capacity of plants, and saving of fuel by operating large modern turbines at high load factors. These practices tend toward the greatest economy in the production of electrical energy, but they are still relatively wasteful in the utilization of the heat energy obtained from fuel.

Cost of Electrical Apparatus and Supplies to Large Central Stations







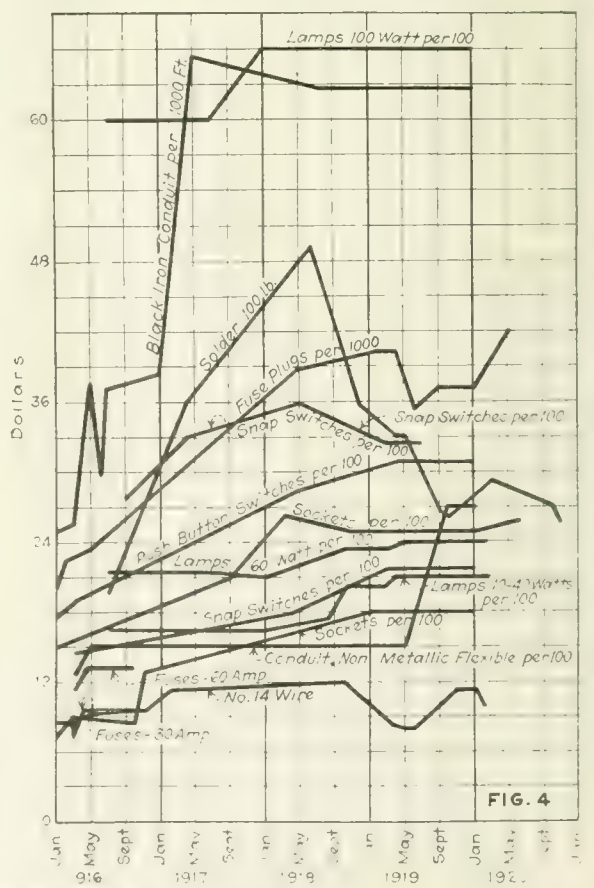
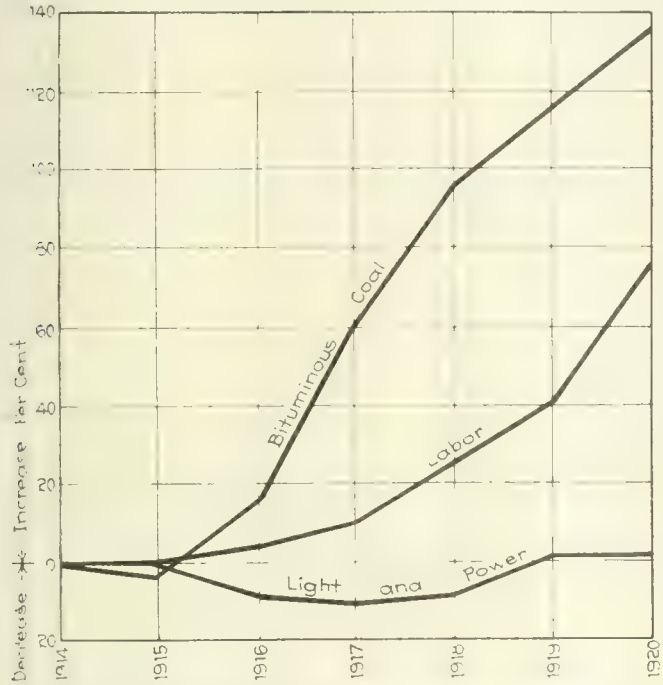


Fig. 1—Motors and meters. Fig. 2—Household appliances. Fig. 3—Line material. Fig. 4—Interior wiring devices.

Insufficiency of Electric Rate Schedules

While Prices of All Material and Supplies Have Increased Greatly, Electricity Prices Remain Almost Constant

THE handicap under which almost all electric public utilities are operating is not generally appreciated. For some unknown reason people imagine that conditions which affect them adversely have no effect whatsoever on public utility corporations. Every man realizes to what extent the high cost of living has affected



TREND IN PRICE OF COAL, LABOR AND ELECTRICITY

him. Food has increased 150 per cent in the last five years, clothing 190 per cent, coal 135 per cent and other lines of material in about the same proportion.

If one stops to consider that coal is one of the chief items of expense in generating electricity, and that labor, which has increased in cost anywhere from 75 per cent to 100 per cent, is also essential, the reasonableness of increased rates of electric service will be apparent. Nevertheless, during the past five years the average rate for electrical energy has not increased perceptibly, but on the contrary has decreased in cost during a portion of that time. What is true of coal and labor is also true of equipment necessary to the generation and distribution of electricity, and, as though that burden were not enough, taxes which every central station must pay have increased 120 per cent.

Figs. 1, 2, 3 and 4 show the trend in prices to large electric central-station companies of motors and meters, household appliances, line material and interior-wiring devices. It must be remembered that while the curves showing the increases above in the cost of bituminous coal and labor are based on official government figures and represent therefore the average condition throughout the country much greater increases have taken place in isolated cases. One of the great handicaps to the more rapid extension of electric service has been the lack of funds for new developments and enlargements. These funds would have been forthcoming had the earnings of the respective utilities been ample to justify the loans, and the curves shown herewith indicate very plainly why earnings were not of a magnitude to demand the needed capital.

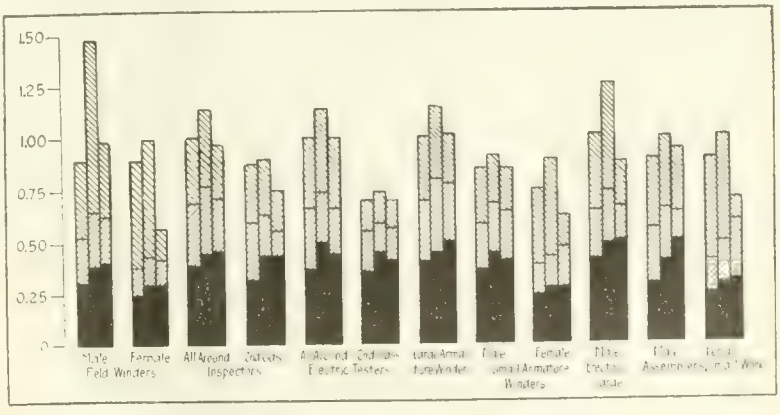
The exhibit indicates how great has been the burden thrust upon the electric public utilities and how unreasonable have been the protestations against the increases in rates. Rates have not advanced during the inflation period incident to the war and the period immediately following it, and there is imperative need of readjustment to meet the changed conditions.

The experience of the steam railroads would indicate that the country is more interested in service than in rates, and yet it is impossible to give good service without competent labor, adequate equipment and ample returns to pay for both. It is essential that the public understand this because once it is comprehended the chances are there will be a fair reception to increased rates when such are requested. The same reasoning ought to apply to the public service commissions. They may not always appreciate how almost impossible existing conditions are. Certainly the business of supplying electric light and power is a legitimate one, and it is unreasonable to expect all the burdens of increases to be borne by the utilities alone and not shared by their consumers as well.

For the public good, the rates permitted must be such as to keep the utilities in a going condition. The public has a right to expect, besides a dependable and sufficient service, a condition of stability that will not waver with every market fluctuation. If this cannot be assured on existing rate schedules, the sooner the latter are amended the better.

Manufacturers' Labor Cost

IN the electrical manufacturing field there have been no very great labor troubles during the past year. So far as can be learned no dissatisfaction is apparent with existing conditions and schedules. There have been no calls of any consequence for shorter weeks with increased wage, nor are any demands of that kind expected. Working hours, which range from forty-



WAGE SCALE OF ELECTRICAL WORKERS

eight to fifty-five hours a week, with an average of fifty hours a week, and a half day Saturday, have not been reduced.

The accompanying curves indicate the range in pay

per diem for both male and female employees engaged in electrical work.

Machine and tool work command the prevailing wage in all machine shops in the district and are little influenced by electrical manufacturers. There are wide variations in the wages paid depending on local conditions. Labor is usually cheaper in small towns than in the large cities and sometimes various degrees of skill command compensation according to the measure of efficiency shown.

The scales shown depict conditions in a representative group of electrical manufacturing companies. The entire wage range is indicated by that section of the diagram above the black portion, the top showing the highest wage reported, the bottom the lowest wage reported and the line between these two shows the average wage of all of the manufacturing companies which have reported.

Condition of Jobber's Business

With Heavy Stocks on Hand and Little to Be Received, Jobbers Will Buy Lightly for First Quarter of the Year

UP TO the fall months the electrical supply jobbing business was exceptionally good. Then the buying strike began to get under way, and naturally the jobbers were not long in feeling its effects. Still, it has been estimated by one who should be in the best position to know that the gross business in the jobbing trade for 1920 probably ran ahead of 1919 by 40 per cent. Inasmuch as 1919 business was stated by this same authority to have been in the neighborhood of $300,000,000, the 1920 business probably did not fall far short of $425,000,000.

At this writing, however, the interest does not lie in

Summary of Conditions in Electrical Supply Jobbing Field as 1921 Opens

District	Condition of Stocks, Days	Inventories: Compared with Jan. 1, 1920	Inventories: Compared with Sept. 1, 1920	First Quar Buying a—Hand to Mouth b—Light c—Heavy	Quantity Material Still to Come	Shall Price Be Cut to Stimulate Buying?	Outlook
New England—six replies	1—60 1—90 1—120 1—180	1—10%+ 1—20%+ 1—30%+ 1—33%+ 1—50%+	1—10%+ 3—Less 1—40%—	6—a	3—none 3—little	1—yes 1—no 1—mnfrs. 1—market	1—fair 1—not bright 1—uncertain 2—poor first quarter, good thereafter
Middle Atlantic—twenty-one replies	1—30 1—45 5—60 1—74 5—90 1—60-90 1—100 1—180	1—15%+ 4—25%+ 1—28%+ 1—37½%+ 1—43%+ 2—50%+ 1—100%+ 1—higher 5—same 1—20%— 1—25%— 1—30%—	1—25%+ 6—same 3—10%— 1—20%—	8—a 11—b 1—c	12—none 3—little 6—large on some items	6—yes 9—no 2—mnfrs. 2—market	4—fair 5—good 2—bright 5—poor first quarter, good thereafter 1—inactive up to fall
South Atlantic—four replies	1—75 1—90	2—25%+ 1—40%+ 1—99%+	1—5%+ 1—27%+	2—a 2—b	2—none 2—little	3—no	2—good 1—poor first half, good second half
East North Central—fifteen replies	2—40 2—45 5—60 1—65 1—90 1—90-120 1—150	3—20%+ 2—25%+ 2—30%+ 1—39%+ 1—50%+ 1—100%+ 4—same 1—20%—	1—11%+ 1—15%+ 2—20%+ 1—same 1—less 1—15%— 1—20— 1—66%—	7—a 7—b	6—none 7—little 2—large some items	4—yes 10—no 1—mnfrs.	3—fair 3—good 1—encouraging 4—poor first quarter, good thereafter 4—poor first half, good second half
East South Central—seven replies	1—60 1—90 1—90-120	1—60%+ 3—100%+ 1—favorable 1—lower	1—30%+	4—a 3—b	5—none 2—little	3—yes 4—no	1—good 1—uncertain 1—discouraging 3—poor first half, good second half
West North Central—nine replies	1—45 2—60 1—75 1—75-90 2—60-90 2—90	1—15%+ 1—20%+ 1—30%+ 1—70%+ 1—same 1—less	1—15%+ 3—same 1—50%—	5—a 4—b	4—none 2—little 3—large some items	4—yes 2—no 1—mnfrs.	3—good 2—poor first half, good second half 4—poor first quarter, good thereafter
West South Central—ten replies	1—75 1—90 1—120 1—180	1—20%+ 1—25%+ 1—30%+ 1—33⅓%+ 1—87%+ 1—100%+ 3—higher	1—10%+ 1—25%+ 1—30%+ 1—45%+ 1—same	5—a 5—b	7—none 3—little	5—yes 4—no	1—excellent 3—fair 1—poor 2—good 1—optimistic 1—better than 1920
Mountain—four replies	1—90 1—125 1—120-150	1—21%+ 1—32%+ 1—50%+ 1—same	2—same 1—5%— 1—18%—	2—a 1—b	2—none 1—little 1—large some items	4—no	1—good 1—off 1—not encouraging
Pacific—six replies	2—60 1—75 2—90 1—120	1—20%+ 1—25%+ 1—33⅓%+ 1—81%+ 2—same	1—30%+ 1—9%—	2—a 4—b	4—none 2—large some items	2—yes 4—no	1—fair 2—good 1—no good 1—better than 1920 1—poor first quarter, good thereafter

the past but in the present and future. How does the jobber enter the new year? Are his stocks long or short, and how much? Will he buy from hand to mouth or lightly or heavily? Will he buy heavily for first quarter in any particular lines? Has he much material on order with manufacturers? Will he cut prices to stimulate business? What is the outlook in his territory for 1921?

ANALYSIS OF 82 ANSWERS

These questions the ELECTRICAL WORLD has asked the electrical supply jobbers of the country, and at this writing it has received answers from eighty-two of them. These answers, which are analyzed in the accompanying table according to sections of the country, afford an excellent cross-section of the condition of the electrical industry and are the best indication anywhere available of what may reasonably be expected in and from this branch of it.

Except here and there, no low stocks are reported. Only occasionally does the survey reveal less than sixty-day stocks. For the most part stocks are over sixty days, and a great many are ninety days or more. While many said that their stocks were average or normal or not large, still it is apparent that stocks rather generally are much larger than the current market warrants. A number of jobbers reported that the overstocks were for the most part in a few lines, and these as a rule were household socket devices, flexible conduit, both metallic and non-metallic, flexible armored conductor, wire, both rubber-covered and weatherproof, and schedule material.

There were occasional evidences of unbalanced stocks, and in these cases it was the rule to find short stocks of porcelain, especially tubes, rigid conduit, steel boxes and motors. A half dozen or more jobbers, strangely enough, reported a shortage of rubber-covered wire.

INVENTORIES LARGER

Inventories grew greatly during the year owing to advances in price on the one hand and to larger receipts on the other. November and December inventories were for the most part from 20 to 50 per cent higher than those at the beginning of 1920. In some cases they were even 100 per cent and 150 per cent greater. Some, however, did not show any change, and in a few instances they were even lower. While a number, owing to decreased buying on the part of customers and to heavier receipts, have accumulated larger stocks, still a good many jobbers have been able materially to reduce stocks since September. On the whole, therefore, jobbers on Jan. 1, 1921, are in a much healthier state than they were at the end of the third quarter of 1920.

With the exception of one house, which will buy heavily for first quarter, the electrical jobbers for the next three months will buy either from hand to mouth or lightly. Some indicated that normal stocks will be maintained.

Almost without exception the canvass shows that the electrical jobber will not buy heavily on any single item for the first quarter.

For the most part, the jobbers have received all the material they had on order with the manufacturers. A number of houses have still a few minor unfilled orders on manufacturers' books. There are some cases, however, where large orders are still unfilled, but these almost without exception are for not more than two or three lines, such as rigid conduit, motors, porcelain and schedule material in which stocks have not yet been built up. A large number of the reporting houses stated that although they had large commitments a while back they had canceled these orders.

SHALL PRICES BE CUT?

On the question of price reduction the replies were varied. It was known that not a few jobbers had made recessions to stimulate buying in order to reduce long stocks, and for that reason a consensus of opinion was asked. Some evaded this question, but of those who made reply 52 per cent were against reducing prices to stimulate a market. Where a reason was given it was, for the most part, that a falling market discourages buying. On the other hand, 35 per cent were in favor of reducing prices, some without reservations, others on lines that had to be moved because of overstocks, and still others with the proviso that it should be done gradually. A little more than 8 per cent were of the opinion that reduction should originate with the manufacturers. The remainder simply said that they would follow the market down.

OUTLOOK

The greatest variation in the answers came in reply to the question "What is the outlook for 1921 in your territory?" Some were very optimistic and others were equally pessimistic. Generally, however, the replies held to the middle ground. The first quarter is not for the most part expected to be anything but dull. After that conditions are expected to grow better. Some put the Presidential inauguration as the turning point. It was generally agreed, however, that the second half of the year will be pretty good and the last quarter excellent.

The feeling arrived at from reading the replies is that the gross volume of business done in 1921 will not be so large as that in 1920. How much smaller it will be it is not possible to determine from the replies. Still, from the apparent probability of lower prices and the expressed certainty of a smaller volume of goods moved, it does not seem unreasonable to predict that the gross business of 1921 will be at least 25 per cent less than that for 1920.

Causes and Possible Remedies of Cancellation Evil

AN EXHAUSTIVE study of the practice of cancellation of orders and repudiation of contracts in almost every division of business has been made by the fabricated production department of the Chamber of Commerce of the United States. As a result of this study it groups opinions as to possible causes and possible remedies under these three heads:

"First—That the practice is the result of war-time irregularities and will pass as we return to a normal basis.

"Second—That we are now reaping the results of the loose business practices inaugurated before the war, when many lines were in a state of overproduction and the measures taken to unload this surplus were demoralizing. Those entertaining this belief feel that the remedy is in a general reformation of our system of order taking, making each order a contract enforceable by law.

"Third—That we have been drifting away from the fundamentals of sound business and the 'Golden Rule' and that we must return to a stronger belief in the rights of others and a higher regard for our own integrity if the change is to be permanent."

Interconnection Benefits Even the Small Plants

Tidewater Steam Plant and Nearby Water-Power and Steam Installation Handled Effectively by Tie Line Under Various Load Conditions

AN INTERESTING example of the benefits of interconnection is afforded by a 4.5-mile (7.2-km.), 13,200-volt single-circuit tie line between generating stations of the Newburyport (Mass.) Gas & Electric Light Company and the Amesbury Electric Light Company. The former company operates an 8,325-kva. steam plant on tidewater near the mouth of the Merrimac River, and the latter receives energy from a group of small hydro-electric stations with steam auxiliary equipment aggregating about 3,000 kva. The two companies are independent, and each serves important industrial power and the usual lighting business to be found in New England manufacturing centers.

The chief advantage of this interconnection lies in the opportunity it offers for the supply of energy to the Amesbury district from the larger tidewater stations, especially during periods of low water at the hydro-electric plants. The hydro-electric stations are in the valley of the Powow River, which rises in Kingston, N. H., and flows by a crooked course southeasterly until it finally joins the Merrimac River near Newburyport.

The tie line has a capacity of about 1,800 kw. It consists of a three-phase circuit of No. 2 copper between the principal hydro-electric station in Amesbury and a terminal tower on the north bank of the Merrimac River, opposite the Newburyport station. Choke coils, taps to disconnecting switches and electrolytic lightning arresters and disconnecting switches by which the line can be opened at the terminal tower are provided. The connection with the Newburyport plant is completed by a three-conductor, 13,200-volt armored submarine cable 1,655 ft. (506 m.) long, terminating in a pothead mounted on an outdoor steel frame inclosing three 625-kw. Maloney transformers installed just outside the station. At this pothead disconnecting knife switches are provided so that the submarine cable section of the line can be opened at this end also. A short cable run from the transformer secondaries to the 2,300-volt bus of the station completes the tie.

The greater part of the time energy is supplied over this line from Newburyport, but at times of very light load in Newburyport, as on Sundays, if water is plentiful in the Powow River, the entire load of the tidewater station is frequently carried by Amesbury. This obviates running a 625-kva. steam-turbine unit. The larger plant, however, is the mainstay of the two systems as regards steam reserve and is needed to handle the main load of Newburyport, including the Ipswich Mills (reached by a 22,000-volt two-circuit line) under week-day conditions.

In the fiscal year 1919 the Newburyport company sold to the Amesbury company 2,397,000 kw.-hr. at a unit price of 1.352 cents. The Amesbury company sold Newburyport 15,570 kw.-hr. at a unit price of 1.645 cents. The total output of the Newburyport station was 12,400,434 kw.-hr., and the average cost per kilowatt-hour produced at Newburyport was 1.26 cents. Coal cost $8.40 per ton at Newburyport, 14,975 tons being used.

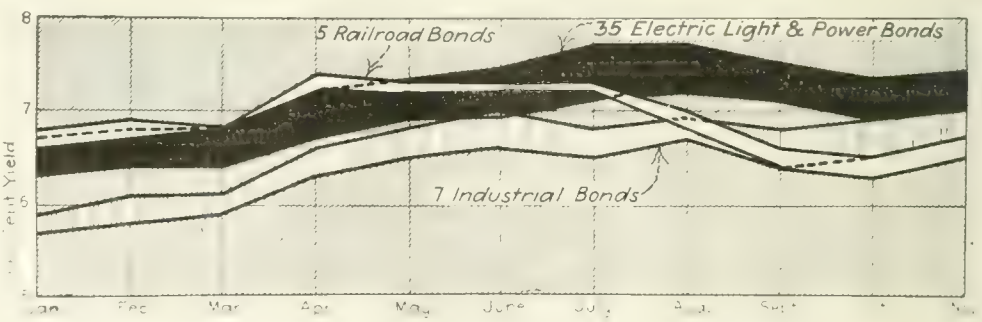
Amesbury's total energy delivery to the bus from the local plants was 496,916 kw.-hr. at a unit cost of 1.82 cents. The line losses in the case of energy delivered to the Amesbury company are borne by the latter, but even so these figures are an interesting example of the economy of centralized energy production in a steam-turbine plant with the units under one roof, as well as an indication of the difficulty of securing low unit costs of operation in a mixed system of scattered hydro-electric plants of small capacity. Each of these generating systems may be and is of use to the other, and the fact that the larger plant supplies the greater portion of the energy utilized on the smaller system in no way invalidates the actual and potential benefits of the interconnection from the viewpoint of the bigger installation. Light-load periods in steam stations are most desirable times to use surplus energy, and the harmonious interoperation insures fuel and water mutual conservation.

Trend of Electric Light and Power Bond Yields

DURING the twelve months just past money cost more than in any previous year in the history of the electric light and power business. In the neighborhood of $400,000,000 of new capital was placed on the market by electric light and power companies at a price which would yield the investor on an average 7.98 per cent.

Older issues did not yield such a high average, but the yield was high enough to attract many new investors in this class of securities. The trend of this market is shown fully in the accompanying diagram by the heavy black curve. Compared with this is the trend of average yield of railroad bonds and industrial bonds.

It is interesting to note that the yield on the utility bonds is only slightly more than from the industrials and about the same as from the railroads. It must be pointed out, however, that while all kinds of electric light and power issues (all first mortgage) are included, the industrials and railroads are picked issues. The former include one of each of a number of fundamental commodities in which the strongest company was picked out. In the railroads geographical distribution of operation was used, with the most representative road in each case.



ELECTRIC LIGHT AND POWER BOND YIELDS COMPARED WITH INDUSTRIALS AND RAILROADS - WIDTH OF CURVES SHOWS RANGE BETWEEN BID AND ASKED PRICES

Engineering Developments of 1920-21

IN REVIEWING THE DEVELOPMENTS *and tendencies that prevailed last year in electrical engineering, those that are most important have been segregated and arbitrarily classified under the following headings: Generation and Protection, Transmission and Distribution, Science and Research, Lighting and Industrial.*

Recent Tendencies in Water-Power Practice

Reaction Wheels Built in Sizes Up to 55,000 Hp. and Others with 800-Ft. Head—New Draft Tubes of High Efficiency—Outdoor Plants

BY JOHN F. VAUGHAN
Consulting Engineer, Boston

PROGRESS in water-power practice during the past year has been in detail of construction and refinement of operation rather than in radical change of plant design or type of equipment. The controlling factors have been high price of money and high cost of labor and material. While these factors react against both steam and water power the increase in cost of steam power due to high price of fuel has been offset to a large degree by the relatively greater first cost and fixed charges of water power. The direct effect has been the stimulation of interconnection, the simplification of plant layout, increase in rating and decrease in number of units, the placing of more apparatus out of doors and the more economical use of building space. Other tendencies are better control of storage and pond level in moderate and low-head plants, reduction of back water on the plant during high stages, improvement in the means of measuring and recording input in water, better load-dispatching, etc.

Progress in design is marked by new limits of size and head for reaction and impulse wheels and increased efficiencies of new draft tubes.

The limit in size of the reaction wheel seems to have been approached in the new units for the Queenston plant of the Hydro-Electric Commission of Ontario, 55,000 hp. under a 305-ft. (90-m.) head, although designs have been considered for units rated up to 100,000 hp. For lower heads of say 30 ft. (9 m.) the present limit appears to be nearer 12,000 hp. or 15,000 hp., depending largely upon transportation facilities. Impulse wheels have reached a size of 30,000 hp. under a 1,000-ft. (300-m.) head in the units being built for the new Caribou development of the Great Western Power Company. In the design of low-head, high-speed runners of the unshrouded or propeller type (such as the Nagler in this country), specific speeds of 175 have been reached without serious sacrifice of efficiency and runners have shown an unusual range of head-speed characteristics. Owing to the high cost of raw material for medium-head work, foreign manufacturers are using higher specific speeds than is considered good practice in this country, sacrificing efficiency to some extent, however, in doing so.

The reaction wheel has reached a new limit of head, 800 ft. (240 m.), in two 22,500-hp. units now being built for the Kern River No. 3 plant of the Southern California Edison Company. Owing to the excessive velocity in the draft tube and high generator speeds, it is likely that even in large units this head encroaches far into the territory of the impulse wheel. Low limit of head has been extended by the further use of the unshrouded or radial-flow propeller type of runner.

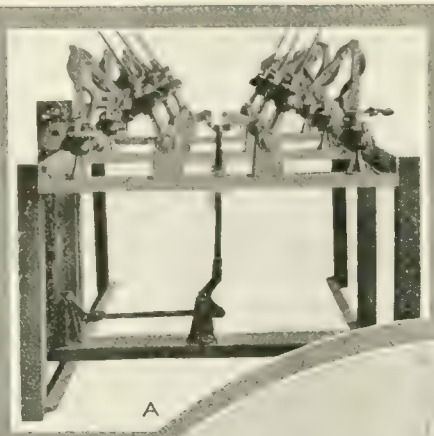
Efficiencies of 93 per cent and better have been established in medium and large-size vertical spiral-case units under favorable conditions, and better fractional-load efficiencies than those of the past have been maintained. One manufacturer has approached this maximum efficiency in the low-head, high-specific-speed type, and others are progressing along similar lines.

The last word in draft-tube design appears in the White hydraucone and the Moody spiral-case types recently tested on the new 40,000-hp. wheels of the Niagara Falls Power Company, which have given virtually the same results in efficiency. It is interesting to note, however, that a modification of the more common quarter-turn type of draft tube is to be installed with

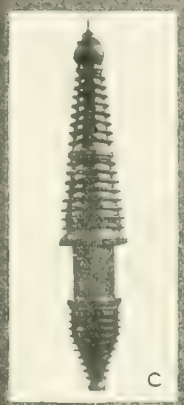
HYDRO-ELECTRIC PLANTS EMBODYING MOST RECENT DEVELOPMENTS

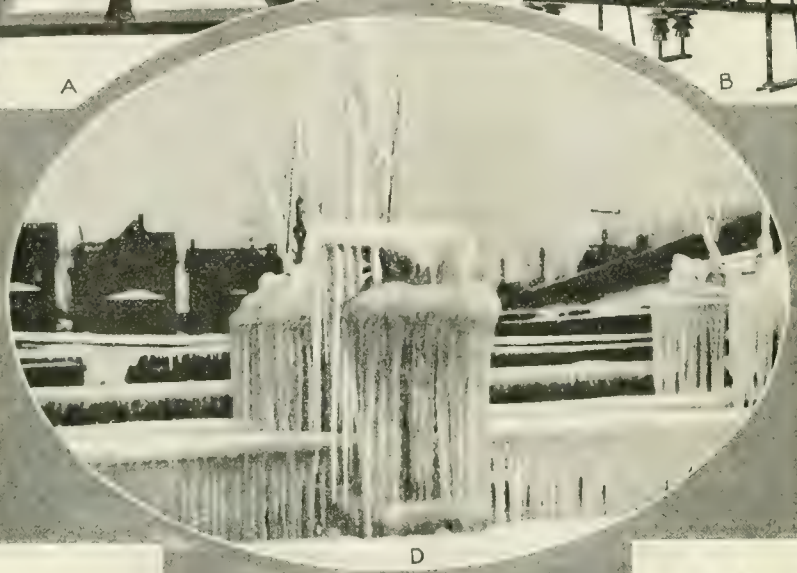
Company	Name of Development	No. of Units	Size of Units (Hp.)	Type of Units	Head (Ft.)	Features of the Plant
Hydro-Electric Power Commission of Ontario, Toronto	Queenston	5	50,000	Vertical spiral-case	305	Largest reaction-type units
Great Western Power Co., San Francisco, Cal.	Caribou		30,000	Impulse	1,008	Largest size for such a head
Southern California Edison Co., Los Angeles, Cal.	Kern River No. 3	2	22,500	Spiral-case	800	Highest head for reaction wheel
United States Government, Ordnance Dept.	Muscle Shoals	4	30,000	Concrete spiral case	95	Highest head for concrete spiral case. Outdoor plant considered
Los Angeles (Cal.) Bureau of Power and Light	San Francisquito	2	22,000	Vertical spiral-case	515	
San Joaquin Light & Power Corp., Fresno, Cal.	King's River		300,000 total	Impulse	2,500	
Pacific Gas & Electric Co., San Francisco	Hat Creek (Nos. 1 and 3	2	15,000			
					200	
Great Lakes Power Co., Ltd.	Sault Ste. Marie, Ontario				18	
Central Maine Power Co., Augusta, Me.	Skowhegan	5	22,500 total	Concrete spiral-case	32	Collapsible crest dam.
Henry Ford's plant	Troy, N. Y.					Extreme use of large units under low head.
Consumers' Power Co., Jackson, Mich.	Grand Rapids	2	200			Automatic and semi-automatic plants
	Battle Creek	1	150			
Tallassee Power Co., Baden, N. C.	Baden, N. C.					
Iowa Railway & Light Co.	Cedar Rapids	3	500			

Some Important Developments in Electrical Apparatus

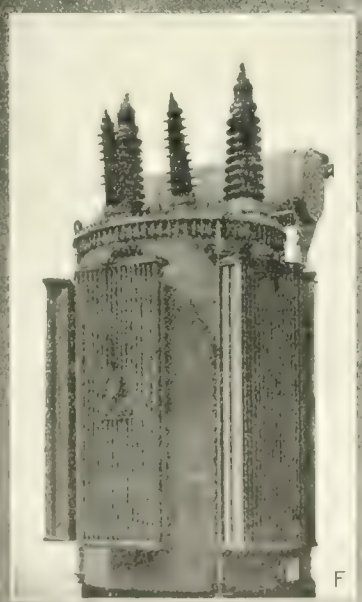

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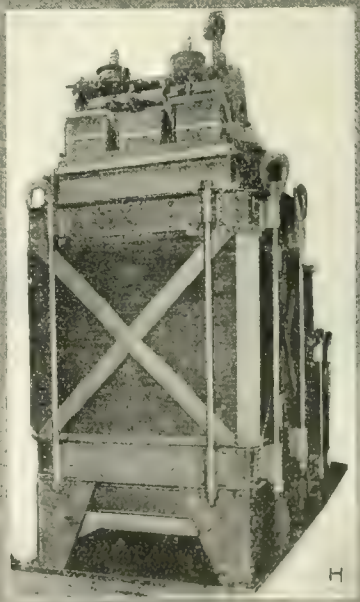

C


D


E


F


G


H

A—New type of air-break switch with vertical break. B—Oxide-film lightning arrester for outdoor service at 73,000 volts. Ground-stack shields removed for inspection. This arrester contains no liquid. C—Outdoor 250,000 volt insulator for Southern California Edison Company. D—Burke air-break motor-actuated switch operating at 80,000 volts despite ice coating. E—Bennett surge arrester for wide range of voltage. F—A 3,000-kva., 110,000-volt transformer with oil conservator and radiators. G—New air-break switch with vertical blades. H—The largest single-phase transformer that has been built in this country—23,600 kva., 132,000 volts, weight 63 tons.

two machines now being constructed for Queenston, and equally good results are anticipated for them by the manufacturer.

More attention is being paid to the recovery of head lost from high backwater, as by the Herschell and Replogle fall increasers, employing high-velocity flow from the dam into the horizontal discharge leg of the draft tube, and by the Tefft method, which slips a fast-moving sheet of water under the discharge within the draft tube. Another method offered introduces an annular jet from the flume itself down into the throat of the draft tube, and still another utilizes the negative head of the standing wave below the dam by discharging the draft tube into the high-velocity water as it leaves the toe of the dam back of standing wave.

The siphon type of dam is receiving more attention, particularly in locations of limited dam-spillway length, one being under construction on the Pacific Coast, for instance, for use under a 190-ft. (57-m.) head.

The use of the Johnson type of hydraulically balanced needle valve for large penstocks is increasing, and other types of internal hydraulically operated valves are under development.

Differential surge tanks are becoming more generally used, as well as other means of penstock control such as the use of a diaphragm in the surge tank above the penstock connections and, in long pipe lines, the use of the governor-actuating synchronous relief valve.

Automatic and semi-automatic plants are receiving much study and new plants are going in, such as that of the Cazenovia Electric Company at Cazenovia, N. Y.

The ice problem is receiving unusual attention, particularly in the new developments on the Niagara River. The Hydro-Electric Power Commission of Ontario is experimenting on intakes of the Johnson type of slotted tubes laid in the bed of the river and the Groat plan of submerged weirs placed so as to divert surface currents away from, and deep water toward the intake.

Troubles with Large Turbines Are Being Overcome

More Care in Starting and Stopping Units Reduces Temperature Stresses—Changes in Design Have Also Helped—Fluttering of Bucket Wheels Stopped

By W. L. Abbott
Chief Operating Engineer Commonwealth Edison Company, Chicago, Ill.

IN GENERAL there have been no marked developments in turbine design during the past year, the principal improvements having been changes in details of design and material to overcome the problems that have been encountered in large units,* namely, higher speeds and greater stresses. Since the tendency has been to push up the linear and the angular velocities of the revolving parts, it has required the combined knowledge and skill of the scientist and of the engineer to interpret and to protect against the destructive phenomena which have been manifested. Another subject which has attracted considerable attention has been running clearances, since turbine parts may be subjected to variations in temperature of as much as 500 deg. Fahr. (260 deg. C.).

*The General Electric Company has produced single-shaft units of 45,000 kw. rating, and the Westinghouse Electric & Manufacturing Company has built multiple-shaft turbines up to 60,000 kw capacity.

Of the several difficulties with which the turbine manufacturers and the turbine operators have to contend, that due to unequal expansion and contraction of casing, cylinders, diaphragms, shafts and blade drums under the widely varying temperatures to which they are subjected is the most prevalent, particularly at times when machines are being started up and when they are being shut down. The designer and the machinist measure the running fits and clearances in thousandths of an inch, only to find, after the machine has heated up, that some parts have expanded 0.25 in. (6 mm.) and other related parts have expanded much less. So serious is this matter of unequal expansions that the principal turbine-manufacturing companies have issued explicit instructions to guide turbine operators in starting their machines.

Overcoming Troubles Due to Unequal Expansion and Contraction

When steam for warming up is admitted to horizontal turbines of the Parsons type the hottest of the steam rises to the top side of the cylinder, while the air and cooler steam settle to the bottom. The resulting unequal expansion of cylinder and blade drum causes both to arch upward slightly, but when the shaft is turned through 180 deg. end rubbing of both fixed and revolving blades is liable to result. With the Curtis type of turbine there is not this same trouble with end rubbing of blades, but there has been serious trouble due to unequal expansions. In this machine the bucket wheels are shrunk onto the shaft and keyed in place. The hubs of the disks and the diaphragm packing rings between them entirely cover that portion of the shaft in the zone of the hot steam. Therefore, when steam is admitted into the wheel space on starting up a cold turbine, the steam comes in contact with the wheel hubs and expands them, while the shaft, owing to its greater mass and because it is generally protected from direct contact with the steam, heats up more slowly. The hub of the bucket wheel, therefore, becomes loose on the shaft temporarily, and when the machine is brought up to speed the disk is liable to "wabble" until the hub and the shaft attain a common temperature. When the wheel wabbles it wears the bore in the hub larger and it wears its seat on the shaft smaller. When the machine is shut down the wheel hub cools more quickly than the shaft and thereby becomes decidedly stretched. After a few repetitions of this process the wheel is never tight on the shaft.

Manufacturers of reaction-type turbines have overcome the foregoing difficulty in different ways—some by more end clearance of the blading, others with blades having thin ends which will wear off quickly in case they rub and with a close-running, feather-edged shroud to intercept the spill around the end of the blading. The latter is designed to wear off quickly with little resultant heating in case of rubbing.

One large manufacturer overcame his trouble with wabbling wheels by using a pinned bushing in the hub of the wheel. This bushing will always approximate the same temperature as the shaft, leaving the hub free to heat up quickly and expand as it may. The bushing, however, while tight on the shaft, is secured to the hub by a number of radial pins, so that as the hub expands and contracts it will always be concentric with the shaft and the bushing, while the pins will keep it from wabbling.

Cast iron is being largely replaced by steel in dia-

phragms and casings, because with the high temperature of superheated steam cast iron is distorted more than steel, not only temporarily but permanently. The heating and cooling cause cast iron to swell permanently, or "grow," as it is sometimes called, thereby becoming porous and much weakened.

There have been a number of mysterious failures of bucket wheels from which segments broke off and were thrown out while the wheels were in operation. Some failures of this kind were traced to fractures starting from the sharp corners of equalizing holes near the rims of the disks of blade wheels and were due to metal fatigue. In working metal nearly up to its elastic limit there are apt to be some small corners or angles where a small particle of metal is more highly stressed than the general mass of the piece, and in such locations stresses may overrun the elastic limit. In time steel in such places becomes fatigued and microscopic cracks develop, which are slowly propagated to an extent which ultimately leads to complete rupture. Such fractures, starting in hair cracks at some sharp corner, may require weeks or months in developing to an extent which finally brings about a sudden ultimate rupture. Correction has been made by a new design of disk in which the web of the wheel is slightly thickened. Equalizing holes are placed nearer the hub than in the old wheels, and the corners of the holes are rounded off to eliminate sharp corners from which cracks start.

Polarized Light Used in Studies to Detect Strains in Metals

It has been found to be virtually impossible to calculate the amount to which metal in the various parts of a disk is stressed while in revolution. However, a novel method for the study of these stresses has been devised by one of the large manufacturing companies. A celluloid disk is employed with buckets attached, all similar in proportion to the steel disk whose strains it is desired to investigate. The celluloid disk being transparent, light will shine through it, and when revolved at high speed the fiber in different parts of the disk will elongate in proportion to the stress to which that portion is subjected. These differences of elongation of the fiber in different zones of the wheel will be clearly shown by the differences in their ability to polarize refracted light.

With the various expansions, contractions and distortions due to heating and cooling, it was to be expected that there would be occasional instances where the bucket wheel, with its narrow clearance, would rub against the diaphragm. More clearance has been provided, but still such rubbing has persisted, and, strangely enough, wheels have been found *rubbed on both sides*, although they were centrally placed between diaphragms with an abundance of clearance, while other wheels on the same shaft would not rub at all.

In addition to the phenomenon of double rubbing, some of these wheels have been found to have radial cracks, and even wheels of the new design with thickened web have given trouble. Here indeed was a problem for the investigators of the research laboratory, who have found the cause of the trouble and at the same time explained a curious phenomenon—so common that it had never been given a thought. The statement of this phenomenon is embodied in the answer to such a question as the following: "Why does a flag flutter when borne rapidly through still air?" The answer gives a clue to why heavy plates of forged steel will also flutter if driven fast enough in a dense enough medium. These violent and continued wavings of the disk readily account for the radial cracks which have been found. The trouble has all been eliminated by simply stiffening the rims of the wheels.

Removing Condensed Steam

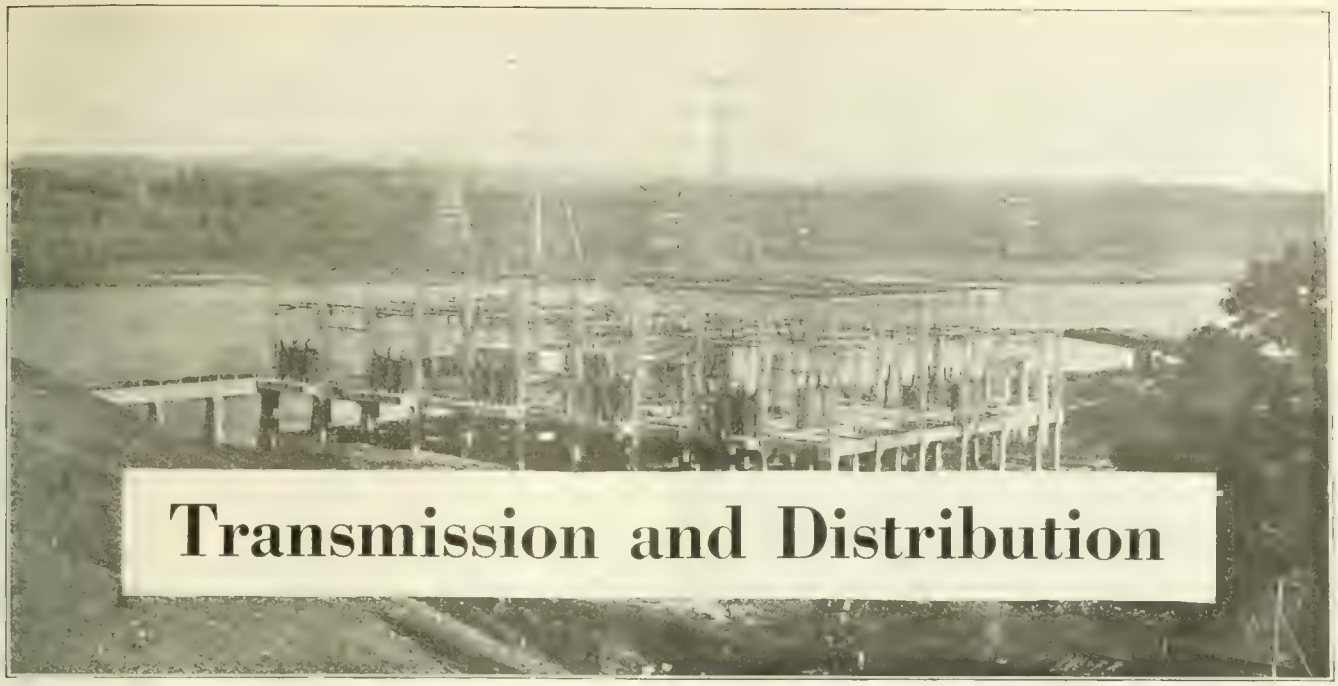
Superheated steam on its way through the turbine blading loses its superheat when about one-third of the way through, and from there on condensation takes place at an increasing rate. The point at which this condensation begins can be easily determined by an inspection of the blading, since those blades that are subjected to moisture are eroded, while those that run in the dry steam retain their original polish. The erosion has been such a serious factor in the last stages that it has been found necessary to drain the water from each stage independently—not into the next lower stage, but into the condenser. Drainage pipes have been installed for this purpose and designed so as not to leave a free opening for the escape of steam.

Great Hydro-Electric Development Planned in Germany

DISCUSSION is rife in Germany of a plan to construct a ship canal from Aschaffenburg on the Main to Nürnberg and to straighten the bed of the Danube River from Keilheim down to Passau at the German border. This scheme is an extension of a former plan to canalize the Main—the so-called Würzburg scheme. Development of many large hydro-electric plants forms part of the plan, which will provide a continuous ship canal from the Rhine to the Main and from the Main to the Danube. The importance of the proposed development to Bavaria, which has thirty-seven electric stations on the Danube, will be apparent.

It is proposed to divide the hydro-electric stations into two main groups—first, the group between Aschaffenberg and Würzburg, with thirty-four stations; second, the Danube group. Thirty of the first group of stations would be entirely dependent on the Main and would therefore supply a variable power in accordance with the height of water in the river. It is thought that ice would interfere with their operation in the winter to an average extent of ten days in the year. To overcome this steam reserve plants would be provided. Interconnection with other systems would take care of the variation in flow. The remaining four stations of the first group would have constant water levels which would render them independent, and their supply could be easily absorbed by the industrial districts of Würzburg, Bamberg and Nürnberg.

The total net output of the stations of the first group, after deduction of all losses in transformation and long-distance transmission, is put at 630,850,000 kw.-hr. a year, of which 291,400,000 kw.-hr. would be constant and the remainder variable supply. On the Danube only three large stations would need to be built—at Poikam, Regensburg and Steinbach in Kachlett. The first two would supply 53,910,000 kw.-hr. and the last-named 232,000,000 kw.-hr., or enough to take care of peak loads. The total possible supply of electricity to be developed by the project would thus reach 919,750,000 kw.-hr. a year, of which 291,450,000 kw.-hr. would be constant.



Transmission and Distribution

Transmission at 220,000 Volts in California

Plans of the Southern California Edison Company and Pacific Gas & Electric Company to Operate Long Lines at 220,000 Volts—Analysis of Engineering Considerations.

By H. A. Barre* and J. P. Jollyman†

THE commercial transmission of power at 220,000 volts, while not an accomplished fact, is assured by the advances which have been made during the year 1920. Scarcely more than a year ago, when the paper on the California 220,000-volt bus was presented to the Pacific Coast convention of the American Institute of Electrical Engineers at Los Angeles by Messrs. Sorensen, Cox and Armstrong, the subject did not receive serious consideration from many of the delegates present. Today plans are well under way for the construction of the two major portions of this bus, and the connection between them has actually been made by large-capacity ties at a lower voltage.

The two companies which have made the decision to resort to 220,000-volt transmission have been forced to it by purely economic considerations. In the case of the Southern California Edison Company the present two Big Creek lines will be loaded to their full capacity of 120,000 kw. at 150,000 volts in one or two years. It will then be necessary to provide additional transmission-line capacity before more generator units can be put into service at the Big Creek stations.

The transmission capacity can be doubled by the construction of two new 150,000-volt lines or by increasing the voltage of the present lines to 220,000. The first scheme will cost between $12,000,000 and $15,000,000, and the second will cost between $2,000,000 and $3,000,000, including the necessary changes in station equipment, which is a saving of approximately $10,000,000. Either of these schemes will provide for the transmission of 240,000 kw. After the development has reached this magnitude there will be approximately 500,000 kw. remaining for development, which will require seven additional 150,000-volt lines or three or four 220,000-volt lines. Assuming that a single line, whether for 150,000 volts or 220,000 volts, will cost $7,500,000, the ultimate saving on the Big Creek project effected by the adoption of 220,000-volt transmission will be roughly $35,000,000.

*Executive engineer Southern California Edison Company.
†Chief of hydro-electric and transmission engineering Pacific Gas & Electric Company.

Preparations by Southern California Edison Company for 220,000-Volt Transmission

The first steps in preparation for the adoption of 220,000-volt transmission have been taken: The equipment for the first unit at Big Creek power house No. 8 has been ordered with characteristics suitable for this transmission voltage. The transformers may be operated either at 150,000 volts or at 220,000 volts, and the generator will be suitable to control the voltage on one 220,000-volt line provided that a 30,000-kva. condenser is connected to the receiving end of the line. Because of the amount of water which will be available for this first unit it was not deemed advisable to have the generator of sufficient size to control the voltage on one 240-mile (386-km.), 220,000-volt line with the line open at the receiving end.

Plans have been made for energizing a 30-mile (48-km.) section of one of the present Big Creek lines at 220,000 volts. This experimental section of lines will be energized at one end from a bank of 4,500-kva. transformers connected in delta on the low-tension side and in star on the high-tension side, which will give a possible variation of line voltage from 206,000 to 272,000. The line will be open at the other end, since no transformers are available to make the transformation between 150,000 volts and 220,000 volts. Various groupings of standard 10-in. cap-and-pin insulators will be tried on this line in an endeavor to determine the best form of insulation to apply to the whole line.

The work of Prof. Harris J. Ryan at Leland Stanford, Jr., University, and of others, on the voltage distribution and the flash-over characteristics of long strings of insulators has shown beyond a doubt that line insulation for voltages of this magnitude can be provided successfully by the use of the standard insulators of today. Of course, better insulators are being sought constantly by the insulator manufacturers and by the power companies.

After all possible information has been obtained from the experimental 30-mile section of line, it may be decided to provide for a transformation from 150,000 volts to 220,000 volts at Vestal, near the middle of the line, and to operate half the line to carry power at 220,000 volts. It is very probable, however, that there will not be sufficient time to do this before the load conditions will require 220,000-volt operation through the entire length of the line.

The problem of changing the present station equipment to accommodate 220,000-volt transmission is one which requires very careful study of many different possible schemes. The present 150,000-volt equipment at the power houses consists of two banks of transformers of 17,500 kva. per bank at Big Creek station No. 1 and three banks of the same capacity at Big Creek station No. 2. At Eagle Rock, the receiving end of the 240-mile lines, there are two banks of transformers of 34,500 kva. per bank and two banks of 13,500 kva. each. At mile 105, numbering from the power houses, there is the Vestal substation with one bank of 13,500 kva. capacity and one bank of 34,500 kva. capacity. At all of these stations each bank of transformers and each of the two lines are connected to the high-tension double bus through 150,000-volt oil switches. Some of the ways of providing for 220,000-volt transmission follow:

At the Power Houses:

1. Provide a bank of auto-transformers having a capacity equal to that of the present installation at each power house, which will transform from 150,000 volts to 220,000 volts.
2. Replace the present transformers with transformers of the same capacity to transform from 6,600 volts to 220,000 volts.
3. Replace the present transformers with one bank of transformers having a capacity equal to that of the present installation at each power house, which will transform from 6,600 volts to 220,000 volts.

At Vestal:

1. Replace the present 150,000-volt transformers with 220,000-volt transformers of the same capacity.
2. Provide a bank of auto-transformers having a capacity equal to that of the present 150,000-volt transformers, which will transform from 150,000 volts to 220,000 volts. These auto-transformers should have a secondary winding for delta connection and for operating a 15,000-volt, 15,000-kva. frequency changer.

At Eagle Rock it will be very difficult to change to 220,000 volts, both because of lack of sufficient clearances in the building and because of the necessity for keeping the station in operation. Then, too, the benefits to be obtained from the change are not so great as they appear at first glance, because the present installation at 150,000 volts will deliver about all the power that can be taken away from that location at 60,000 volts and 15,000 volts.

For these reasons there is a strong tendency toward the plan of leaving Eagle Rock as it is and installing another station at a convenient point about 20 miles (32 km.) up the line. This station should provide auto-transformation from 220,000 volts to 150,000 volts of sufficient capacity to carry Eagle Rock, 96,000 kva. It should also provide the necessary 220,000-volt to 60,000-volt transformation and the additional condenser capacity required. The only way to decide which of these schemes should be adopted is to make a careful estimate.

Plans of Pacific Gas & Electric Company

Early in 1920 the Pacific Gas & Electric Company resumed work on its Pit River projects and determined upon the immediate construction of three hydro-electric plants with an aggregate installed capacity of 95,000 kva., together with a transmission line to the load centers in the vicinity of San Francisco Bay. The total installed capacity of the company's projects on Pit River will ultimately be about 450,000 kva. It is anticipated that the major portion of the power developed along the Pit River will have to be transmitted to the districts bordering on San Francisco Bay, the load centers of which are 200 miles to 260 miles (320 km. to 420 km.) distant from the plants now being installed. To transmit the energy obtainable over the distance involved with the highest efficiency and at the lowest cost required the use of the highest practicable voltage, and 220,000 volts was adopted after a careful study of all the factors involved in the problem. The frequency will be 60 cycles, which is the frequency now used by the Pacific Gas & Electric Company and also by its neighbors in central and northern California.

The maximum capacity of a circuit of any given frequency is limited by the impedance drop over the line. For 60 cycles the maximum capacity of a 110-kv. line is about 35,000 kw. and of a 220-kv. line about 140,000 kw. The total weight of copper and towers in the 220-kv. line is about twice the corresponding weights in the 110-kv. line, but the capacity is four times as great; hence the weight per kilowatt transmitted for the 220-kv. line is only one-half as great as for the 110-kv. line. The adoption of 220-kv. where the power and distance are large enough to justify it is clearly indicated by these considerations.

A thorough survey of the possible difficulties that might arise from operation at a higher voltage than now in commercial use has been made. Four major problems are involved—first, transformers for higher line voltage; second, circuit breakers for higher voltage and larger capacities; third, insulators for higher line voltage and heavier mechanical loadings; fourth, the successful operation of circuits having greater capacity and higher charging currents.

The company's favorable experience with solidly grounded neutral on its 60-kv. system for more than twenty years and on its 110-kv. system for seven years confirms the growing belief that this is the only practicable arrangement for extensive high-voltage networks. It was, therefore, determined to employ solidly grounded neutrals at the generating plants and at the substations of the 220-kv. system. The use of the solidly grounded neutral greatly simplified the transformer problems. The transformers will actually be wound for fewer volts than those now employed on the 165-kv. systems in delta connections, and the use of one permanently grounded terminal greatly simplifies the problems of internal insulation. The development of suitable bushings for the higher voltages has been accomplished, and this permits a solution of the circuit-breaker problem as well as insuring the success of the transformers.

The improvements in suspension insulator units that have been attained in the last few years, together with the work of Prof. Harris J. Ryan and others, previously mentioned, appears to have made possible a suitable insulator for 220-kv. operation. The classic work of Peek and others on corona phenomena has furnished the basis on which the diameter of the line conductor may be chosen so as to avoid excessive energy loss into the air.

The charging kva. of a 200-mile, 60-cycle, 220-kv.

circuit amounts to 42,250 kva., and this introduces an operating problem to which careful consideration must be given. Obviously such a circuit cannot be energized by a generator of a few thousand kva. The solution lies in selecting a generator of sufficient capacity to charge the line to full voltage at the receiving station without becoming self-exciting. To control the voltage at the receiving end and permit the delivery of the maximum load over the line synchronous condensers must be used at the receiving stations. These requirements have been met in the Pit River development by the selection of two 35,000-kva. generating units at the Pit River No. 1 plant, either of which will handle one 200-mile circuit, with the initial installation of one 20,000-kva. synchronous condenser in each of the substations.

Construction work on the project is well under way. Hat Creek power plants No. 1 and No. 2, each with 12,500 kva. installed capacity, will be in operation in the spring of 1921. The equipment for Pit River No. 1, of 70,000 kva., has been purchased, and it is planned to have it in operation by the end of 1921. Construction of the first 60 miles (96 km.) of line, which will permit a temporary tie with the existing system at 60 kv., is well under way, and contracts are now being placed for the equipment of the rest of the line and the substations.

The year 1920 will pass into history as the year in which the first 220,000-volt transmission projects were started. This work will show its importance in the accomplishments of 1921 and 1922 already planned.

Rating and Reliability of Electrical Apparatus Increasing

Single-Phase Transformers of 23,600 Kva.—Tests Justify Use of Pin Insulators in Horizontal Position —Vertical Break in Air-Break Switches

BY M. M. SAMUELS
Electrical Division J. G. White Engineering Corporation

NO STARTLING discoveries or brilliant inventions have marked the path of progress in the electrical industry during the past year. Nor have new principles, methods or radically new types of apparatus been brought out. Rather, the tendency has been to elaborate and improve upon the known types of apparatus to make them safe and more economical. Transformers of 23,600 kva. have been put in service, while 45,000-kva. single-unit generating sets have become standard. Oil circuit breakers for 220-kv. service and low-voltage breakers having 1,500,000 kva. rupturing capacity are in process of development.

In the race for size the transformer has run a close second to the generator, 23,600-kva., 130,000-volt, single-phase transformers having been completed and now operating satisfactorily. The following data will give a rough idea of their size: Diameter, 10 ft. (3 m.); height over tank, 16 ft. (4.9 m.); height over bushings, 22 ft. (6.7 m.); weight with oil, 63 tons; weight of oil, 18 tons. The "oil conservator" may now be considered a standard accessory to a large transformer, since it has fully demonstrated its value in the saving of oil and the reduction of breakdowns. There seems to be a backward tendency in some quarters to design transformers for indoor service, although the place for them is out of doors or away from occupied buildings.

Along with the increase in generator and transformer sizes, suitable switches had to be developed for both enormous rupturing capacity and very high voltages, and it seems that the switch designers have encountered greater difficulties than did the generator and transformer designers. However, oil circuit breakers are now in the process of development having a rupturing capacity of 1,500,000 kva. at 13,000 volts, and if successfully produced these circuit breakers will represent a very creditable achievement. On the other hand, high-voltage oil circuit breakers are also being developed for 220,000-volt operation. These will be approximately 34 ft. x 18 ft. x 21 ft. (10.4 m. x 5.5 m. x 6.4 m.) and will require about 17,000 gal. (64,000 l.) of oil. Because of the enormous size already reached there is evidently a great field for the inventor to develop new principles in switching and perhaps new mediums to be used in place of oil.

INTERCHANGEABLE BUSHINGS FOR 220-KV. LINES

Great strides have been made in the design of bushings and in the tendency to standardize them so that it is now possible to interchange transformer and switch bushings for very high voltages. One type of bushing now being developed for 220,000-volt switches will be oil-filled and have a dry flash-over voltage of 660,000, which is below its puncturing voltage. The wet flash-over voltage will be 485,000.

The recent tendency in air-break switch design has been toward the vertical break, which promises to give better satisfaction in operation. Several new switches of this type have been brought out recently. A novel idea in air-break switches is the vertical blade switch brought out recently which adapts itself to simple station design when used for disconnecting purposes. Automatic air-break switches are gradually making their way into the industry, and as more opportunity shall be offered for their study their field of usefulness will no doubt be considerably enlarged. However, the air-break switch is still in its infancy and must be made the subject of study and have many improvements before it will be able to compete successfully with the oil circuit breaker for interrupting load currents.

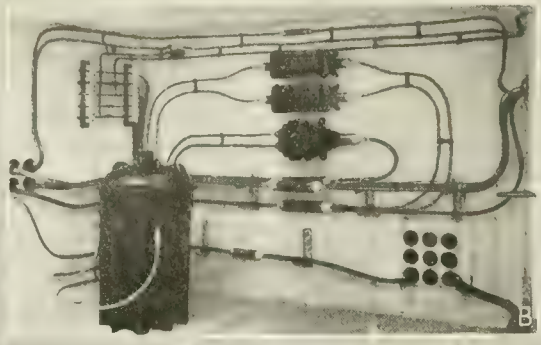
Insulators have of late been subjected to thorough study and laboratory research and valuable improvements have been made in their design. It will be of interest to many engineers to learn that it has been found through many independent tests that pin-type and post-type insulators have when mounted in horizontal position as great wet flash-over as when in upright position, if not greater. It is therefore no longer necessary to use the clumsy 45-deg. arrangement of insulators on vertical disconnecting switches, choke coils and bus runs, since it is perfectly satisfactory to install insulators in the horizontal position.

Some standard as to the meaning of the insulator rating of apparatus such as switches, choke coils, etc., should be established to enable a purchaser to know definitely when purchasing a switch just what flash-over tests and mechanical strength to expect of the insulator supports. At the present time some manufacturers use, for instance, the same insulator on 33,000 volts as others use on 22,000 volts, a practice which should be changed if the same margin of safety is desired.

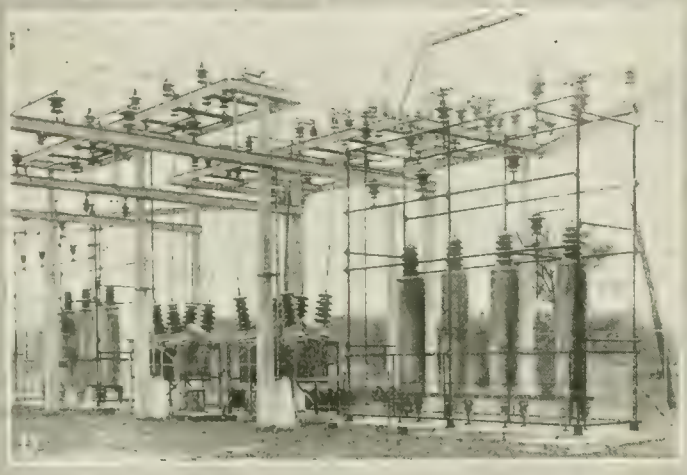
Very little has been done along the line of developing practical mechanically operated disconnecting switches, even though the demand for them is continually increasing, since the many obvious objections to the hook type of switch are being more and more realized. Here, too,

Typical Methods of Meeting Service Requirements

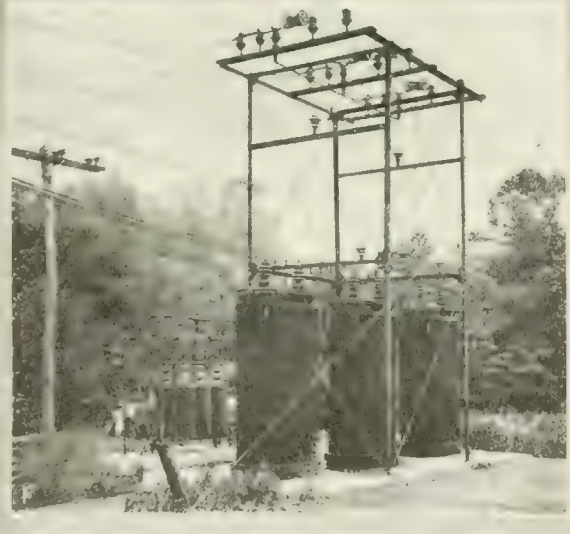














A—Open-wire circuit connected with 26,000-volt underground cable by means of single-conductor cable and open-air potheads. B—Stacking and arrangement of manhole cables with primary and secondary boxes and subway transformer. In the upper left-hand corner is the service bus from which connections are made to consumers. C—Vertical connection along pole from open-wire transformer service to underground conduit. D, F and G show recent tendencies in outdoor substation construction—the first with concrete poles, channel-iron bus supports and pin insulators; the second with angle-iron framework, vertical break disconnects and no sharp bends between line and arresters; the third with pipe framework on wood poles. Pipe framework is being used to the exclusion of other structural materials on all of the more recent installations. E—This illustration shows a 132,000-volt substation which is equipped with a high-voltage metering installation.

as is the case with air-break switches, a field of development is open to the inventor.

The super-generator of 45,000 kva. in a single unit has established itself definitely among standard apparatus. Several such units have been completed and put into successful operation, marking great economies in the cost of generation. There seems to be no tendency, however, to build these super-generators for higher voltages than the accepted maximum of 13,000, although there doesn't appear to be any reason why an attempt should not be made to generate at 22,000 volts or 33,000 volts.

No doubt there are some difficulties in taking proper care of slot insulation for these voltages, but at the present stage of development of insulating materials it should be possible to overcome these difficulties. Generator designers should also pay more attention to the way in which a large machine will be placed in the station and should provide greater accessibility to terminals than they have done in the past. Large generator terminals are generally brought out within the air duct, and with the types of steel foundations now in common use it is very difficult to provide neat connections from the switching apparatus into the air duct. The best that has been done along this line has been to provide holes in the steel foundation girders, placing micarte tubes in these holes and extending the generator terminals through the tubes from the air ducts to the outside of the foundation. The necessity of this procedure should be eliminated by proper arrangement of wiring at the machine frame. In the industrial field the tendency has been toward safety and economy. The dead-front switchboard, particularly the truck-type switchboard, is now in practical use in most plants where it is the purpose to have up-to-date electrical equipment. The dead-front type of switchboard has made it possible to use steel panels instead of slate, and there is reason to predict that in the near future slate switchboards will become a matter of history and steel panels will be used exclusively.

While many types of refillable fuses have been brought out, none of these may yet be considered to approach perfection. In developing new fuses it should be borne in mind that they must be so designed that the contacts are safe, that there should be not more than two or three parts to handle, that renewals should be possible without the use of tools, that there should be an indication on the outside of the size of the fuse, and that it should not be possible for any one to install more than one size renewal in a shell. Here is an opportunity for invention as well as for development. The tendency among engineers, however, is to eliminate fuses and to use circuit breakers wherever possible, and some very satisfactory oil circuit breakers with overload and low-voltage protection have been brought out recently. It is unfortunate that a clause slipped into the new National Electrical Code requiring fuses on motor circuits even when automatic circuit breakers are used. This ruling is an unnecessary hardship. After many years of discussion, and after having been in general use for years, varnished-cloth insulation has finally made its appearance in the code. To prevent rulings like the foregoing and the omission of necessary rulings practical engineers should take a more important part in the framing of the code, instead of leaving it to the arbitrary decision of inspectors.

In the near future another article will deal with progress in the high-tension field.

Effect of High Costs on Transmission and Distribution

Steel Cross-Arms Not So Attractive—Maintaining Live Lines—Economical Loading of Transformers—Sidewalk Distribution—Fiber Duct Favored

BY E. B. MEYER

Assistant Chief Engineer Public Service Electric Company of New Jersey

ABNORMAL credit conditions and the failure of rates to keep pace with the excessively high cost of material and equipment have forced utility companies to keep their financing for expansion and new construction down to the lowest possible figure consistent with furnishing adequate service. No extensive construction programs can be undertaken until prices of equipment have been reduced to somewhere near the pre-war level.

The interconnection of systems which was advocated so strongly during the war period is being carried forward, but not so rapidly as might be desired, owing largely to the financial situation. However, it is important to consider any interconnections which will result in saving fuel, since this material represents the largest element of the cost of producing electric energy. The difficulty of obtaining coal during the past year or two has made the matter of interconnecting power one of prime importance, as by this means service has been maintained which could not otherwise have been given.

The large amounts of power and the long distances involved in the interconnection of utility properties have made the study of the economic range of transmission voltage of considerable interest during the past year. As a result the feasibility, design, cost and characteristics of transmission at materially higher voltages have had particular consideration. The studies which have been made seem to indicate that the problems differ in degree, but not in character, from those which have been satisfactorily handled at lower voltages. In the studies of extra-high-voltage problems apparently the simplest design is the most desirable, and the elimination of unnecessary equipment tends to reduce the possibilities of service interruptions.

Voltage standards play an important part in interconnection, and for this reason the need of standardization is being discussed by engineers throughout the country. The advantage of keeping these standard voltage steps to a minimum is great, even more from the point of view of future interconnection than from that of economy of manufacture.

In the case of lower-voltage transmission systems the use of wooden poles rather than steel-tower construction seems to have been the general tendency. Some companies which have been using steel arms for lower-voltage transmission have seriously considered standardizing on wooden arms. The substitution of suspension strings for the strain insulators on transmission lines, with anchor towers on straight sections, also seems to be the general trend. The result of such a change is to reduce the number of insulator units which are in a horizontal position and thus reduce the percentage of total insulator failures.

The practice of maintaining transmission lines while alive seems to be gaining in favor, tools and equipment having been designed for changing insulators, carrying on new construction work and making repairs both to the line and other parts of the equipment.

All work is done without taking the line or circuit out of service, thereby effecting considerable saving.

Service connections to consumers represent a considerable portion of a utility company's investment, and on account of the high cost of labor and material in making such connections some companies have arranged to have the cost borne by the consumer either under a refund agreement or otherwise.

Selling at Primary Voltage

Within the last few years the development of numerous industries with large-scale production has made it desirable for a number of utilities to sell energy direct to the consumer at primary voltage, the consumer providing and maintaining all the transforming equipment and receiving the benefit of a differential in rate. Still others are continuing to sell energy metered and sold at the low-tension side of the transforming equipment, the utility providing and maintaining the apparatus.

Economical loading of distribution transformers to avoid the installation of unnecessarily large units and to prevent burn-outs is receiving close attention, and in many cases it has been found necessary to make tests in order to learn whether the transformers were being overloaded and subjected to undue and unnecessary strains. The need for a proper device to indicate automatically when the maximum safe loading of a transformer has been reached is evident, and the lack of an adequate method of checking and following the loads on transformers has resulted in many cases in the practice of installing larger transformers than are necessary. The practice of banking transformers is not so general as might be expected in view of the many advantages attendant upon such operation. This attitude is probably due to the trouble experienced in restoring service after a local interruption, but these difficulties are usually caused by indiscriminate banking without a sufficient study being made to insure a reliable and workable layout. The banking of transformers usually makes it easy to use fewer transformers of a larger size, thus resulting in a lower cost per kilowatt and a higher efficiency.

Underground Work Deferred

Like all other forms of construction, underground installations have so increased in cost that this branch of central-station work has been deferred wherever possible. It is unreasonable for municipalities to expect utility companies to continue extending their underground installations in the face of prohibitive costs, and it therefore is desirable that the two interests co-operate with the view of deferring such work until financial conditions are more favorable. Where it has been necessary to connect consumers from existing underground systems various schemes have been employed for reducing the cost. One of the methods employed where the streets have improved forms of pavement is to use a sidewalk distribution system with hand-holes near the curb as distributing boxes.

In connection with the heating of cables, proper design of conduit systems plays an important part; hence many companies in the past year have given considerable attention to the spacing and separation of ducts in the conduit runs to permit of proper radiation and also to prevent trouble in one cable from being communicated to a cable in an adjacent duct.

The use of fiber conduit is gaining in favor every day, and it is estimated that from 60 to 70 per cent of the companies are now laying fiber ducts in preference to other types of material. There are, however, some companies still continuing the use of vitrified-clay duct both single and multiple, while a number are also installing stone conduit. In making installations of fiber and stone ducts watertight joints are comparatively easy to obtain, but with vitrified-clay ducts, where the joints must be wrapped with cloth or paper and then covered with a cement or waterproofing compound, it is difficult and costly to keep the conduit free from water in wet or swampy ground.

Considerable interest has been shown during the past year in the subject of current-carrying capacity of cables. Many of the operating companies have been making extensive investigations with the view of learning more about the temperatures at various current ratings of underground cables. It is hoped that the investigations now being made by committees from a number of engineering bodies will be carried forward to some conclusive results in the near future.

Lower Dielectric Losses and Higher Voltages

One of the principal improvements in underground high-tension cables has been the reduction of dielectric loss at relatively high temperatures. This has been accomplished principally as the result of thorough study of the properties of impregnating compounds. It is now possible to manufacture cable the rating of which will be decreased only a few per cent at even 100 deg. C.

It seems highly probable that the proposed scheme of applying a metal sheath over the insulation of each conductor to improve the carrying capacity of the cable might be effective, not because of the reduction of dielectric loss, but because of the reduction of temperature of the insulation at the center of the cable due to the better thermal conductivity thus provided.

Temperature surveys of conduit systems to learn more about the heating of the cables are extremely important; therefore it is desirable that observations be obtained periodically so that relief may be furnished as soon as temperatures are found to be excessive.

The improvements in the manufacture of cables have been such that several companies are now considering the operation of three-conductor cables at 33,000 volts, and it is expected that in the near future even higher voltages will be undertaken. Since there are inherent limitations to the development of the usual three-conductor cables at extra-high voltage, the use of single-conductor cables seems to have merits.

The general tendency in underground-cable practice has been to use cables of large size, thus making it necessary to increase the diameter of the conduit in all new installations. In the past 3-in. (7.6-cm.) duct was considered standard, while today 3½-in. (8.9-cm.) and in some cases as large as 4-in. (10.1-cm.) duct have been used. The advantage of the larger size of duct is that splices may be drawn into the duct, thereby permitting the use of short lengths of cables which would otherwise have to be junked. This practice has been made desirable by the high cost of cable. In several cases it has been found necessary to reroute cables, and the duct splice has been a very desirable means of accomplishing this end most inexpensively.

Cable failures have been receiving more and more attention from year to year, and companies are now making investigations in order to analyze their failures

and put into effect measures which will prevent recurrence of such troubles. The protection of cables from fire in manholes by the use of cement covering has become more or less recognized standard practice.

There has been much discussion of the distribution of voltage stresses in three conductor high-tension cable, and several companies have installed cable of the Hochstadter type. Some companies are continuing the use of split-conductor cable, which is an installation similar in principle to the Merz-Price and other English systems of balanced protection. The first cost of split-conductor cable and the higher cost of making joints and connections make this type of cable considerably more expensive than cable of the usual design, hence its installation is not justified in all cases.

However, split-conductor cables give service as good as that of the usual type of cable, their only disadvantage being that for a given conductor size they are slightly larger in diameter. For tie lines between generating stations where it is of extreme importance to maintain service, and where faulty lines should be tripped out with the least possible disturbance to other lines and equipment, this type of cable is very satisfactory. Split-conductor cable is also desirable for loops fed from a generating station at one end and running back to the generating station at the other end, since in this case service to the substation is generally of prime importance and the ordinary relay has not a sufficient setting for safe use.

It should be borne in mind that for tie lines between stations to obtain the benefits of split-conductor cable—namely, uninterrupted service and disconnection of a faulty line with no resulting disturbance—there should be installed two or more cables, so that with the disconnection of one line the others will carry the load.

Aërial cable has been found very satisfactory, and its service has been extended considerably in the last few years because it has been found to meet certain needs in electric power transmission where underground construction costs are prohibitive and open-wire construction is undesirable. Its use has been confined, however, to special work, such as under bridges and over railroad crossings. In certain localities where high-voltage lines have to be run through trees aërial cable has been of decided advantage.

Superpower Investigation Between Boston and Washington

Engineering Organization and Nature of Studies Undertaken, Together with Some Aspects of the Investigation as Thus Far Made

BY W. S. MURRAY
Chairman Superpower Survey

IN JUNE of 1920 Congress passed a bill appropriating $125,000 to the United States Geological Survey for conducting power production and distribution studies in the United States, including a power survey between Boston and Washington. The plan proposed by the writer and assigned to him for execution in detail has for its central idea the construction of a regional power system with which to generate, transmit and distribute electrical energy to the railroads and industries within a territory the major limits of which are Boston on the north, Washington on the south and a point inland from the coast approximately 150 miles. Within this zone there is a present total demand of approximately 17,000,000 hp., 10,000,000 hp. for the industries and 7,000,000 hp. for the railroads.

Owing to the existing situation of unassociated power developments for the industries and railroads, the load factor (the ratio of average power to maximum power) in the zone is excessively low, and because of the small average size of central stations and the extremely uneconomical use of fuel by steam locomotives the waste of coal is prodigious. Thirty million tons is a conservative estimate of the annual waste of fuel, and this total is growing rapidly because of increasing power requirement, so that in 1930 the waste, if present methods are pursued, will reach the enormous figure of 53,000,000 tons.

The proposed regional plant will be electrical, and through its higher operating efficiency this great amount of coal can be saved and many economies in other materials and labor effected. The Superpower System comprehends the installation of large, economical steam electric plants, to be erected at tidewater points and at the mouths of mines where condensing water and other conditions permit. These steam stations will be supplemented with large hydro-electric plants, to be installed on the major rivers within the zone or within transmission distance of it. Such an assembly of plants severally connected to a system of transmission and distribution will serve the whole zone with adequate, reliable and economical power, relieve the railroads of the task of transporting the coal heretofore wasted, and also turn a large amount of the remaining coal tonnage, used for power and lighting, into electrical energy, and through the proposed electrical overhead carrier system of power again lessen the coal burden imposed upon the railroads and automatically release the new cargo space so badly needed for other commodities. The engineering organization authorized July 1, 1920, to make the investigations under the auspices of the United States Geological Survey was shown diagrammatically in the issue of the ELECTRICAL WORLD for Aug. 28, 1920 (page 447). It consists of an advisory board and an engineering staff.

The engineering staff, consisting of the chairman, three division engineers covering respectively power and transmission, railway and industries, the chief hydraulic engineer of the United States Geological Survey, the chief mechanical engineer of the United States Bureau of Mines and an engineer-secretary, with their several assistants, was duly appointed and in action prior to Aug. 1. Nearly all of the present twelve members of the advisory board had also accepted service on that date, and the board has since held two meetings. During the first two months weekly engineering staff meetings were held. More recently these meetings have been held at two-week intervals in order to afford more time for the receipt of analyses and assembly of data from the field in response to the information sheets which were sent out to the railroads, to industries and to central stations.

At this point I shall shed modesty and claim credit for the suggestion that an advisory board should be appointed, with recommended members appointed by the Secretary of the Interior. This board as now composed includes men of national reputation, who, although their minds are basically of an engineering cast, are serving the survey in matters pertaining to executive procedure. To my mind it was not enough, well surrounded as I am

with engineering talent, to allocate to myself or to these engineers the many problems that are allied to, yet quite separate from, engineering. I firmly believe that no man is a real engineer who does not relate law, finance, corporate relations and so forth to his problems; but with the wealth of talent now comprised in the advisory board ready at hand, interested and willing to assist in the solution of this great national power problem, I could justifiably have been charged with professional negligence had I not availed myself of it.

I have had the pleasure of addressing a number of engineering societies, organizations and chambers of commerce, and many questions have been asked. Some of these, together with others that have been asked by the editors of the ELECTRICAL WORLD, are quoted in the following paragraphs, with such answers as I find it possible to make at this time:

Is your plan in building the Superpower Zone to use existing power plants and lines as a nucleus, enlarging or strengthening where necessary, or is it to build superpower stations which will supplant existing large stations?

The plan of the Superpower System is to consider the building of new and very large stations, which may be of the order of 300,000 kw. None of these suggested stations will supplant stations now built whose inherent economies of operation are equal to the proposed new ones. The Superpower System might well be likened to a "university of power," matriculation in which will be the passing of an examination in economics of power production. As an example of a station not to be supplanted, take the station now being built at Hell Gate by the United Electric Light & Power Company in New York City. The thermal efficiency of this plant will be such that a kilowatt-hour will doubtless be placed on its main buses at an expenditure of energy not to exceed 17,000 B.t.u. Such a station, if agreeable to the operating company, will form a direct part of the Superpower System, and it is easily within expectation that the Superpower System will receive rather than deliver power to such a plant. On the contrary, there are many other and very large power stations whose economy of power production is less than those in New York City, and these should receive power upon their buses from the Superpower System. It will be of general interest to know that a committee has been appointed known as the "committee on power interchange," the chairman of which is John W. Lieb, vice-president of the New York Edison Company. I am asking this committee to make recommendations concerning power delivered to or received by the Superpower System in its relation to existing electric utilities. Service on this committee with Mr. Lieb has been accepted by representatives of both large and small public utilities within the Superpower Zone.

Many of the large systems, while their station efficiencies may not be the equal of that of the Superpower System, will contribute their quota in the form of capacity required during peak-load operation. The load factors of peaks is amazingly low, which means high capacity but low energy demand. The chief cost in a peak kilowatt-hour lies in the investment. An enormous reduction of this investment is gained through the use of hydro-electric plants where opportunity of storing water is possible. There are a number of places within the Superpower Zone where this principle can be applied. It is of interest also to note that, although the Eastern section of the United States has a smaller percentage of water power than the Western section, by proper application it can be made enormously effective in the reduction of investment cost. This fact and the application of diversity factor will permit a wonderfully economic intercorporate operation where so many plants may be associated. In short, the Superpower System motto might be "Competition with none, help to all." It is nothing more or less than a great economic pool of power, the functions of which are two: (a) the reduction of the cost of a kilowatt; (b) the reduction of the cost of a kilowatt-hour. When these two ends shall have been accomplished the national aspect of the scheme becomes immediately apparent from the resulting conservation of the natural resources of the country (coal) and of money.

Where are the most likely sites for new superpower stations?

Data to the extent of 80 per cent of the information required are in the hands of the survey, and co-ordinate analysis is now under way. At this writing it is impossible to state definite locations of the proposed new superpower stations. The report will include recommendations relating to the size, the location and time of location of transmission lines, substation and superpower stations.

Which existing large stations will form the foundation of the zone?

The large stations now in operation in Boston, Providence, New York, Newark, Philadelphia, Baltimore and Washington and such others as may qualify for base or peak-load operation will form a part of the Superpower System.

Is it your contention that 220,000-volt lines will be required merely to exchange energy between adjacent plants?

No; the 220,000-volt lines will be associated only with power transmitted from the more distant points, as from the St. Lawrence River or the coal mines. The zone transmission voltage will be at a lower potential, possibly employing 110,000 volts. While the central stations will supplement each other, the clearing house for this exchange will be the substations. It will be only in exceptional cases, though the operation is perfectly possible, that power stations will exchange power.

Will the Superpower System consist of a trunk line or merely a heavy network between the larger stations with laterals to connect other systems?

The Superpower Zone is not so extensive but that a ring bus carrying a potential of 110,000 volts may be entirely sufficient to carry loads within the range of commercial loss. These loads can be supplemented, as explained in the answer to the preceding question, by power transmitted from distant points at 220,000 volts and stepped down to zone voltage.

What investigations have been made so far to determine feasibility?

There is nothing untried in the proposed system except possibly the art of the complete co-ordination of so many systems. A central control system whose functioning head will be a load dispatcher will, of course, be necessary, but no particular difficulty is anticipated on a wider extension of the principles now in operation.

How do existing central-station systems feel toward the plan?

If interest and assistance are indicative of their feeling, I would say it to be most friendly. My report indeed has been made possible only by the hearty co-operation I have received from the public utilities, railroads and industries.

How do the companies in the vicinity of Niagara Falls feel toward the project of connecting with such a system?

No discussion has yet taken place concerning the Niagara companies. If power in excess of the immediate local requirements is available in this zone, the radius of transmission for large blocks of power is within commercial transmission distance. Niagara Falls is practically the same distance from New York as the St. Lawrence River.

What certainty is there that railroad electrification loads can be secured in the near future?

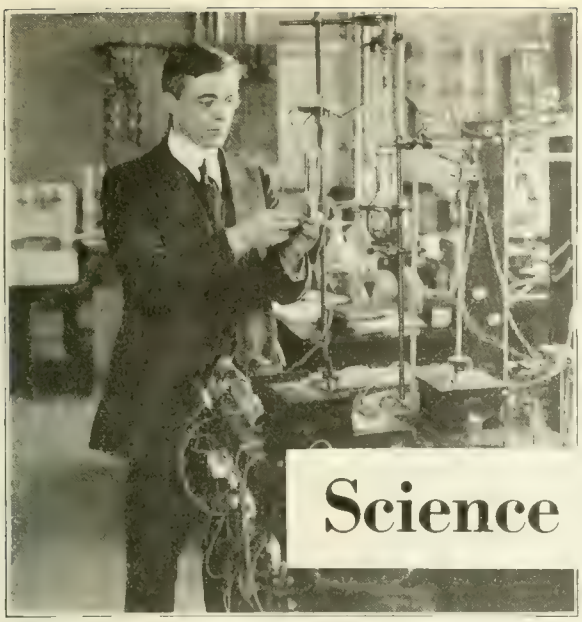
Of the railroads in the zone, about 6,000 miles (single-track basis) indicates a density sufficient for immediate electrification.

Can you indicate the magnitude of load expected within two years after completing the system?

For the Superpower Zone the data so far received indicate the following electrical loads: 1920, 12,500,000,000 kw.-hr.; 1930, 36,400,000,000 kw.-hr.

What conclusions have been reached so far?

At this writing, since much of the data are yet to be analyzed, it is thought inadvisable to offer any conclusions. I find, however, that so far I have no reason to depart from my earlier estimates regarding the density of power requirement within the zone, nor any reason to believe that an electrical regional plant of the character described will not effect the economies predicted.





Science and Research

Electromagnetic Theory Is Fundamental in the Sciences

Reaches Pinnacle of Usefulness in One Hundred Years —Langmuir's Postulates and Einstein's Theory Are Being Tested.

BY A. E. KENNELLY

Professor of Electrical Engineering Harvard University and Massachusetts Institute of Technology

THE year 1920 has been notable in scientific annals as being the centennial of the first discovery of electromagnetism through the classical researches of Oersted and Ampère. We who live in this century are accustomed to see great industrial power plants, having large electromagnetic generators, motors and connecting lines, with their electric and magnetic fields in co-operative association. We are also familiar with the emblem of the American Institute of Electrical Engineers, which shows a magnetic circuit ring linked rigidly with an electric circuit ring. It is difficult for us to realize that prior to 1820 there was no recognized association between magnetism and electricity.

A noticeable feature of the scientific literature of the past year has been its phase displacement. Owing to the effects of the world war we have been many months in arrears of publication. Work done in applied and unapplied electrical science during the period of the war and held back from dissemination for various reasons connected with that greatest event of modern history is only now being released, examined and discussed. Nor is this time lag discernible only in electromagnetic literature. It clearly pervades all scientific literature. All whose tasks are connected with science in some branch or application, which today includes a large share of the entire community, are now called upon to make a greater mental effort of readjustment than formerly in order to bring themselves once more into synchronism with the creative effort of the day.

But if the greatest of all wars has left the world depleted materially and with a harder task in maintaining pre-existing standards of material comfort and intellectual satisfaction, it has also left the world in much closer national association. The fact that the most distant antipodal regions are probably only one-tenth of a second remote by radio has come to stay with us and to influence our lives in ever-increasing ratio. The world war has destroyed national isolation, and we find ourselves compelled to think in international terms. The recent official opening of the great Lafayette radio station at Bordeaux is a typical event of the year. It marks the satisfactory completion of a co-operative electrical engineering plant, the daily operation of which will make itself audible not only in America but all over the globe.

Electromagnetic researches are now so comprehensive in their scope that they may be regarded as including, from a broad standpoint, nearly all of the scientific researches comprised within the original meaning of natural philosophy. Chemistry, mechanics, light, heat, and now even gravitation, are claimed as branches of electromagnetics. Perhaps the most recently active field of electromagnetic investigation has been physical chemistry, on the border line of atomic theory. The interest in atoms has been directed to their constituent electrons. It is curious that the electron, which has been so prominently occupying scientific attention everywhere, is an entity having a mass of less than 10^{-27} gram. The number of electrons in a gram of matter is therefore estimated at more than 10^{27}. A convenient method of visualizing a large number of this kind is to consider the size of a cubical box necessary to contain that number of small shot. An ordinary diameter of small bird shot would be 1 mm. On this basis shot would be 10^{9} mm., or 10^{6} m., or 10^{3} kg., in length the cubical box that would be necessary to hold 10^{27} shot would be 10^{9} mm., or 10^{6} m., or 10^{3} km., in length of edge. It would be about as long as the distance from Norfolk, Va., to Ottawa, Canada. Albeit a gram of matter is supposed to hold that number of electrons, these are not believed to be tightly packed, like shot in the hypothetical box. On the contrary, the average distance between adjacent electrons must be very large compared with the dimensions of each electron. The electron is at present the smallest thing known to exist, and is about fifty thousand times smaller in "diameter" than the hydrogen atom, which, in its turn, was the smallest thing recognized in science a generation ago.

Since the experimental researches of Millikan have enabled us to study the behavior of individual electrons and to count them one at a time like coins, the belief in the existence and properties of these most minute electrics of the under-microscopic world has made great

advances. Chemical affinities, forces and combinations are assumed to be the stories of the properties and propensities of electrons in their various organized atomic groups.

The recent brilliant investigations of Bragg and Moseley have led to the belief that the eighty-eight known chemical elements, from hydrogen to uranium, occupy a series of simple atomic numbers from 1 to 92 inclusive, with only four missing or unidentified members. To each of these atomic numbers belongs, according to theory, a like number of nucleus electropositive charges and a like number of electronegative electrons.

LANGMUIR'S POSTULATES OCCUPY SCIENTISTS

A very interesting recent theory of Langmuir deals with the constitution and construction of the various eighty-eight chemical elements. Each kind of atom has a three-dimensional structure, approximately spherical in form. The polar axis of an atom is an axis of symmetry, and the equatorial plane perpendicular thereto is a plane of symmetry. By building up spherical aggregations of one, two, three and four units in radius, with "cells" of equal size apportioned among the different electrons, the theory claims to account for a number of the known chemical properties of the different atoms and to satisfy the periodic series originally pointed out by Mendeléeff.

Langmuir's spherical atoms are actually more easily worked with as cubes. The atoms are chemically inert when the number of electrons is such as form simple stable groupings of positive nuclei and negative electrons evenly divided over the surface. Thus, neon with two electrons and helium with $10 = 2 + 8$, two in the inside and eight in the outside shell, are the first two of the highly inert atoms. When, however, the atomic numbers do not fill up the outside shells forces are exerted on neighboring atoms to bring about a structural union, or chemical combination, that will complete octet groups of electrons between them. In this manner a very fascinating stereochemistry is worked out for a number of atoms and molecules, which is purely electromagnetic in one aspect, purely chemical in another and purely structural in a third.

The Langmuir theory offers so many opportunities for examination and discussion over an enormous field of bald chemical facts, which have hitherto for the most part defied explanation, that it will take the chemists a long time to come to a decision as to the final place of the theory in the general field. It is difficult to decide at first sight how atoms in a given molecular combination behave toward each other on this electron hypothesis. It is advantageous to construct mechanical models of the various component atoms and to study the ways in which these can be brought into mutual contact, with the maximum stability and structural simplicity. The theory is built upon eleven postulates and offers a new view of chemical valences.

EINSTEIN'S THEORY APPEARS WELL FOUNDED

Another subject of investigation which has assumed great scientific prominence during the past year is the Einstein theory of relativity in its latest form. Indeed, the interest in this scientific subject may be said to have overshadowed almost all others during recent months. The theory is admitted to involve three consequences, capable of being experimentally verified and not otherwise explainable—namely, first, a slow rotation of a planetary orbit, which in the case of Mercury takes 140 years to advance through one minute of arc, or 3,000,000 years to complete one revolution; second, a bending of light in a powerful gravitational field, as though the light were ponderable material, and, third, a minute displacement of the spectral lines of the sun toward the red end of the spectrum. The first two predictions are declared to have been already verified, while the third is still undecided.

As to the consequences of the theory, they may be regarded as at present unrecognizable to the ordinary observer, inappreciable in engineering or geodesy, appreciable in astronomy, but of very great significance in philosophy or the doctrine of the universe. The remarkable fact, from an electromagnetic standpoint, is that the new space geometry, which is no longer simple Euclidian three-dimensional geometry, is claimed to be in complete conformity with the Maxwellian theory of the electromagnetic field. According to this doctrine, space is not infinite, but very large and limited; gravitational force is merely a fictional phenomenon, due to our misinterpretation of the vagaries of geometrical space in the vicinity of matter, and time is indissolubly linked with space. While it is not difficult to obtain an abstract comprehension of this doctrine, on the basis of mathematical equations, it is extremely difficult to obtain a concrete comprehension that can be visualized or constructed. It is pointed out, however, by the protagonists of this remarkable theory that we have no right to deny its validity merely because we have difficulty in visualizing it to our untrained senses.

Insulator Progress During 1920

A Review of Important Research Work Now Under Way —Requirements for 220-Kv. Transmission Lines— Insulator Failures Resulting from Lightning— Fundamental Developments in Insulator Design

BY HARRIS J. RYAN

Professor of Electrical Engineering Leland Stanford, Jr., University

THE year 1920 will be distinguished for the determined efforts that have been made in studies of transmission-line insulation to insure operating reliability, to develop greater durability of insulators and to find forms that should be satisfactory for the support of 220-kv. lines. In respect to design there has been considerable authoritative effort to overhaul the analytical work of ten years ago in order to profit by a more modern knowledge of fundamentals. In this the manufacturer has welcomed the cordial co-operation of the operating engineer.

Along other lines a notable work of co-operation was accomplished by the ELECTRICAL WORLD* in obtaining practical data from the engineers of forty-one power companies operating high-voltage transmission lines in the United States and analyzing and publishing them. The companies permitted their names to be published with the data and answers supplied by them. In the judgment of the writer this is the most important single insulator achievement of the year.

The National Electric Light Association has an insulator research committee at work on the problem of the

*"Analysis of Insulator Practice," ELECTRICAL WORLD, March 6, 1920, page 543; March 13, 1920, page 596; March 20, 1920, page 673.

durability of suspension insulators as affected by temperature cycles. The association is financing the undertaking. This committee has developed and is maintaining in operation equipment by which five twelve-unit strings sustaining individual mechanical loads varying from zero to 5,000 lb. (2,267 kg.), as desired, are carried through 150 temperature cycles each week. The temperature ranges run upward from room temperatures to temperatures not exceeding 130 deg. Fahr. The automatic "ovens" have been put to work on specimens collected for this purpose in 1917. The work as originally undertaken was interrupted by the war. With the knowledge and experience gained through the 1917 material, specimen products of the latest state of the art will be put through presumably 1,500 cycles under appropriate mechanical loads.

Revision of Insulator Specifications

The American Institute of Electrical Engineers standards committee has also organized a sub-committee on insulators that is engaged upon a revision of insulator specifications in response to a resolution passed at the Portland meeting in July. When the details of insulator requirements for the proposed 220-kv. lines were first considered a difficulty was encountered because of the excessive voltage duty that must be carried by the unit in the string next to the line conductor. It was generally conceded that the safe practicable limit had been reached at 18 kv. for the 10-in. (25-cm.) unit on 150-kv. lines. It was known that such voltage duty on the end unit of the conductor was likely to increase approximately as the line voltage, quite independently of the number of units that might be added to the string.

At a line voltage of 220 kv., therefore, the duty on the conductor end units would be 26.5 kv. when dry, and the corresponding factor of safety against general breakdown of the air surrounding it would be about three, whereas the corresponding factor of safety on the 150-kv. line is four and one-half. Eventually the majority of conductors in the 220-kv. lines may be too heavy to be supported from single strings of the 10-in. insulator units that are in common use today. Furthermore, reliable makers have come forward with tentative assurances that on demand larger units will be furnished that are capable of supporting the heavy conductors and withstanding higher end-unit voltage duties.

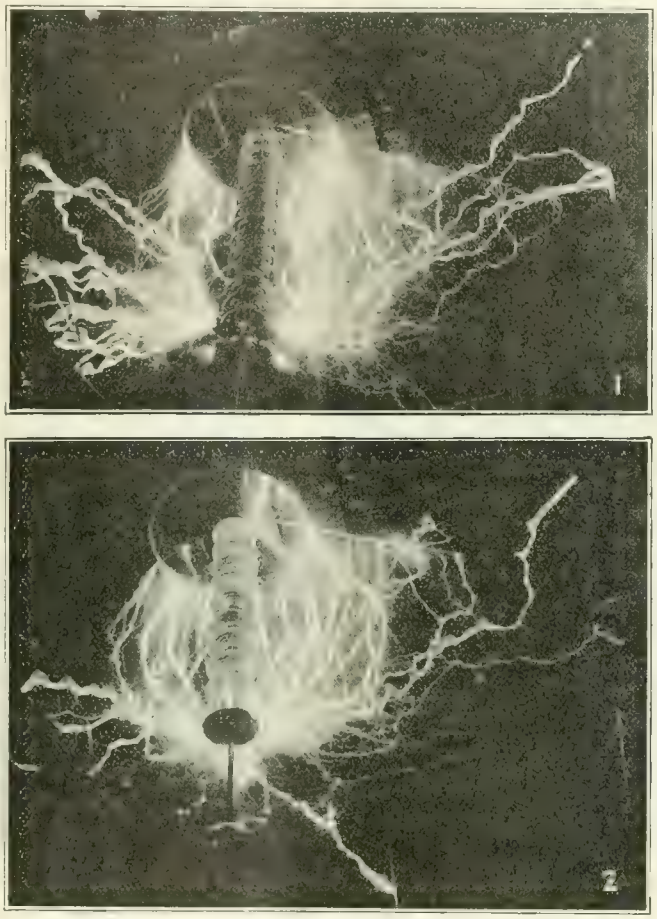


FIG. 1 — IMPULSING SUPERVOLTAGE CAUSING DISCHARGE ABOUT A FOURTEEN-UNIT STRING OF 10-IN. CAP-AND-PIN-TYPE INSULATOR UNITS. FIG. 2—IMPULSING SUPERVOLTAGE CAUSING DISCHARGE ABOUT A TEN-UNIT STRING OF CORE-AND-TINE-TYPE INSULATOR UNITS.

Nevertheless, the outlook today, like the outlook a year ago, is, in effect, that the first 220-kv. line to be tried out will not be too heavy for support with single or double strings of common 10-in. units. Accordingly the year has witnessed a determined co-operative effort in various quarters to determine upon the manner in which ordinary suspension insulators may be used satisfactorily for the support of the proposed 220-kv. power lines. These efforts have resulted in a crop of technical papers and reports to committees, with the attendant discussions, indicating that excellent progress in this regard has been made. The earlier discussions developed the fact that knowledge of the flash-over characteristics of long suspension insulator strings was lacking in many essential respects. One of the National Electric Light Association committees has undertaken to obtain an understanding of these characteristics in definite terms. Progress is being made.

Three Types of Flash-overs Being Studied

In general three types of flash-overs are being studied: (1) Impulsing supervoltage (by oscillator at 75,000 cycles); (2) 60-cycle flash-over voltage; (3) disturbances started by foreign conducting or ionized material on the insulators or the conductors or in the air about them. In the first of these studies it has been found that in the short strings of two to seven units, wherein the unit-voltage duty distribution is excellent, cascading occurs during flash-over; that as the string is lengthened to ten units the cascading is greatly diminished, and that it is virtually absent for strings of greater length. This has been found to be true regardless of the type of unit. The characteristic behavior in this respect is the same for the cap-and-pin units having the higher capacitance as for the core-and-tine type having the lower capacitance.

The results so far obtained indicate a decided superiority of the long over the short suspension insulator strings in the matter of flash-over characteristics under impulsing supervoltage. In this flashing over long strings it has been observed that the tower cross-arm end units are occasionally cascaded by "in-shoot" flashes. This may or may not be caused by the surface charges referred to below—a matter that is being included in the studies.

The studies of this committee include also a set of

fundamentals about which little is as yet known and that attain importance when the 220-kv. line is under consideration. These are: (1) The character of discharge-route options that exist in all ordinary circumstances for impulsing supervoltage transients because of the now known nature of the process by which discharges must begin, extend and culminate in flash-overs; (2) the strength and figure of the main electric field about an insulator as factors in the control of routes of discharge produced by steep-wave-front supervoltage transients; (3) the magnitude of corona formation and dissipation of energy along the transmission-line conductor during the brief interval required for a supervoltage transient to form and extend an isolated flash sufficiently to cause flash-over to cross-arm or tower, through lightning arresters or over bushings to ground. Little has been known heretofore as to why supervoltages can be thrown onto a transmission line in huge amounts sufficient to break through great air columns with apparently little dissipation of energy in corona formation about the conductor.

Studies in Unit-Voltage-Duty Control and Super-Voltage Flash-overs

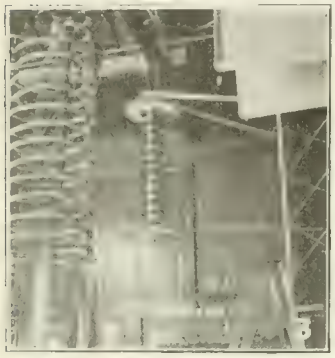


FIG. 3 — LABORATORY SET-UP OF A DOUBLE TWELVE-UNIT STRING OF CAP-AND-PIN-TYPE INSULATOR UNITS WITH LARGE DISK SHIELDS FOR THE STUDY OF THE CONTROL OF UNIT-VOLTAGE DUTIES

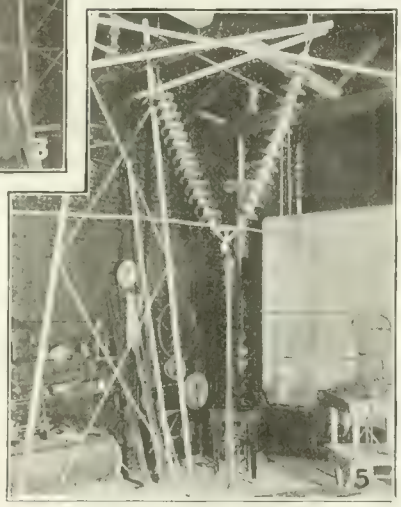




FIG. 5 — A DOUBLE THIRTEEN-UNIT V-STRING OF COMMON TYPE UNITS BEING STUDIED WITH RESPECT TO THE REQUIREMENTS OF THE 220-KV. LINE
FIG. 6 — SUPERVOLTAGE FLASH-OVER STUDIES OF THE SPECIMEN IN FIG. 5, EXCEPT THAT "PICK-UP" SHIELDS HAVE BEEN ADDED

The discharge route options in this case are particularly interesting. In 32 flashovers, two struck 84 in. to the wall, twenty-seven struck 51 in. (minimum) to the cross-arm, and three struck 49 in. (minimum) to tower members. The studies include electrode fittings formed to prevent the start of flashes until the main fields have been built up sufficiently to be controlling in regard to discharge routes.

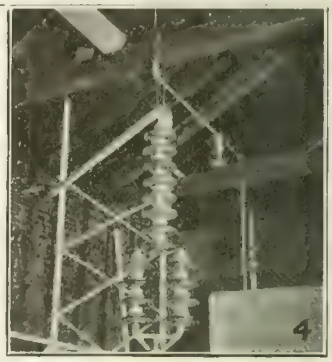


FIG. 4 — ONE OF MANY LONG SUSPENSION-INSULATOR FORMS BEING STUDIED FOR UNIT-VOLTAGE-DUTY CONTROL. NOTE THE TWO SETS OF INSULATORS USED AT THE LINE END OF THE STRING.

The questionnaire submitted by the technical press already referred to and the returns that were published reveal with a certainty the many positive factors that enter into the construction, erection and maintenance of high-voltage line insulators. There are in the returns important lessons for all concerned. For instance, a nation-wide effort should evidently be made to educate hunters and all users of the rifle to understand that the destruction of line insulators means the wanton interruption of a vital service rendered to large communities.

The returns also emphasize the serious difficulties caused by the dust that settles upon insulators in many localities and which may be rendered highly conductive when moistened by fog or dew. The final victory here will not be easily won. The circumstances indicate the importance of team-work on the part of the engineer and the manufacturer to develop the most suitable type of insulator to meet this sort of duty, and on the part of the engineer and his management to institute the kind of care and maintenance that will obtain the best results in the end.

Lightning Again Indicted as Great Factor in Causing Insulator Failures

Lightning is again indicted as a great factor in causing insulator failures in many localities. The year has witnessed some real progress in minimization of damage to insulators and insulations from this cause. It has been pretty well demonstrated that damage by lightning is at a minimum on extra-high-voltage lines that have been liberally insulated. Granted that the 220-kv. lines are carried on string lengths of thirteen or more units, the expectation is warranted that the magnitude of bound charges will rarely be sufficient to cause flash-overs when released by neighboring lightning strokes, and that troubles due to other factors, such as switching, transients, wet dust or other foreign material, will be correspondingly diminished. The known characteristics of long suspension-insulator strings when equipped with appropriate shields support this contention.

One engineer related that the progress of a lightning storm over his transmission lines could be noted by the slow transients recorded by the ammeter in the neutral-to-ground connection in the main generating station. His explanation was that, his lines being well insulated, the release of bound charges did not in general produce a sufficiently high potential to flash over the insulators in the neighborhood of their origin, and that they spread over the lines and were

drained to earth through the grounded neutral at the generating station.

The extensive lightning investigation in the Chicago area has demonstrated the value of "arrester density" and the protective effects of overtopping trees, buildings and all similar shielding structures in eliminating damage by lightning on transmission lines operated at the lower voltages, that is, 11 kv. to 66 kv. The engineer in charge of lines of this class in lightning districts can now confidently count upon the value of overinsulation, increased lightning-arrester density and well-arranged ground cables to cut down the frequency of interruptions due to lightning and thus to increase the reliability of service from his lines.

Effect of Alternating Fields on Dielectrics Surrounded by Air

In conclusion, there should be mentioned two outstanding fundamental developments in insulators that the year has brought forth. Nishi ("Surface Creepage and High-Voltage Insulation," *Journal A. I. E. E.*, November, 1920, page 949) has shown that surfaces of dielectrics surrounded by air become highly charged when subjected to strong alternating electric fields in which there is local corona formation, *i.e.*, a local source of ions.

Aside from the presence of ions, the essential factor in the production of the unidirectional surface charges is the component of the electric field that is normal to the surface. Obviously the effect is to cause a breakdown of the air columns adjacent to the dielectric surfaces at lowered voltages. The results enhance the importance of the Fortescue principle ("Air as an Insulator," *Transactions A. I. E. E.*, Vol. XXXII, page 893, 1913), whereby solid dielectrics which are used to avoid overstresses in the air about high-voltage electrodes must be so formed that their surfaces in contact with the surrounding air will everywhere be parallel to the Faraday tubes of electric force that pervade the zones of air and solid dielectric adjacent to such surfaces.

Because in an actual case it is often difficult to eliminate all corona formation when the insulator is subjected to its highest voltage duty and the application of the Fortescue principle is not often completely feasible, it then follows that insulator design must to a high degree remain an art as well as a science.

Advantage of Glass as a Conductor in Precipitation Treaters

The other outstanding fundamental development is likewise remarkable and was also developed in Japan. Shibasawa and Niwa ("A New Electrical Precipitation Treater," *Journal A. I. E. E.*, October, 1920, page 890) have shown that glass can be used to advantage as a conductor, having the resistivity requisite for the control of the density at which high-voltage direct current passes from the surface of the central cylindrical electrode of a dust precipitator. Ordinarily the current is allowed to pass from the bare metal surface of the central electrode. The action then becomes stabilized in a highly irregular distribution of density of exit of the precipitation current from the surface of the electrodes, which causes the electrodes to "foul" too quickly.

Increasing Cable Rating Has Received Considerable Attention

A Decided Decrease in Dielectric Loss Has Been Effected and New Schemes of Dissipating Heat Are Being Tried—Problems for Future Research Are Outlined.

By William A. Del Mar
Chief Engineer Habirshaw Electric Cable Company

SO RAPIDLY has the use of electricity grown since the war that electric lighting companies have been embarrassed by the overloading of their existing cables and the difficulty of getting sufficient new cable to meet their growing requirements. Some of the companies are also operating under municipal restrictions which prevent the opening of streets for laying new ducts except at infrequent intervals, and for this reason means of increasing the current-carrying capacity per unit cross-section of ducts is of utmost importance. Recognizing these facts, cable manufacturers have cooperated with users in efforts to increase the current-carrying capacity of impregnated paper cables. These efforts have resulted in a noteworthy reduction of dielectric losses by the use of new impregnating compounds and in novel methods of carrying away heat generated in cables.

Five distinct lines of attack have been tried:

1. To decrease the heat developed in the cables by reducing the dielectric losses to a minimum.
2. To increase the heat-dissipating ability of the cables by affording special facilities for the escape of heat.
3. To increase the maximum permissible operating temperature of insulation.
4. To improve the heat dissipation from the outside of cables to ducts.
5. To install cables aërially on messenger cables instead of in ducts so as to obtain the benefit of a full circulation of air around them.

Such success has attended the efforts to decrease dielectric loss that users of cable may be less concerned about this loss than about the possibility that too rapid development in manufacturing processes may have led to the sacrifice of other equally desirable but less easily measured qualities. The big change which brought about a material reduction of dielectric loss was the abandonment of mixtures of resin oil and resin for impregnating the paper and the substitution of compounds composed principally of petrolatum and resin. The next step was the introduction of more thorough methods of drying the paper and both drying and purifying the compound. Then certain manufacturers introduced variations which at the present time may be regarded more or less as trade secrets. The net result is that cables may be purchased having a fraction of the dielectric loss common to cables purchased ten years ago.

The attempts to improve the heat-dissipating ability of three-conductor cables have met with considerable success, and at least one cable designed with this end in view is in successful operation. The most promising design consists of three paper-insulated conductors covered with copper tape and inclosed in a lead sheath. The copper tapes convey the heat out to the lead sheath. These cables have not been in use long enough to have established their merit, as questions of eddy-current

loss and the balancing of saving in first cost against increased energy loss have yet to be published.

Attempts to increase the permissible operating temperature of impregnated paper insulation have met with little success, as paper itself begins to deteriorate at a temperature but slightly above the A. I. E. E. limit of 85 deg. C. Some of the lighting companies find it commercially economical to operate their cables during the hours of peak load at temperatures which it is known would promote deterioration of the paper if maintained for long periods, but the aggregate duration of such periods of peak load may not be sufficient to cause serious deterioration. It is even suspected that paper will be less injured by numerous short exposures to high temperature than by continuous exposure to the same temperature for the same aggregate time. This, however, cannot be said to be definitely established, and, indeed, the contrary opinion is held by some—that such peak loads are particularly harmful. The companies which are operating their cables above 85 deg. C. have not, therefore, justified their practice on generally known scientific grounds. This question is to be discussed at the mid-winter convention of A. I. E. E.



EXPERIMENTAL TEST OF HIGH-VOLTAGE CABLE

The voltage test was made after bending at minus 10 deg. C. at the Habirshaw research laboratory. The 150-kv. transformer is in the far corner of the laboratory.

Important work has been done on the measurement of cable temperatures in ducts and on heat dissipation from ducts,* both in actual and experimental duct lines, which may form the basis of a new temperature standard. In any case this work has shown both the importance of designing duct lines with the view of maximum heat dissipation and the desirability of placing cables in duct banks in such a way as to get the greatest carrying capacity. Researches are also under way to determine the nature of the deterioration of impregnated paper at high temperatures.

While not exactly in the line of cable research, more attention is now being given to ways and means of dissipating heat from the outside of cables, and one engineer has gone so far as to suggest that ducts be filled with petrolatum in order to give better heat conduction from sheath to duct.

The use of aërial† cables insures not only the benefit of open-air conditions to increase the carrying capacity but also cheapness and rapidity of installation. Three companies make special types of cables for this purpose, but the success of the telephone companies with lead-sheathed aërial cables seems to indicate the construction that will be favored. Good work has been done in tracing fields of force and in ascertaining the dielectric stresses in triplex cables.

The present voltage limit, both in America and in Europe, for three-conductor cables is 30,000 volts to 33,000 volts, and for single-conductor cables 60,000 volts; but researches now under way indicate that higher voltages may be attained, with small conductors especially. This is contrary to the common view, which is based on the assumption that the dielectric stress at the surface of a conductor is greater the less the diameter of the conductor. The merit of the small conductors, from the point of view of dielectric stresses, lies primarily in the fact that the dielectric strength of ionizable insulation, such as impregnated paper, is greater in an electric field that dies off rapidly, like that around a small wire, than in a field that is comparatively uniform, like that around a large wire. Another factor, however, is that for analogous reasons the dielectric loss is less for a given charging current with a small than with a large wire. These matters are still in the laboratory stage.

Little has been accomplished in the line of improving rubber or varnished-cambric insulation, and no new types of cable insulation have appeared on the market. Varnished-cambric cables are now recognized by the National Board of Fire Underwriters, and manufacturers have improved them so that when used on vertical runs the "slipper" compound will not drip out.

Cable users can help development both by allowing the manufacturers to study their conditions of service and by adapting their conditions to permit the use of standard types of wires and cables. A recent handbook issued by a manufacturer shows he has calls for at least a hundred different standard types of wire and cable and for an average of about ten sizes in each type, or a total of 1,000 wires and cables listed. Besides these, there are thousands of different wires and cables on special orders. This condition affects the cable users most unfavorably and calls for some effort by them to reduce the number of special wires and cables required.

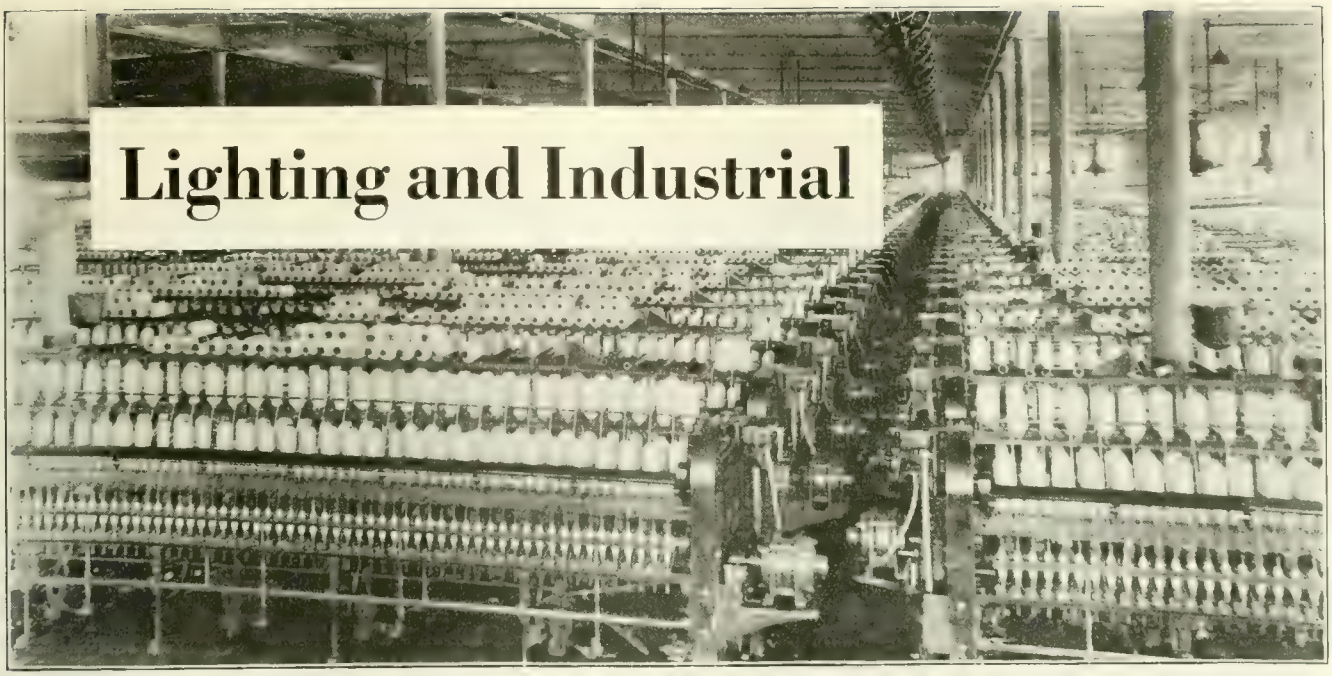
The obstacles that stand in the way of progress in cable design are as follows:

1. The low temperatures at which insulating materials deteriorate.
2. The low temperatures at which ionization occurs in impregnating oils.
3. The impossibility of obtaining the full benefit of the specific qualities of dielectrics, due to the low ionization voltage of entrapped air.
4. Growth of dielectric losses with increase of voltage.
5. High heat resistivity of insulating materials.

The formation of the insulation committee of the National Research Council promises to open a new era in cable research. While four or five cable manufacturers are well equipped with research facilities, most of the work they have done has been of a practical character, with but little pure science to serve as the foundation for a vast store of practical knowledge. Research on the nature of dielectrics, dielectric loss, ionization, conductance, etc., is badly needed.

*"Thermal Conductivity of Underground Ducts," by Willard S. [illegible], ELECTRICAL WORLD, Dec. 2, 1920.

†"Overcoming Difficulties with Aërial Cable," by E. B. Meyer, April 14, 1917.



Non-Ferrous Furnaces Becoming Very Attractive

Predicts Electrification of Three-quarters of Brass-Melting Industry in Ten Years—Power Distribution Lines Should Be Separated from Lighting Circuits

By Edwin L. Crosby

President Detroit Electric Furnace Company, Detroit, Mich.

THE electric furnace business has already become a substantial portion of the total load of a large number of central stations and if the companies will devote to electric heating of all types even a small measure of the energies expended during the last ten years to build up their motor load the results obtained will be equally gratifying.

The most important point for consideration in connection with this business from the central-station standpoint is the establishment of certain standards of distribution which will permit the operation of furnace loads amounting to from 250 kw. to 2,500 kw. in a single unit without affecting the power and lighting service by unbalancing the system. The largest utilities seem to have realized the advisability of establishing independent power circuits both for interurban transmission and local distribution. On such a system any furnace now in the market will operate with maximum satisfaction both to the user of the furnace and to the central station supplying the service. The inadvisability of connecting electric furnace loads to the same distribution system with commercial lighting has been pointed out in the technical journals and at various meetings, but a great many companies are still inclined to experiment along this line. Such action is disastrous not only to the central station supplying service, but particularly to the power consumer who has purchased the furnace equipment. No electric furnace will give satisfactory results in a modern industrial plant unless it is supplied with electrical energy having reasonably good regulation, not greater than say 8 per cent, and it is absolutely suicidal to connect such equipment to a system which is barely staggering along with overloaded generating, transmission or distribution conditions.

Within the next few years there will undoubtedly be a more complete segregation of distribution systems in industrial centers. They will be divided into lighting circuits and entirely separate circuits to which will be connected all classes of power, including electrolytic and electrothermic loads.

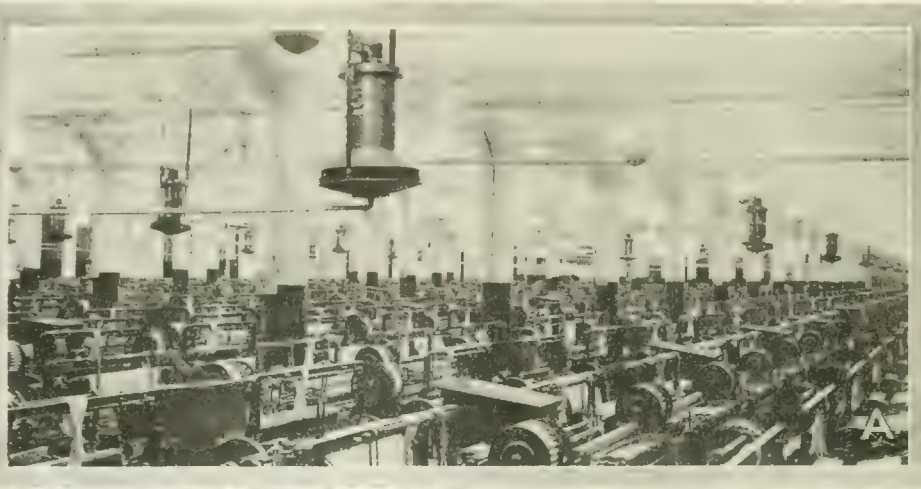
Great Opportunity in Non-Ferrous Work

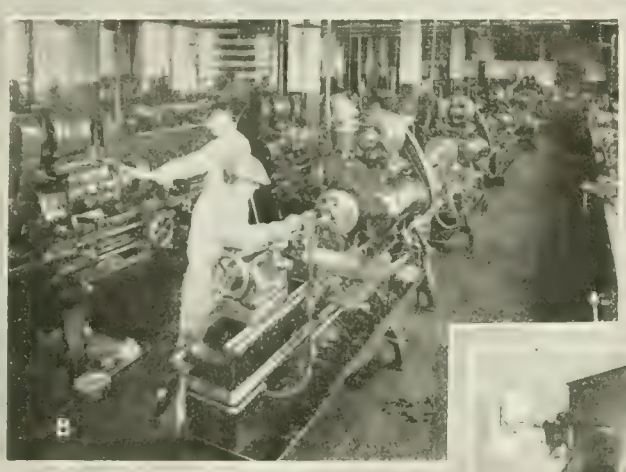
Perhaps the most remarkable development in the electric furnace industry has been in non-ferrous electric furnaces, which undoubtedly offer more advantages to the purchaser than any other kind. In addition to an output of a very much improved quality, the non-ferrous electric furnace has reduced the cost of producing this superior metal below the cost of melting where any other method is employed. Working conditions in the shops have been vastly improved because of the absence of excessive heat and fumes. Furthermore, it is now possible to teach ordinarily intelligent workmen in a comparatively short time to produce much more uniform metal with lower melting losses than could be done with fuel-fired furnaces.

The unparalleled situation created by the war was undoubtedly the principal cause for the development of a great number of electric steel furnaces, several of which were practically identical in design, at least as far as operating practice is concerned. Continuous operation of the many furnaces installed during the time mentioned has resulted in the enforcement of the law of the survival of the fittest, and a great many furnaces which were evolved somewhat spontaneously have in general disappeared. The development in electric steel manufacture has, however, placed this product in a virtually unassailable position in the metal industry. The resumption of a healthy, normal business condition, especially in motor-car manufacture, together with the development which is certain to take place in aircraft production, will cause the business of electric steel melting to grow along a steadily increasing scale within a very few years.

The materials necessary for the development of the electric steel furnaces up to the present point were almost without exception already at hand and in daily use in the steel industry. However, for the purposes of melting brass electrically extensive research and development have been necessary in refractories and electrodes. This work has gone along rapidly until there are today on the market furnaces which will meet prac-

Electric Light, Power and Heat Essential to Industrial Production

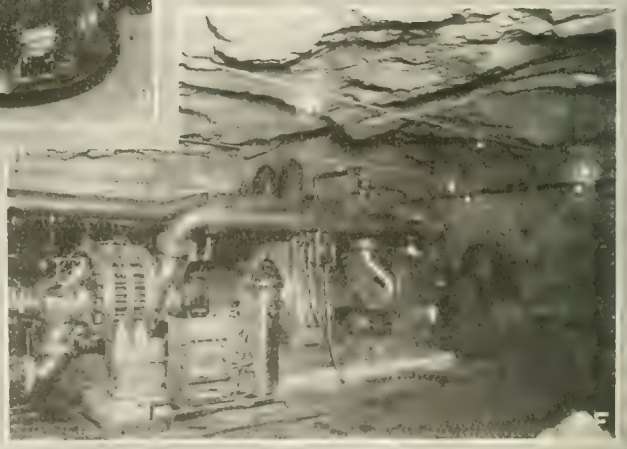












A—Westinghouse unit drive in weaving room of Republic Cotton Mills, Great Falls, S. C., showing 120 looms, each driven by a ¼-hp. motor. Indirect-lighting units are used. This installation embodies recommendations of J. E. Sirrine & Company, mill engineers. B—A field in which the individual motor drive has revolutionized lighting and working conditions [illegible] and drafting [illegible]. Modern lighting with R.L.M. reflectors in assembly room of small motor manufacturing plant. D—An electric brass furnace pouring directly into rolling-mill molds. E—Huge electric oven for baking japan on Cadillac automobile bodies. F—This illustration shows a mine pumping outfit which operates under a 1,000-ft. head. A motor of 400 hp., 1,200 r.p.m., drives a 1,000 g.p.m. six-stage centrifugal pump.

tically every requirement in the melting of non-ferrous metals. The metal industry in general seems to be fully cognizant of this fact and anticipates the universal adoption of electric melting, except possibly in the occasional instance where there is only intermittent operation—one or two small heats a day—of widely variant alloys.

Prospects for Electric Melting for Brass

While less than 5 per cent of the copper-zinc alloys produced today are melted electrically, it is confidently to be expected that within the next ten years the electric furnace will be used for melting 75 per cent of these metals.

After exhaustive investigation at least five of the largest brass melters in the world are today absolutely committed to the electric furnace for melting their entire requirements of the metals named. This decision is perhaps more easily understood when it is realized that in a great many instances the use of electric furnaces has shown a saving sufficient to amortize within ninety days or less the entire investment incident to the installation of electric melting equipment.

The continuity of operation of electric furnaces is of extreme importance to the user, and naturally to the power company supplying the service. Refractories are now developed that permit of the production of from 2,500,000 lb. to 4,000,000 lb. (1,130,000 kg. to 1,810,000 kg.) from one furnace lining. It will readily be recognized that under such conditions the cost of electric furnace maintenance is negligible as compared with that of any other combustion-type furnace.

Practically all of the brass-melting furnaces are of such construction that they must be operated single-phase, but the load required by even the largest unit is not great enough to cause serious disturbance upon the ordinarily well-balanced polyphase power system. It is only where these furnaces have been connected at the end of long, heavily loaded circuits that any difficulty due to regulation has been experienced.

In a fairly large brass foundry, heat-treating plant, rolling mill or smelting and refining plant the installation of multiple units of electric furnaces provides for a very excellent load characteristic from the standpoint of power distribution. For instance in a plant having a total connected load of from 1,500 kw. to 2,000 kw. in single-phase furnaces the load may be balanced so that at no time would the unbalance exceed 30 per cent; this would occur during the operation of one furnace. This line disturbance is slight as compared with the inherent condition in a steel furnace melting cold scrap, when the current may fluctuate instantly between open-circuit and short-circuit conditions in any phase.

The load factor in such a group installation will be comparable with the average motor-load factor in modern industrial plants, and the power factor at the primary terminals of the furnace transformers, given proper design, should in no case be less than 0.85 and can be higher.

Electric furnaces are receiving careful consideration for the production of high-quality gray-iron castings, and the development thus far indicates a very large growth in this branch of the application of electric heating. The electric melting of aluminum and also of copper for castings or wire of high tensile strength and high conductivity is rapidly becoming commercial practice.

Industrial Illumination Far Behind Lamp Development

Limits of Intensities Not Yet Reached—Safety, Production and Morale Increased by Accepting Higher Lighting Standards

By S. E. Doane

Chief Engineer National Lamp Works of the General Electric Company, Cleveland

During the past year or so the standard of industrial lighting has been steadily improved until predictions of a few years ago have become realities. It cannot be said, however, that illumination standards have kept pace with lamp development. Still, the industries are learning to look at their lighting problems in a new perspective because under these new standards of artificial lighting the quantity of industrial output has been increased and its quality has been raised. They also admit that the morale and the welfare of the worker have been bettered.

A report on engineering progress in an industrial field is usually expected to deal with developments of the products in that field and improvements that have been made in their application. However, from the standpoint of better illumination on the working plane the possibility of new and better lamps can be neglected for a time. Interest, indeed, centers more on the application of lighting units already available, since lamp application is far behind lamp development.

It is essential to remember as a collateral consideration that the improvements in the lamps and accessories themselves, together with increased generating efficiencies, have, in terms of other manufacturing costs, reduced the relative cost of light as a raw material to one-tenth of what it was ten years ago. The lamp itself, supplying light as a raw material, is only a means to an end. It only becomes effective when reduced to terms of illumination at the work. One of the greatest deterrents to progress a few years ago was the fact that under the pressure of developing a product the necessity of good light on the working plane was overlooked, with the result that industrial lighting installations oftentimes did more harm than good. So if the electric lighting industry is to make progress—progress which is fundamental—more attention must be given the application of illumination where the light begins to affect the individual.

Signs of much progress in this direction are unmistakable. During the war, when industries were making every effort to obtain capacity production, artificial lighting became an established factor of prime importance. Studies were made of the physical and psychological aspects of lighting and their relation to the individual. All of these pointed to the profitable use of higher levels of artificial illumination when properly installed and safeguarded against such evils as glare, reflected glare, etc. It is toward this end that leaders in the lighting branch of the industry are striving at the present time.

Glare, which has always been a hindrance to promotion of higher standards of lighting, has been effectively taken care of by the adoption of the bowl-enameled lamp which was brought out commercially during the past year. This lamp, used with the correct size of R.L.M. dome reflector, a product previously standardized by many manufacturers, forms a good lighting unit which is "fool proof" from the standpoint of glare. It

has the further advantage of being almost universally applicable to industrial lighting. Other recent lighting units of the glass-inclosed type, favorable in appearance and producing good illumination, also find limited application in the industrial lighting field. In modern practice no unit can be successful for general illumination which does not inherently eliminate glare and deliver an abundance of well-diffused light on the working plane.

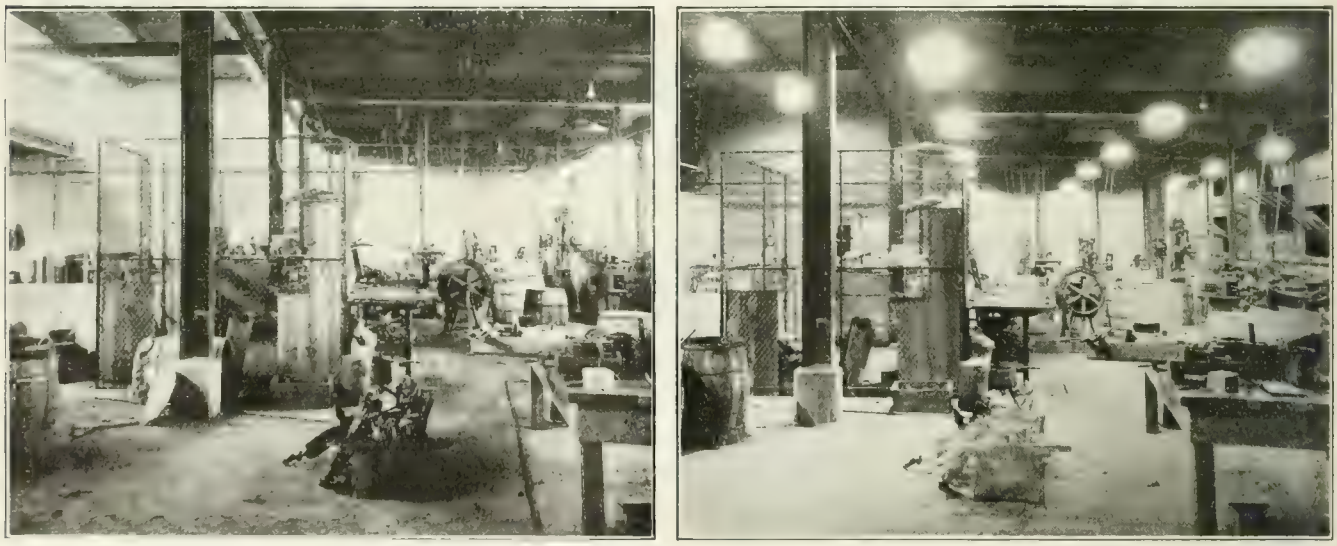
A great many factory managers and foremen have a fair acquaintance with the advances made in industrial lighting and appreciate the significance of the new standards, but in a large majority of cases a practical conception of these standards is lacking. In an effort to overcome this condition the National Electric Light Association has established in the larger cities throughout the country lighting exhibitions, by means of which good lighting can be demonstrated and promoted entirely on its merits. A number of these permanent demonstrations have already been installed in places where industrial men can see what good lighting really is and can observe its effects in contrast with old standards. This has been found to be a most effective method of bringing the industries to a proper appreciation of the advantages of productive intensity lighting. General figures are not yet available on the increased production obtained under these higher levels, but after a modern system has been installed with higher intensities there is no record of an owner, superintendent or foreman agreeing to have the illumination reduced.

It is difficult to predict just what the near future holds. Installation possibilities are enormous. What the ultimate result will be, from the standpoint of "higher intensities," is at present very problematical. A point that stands out in this connection is that the phrase "higher intensities" is not descriptive of that for which engineers are striving. In this connection it must be remembered that daylight values of illumination from a clear day out of doors may reach several thousand foot-candles. Even in the shade intensities as high as a thousand foot-candles are common and agreeable. The daylight intensities in a well-lighted factory may be several hundred foot-candles near the windows, gradually diminishing, of course, toward the centre of the room. Thus, the present artificial lighting standards, of say 5, 10 or 15 foot-candles, which are often referred to as "higher intensities," are in reality low intensities when compared with daylight conditions in the same location. The accompanying photographs may serve to illustrate this idea.



The point has not yet been reached where daylight intensities can be duplicated, but there is a marked tendency in that direction. It is difficult to foretell the limit to which the intesities of artificial illumination can be increased to advantage, but as an interesting indication of progressing thought the following is cited: A machine shop which was considered sufficiently lighted with 12 foot-candles four years ago was moved recently, and in its new location the lighting installation was designed to give 25 foot-candles. This is evidence of the change in view that has taken place in a short time.

It cannot be said positively that 25 foot-candles is too little or too much. It will take two or three years before knowledge is exact, but in that time safety will be increased and production augmented through a rule-of-thumb acceptance of higher standards.

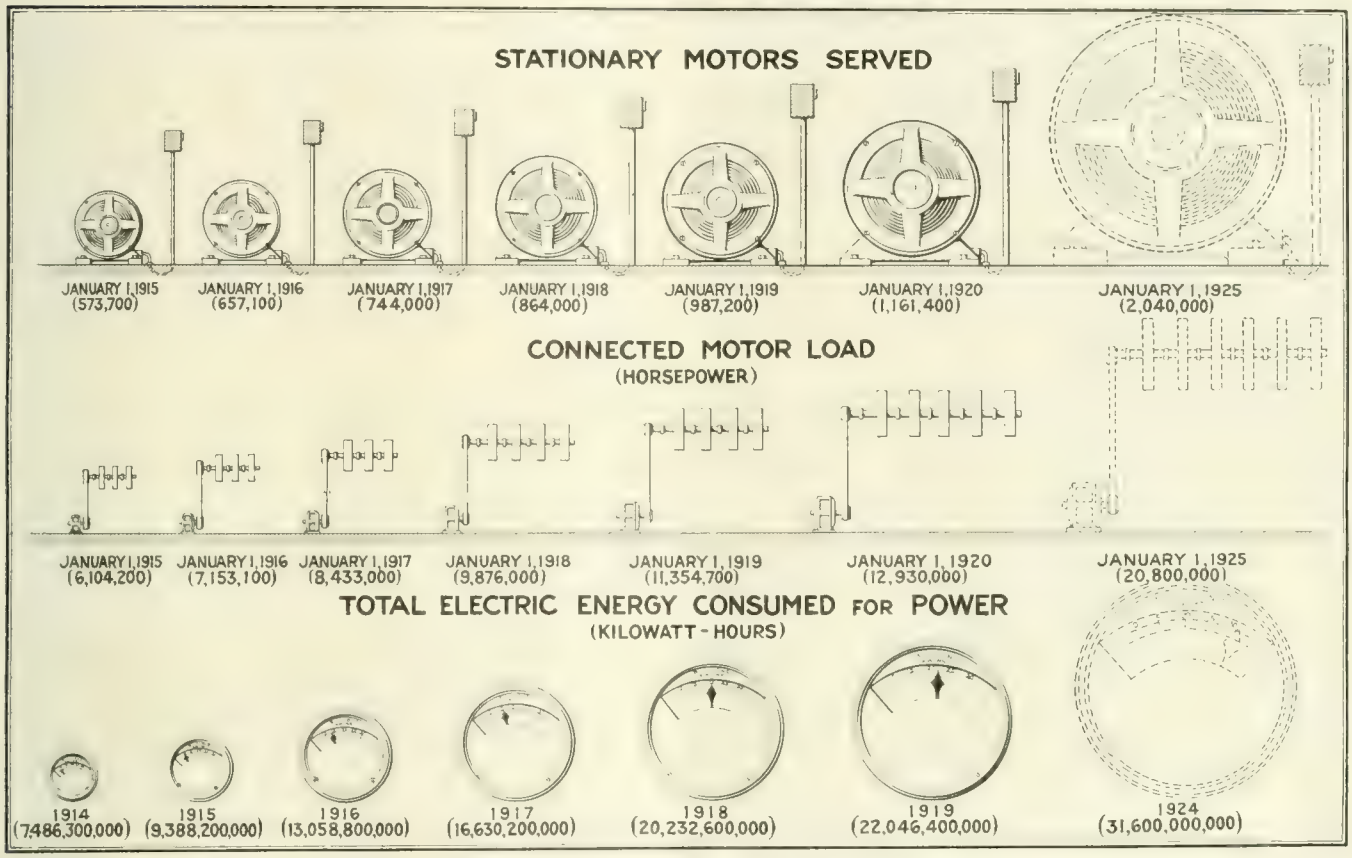


THE SAME PLANT WITH DIFFERENT LIGHTING SYSTEMS

Top—Glaring and inadequate lighting as the result of installing lamps without shades to conceal brilliant filaments. Bottom, left—Excellent daylight illumination. Bottom, right—Efficient artificial lighting which compares favorably with daylight conditions.

Phenomenal Growth of Industrial Load

Nation-Wide Survey Indicates that 1,161,400 Industrial Motors Were Served by Central Stations in 1919—Motor-Connected Load Estimated at 12,930,000 Hp.—Energy Sold to Power Customers Has Increased from 7,486,300,000 Kw.-Hr. in 1914 to 22,046,400,000 Kw.-Hr. in 1919



IN AN endeavor to ascertain the growth in the use of purchased energy by industrial plants and the present status of this demand the ELECTRICAL WORLD has undertaken a comprehensive nation-wide survey of the industrial loads carried by central stations. Satisfactory replies have been received from generating and distributing companies representing about 65 per cent of the installed rating of generating stations, and from these basic data estimates have been made of the total number of motors, the connected load exclusive of lighting and the total electrical energy sold by the central stations to power customers. From the basic data received for the years 1914 to 1919 inclusive the accompanying tabulation by states and divisions of the country has been compiled. Including, as it does, the pre-war year of 1914, the war years of 1915, 1916, 1917 and 1918 and the post-war year of 1919, this tabulation presents an interesting study of the electrification of industries and gives to the executive, the electrical engineer and the electrical manufacturer a starting point from which to operate during the period of world reconstruction. A discriminating use of the table, taken in conjunction with the survey made by the ELECTRICAL WORLD to ascertain the number of wired houses in the country, which appeared in the issue of May 15, 1920, and the survey to ascertain the distribution of residential, commercial and industrial customers, which was tabulated in the issue of July 24, 1920, will enable manufacturers and jobbers of electrical supplies to measure the market of the future with confidence.

The results of this survey present some very interesting and startling statistics on central-station output and distribution growth. Monthly operation returns received by the ELECTRICAL WORLD continuously for the past six years indicate that the total output of the central stations of the United States in 1919, after deducting the energy issued in intercompany business, was 38,559,000,000 kw.-hr. The present survey indicates that the total energy sold by central stations to power customers in 1919 was 22,046,400,000 kw.-hr., or 57.2 per cent of the total output. The 1917 United States "Census of Central Stations" indicates that about 14.4 per cent of the total output is dissipated in distribution and line losses, the loss from these sources in 1919 being about 5,555,000,000 kw.-hr. The total output sold to lighting customers in 1919 was, therefore, about 10,957,600,000 kw.-hr., or 28.4 per cent of the total output. In 1915 the energy sold to power customers was about 51.1 per cent of the total output, and lighting customers consumed about 34.5 per cent, indicating that from 1915 to 1920 the proportion of the total output sold for power increased by about 6.1 per cent.

Number of Motors Served, Connected Load and Total Energy Sold By Central Stations to Power Customers—1914 to 1920

Geographical State	Industrial Motors Served* (Thousands)						Motor Connected Load* (Thousands of Horsepower)						Other Connected Load (Not Lighting)* (Thousands of Horsepower)						Total Electrical Energy Sold to Power Customers (Millions of Kilowatt Hours)					
	1915	1916	1917	1918	1919	1920	1915	1916	1917	1918	1919	1920	1915	1916	1917	1918	1919	1920	1914	1915	1916	1917	1918	1919
United States	573 7	657 1	744 0	864.0	987.2	1,161 4	6,104 2	7,153.1	8,433 0	9,876 0	11,354 7	12,930.0	684 0	839 6	1,058.8	1,446 8	1,679 0	1,868 8	7,486 3	9,388 2	13,058 8	16,630 2	20.232 6	22,046 4
[illegible]																								
[illegible]	79 8	91 0	102 4	120 4	137 4	169 2	742 1	830 0	983 3	1,181 0	1,356 8	1,640 6	20 2	23 7	27 2	46 3	51 1	56 3	608 7	733 9	1,063 1	1 359 0	1,681 9	1,856 0
[illegible]	134 1	158 2	183 6	222 7	268 8	322 1	1,372 7	1,717 7	2,081 4	2,541 2	3,130 3	3,547 0	262 5	301 1	341 3	531 9	571 4	606 6	2,303 7	2,846 8	3,975 5	5,435 2	6,823 5	6,740 5
[illegible]	20 9	23 4	26 3	32 3	39 1	47 5	278 6	326 3	395 1	507 5	640 4	803 5	36 6	24 1	51 9	60 8	78 1	105 2	453 9	585 3	687 0	952 1	1,197 9	1,622 9
[illegible]	130 1	152 4	178 9	212 0	233 7	275 9	1,345 4	1,559 2	1,825 9	2,203 5	2,555 8	2,653 4	134 6	172 6	217 9	272 6	312 9	360 0	1,223 5	1,660 1	2,498 8	3,308 0	3,898 7	4,479 8
West North Central	53 3	58 1	63 5	72 3	80 0	93 0	476 9	561 8	664 9	757 1	832 2	940 8	16 4	18 0	22 3	40 5	67 1	73 0	673 5	855 8	1 061 3	1,207 9	1,298 7	1,533 5
[illegible]	22 8	24 9	27 2	29 1	32 6	37 3	100 7	128 9	167.2	209 3	263 0	304 1	15 1	18 6	22 2	27 0	72 0	117 2	99 4	151 5	251 6	349 6	465 2	654 0
[illegible]	17.5	20 0	23 8	27 7	31 8	36 2	134 3	165 0	209 0	273 5	329 4	479 5	7 6	7 9	16 1	18 9	24 2	28 1	91 6	125 3	188 4	284 4	453 3	564 0
[illegible]	26 3	29 4	32 1	38 1	41 6	46 0	415 7	513 5	574 6	645 3	670 3	732 6	97 7	179 8	260 5	311 6	347 3	345 3	715 5	1,043 9	1,776 9	1,889 2	2,067 2	1,872 9
Pacific	88 9	99 7	106 2	109 4	122.2	134 2	1,237 7	1,350 7	1,531 6	1,557 6	1,576 5	1,828 5	93 3	93 8	98 8	132	154 8	177 1	1,316 5	1,385 6	1,556 2	1,864 8	2,346 2	2,722 8
NEW ENGLAND																								
Maine	3 7	3 8	3 6	3 9	4 2	4 6	46 2	47 6	49 1	57.0	60 3	65 4	0 8	1 7	1 7	1 7	1 8	1 8	100 5	112 6	126 2	133 1	211 5	193 7
New Hampshire	2 6	2 8	3 2	3 7	4 0	4 3	28 8	30 7	34 1	41 4	47 7	55 5	0 3	0 7	0 7	0 7	0 8	0 8	28 2	35 6	44 3	64 8	81 3	94 8
Vermont	3 3	3 3	3 5	3 8	3 9	4 2	31 7	36 5	39 4	43 5	43 7	47 7	2 3	2 3	3 0	3 0	3 3	3 3	60 8	60 0	81 6	95 3	129 0	148 2
Massachusetts	43 8	53 4	63 0	77 3	92 3	110 8	431 0	488 0	608 0	750 0	882 0	1,063 0	15 9	18 1	20 7	39 7	42 3	46 1	300 0	375 3	557 5	707 0	858 0	978 0
Rhode Island	3 8	4 1	4 6	5 3	5 6	6 3	51 0	56 2	62 2	72 1	81 1	108 0	0 2	0 2	0 2	0 2	0 5	0 8	44 8	59 7	92 6	122 7	146 0	161 0
Connecticut	22 6	23 6	24 5	26 4	27 4	39 0	153 4	171 0	190 5	217 0	242 0	301 0	0 7	0 7	0 9	1 0	2 4	3 5	74 4	90 7	160 9	216 1	256 1	280 3
MIDDLE ATLANTIC																								
New York	79 3	92 8	103 0	115 3	137.5	151 8	718 0	867 0	978 0	1,103 0	1,265 0	1,400 0	134 0	162 6	184 2	360 2	383 8	363 0	1,218 0	1,542 0	2,035 0	2,672 7	3,620 0	3,475 0
New Jersey	15 4	19 4	24 6	30 9	40 5	42 5	139 7	180 7	233 4	298 2	372 3	397 0	22 9	24 0	32 8	35 5	42 8	46.8	79 7	122 8	205 5	299 0	383 5	360 5
Pennsylvania	39.4	46 0	56 0	76 5	90 8	127 8	515 0	670 0	8 0 0	1,140 0	1,493 0	1,750 0	105 6	114 5	124 3	136 2	144 8	196 8	1,006 0	1,182 0	1,735 0	2,463 5	2,820 0	2,905 0
SOUTH ATLANTIC																								
Delaware	0 7	0 8	0 9	1 1	1 2	1.4	7 2	8 1	15 4	24 2	36 7	38 8	0 1	0 1	0 2	0 2	0 3	0 3	3 8	5 3	10 6	22 6	33 0	38 0
Maryland	4 8	5 6	6 4	10 3	14.1	18 7	62 8	71 0	80 2	130 5	180 0	239 5	6 0	9.2	14 0	18 8	32 2	40 6	102 6	120 2	140 8	223 5	318 5	418 0
Dist of Columbia	0 6	0 7	0 8	1.0	1 1	1 3	16 1	20 3	23 4	25 7	29 4	35 0	5.1	5 1	5 2	5 7	7 0	8 7	7 2	9 0	11 5	17 8	23 4	32 5
Virginia	1 0	1 5	1 9	2 2	2 5	3 1	10 5	14 9	21 1	27 8	38 5	41 9	1 1	1 6	1 7	2 0	2 1	3 5	37 2	53 9	60 1	115 2	173 0	205 7
West Virginia	2 9	3 1	3.5	3 9	5 6	6 2	53 5	67 7	85 6	98 6	109 2	136 4	19 7	21 4	23 3	25 6	27 2	36 9	55 4	75 0	102.2	140 0	153 4	242 0
North Carolina	3 8	4.1	4 6	5.0	5.2	5 9	37 8	41 3	50 7	59 5	75.7	91 5	1 2	1 8	2 0	2 3	2 5	4 1	86 3	107 0	124 0	146 2	158.0	235 0
South Carolina	2 1	2 2	2.4	2.5	2.6	2 9	24 7	27 9	32 0	37 5	43 8	52 2	1 4	2 1	2 3	2 6	2 9	4 7	63 8	79 5	92 2	108 2	117.0	174 0
Georgia	3.4	3.7	4 0	4 2	4 4	4.8	53 8	60 7	69 7	81.5	95.1	113.5	1.6	2 3	2 6	2 9	3 2	5 2	88 5	124 0	127 0	157.7	179.8	206 9
Florida	1.6	1 7	1 8	2 1	2 4	3 2	12.2	14.4	17 0	22 2	32 0	54 7	0 4	0 5	0 6	0 7	0 7	1 2	9 1	11 4	18.6	20.9	41 8	70 8
EAST NO. CENTRAL																								
Ohio	26 1	29 1	32 4	36 0	37 8	42 0	160 5	178 0	198 0	265 3	317.0	391 0	42.5	53.5	67 3	90 7	90 3	97 3	142 0	252 0	448 0	603 5	662 5	720 0
Indiana	8 7	9 6	10 7	14 3	22.6	31.7	107 2	117 3	128 4	139 7	158 0	180.4	14 2	18 0	22 8	28 8	34 7	38 8	114 5	143 2	181 8	245 7	290 2	311 3
Illinois	61 2	71 4	83 5	100 4	108 0	125 3	665 0	792 5	910 0	1,079 0	1,200 0	1,305 0	32 6	45 3	56 8	74 7	91 4	118 1	502 0	637 0	812 0	1,058 9	1,312 0	1,590 0
Michigan	26 4	33 8	43 3	50 3	53 3	63 6	288 0	331 0	422 5	502 5	562 0	647 0	29 8	31 2	42 8	46 4	55 8	61.0	345 0	442 5	802 0	1 058 6	1,255 0	1,470 0
Wisconsin	7.7	8 5	9 0	11.0	12 0	13 3	124 8	140 4	167 0	217 0	318 8	330 0	15 5	24 6	28 2	32 0	40.7	44 8	120 0	185.4	255.0	341 3	379.0	388 5
WEST NO. CENTRAL																								
Minnesota	16 7	17 0	17.4	20 9	21.2	25 3	211.2	231.0	252 0	282 8	298 0	322 0	0 1	0 1	0 9	1 1	3 0	3.1	277 5	380.5	446.6	518 2	474 3	568 0
Iowa	11 2	12 6	14 1	15 7	16.6	17 5	65.2	72 5	80 7	89.9	95 3	104 0	0 1	0 2	1 2	1 5	3.9	4.0	93 2	107.9	131.2	159 5	191.4	256 1
Missouri	9.5	10.5	12.4	13.7	15.4	17.2	115.6	128 2	155 8	174 9	202 1	234 8	14 8	16 2	17 7	28 0	42 1	46.4	157 7	201.7	289 0	303 4	354 7	397 4
North Dakota	1.6	1.8	1.9	2.3	2.5	3.1	8.9	9 5	9.9	11 1	11 9	12 9	0 1	0 1	0 1	0 7	1 1	1.2	4 7	5.1	5.3	5.9	6.3	6 9
South Dakota	2.3	2.6	2.6	3 1	3 5	4.3	15 8	16.9	17.6	19 7	21 2	22 9	0 1	0 1	0 3	1.7	2 2	2 2	12 6	13 2	12 3	11 0	10 5	12 8
Nebraska	6 0	6.8	7 5	7 8	10 7	14.4	24 8	28.3	49.1	57.4	74 5	100 2	0 2	0 2	0 3	2 4	4 9	5 3	38 0	40 4	51 4	61 9	90 3	117 8
Kansas	6.0	6 8	7.6	8 8	10 1	11.2	35.4	75.4	99.8	121 3	129 2	144 0	1 0	1 1	1 8	5.1	9.9	10 8	89 8	107 0	125.5	148 0	171 2	174 5
EAST SO. CENTRAL																								
Kentucky	6.8	7 6	8 5	9.2	12.0	14.7	19.0	30.9	50 5	63 8	77.2	99 2	0 7	1 1	1 2	1 3	1 9	2 0	16 7	26 0	41 1	69 9	69 9	103 1
Tennessee	3.0	3 2	3 5	3.7	3 8	4.1	32.0	35.6	39 8	43 2	44 8	54 5	1 1	1 6	1 8	2 1	2 8	3 1	45.9	58 6	75 1	89 5	105 2	173 2
Alabama	12.0	13.0	14.1	15.0	15.5	17.2	40 8	51 3	64 5	88 5	126.7	133 4	10 5	13 1	16 4	20 8	64 5	109.3	20 5	48 2	113 9	171 4	271 0	356 2
Mississippi	1.0	1.1	1.1	1.2	1.3	1 3	8 9	11 1	12.4	13.8	14.3	17.0	2 8	2 8	2 8	2 8	2 8	2.8	16 3	18 7	21.5	18 8	19 1	21 5
WEST SO. CENTRAL																								
Arkansas	0 9	1 0	1 1	1 2	1 3	1.4	7 9	8 9	10.1	11 5	12 7	15.9	1 9	2 0	3.1	3.6	3.6	3 7	7 8	10 8	13 6	19 0	21 5	23 4
Louisiana	0.7	0 8	3.0	3 2	3 7	4 5	15 8	20 8	30 8	37 2	44.3	68.3	1 4	1 4	2.7	3 4	3 9	5 8	10 9	12 5	22 5	28 5	43.3	53 6
Oklahoma	4 0	4.6	5 2	6.4	7.3	8 8	31 1	36 8	45 6	61 3	70 2	94 8	2 8	2 9	4.6	5.2	9 2	10 6	18 1	22 8	37 8	66 1	84.5	96 0
Texas	11.9	13 6	14 5	16.9	19 5	21 5	79 5	98 5	122.5	163 5	202.2	300 5	1 5	1 6	5 7	6 7	7.5	8 0	54 8	79 2	114.5	170 8	304 0	391 0
MOUNTAIN:																								
Montana	7.3	9.4	11.2	13 0	13 6	14 5	162 3	204 5	211 5	231 5	237.5	256 0	32 0	81 7	138.0	173 0	198 5	200.0	282 5	508 0	915 0	1,012.0	1,195 0	898 0
Idaho	2.3	2.4	2.4	3 0	3 5	4 1	10 1	23 2	34 8	43 8	47 4	59 2	8 2	18 5	31.2	39 2	44 8	45.0	53 5	96 5	175 2	194 6	235 8	258 6
Wyoming	0.4	0.4	0.4	0.8	0.9	1 0	15 8	16 3	15.8	15 0	22.8	23 7	0 1	0.2	0 6	1.0	1.1	1 2	7.5	8.2	9.1	13 7	14 9	15 7
Colorado	7.4	7.7	8.1	8.8	9 7	10 2	78 8	100 8	129.3	155 6	157.4	158 5	0 1	0 1	0 1	4.1	8 5	8 9	117.6	133 6	152.1	176 2	196 2	188.6
New Mexico	0.3	0.5	0.6	0 7	0 7	0 8	5.3	5 6	5 9	6 2	6 2	6 1	0 1	0 2	0 3	0 4	0.5	0.5	4 5	6.6	6.2	7.0	7 5	7 6
Arizona	0.8	1 0	1.1	1 4	1.4	1 6	14 5	15 0	15.9	16 5	16 6	16 4	45 2	61 1	64.3	66 9	66 9	65 7	25 7	30.2	92.7	54 0	44 4	90.0
Utah	7.2	7 3	7 5	9.4	10.8	12 6	115 0	133 7	146 2	160 8	166 5	197 0			4 0	4 0	4 0	4 0	207.2	240 8	365.2	396 0	344 0	355 0
Nevada	0.6	0 7	0 8	1 0	1.0	1 2	13 9	14 4	15 2	15 9	15 9	15 7	12 0	18 0	22 0	23 0	23 0	20 0	17 0	20 0	61 4	35 7	29 4	59 4
PACIFIC																								
Washington	3 4	3 5	4 3	5 7	9 2	10 2	63 7	65 3	71 0	86 0	103 0	114 0	3 8	4 0	5 7	9 1	24 6	39 8	89 2	92 4	119 0	147 7	333 0	509 0
Oregon	1.7	2 9	5 2	6.4	7.2	7.5	22.0	38 4	49.6	61 3	69 5	72 5	0 2	0 3	0.5	1 5	2.6	7.7	52 7	59 7	67.2	88 6	110 7	118 8
California	83 8	93.3	96.7	97.3	105.8	116 5	1,152.0	1,247.0	1,411.0	1,410.3	1,404 0	1,642.0	89.3	89.5	92.6	126.6	127.6	129.6	1,174.6	1,233.5	1,370.0	1,628 5	1,902 5	2,095.0

*January 1 of each year

The growth in number of motors served, motor-connected load and the energy sold by central stations to power customers during the five-year period from 1915 to 1920 is shown diagrammatically by the accompanying curves. These curves have been projected five years into the future, giving some idea of probable central-station operations in 1925.

In 1919 there were 1,161,400 industrial motors served by central stations. The Atlantic States, comprising New York, New Jersey and Pennsylvania, lead all other sections of the country in number of industrial motors served, with 322,100, being followed at some distance by another essentially industrial section, the East North Central States, with 275,900 motors. Of the 134,200 motors attributed to the Pacific States in 1919 more than 87 per cent were in California. The greatest proportionate growth in number of motors during the five-year period was shown in the Middle Atlantic States, with 140 per cent. Pennsylvania leads the states in number of motors served, being followed by New York and Illinois in order. The total number of installed motors which will be served by central stations in 1925 is estimated at 2,040,000.

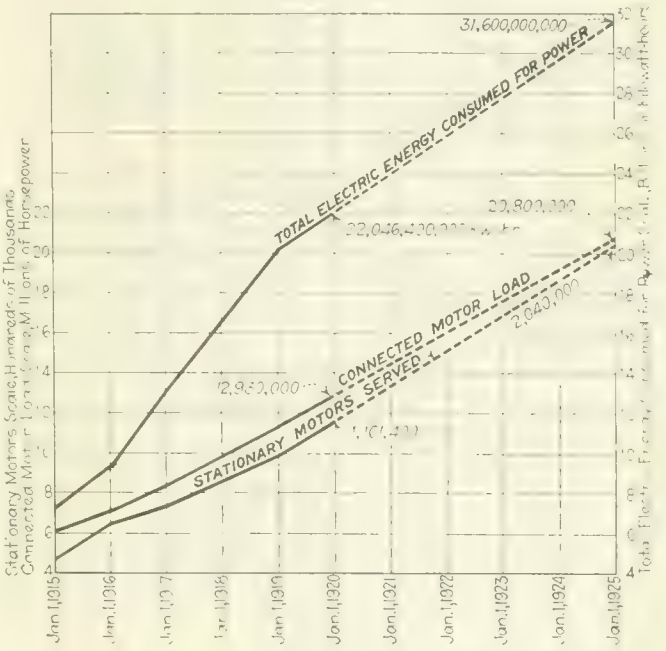
A study of the returns received by the ELECTRICAL WORLD indicates that the increase both in number and horsepower of motors has been, during the five-year period, much more rapid for the municipal than for the commercial plants. Prior to 1907 the municipal stations did virtually no power business, and even in 1919 they returned only a relatively small proportion of the total connected horsepower for all central stations, about 5 per cent. This explains this relatively large percentage increase. On the other hand, the returns show that the municipal plants serve about 10 per cent of the stationary motors, which would indicate that the average horsepower of motors served by municipal plants is much smaller than that for the commercial plants.

The remarkable growth in the use of electrical energy in the mills and factories of the country is best shown by the tabulation of the motor-connected load. The total motor-connected load of the central stations on Jan. 1, 1920, is estimated at 12,930,000 hp. It is interesting to note that during the period from 1907 to 1920 the rate of increase in horsepower of motors for the various sections of the country has been relatively uniform. The divisions of the country follow the same relative rank as in the motor tabulation, the Middle Atlantic section leading with 3,547,000 hp. and the East North Central States following with 2,653,400 hp. Although New York State leads in the number of industrial motors served, yet a large proportion of the motors are evidently of small rating, as the Empire State is led in motor-connected load by both Pennsylvania, with 1,750,000 hp., and California, with 1,642,000 hp. By projection of the motor-connected load curve the figure of 20,800,000 hp. is obtained for Jan. 1, 1925.

Under "other connected load, not lighting," are included central-station electric railway load, electric furnace load, etc. The total power load of this class is estimated at 1,868,800 hp., New York State leading with 363,000 hp., followed by Montana with 200,000 hp.

The per capita consumption of electrical energy for power purposes during 1919 in all districts within reach of central-station service was about 355 kw.-hr., as against a per capita consumption of 176 kw.-hr. for lighting. The highest per capita consumption of electrical energy for power is found in the Mountain section, which reports 913 kw.-hr., a figure almost twice as high as that shown by the Pacific division, with 580 kw.-hr. In the Mountain section, with the exception of Wyoming and New Mexico, the per capita consumption is higher than in most states. This would seem to be accounted for by the enormous quantity of electrical energy used in mining operations in the Mountain States and the large agricultural pumping load in Idaho. California, where more extensive hydro-electric developments are found than in any other state, ranks among the highest in the per capita consumption of electrical energy for industrial power, with 742 kw.-hr. None of the so-called "industrial" states appears to have a per capita power consumption at all approaching that of the Mountain and Pacific States.

The industrial consumption of electrical energy during 1919 is especially significant of the



THE RAPID GROWTH IN THE ADOPTION OF ELECTRICAL ENERGY AS A SOURCE OF INDUSTRIAL MOTIVE POWER

central-station industry. In spite of large curtailment of war-time industrial activity throughout the country during the year, the returns of the survey indicate that only the Middle Atlantic and Mountain States decreased their industrial energy consumption. All other sections of the country increased their consumption over 1918, the South Atlantic States making larger gains in 1919 than even during the war years. The decreases and increases are in all cases due to local economic reasons, especially in the Mountain States, where the stagnation in copper mining was especially noticeable. The estimate of 31,600,000,000 kw.-hr. as the probable total amount of electrical energy to be sold to power customers in 1924 is believed to be very conservative, as it is based largely on the amount of energy sold for similar purposes during 1919.

The results of the investigation show that during the war period the central station made phenomenal strides as a source of energy for American industry. An increase in energy sold for power consumption of from 7,500,000,000 kw.-hr. in 1914 to 22,000,000,000 kw.-hr. in 1919 is an achievement worthy of the men who have given the central-station industry the kind of management and thought which makes for success.

Water-Power Applications Total Over 10,000,000 Horsepower

Federal Power Commission Reports 129 Applications for Preliminary Power Permits Filed Prior to Dec. 18— Total Horsepower Involved Exceeds Present Total Water-Power Developments of the Country— New York State Leads the Union in Total Horsepower of Proposed Developments.

WATER-POWER applications now on file with the Federal Power Commission involve a development of over 10,000,000 hp. This is in excess of the total water-power developments on Jan. 1, 1920, as estimated by the ELECTRICAL WORLD in its water-power issue of March 20, 1920. Following is a list of the applications on file with the commission prior to Nov. 20. These applications total 7,726,651 hp., but if the treaty with Canada relative to the diversion of the water of the Niagara River is modified to permit the diversion of 20,000 second-feet in addition to the amount allowed under the regulations of the present treaty, these figures will be increased by 400,000 hp., giving a total to Nov. 20 of 8,126,651 hp. New York State leads in total horsepower involved with 2,933,250 hp., followed by California with 1,071,123 hp. and Washington with 1,066,000 hp. Complete details on applications filed since Nov. 20 are not available at the present time.

ALABAMA (Total 150,000 Hp.)

Name of Company	Location of Project	Capacity, Hp.
Alabama Power Co., Birmingham, Ala	Coosa River, Ala	30,000
Alabama Power Co., Birmingham, Ala.	Coosa River, Duncan's Riffle, Ala.	120,000
City of Dothan, Ala	Choctawhatchee River, Ala	

ALASKA (Total 58,300 Hp.)

Alaskan-American Paper Corp., New York City	Orchard Lake outlet to Shrimp Bay, Revillagigedo Island, Tongass National Forest, Alaska	7,000
R. L. Weeks, Los Angeles, Cal.	Shrimp Bay, Tongass National Forest, Alaska	7,000
Speel River Project, San Francisco, Cal.	Speel River, Crater Lake, Long Lake, Alaska	10,000
Tongass Pulp & Paper Co., Seattle, Wash.	Fish Creek, Swan Creek, Big Lake, Mirror Lake, Swan Lake, Alaska	19,000
L. J. Vogter, Tacoma, Wash.	Orchard Lake, Swan Lake, Fish Creek, Shelockum Lake, Alaska	32,000
William D. Grant et al, Wrangel, Alaska	Critterden Creek, Mill Co., Bradfield River, Alaska	16,000
Alaska Endicott Mng. & Milling Co., Juneau, Alaska	William Henry Bay, Alaska	300

ARIZONA (Total 589,200 Hp.)

Frank G. Baum, San Francisco, Cal.	Little Colorado River at Grand Falls, Ariz	27,900
Frank G. Baum, San Francisco, Cal	Black River, Arizona	6,300
Beckman & Linden Engineering Corpn., San Francisco, Cal.	Colorado River, Ariz	126,000
C. A. Heberlein, Prescott, Ariz.	Cataract Creek, Grand Canyon National Park, Ariz.	9,000
Edward L. Bayard, Seligman, Ariz.	Hualpai Indian Reservation, Colorado River, Ariz.	420,000

ARKANSAS (Total 125,000 Hp.)

Garland Hydro Electric Power Co., Little Rock, Ark	Ouachita River near boundary between Montgomery and Garland Counties, Ark	25,000
Dixie Power Co., St. Louis, Mo.	White River, Ark.	100,000

CALIFORNIA (Total 1,071,123 Hp.)

Coast Valleys Gas & Electric Co., San Francisco, Calif.	San Benito, Cal., Transmission Line	
City of Los Angeles.	South and Middle Forks and Kings River, Cal	400,000
Merced Irrigation Dist., Merced, Cal.	Exchequer on Merced River, Cal.	40,000
The Nevada-California Power Co., San Francisco, Cal	Warren Creek & Slate Creek, Leevining Creek, Bishop Creek, Cal.	19,000
Emma Rose et al San Francisco, Cal.	Stanislaus River, Cal.	30,000
San Joaquin Light & Power Corpn., Fresno, Cal.	San Joaquin River, Cal.	45,000
Southern California Edison Co., Los Angeles, Cal	Salmon Creek, Cal	7,500
Western States Gas & Electric Co., Stockton, Cal.	Trinity National Forest, Cal.	2,500
Pitt River Power Co., Washington, D. C.	Pitt River, Cal.	92,000

CALIFORNIA (Continued)

Name of Company	Location of Project	Capacity, Hp.
R. W. Hawley, San Francisco, Cal.	Silver Creek, Cal.	107,000
Luther Hill, Independence, Cal.	Sam Mill Creek, Cal.	386
A. P. Seybold, San Francisco, Cal.	Klamath River and Bluff Creek, Cal.	31,200
Sespe Light & Power Co., Los Angeles, Cal.	Piru Creek, Cal.	15,000
Southern California Edison Co., Los Angeles, Cal.	Big Creek, Cal	120,000
H. H. Wadsworth, San Francisco, Cal	Middle Yuba, near Dobbins Creek, Cal	30,000
Southern Sierras Power Co., Riverside, Cal.	Convict Creek, Cal	6,800
J. G. Van Zandt, San Francisco, Cal.	Bear Creek, Santa Ana Creek, Cal.	37,000
R. G. McDonald, Williams, Cal.	Convict Creek, Cal.	4,000
J. Harvey Pierce, Los Angeles, Cal.	Mammoth Creek, Cal	737
Snow Mountain Water & Power Co., San Francisco, Cal	Not given	15,000
Western States Gas & Electric Co., Stockton, Cal.	South Fork, American River, Cal.	72,000

FLORIDA (Total 8,600 Hp.)

The Cove Co., Ocala, Fla.	Withlacoochee River, Fla	4,000
Reed Bingham, Pensacola, Fla.	Perdido, Styx and Blackwater Rivers, Ala and Fla	4,600

IDAHO (Total 260,500 Hp.)

G. W. Sperry, Bonners Ferry, Ida.	Moyie River, Idaho.	5,000
Idaho Power Co., Washington, D. C.	Snake River (Twin Falls), Idaho.	25,000
Idaho Power Co., Washington, D. C.	Snake River (Upper Salmon Falls), Ida.	66,000
Utah Power & Light Co., Washington, D. C.	Bear River, Idaho.	21,500
Moore's Creek Boulder Gold Dredging Co., Boise, Idaho.	Transmission Line.	
Electro-Metals Co., San Francisco, Cal.	Salmon River, Idaho.	143,000

ILLINOIS (Total 40,000 Hp.)

State of Illinois, Springfield, Ill.	Desplaines and Illinois Rivers, Illinois.	40,000

MASSACHUSETTS (Total 20,000 Hp.)

A. P. Connor, Springfield, Mass.	Connecticut River, Conn. and Mass.	20,000

MINNESOTA (Total 17,000 Hp.)

J. D. Markham, et al, St. Paul, Minn.	St. Croix River, Minn.	11,000
St. Cloud Electric Power Co., St. Cloud, Minn.	Mississippi River, Minn.	6,000
Grand Rapids.	Mississippi River, Minn	

MISSISSIPPI (Total 1,500 Hp.)

W. H. Shrader, Pensacola, Fla.	Sunflower River, Miss	1,500

MISSOURI (Total 32,000 Hp.)

John Danell, Springfield, Mo.	Current River, Mo.	30,000
Western Tie & Timber Co., St. Louis, Mo.	Current River, Mo.	4,000
W. R. Banks, Lamar, Mo.	Osage and Nianqua Rivers, Mo.	2,000

MONTANA (Total 490,778 Hp.)

Name of Company	Location of Project	Capacity, Hp.
Amazon Dixie Mining Co., Wallace, Idaho	Lolo National Forest, Mont., Transmission Line	
Town of Ronan, Mont.	Crow Creek, Mont.	200
Rocky Mountain Power Co., New York City	Flathead Lake and River, Mont	272,000
Big Horn Canyon Irrigation and Pwr. Co., Hardin, Mont.	Big Horn River, Mont	217,550
Montana Water, Power & Electric Co., Portland, Ore.	South Fork Flathead River, Mont.	
William Park Mills, Missoula, Mont.	Vermilion River, Mont.	600
Rock Creek Power Co. Missoula, Mont.	Rock Creek, Mont.	428

NEW JERSEY (Total 432,300 Hp.)

Paul T. Brady, New York City	Delaware River, N. Y., Pa., and N. J.	228,600
Canada Syndicate, Ltd., New York City	Delaware River, N. Y., Pa. and N. J.	432,300
W. C. Elbertson et al., Newark, N. J.	Delaware River, Foul Rift, N. J.	20,000

NEW YORK (Total 2,933,250 Hp.)

Niagara County Irrigation & Water Supply Co., Washington, D. C.	Niagara River, N. Y.	75,000
St. Lawrence Trans. Co., Potsdam, N. Y.	St. Lawrence River, N. Y.	900,000
Ford Motor Co., Dearborn, Mich.	Green Island, Hudson River, N. Y.	8,250
Western New York Utilities Co., Inc., Medina, N. Y.	Erie Canal, N. Y.	10,000
Hydraulic Race Co., Lockport, N. Y.	Niagara River, N. Y.	5,000
Niagara Falls Power Co., Niagara Falls, N. Y.	Niagara River, N. Y.	(a) 400,000
Louisville Power Corpn., New York City	St. Lawrence River, N. Y.	600,000
Lower Niagara River Power & Water Supply Co., New York City	Niagara River, N. Y.	250,000
Niagara, Lockport & Ontario Power Co., Buffalo, N. Y.	Niagara River, N. Y.	
City of Buffalo	Niagara River, N. Y.	
J. K. Thomson et al., Buffalo, N. Y.	Niagara River, N. Y.	900,000
M. F. Bowen, Washington, D. C.	Lake Erie, Niagara River, N. Y.	800,000
Niagara Gorge Power Co., Buffalo, N. Y.	Niagara River, N. Y.	300,000

NORTH CAROLINA (Total 3,400 Hp.)

Granite Falls Mfg. Co. Granite Falls, N. C.	Wilson Creek, N. C.	2,000
United Mills Co., Hickory, N. C.	Harpers Creek, N. C.	1,400

OKLAHOMA (Total 4,500 Hp.)

Courtland P. Chenault, Tulsa, Okla.	Arkansas River, Okla.	3,000
W. T. Larimore, et al, Hugo, Okla.	Little River, Okla.	1,500

OREGON (Total 385,200 Hp.)

Name of Company	Location of Project	Capacity, Hp
Crown Willamette Paper Co., Portland, Ore.	Willamette River, Ore.	7,200
Columbia Valley Pwr Co., New York City	Deschutes River, Ore.	378,000

PENNSYLVANIA (Total 20,000 Hp.)

W. A. Dromgold, York, Pa.	Susquehanna River, Pa.	20,000

SOUTH DAKOTA

Paving Granite Quarry Co., Rapid City, S. D.	Blackhills Nat. Forest, S. D., Transmission Line.	

VIRGINIA (Total 98,000 Hp.)

Roanoke River Development Co., Richmond, Va.	Roanoke, Va.	60,000
Big Bend Power Co., Lynchburg, Va.	James River, Va.	8,000
Tri-State Power & Milling Co., Salem, Va.	New River, Va., and W. Va.	30,000

WASHINGTON (Total 1,066,000 Hp.)

Washington Irrigation & Development Co., New York City	Columbia River, Washington	300,000
Sound Power Co., New York City	Sultan River & Olney Creek, Wash.	106,000
Straits Power Co., New York City	Solduc River and Crescent Lake, Wash.	95,000
Northwestern Power & Manufacturing Co., Seattle, Wash.	Lake Crescent, Lyre River, Wash.	5,000
Alex Polson, et al, Montesano, Wash.	Wyanooche River, Wash.	
Hugh L. Cooper, New York City	Columbia River, Wash.	350,000
Washington Development Corporation, Seattle, Wash.	Dungeness River and West Fork Creek, Wash.	
Spirit Lake Railway & Power Co., Vancouver, Wash.	Spirit Lake, Wash.	10,000
William F. Scheffel, Wenatchee, Wash.	Columbia River, Wash.	100,000
Wenatchee Commercial Club, Wenatchee, Wash.	Rock Island and Cabinet Rapids, Columbia River, Wash.	100,000

Total horsepower involved in applications	**9,411,251** (a)
Conflicts with other applications	**1,684,600** (b)
Net total horsepower	**7,726,651** (a

(a) If treaty is modified figures will be increased by 400,000 hp.
(b) If treaty is modified figures will be increased by 550,000 hp.



HIGH SNOW-COVERED PEAKS IN MONTANA FROM WHICH THE MONTANA POWER COMPANY DRAWS ITS "WHITE COAL"

Statistics on 1920 Production of Electrical Equipment and Supplies

	Value	Number of Units
Insulated Copper Wire:		
Rubber-covered	$85,000,000	..
Total code	30,000,000	1,700,000,000 ft.
No. 14	11,250,000	1,105,000,000 ft.
Flexible cords		204,000,000 ft.
Motors:		
Fractional	40,000,000	
1 hp. to 50 hp.	66,000,000	
51 hp. to 200 hp.	11,000,000	
Above 200 hp.	2,000,000	
Transformers:		
5 kva. and under		330,000 kva.
Above 5 kva.		660,000 kva.
Distribution type	11,400,000	
Power type	13,200,000	
Meters, watt-hour		2,200,000
Control, industrial	25,000,000	
Lamps:		
Type "B"		172,000,000
Type "C"		43,000,000
Carbon		15,000,000
Miniature		105,000,000
Socket Devices:		
Heating appliances:		
Domestic	21,250,000	
Heating pads	200,000	
Industrial	1,500,000	
Fans	20,500,000	1,700,000
Washing machines	72,000,000	600,000
Vacuum cleaners	45,000,000	900,000
Wiring Supplies:		
Rigid conduit	20,300,000	140,000 tons
Non-metallic flexible conduit	5,000,000	95,000,000 ft.
Metallic flexible conduit	150,000	2,300,000 ft.
Flexible armored conductor	6,400,000	71,000,000 ft.
Outlet boxes and fittings	1,800,000	
Tape:		
Friction		18,000,000 lb.
Rubber		2,000,000 lb.
Fuses:		
Renewable	3,500,000	
Non-renewable	3,500,000	
Schedule Material:		
Key sockets		13,500,000
Pull sockets		9,000,000
Keyless sockets		5,500,000
Flush switches		9,000,000
Exposed switches		8,000,000
Plugs		15,000,000
Receptacles		15,000,000
Storage, Batteries	100,000,000	
Starting and lighting	52,500,000	3,500,000
Dry Batteries		70,000,000
Electric Vehicles:		
Trucks	22,000,000	5,000
Industrial tractors	8,000,000	4,000

IN EXCESS of $1,250,000,000 is the conservative estimate of the manufactured value of the output of electrical materials during 1920.

In the table in the left-hand column are statistics of the year's output covering electrical engineering equipment and supplies so far as they pertain to electric light and power utilities, industrial plants, construction work and the household. The figures were compiled by the ELECTRICAL WORLD from estimates made by those who because of their connections should be able to give figures that are reasonably accurate.

This table does not include all electrical manufacturers, because in many instances no accurate estimates are available. No mention is made of wire or wireless communication, automotive equipment outside of starting and lighting batteries and lamps, medical equipment, generating equipment, farm plants and various other items which in the aggregate amount to many millions of dollars. The products listed here total around $750,000,000.

No items, with one exception, show any decrease from the values listed for the year 1919. But several of the lines do not show increases as great as they would have shown had raw materials been available to carry on the production made necessary to supply the insistent demands. Watt-hour meters provide one noteworthy instance. Although 1920 production is listed as 2,200,000 meters, it has been estimated that the industry could have absorbed about 2,500,000. Again, flexible armored conductor was produced to the extent of about 71,000,000 ft. The supply of steel strip was so limited during the first half of the year that production of finished conductor was hampered to a large extent. At the same time this reacted favorably to the increased production of non-metallic flexible conduit and knobs, tubes and cleats.

From the way the year started off, records gave promise of being badly broken in lines of socket devices. Fans and heating appliances increased well, but the demand for domestic motor-driven appliances, which started off with a rush, fell off in the last half year and production suffered greatly. Otherwise washing-machine figures, especially, would have been considerably higher. The same might be said of the production of starting and lighting batteries. Here is one case where 1920 production was probably under that of 1919 by about 500,000 batteries.

Lamp production has responded to a big increase. Sales of tungsten filament lamps increased from 170,000,000 in 1919 to about 215,000,000 in 1920. Miniatures have gone from 70,000,000 to about 105,000,000.

About $120,000,000 worth of motors were manufactured in 1920, surpassing 1919 by 20 per cent.

Conduit sales increased to a favorable extent. Rigid and flexible conduits total about $26,000,000, and to this may be added stone and fiber conduits. About 13,000,000 ft. of fiber conduit was produced in 1920.

Wire production was heavy all year, rubber-covered increasing about 13 per cent over 1919.

Transformer production amounted to 10 per cent more than it did last year, the power types going to 20 per cent.

Schedule-material production showed varying amounts for different items. Receptacles and plugs increased 50 per cent in 1920 over 1919, while sockets showed from 10 to 20 per cent increase. Flush switches held steady, but exposed switches increased 7 per cent.

Output for 1920 Estimated at 46,700,000,000 Kw.-Hr.

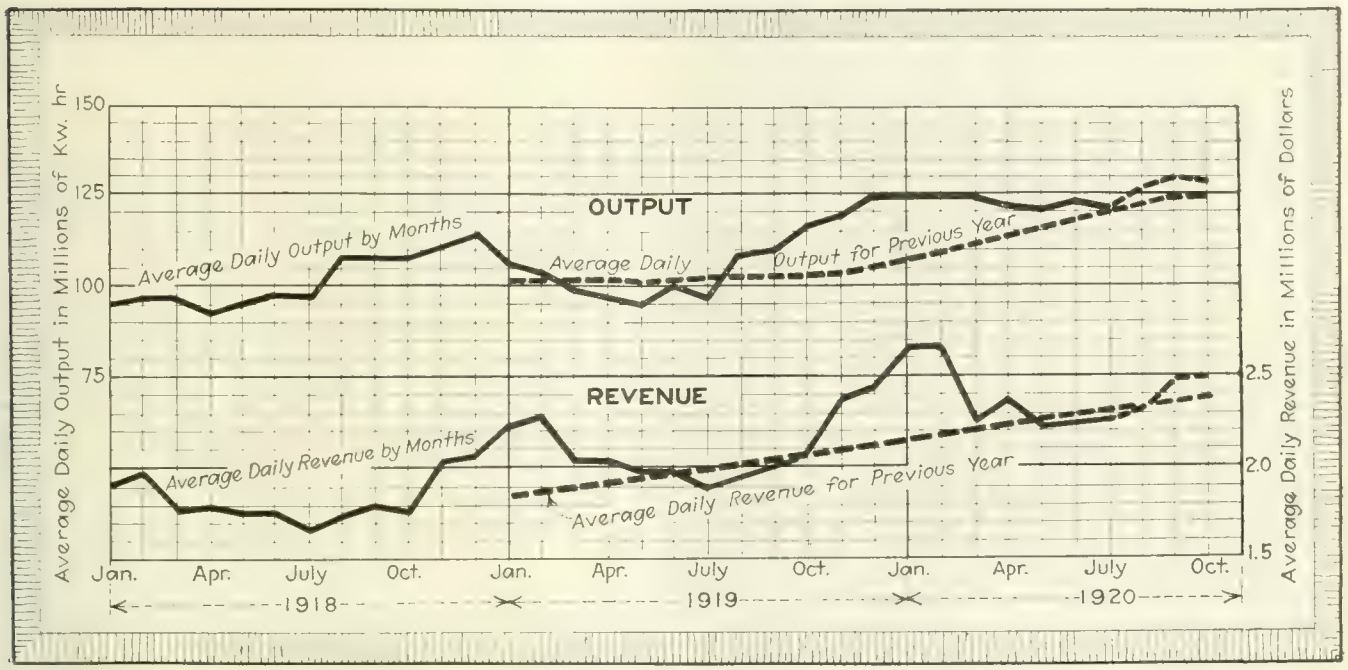


FIG. 1—CENTRAL STATION OPERATIONS SHOW DECREASE IN OUTPUT DURING OCTOBER

FOR the year just closed the central-station output was 46,700,000,000 kw.-hr., as nearly as can be estimated from returns received by the ELECTRICAL WORLD for the first ten months of 1920, while the total gross revenue is estimated at about $922,300,000. These figures represent an increased output over 1919 of 21.2 per cent and an increase in the revenue from the sale of energy of 19.2 per cent. Diagram 2 indicates that during the six-year period in which the ELECTRICAL WORLD has received regular monthly returns from electric light and power plants of the country the output has grown from 16,782,000,000 kw.-hr. in 1914 to the figure given above, a total increase in the six years of 178 per cent, and the revenue has grown from $336,980,000, an increase of 174 per cent. The following table gives the increase in central-station output throughout the country during the past six years:

Section	1914 Kw.-hr.	1920 Kw.-hr.	Gain in Six Years, per Cent.
New England States	1,217,900,000	2,892,200,000	137
Atlantic States	5,746,000,000	16,900,000,000	194
Central States	6,413,500,000	17,768,400,000	177
Mountain and Pacific States	3,404,700,000	9,139,400,000	168

The returns received for the month of October of last year reflect the large curtailments in production prevalent throughout the plants and factories of the country. In spite of the large seasonal increase in energy demand for lighting purposes, the average daily output for October was only 127,400,000 kw.-hr. against 128,300,000 kw.-hr. reported for September. Despite the decrease in energy sold to power customers, the usual large seasonal increase in lighting requirements was sufficient to produce a slight increase in the gross earnings for the month.

Every section of the country excepting the Atlantic States showed a decrease in output for October under that of September. From New England came reports of curtailments in nearly every manufacturing industry, and few factories were working on a six-day schedule. As a result the central-station industrial load of that section suffered materially, the daily output averaging 7,720,000 kw.-hr. against 7,900,000 for September.

Similar factory production curtailments occurred in the Atlantic States. In the South Atlantic States, however, more than 158,000 more spindles were active in October than during September, and for the most part the steel companies of the Middle Atlantic States were operating at about 80 per cent capacity. The decrease

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy			Percentage of Installed Ratings Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
Nov.	53	$37,439	$31,927	17.2	58	2,055,428	1,895,693	8 2
Dec	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10 0
		1920	1919			1920	1919	
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18 0
Feb.	63	45,881	37,502	22.1	69	2,494,764	1,986,493	25.3
Mar	65	46,155	36,840	25.0	70	2,698,890	2,103,587	28 0
April	65	45,547	36,541	24 5	70	2,603,692	2,098,559	24 1
May	65	43,888	35,512	23 4	70	2,631,560	2,179,916	21 2
June	66	44,433	35,528	24 5	71	2,633,831	2,175,645	20 2
July	66	46 608	36 265	28 5	71	2 677.131	2 234 215	20 0
Aug.*	66	47,410	36,713	29.1	71	2,769,175	2,303,099	20 1
Sept.†	66	49,084	38,274	28.2	71	7,732,056	2,324,215	18 7
Oct.‡	66	51,008	40,979	25 1	71	2,802,357	2,493,710	12.5

*Includes estimates for twenty-four companies, representing 2.5 per cent of the total installed rating of all central stations.
†Includes estimates for forty-one companies, representing 9.2 per cent of the total installed rating of all central stations.
‡Includes estimates for ninety-three companies, representing 17.6 per cent of the total installed rating of all central stations.

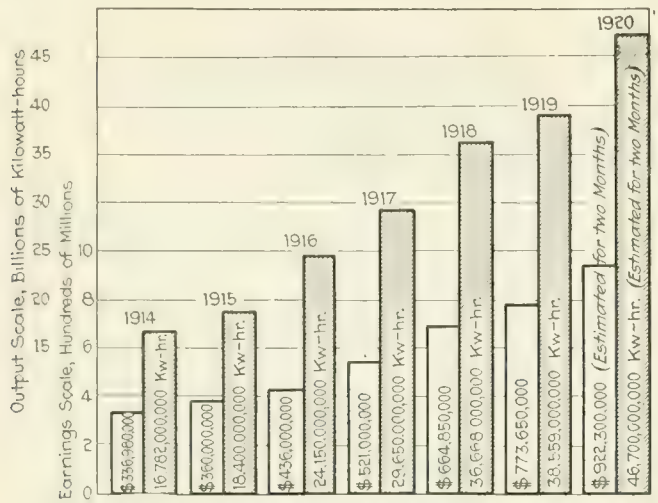


FIG. 2—OUTPUT AND EARNINGS OF CENTRAL STATIONS, 1914 TO 1920 INCLUSIVE

in factory energy requirements of the North Atlantic States was, therefore, apparently overcome by the requirements of other portions of the section, and the average daily output for this division consequently was slightly increased over that of September.

Production curtailment in the North Central States was not so drastic as in the New England States, but was sufficient to cut materially the energy sold to power customers by the central stations of that section. The daily consumption of energy for all purposes was about 300,000 kw.-hr. below that reported for September.

The rising importance of the industrial load in the Southern States is emphasized in the October returns for that section. Until very recently the energy requirements of these states could be gaged very accurately by the seasonal demand for lighting, but in October, in spite of the advancing season, the central-station output averaged 150,000 kw.-hr. less than during the month previous.

For the first time in the year the output of the Mountain and Pacific States showed a decrease under that of the previous month. The Northwestern States showed a distinct gain in output during the month, but the reduced output reported from California was sufficient to overcome this increase. The large proportion of the total output sold to power customers by the California generating companies and the slump in industrial production are clearly reflected by the returns.

ECONOMY *in government expenditures is now of vital importance. We should expect and demand the same degree of efficiency in the conduct of our government as we require in private business. Reckless expenditure by the government, national, state or city, necessitates higher taxes. These taxes increase prices, and higher prices curtail consumption. The effect of a curtailment of consumption is to increase non-employment. There is need of immediate revision of our tax laws. While the war lasted we had to put up with a makeshift policy, badly conceived and badly executed. Now that the time for real readjustment has come it is the duty of citizens to see to it that taxes are not imposed which encourage extravagance and take from industry the opportunity to invest its earnings. Only by such investments can factories be kept running, and the more factories kept running at full time, the more men will be required to work, the greater will be their output and the higher their wages. If the business of the United States is to go forward as it must go forward, our people must take a world view. We must think internationally. We must trust in the good faith and in the productive power of Europe, sending to them our raw materials and goods to enable them to resume productivity.*—CHARLES M. SCHWAB.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Installed Ratings Represented	New England States			Percentage of Installed Ratings Represented	Atlantic States			Percentage of Installed Ratings Represented	North Central States			Percentage of Installed Ratings Represented	South Central States			Percentage of Installed Ratings Represented	Pacific and Mountain States		
			1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
REVENUE	Nov.	71	$4,432	$3,800	16.2	56	$14,738	$12,761	15 7	44	$10,541	$8,689	21.2	39	$2,063	$1,694	21 8	63	$5,665	$4,983	13.9
	Dec.	73	4,908	4,254	15.1	57	15,926	13,806	15.8	49	11,660	9,833	18.3	44	2,496	2,070	20 0	77	9,135	8,015	14 2
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	5,635	4,718	19.8	59	17,659	14,625	20.9	51	12,885	10,799	19.6	53	3,047	2,538	19 9	75	7,388	6,322	16.1
	Feb.	82	5,354	4,368	22.1	61	17,245	14,343	20.4	55	13,191	10,403	26.0	53	2,949	2,360	24.7	79	7,142	6,028	18.3
	Mar.	82	5,136	4,044	27 0	63	17,696	14,299	23 7	57	13,270	10,469	26.5	54	2,910	2,287	27 8	79	7,14	5,741	24.2
	April	82	5,087	3,943	29 0	64	17,700	14,383	23 5	57	12,690	10,042	26.9	54	2,952	2,181	35 2	79	7,118	5,992	19.2
	May	82	4,897	3,741	30.1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32 0	79	7,067	6,147	15.1
	June	82	4,948	3,778	30 5	65	16,525	13,449	22.1	57	12,412	9,776	26.9	54	2,849	2,127	33 9	79	7,700	6,398	20.5
	July	82	5,009	3,902	28.5	65	16,879	13,438	25.5	57	12,822	9,793	30.9	54	2,787	2,194	5	79	8,131	6,948	31.5
	Aug	82	5,075	4,093	24 0	65	17,210	13,731	25 9	57	13,497	10,151	32 9	54	3,168	2,281	38 1	79	8 460	6,457	31.1
	Sept.	82	5,407	4,293	25 9	65	18 012	14.449	24 2	57	13,767	10,525	30 5	54	3.230	2 386	35 4	79	8 668	6,571	32.1
	Oct.	82	5,673	4,616	22 9	65	19,123	15,675	21.9	57	14,312	11.654	22.8	54	3,343	2 547	30 9	79	8 557	6,487	32.1
KW-HR OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918			1919	1918	
	Nov.	71	153,171	140,240	9.2	56	724,667	707,347	2 4	60	686,486	597,855	14.9	39	68,352	59,507	14 7	63	422,812	390,744	8.2
	Dec.	73	180,493	152,304	18.0	58	803,165	733,222	8.9	67	825,313	713,959	15.8	44	88,658	73,728	20 1	77	611,947	597,620	2.5
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	207,158	159,773	29 8	60	853,057	717,303	19.2	69	841,841	731,758	15.2	56	140,736	117,677	19.9	75	538,304	460,221	16.2
	Feb.	82	187,264	148,103	26.2	62	809,865	672,836	20.1	73	858,939	663,523	29 4	56	130,473	98,098	33.0	79	508,223	403,933	26.1
	Mar.	82	198,603	148,512	33.7	64	897,327	711,828	26 0	74	913,659	711,761	28 1	56	137,30	102,545	33 6	79	551,995	428,941	28.6
	April	82	187,174	144,922	29.1	65	883,264	701,778	25 9	74	857,467	687,751	24 7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May	82	188,566	148,186	27.5	65	854,631	711,276	20 0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June	82	189,934	149,607	26 5	66	8 5,714	721,688	19 9	74	855,013	681,780	25.5	56	137,733	99,660	33.2	79	587,437	522,901	12.2
	July	82	190,668	159,00	20.0	66	88 ,241	7 4,485	23 5	74	841,351	702,302	19 7	56	138,937	106,460	30 1	79	6 4,934	551,959	13 4
	Aug	82	194,028	171,002	13	66	905,170	728 097	24 2	74	891,712	750,787	18 6	56	147,082	111,573	32 0		631,183	541,640	16 5
	Sept	82	194,610	170,314	14 0	66	906 353	758 287	19 5	74	876,770	754,855	16 0	56	146,5 1	113,212	29 9	79	60 ,80	527,547	15.5
	Oct.	82	196,097	190,713	2 6	66	965,665	840,189	14.7	74	900,985	814,14	10 6	56	148,800	124,250	19.8	79	5 0,810	523,816	10 5

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Recent Equipment Costs in Massachusetts Central Stations

IN VIEW of the interest of engineers in equipment costs at present the following segregated data are published for several Massachusetts central stations filing construction-cost information with the Department of Public Utilities in connection with petitions for authority to issue securities. Only such data as are of general significance are presented, but virtually all these costs are 1919-1920 figures.

One 12,500-kva. turbo-generator, erected	$195,397
One 22,000-sq.ft. surface-condensing equipment with exhaust distance piece	69,840
One 4,300-kva., 25-cycle, three-phase, 11,000-volt generator, erected	60,200
Two 755-hp. water-tube boilers	36,886
Two 755-hp. Foster superheaters, erected	7,350
Two seven-unit Diamond soot-blowing equipments	1,544
Two seven-retort underfeed stokers with steam-power dump	11,666
Four 36-in. cast-iron ash gates	1,303
One air washer, 40,000 cu.ft. per minute	2,328
One 2,000-lb. electric weighing lorry	2 100
One 30-in. hydraulically operated atmospheric relief valve	1,125
One No. 8 green forced-draft fan	6,800
One 50-ton, four-motor electric crane	16,410
Two superheaters for 500-hp. boilers	8,223
Two 1,500-barrel steel fuel-oil tanks with foundation	16,738
Oil-burning equipment for 15,000-kva. station	90,379
One 150-kw. combination turbo-motor exciter set	9,375
One 20-ton, eight-wheel locomotive crane with 60-ft. boom	15,985
Two 1,200-amp. and fourteen 600-amp., 15,000-volt solenoid-operated oil circuit breakers	19,725
Three 1,250-kva. transformers, 66,000/13,000 volts, water-cooled type	16,200
Three 1,500-kva., 66,000/13,200/2,200-volt water-cooled transformers	19,600
Water-cooling system for three 1,500-kva., 66,000/13,200/2,200-volt transformers	1,704
Three 2,500-kva. transformers, 23,000-4,000-volt, installed, including switching and connections	20,533
Six 1,000-kva. transformers, 13,200/2,300-volt, single-phase, 60-cycle, oil-insulated, self-cooled, outdoor type for bus-tie work	13,388
Four 100-kva., 2,300/230/115-volt oil-insulated, self-cooled transformers, indoor type, auxiliary station service, single-phase, 60-cycle	2,222
One 1,300-amp., 6-ohm, 15,000-volt, 350-deg. C. (1 minute) neutral-grounding resistor for 12,500-kva. generator	2,600
Two 13,200-volt, three-phase, 60-cycle oxide-film lightning arresters, with fuses, etc., for 13,200-volt bus	1,122
One 46-kva., 200-amp., 2,200-volt, 60-cycle feeder-voltage regulator, complete with three-phase non-automatic motor control, f.o.b. factory	1,272
Five 66,000-volt potential transformers	9,540
One 66,000-volt air-break switch	970
Four 200-amp. and five 300-amp. feeder reactors	8,108

Steam Leakage Through 0.001-Sq.In. Hole Wastes $40 per Year

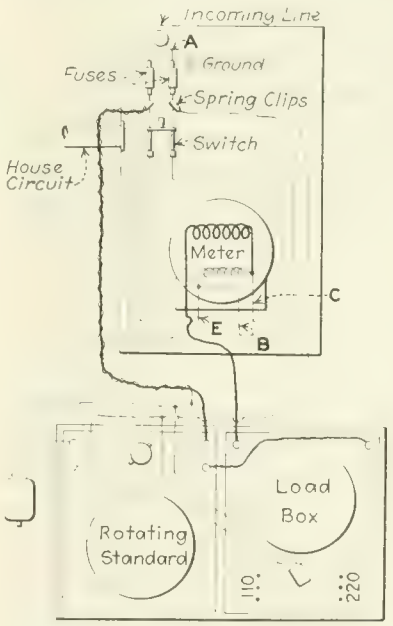
ABOUT 100,000 lb. (45,000 kg.) of steam per year will leak through a hole having an area of only 0.001 sq.in. (0.006 sq.cm.) with a pressure of 200 lb. (14 kg.) on the steam. With coal at $5 per ton and 6 lb. (2.7 kg.) of water evaporated for 1 lb. (0.45 kg.) of coal, this will amount to about $40 per year for extra fuel on account of the leak. It is seen from these figures that the cost of additional fuel which is necessary on account of small leaks is much greater than would be expected from a hasty consideration. Leakage of steam from pop safety valves is a frequent cause of loss. These can be shut tight and made so there is no chance of leakage under operating pressure. Leakage into cold boilers is another cause of very considerable loss in almost all plants. Leakage through throttle valves and by-pass connections of idle prime movers, auxiliary engines and pumps is a universal source of loss. Other points where steady leaks are found are valves in drip or drain pipes from steam piping, superheaters, and throttle valves, in couplings, unions and holes in valves and fittings, water-columns, blow-off cocks and floor pumps, steam traps, pressure-gage connections, boiler seams, etc. The fact that an engine shows a nearly perfect indicator diagram is not absolute proof that the engine is operating economically as these leaks may lower the over-all efficiency.

The blowing of high and low-water alarm whistles of water columns is another source of waste, and so sometimes is blowing off steam through boiler and economizer pop safety valves. It is necessary to blow these valves only once every day to test them momentarily. Another source of loss is the use of too much steam under grates for protection against burning or to facilitate the combustion of coal.

H. F. EDDY,
Consumers' Power Company, Mechanical Engineer.
Jackson, Mich.

Outfit for Speedy Testing of Meters

AN OUTFIT for testing customers' meters which is convenient, speedy and easy to handle was designed by the writer for the Depew & Lancaster Light, Power & Conduit Company, Lancaster, N. Y. A rotating standard and load box are inclosed in one case. Only three connections are made and only one service wire is removed from the meter. The apparatus consists of a Westinghouse rotating standard watthour meter and a States Company type F phantom-load box mounted in a hardwood case lined with ½-in. (1.25-cm.) felt. The load box is set at a 30-deg. angle to allow insertion of the potential plug in front, radiation from the back and a view of the load point markings on top. The three leads are cabled and fold inside the case for carrying. The customer's meter in the drawing is Westinghouse OA, and current connection for the test is made to the left terminal after removing the distribution wire *E*. This meter has right hand feed. For meters with left hand feed the procedure as outlined



ONLY ONE LEAD OF METER NEED BE REMOVED FOR TESTING

is reversed accordingly. The incoming service leads at the right remain in normal position to liven the meter potential coil. Two snap connections are made at the service fuses. The current wire connected at the left-hand fuse is extra-heavy lamp cord, and ordinary lamp cord is soldered to it at the top and twisted around it down to the test outfit for one potential of the standard meter. The other potential wire is run separate to the right-hand fuse. As these connections are made at the incoming point error due to voltage drop is eliminated. The current when being tested passes from load box through meter to left-hand fuse and back over the heavy lamp cord to the rotating standard and thence to the load box.

The directions followed by the tester are as follows:

1. If either wire is grounded, it must be on the *A* side of the service as indicated.
2. If found otherwise, change to the *A* side.
3. *A* side must go to the *B* terminal of the meter.
4. Other side of service goes to *C* terminal of meter.
5. Remove distribution wire from terminal *E* of meter.
6. Set rotating standard to the proper amperage and voltage.
7. Set load box dial below lowest point.
8. Make connections according to the sketch.
9. Put the plug in the load box at the proper voltage.
10. Proceed with the test.
11. Be sure customer has service before leaving.

The tester always sets the load-box dial below the 0.1-lamp point while connecting up. After bringing the dial to this position if the connections are wrong this coil will blow, thereby protecting the rest of the outfit. It is only necessary to wind on a few feet of resistance wire, with which the tester is supplied, to make the outfit serviceable again.

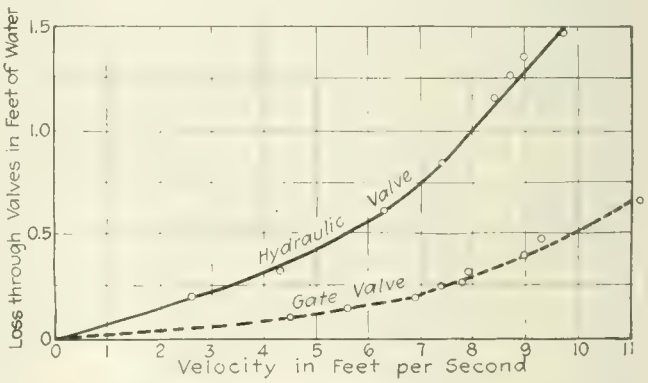
B. R. PAYNE,
Meter Superintendent.
Depew & Lancaster Light, Power & Conduit Company,
Lancaster, N. Y.

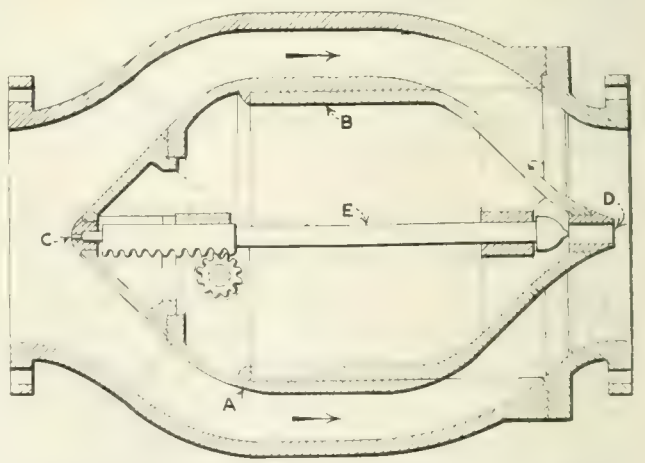
Test of a Hydraulically Operated Throttling Valve

A THROTTLING valve operated by the water pressure in the main in which it is inserted has recently been installed and tested in the hydraulic laboratory of the University of California. This valve is of considerable interest because of its probable use in the Hetch-Hetchy project and in the filtration plant at Sacramento. The valve is diagrammatically shown in the sketch. The following are some of the advantages found in this type of valve: (1) It is easily and rapidly closed. The 6-in. (15-cm.) valve in the hydraulic laboratory was closed against a pressure of 150 lb. (10.5 kg.) in six seconds and opened to full extent in five seconds. A standard gate valve of the same size was opened under the same conditions in twelve seconds and closed in ten seconds and required many more times the amount of muscular effort. (2) The internal parts are machined and require no packing. (3) No by-pass is required. (4) The valve can be placed in any position of partial closure and left indefinitely without injury. (5) Tightness. This valve was closed against a pressure of 150 lb. per square inch and showed no signs of leakage. (6) Wear. Although the valve had been used by the Niagara Falls Power Company before it was presented to the university it shows no signs of wear, and because all of the parts subjected to pressure are circular there is no tendency to distortion.

Some disadvantages are: (1) That the valve may be closed so rapidly as to produce an exceedingly strong water hammer, and (2) that for full-open position the loss through the valve is greater than through a gate valve of the same size. A comparative test was made on the two valves for head loss with different velocities. The results are shown in the curves reproduced.

The valve operates in the following manner: The internal cylinder *A* is supported by radial ribs. Within the cylinder *A* the piston *B* is actuated by the piston rod E. It will be noted that the valve closes with the direction of flow. If we start with the valve in the open position as shown and turn the pinion toward the right, the piston rod *E* moves toward *D*. Water enters at *C* and produces within the cylinder a pressure which is greater than that on the front side of the plunger because at *D* the water is flowing while within the cylinder it is at rest. It must be remembered that the opening *C* is very small compared with that at *D*. This permits the relative decrease of pressure through *D* and at the same time a relative increase through *C*. The tendency then is for the plunger *B* to move forward. This it does, but it can move only a very short distance because it moves away from the piston rod at *D* and thus creates within the cylinder a pressure equal to that outside and the plunger would stay in this position of equilibrium if the hand wheel is not again revolved and the whole process repeated.





HYDRAULIC VALVE CLOSED BY PRESSURE OF THE WATER

The curves show comparative head losses of the hydraulically operated valve and a gate valve under varying velocities.

If the valve is operated in air or in still water, the piston rod closes the plunger *B* by sliding it along. A reversal of the above operation opens the valve.

University of California, BLAKE R. VANLEER,
Berkeley, Cal. Instructor in Mechanical Engineering.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Temperatures for Switches, Buses and Bare Conductors

MAXIMUM operating temperatures which should be allowed in switches and bare conductors and buses were agreed upon by the Electric Power Club at its November meeting. According to the recommendations of the club, switching devices should carry continuously their rated current and the rated currents of the circuits in which they are applied, without exceeding the temperature-rise limits set by the A. I. E. E. standardization rules. These ratings are based on an ambient temperature of 40 deg. C.

Maximum temperature of contacts in air when clean and bright and maximum temperature of oil and contacts therein must not exceed 70 deg. C. Maximum temperature on coil insulation, according to insulation, shall not be above 108 deg. C. to 125 deg. C. (except that in the case of such materials as pure mica, porcelain, etc., no limits are specified). Maximum temperature of other parts, including frames, may reach such temperature as shall not be injurious in any other respect.

Fuses, shunts for meters and resistors which must necessarily operate at temperatures higher than the foregoing limits will be placed so that they will not increase the temperature of other apparatus above the limits stated.

Bare buses and bare conductors may be operated at temperatures not exceeding 90 deg. C. provided that their location or connection does not increase the temperature of connected switching devices above 70 deg. C., or of connected insulated conductors above that specified in the A. I. E. E. standardization rules. Where insulated conductors are used their temperature rise shall not exceed that specified by the A. I. E. E. rules.

Motor Record System for Plant with Several Departments

A SYSTEM for keeping track of motors in use by the Dayton Engineering Laboratories Company is complete and simple to use. There are three files. One placed in the main office contains 4-in. x 6-in. (10-cm. x 15-cm.) cards, bearing the shop number of each motor and the name of the department in which it is installed. In each department there is another file with cards of the same size containing nameplate, winding and other data.

A white card is employed for alternating-current motors and a red card for direct-current machines. It will be noted on the card shown here that the specification numbers of the rotor and stator as given on the nameplate are also shown on the record card. This is important with motors manufactured by certain companies, because the letter at the end of the specification number indicates the manner in which the windings are connected.

A detail of the record that is very carefully kept is the size and description of the bearings. Bronze bearings sometimes scar the shaft to such an extent that it has to be turned down and will no longer take a standard bearing. In such cases the exact size of the bearing required is shown on the record. Spare rotors are put in service while shafts or bearings have to be repaired. Special bearings are made for a shaft as soon as it has been turned down, and the rotor is put in stock complete with the special bearings on the shaft ready for service.

Delco		Make	Serial
H. P.	Volts	Type	Frame
Form	Phase	Cycle	R. P. M.
Spec Nos. Stator	Rotor	Amp.	
Bearings-F	Rear	Type	
Rotor Amp	Rotor Voltage		Total Coils
Slots	No Brushes	Kind	Size
Stator Connections			Drawing No.
Pulley	Bore	Diam.	Key

CARD FOR DATA ON AN INSTALLED MOTOR

The third file is a permanent motor record in a loose-leaf book in the main office, in which the motors are filed according to horsepower and speed. The records of about twenty-five motors can be entered on one page and at least one page is allowed for each motor and size.

The best of records needs checking. This is done by means of an inventory of the motors made every six months by the men who inspect and oil them. These inventories serve the double purpose of maintaining the accuracy of the records and checking up on the work of the inspectors.

H. L. BURNS,
Chief Electrician.

Dayton Engineering Laboratories Company,
Dayton, Ohio.

Operating Records of Brass Furnace Pouring Directly Into Molds

ABOUT 250 kw-hr. is consumed for each ton of yellow brass melted in the casting shops of a large brass mill operating in Ohio. Six or seven heats are usually poured in a day of ten hours, and when the furnace is warmed up the average time between the heats is one hour and fifteen minutes, made up of ten minutes for charging, fifty minutes for melting and fifteen minutes for pouring. It will be noted from the typical daily report that the energy consumption dropped from 260 kw.-hr. on the first heat to 200 kw.-hr. on the sixth, as the furnace became hotter with each succeeding heat. On that day the charges consisted of 2,178 lb.(897 kg.) of ordinary yellow brass scrap;

10 lb. of grade D zinc, which contains approximately 0.4 per cent of lead, and 12 lb. (5.5 kg.) of lead. The furnace was a 1-ton (900-kg.) Detroit rocking electric brass furnace and the metal was poured directly into the molds.

Eliminating the ladle in this mill has saved the cost of replenishing crucibles. A number of difficulties were encountered when this practice was first tried, but they have been overcome by carrying the molds on a truck

MELTING YELLOW BRASS, 2,200 LB. PER HEAT

	Heat No. 1	Heat No. 2	Heat No. 3	Heat No. 4	Heat No. 5	Heat No. 6
Time arc was turned on	7:05	8:45	10:35	12:00	1:25	3:00
Meter reading, kw.-hr	0	0	0	0	0	0
Time rocking started	7:45	9:30	11:10	12:33	2:00	3:30
Meter reading, kw.-hr.	150	150	150	135	130	130
Time arc was turned off	8:15	10:10	11:25	12:55	2:25	3:45
Meter reading, kw.-hr.	260	250	240	232	212	200

operating on 30-lb. (13.5-kg.) rails. The four molds are so placed on the truck that each mold is elevated 6 in. (15 cm.) above the preceding one in order to bring the mold as close as possible to the pouring spout and to reduce the spill to the minimum. The truck is moved back and forth under the furnace spout by means of a rack and gear controlled by a hand-operated wheel, and the arrangement has proved very satisfactory.

The metal for the furnace is taken from the metal storage room to the charging platform in steel pans of approximately 200 lb. (90 kg.) capacity by means of an overhead conveying system. The furnace can then be filled with 2,000 lb. (900 kg.) of metal from the charging platform in about ten minutes.

JAMES F. BRUSSTER,
Assistant Mechanical Engineer.
Cleveland Brass & Copper Mills, Inc.,
Cleveland, Ohio.

Correct Current Values for Welding with Metallic Electrodes

CORRECT current value is an important feature in electric welding. This fact was demonstrated in a series of tests made by the welding committee of the National Research Council and Emergency Fleet Corporation. In these investigations a number of ½-in. (13-mm.) plates were welded in sixteen different plants under identical conditions as to material and size of plates. Although several types and sizes of electrodes were used, including bare and covered, and both direct

CURRENT TO BE EMPLOYED IN WELDING MILD-STEEL PLATES

Electrode Diameter, Inches	Plate Thickness, Inches	Amperes
	up to	25- 50
	up to	50-
	to	75-160
	up	125-200
	up	175-250

and alternating current were employed to make the welds, an analysis of the results of physical tests, such as tensile, elongation, bending and fatigue tests, revealed no noteworthy difference in the mechanical characteristics, whether the welds were made with bare or flux-covered electrodes or with alternating or direct current. However, it was noticed that the strongest and most ductile welds were made with a high current.

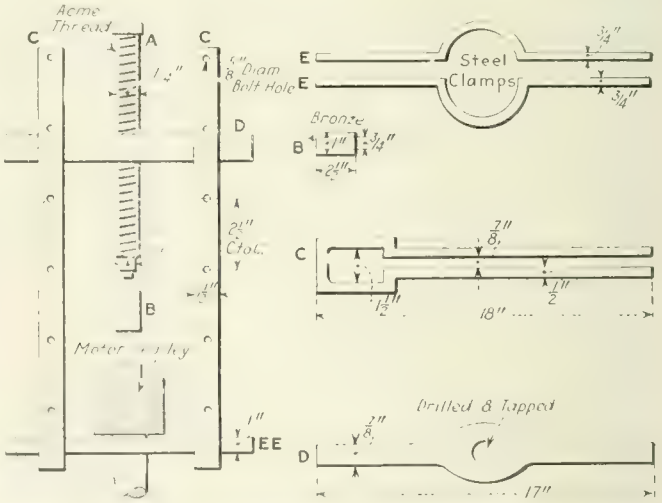
The currents which seem to be the most favorable for mild-steel plates are listed in the accompanying table. The same size of electrode may be used with various thicknesses of plate, using the higher limits of current noted in the table with the heavier plate. In general, the larger size of electrode permits greater speed of welding but requires greater skill and care on the part of the operator. However, there are decided limitations to the increase in speed which may be obtained in this manner.

Excessive current causes a "cutting" arc which either burns holes in the work or else melts the electrode material so rapidly that it piles up and does not insure perfect fusion with the parent metal. To avoid these undesirable factors the operator is compelled to work intermittently to allow the work to cool somewhat. This waste in time more than offsets the gain in the rate with which the electrode is deposited. The general conclusion seems to be that the average operator should use higher current than has heretofore been the practice.

WILLIAM SPRAGEN,
Secretary Engineering Division, National Research Committee.

Home-Made "Come-Along" for Drawing Motor Pinions and Pulleys

PINIONS, gears and pulleys are easily removed from motor shafts in the Chapman valve shops by the screw brace and clamping outfit illustrated in the accompanying sketch. To remove a pinion from a motor shaft the pair of clamps *EE* are placed above and below the shaft and against one side of the pinion; the centering piece *B* is placed in the shaft end and is followed up by the plugged end of the screw *A*, which is 1¼ in. (3.18 cm.) in diameter, with an Acme thread.



PULLEY REMOVED FROM MOTOR SHAFT BY TURNING SCREW *A*

By turning the latter with a wrench the shaft is virtually pushed out of the pinion. The centering piece *B* is of bronze, and the other pieces of the clamping device are mainly wrought-steel bars, provided with bolt holes to facilitate adjustment for different sizes of pinions and pulleys and knocking down for easy transportation to and from different parts of the plant.

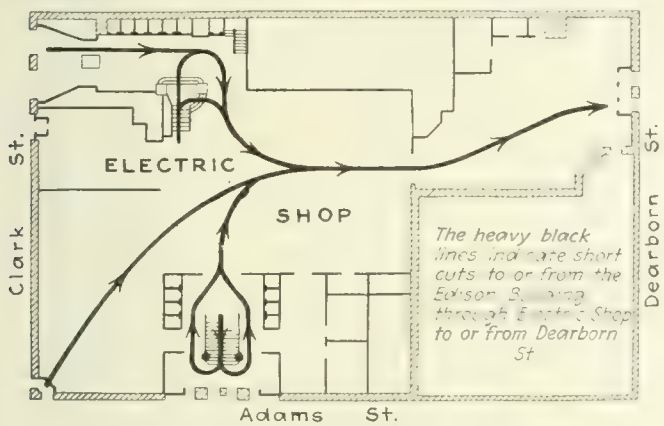
WALTER B. ATCHINSON,
Electrical Engineer.
Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Department-Store Methods Applied to Electrical Store

SINCE the extension of the electric shops of the Commonwealth Edison Company, Chicago, to Dearborn Street, an "electric thoroughfare" has been created between Dearborn Street and Clark Street. This short cut is used daily by thousands, and in order to encourage more persons to go through the shops the accompanying diagram has been printed and distributed. The scheme has been instrumental in increasing traffic through the shops and has helped solve the problem of showing the



COMMONWEALTH EDISON COMPANY'S "ELECTRIC THOROUGHFARE"

public the merchandise on sale in a retail electric store. This is an application to electrical merchandising of one of the department store's business axioms. The experience of general retail stores, that, other things being equal, sales are proportional with the number who see the goods, is proving true also in the electrical shop.

Employees Prefer Insurance to Turkeys for Christmas

AT THE request of territorial councils, consisting of company and employee representatives, the Public Service Company of Northern Illinois has agreed to insure its employees at a cost of about $24,000 per annum instead of following the customary practice of giving each employee a turkey for Christmas at a total cost of about $10,000. When the insurance goes into effect every employee who has been with the company three months will receive a policy, and those who have not been with the company for that length of time will receive a policy at the end of three months' service. Future new employees after six months' service will be entitled to the insurance, which starts with a policy of $500 and increases with the length of service to $1,500 for those who have been with the company for more than six years. The insurance will cost the company about $21,000 the first year for a total of 1,750 employees. However, to the cost of the premiums must be added about $3,000 for the necessary office work and details in connection with carrying out the scheme.

The average age of the employees is now thirty-three years, but as business conditions become stabilized it is expected that the labor turnover will decrease, so that the average age will increase. This may raise the annual cost to around $30,000 within a few years. When put to a vote of the employees 73.8 per cent expressed a preference for the insurance. If an employee leaves the company, he has the privilege of converting his company policy into a regular insurance policy without medical examination.

Utility and Newspaper Production Costs Compared

AN INTERESTING comparison of the increases in production costs of newspapers and gas and electric companies was prepared recently by the Illinois Committee on Public Utility Information. The percentages of increases from Aug. 1, 1914, to Jan. 1, 1920, and additional increases from Jan. 1 to Sept. 1, 1920, are shown to be as follows:

NEWSPAPER PRODUCTION COSTS

	Per Cent Increase Jan. 1, 1920, Over Aug. 1, 1914	Additional per Cent Increase Sept. 1, 1920, Over Jan. 1, 1920
Print paper	212 50	48 75
Ink	200 00	16 55
Metal	108 00	*4 00
Machinery, equipment	104 00	20 00
Twine	225 00	*3 55
Labor	91 75	10 87

GAS AND ELECTRIC COMPANY PRODUCTION COSTS

	Per Cent Increase Jan. 1, 1920, Over Aug. 1, 1914	Additional per Cent Increase Sept. 1, 1920, Over Jan. 1, 1920
Bituminous coal	126 06	37 5
Anthracite coal	152.77	3.19
Coke	103 53	101.23
Gas oil	200 00	83.33
Oxide	110 53	15 00
Firebrick	140 00	27 78
Pipe	149.82	19 63
Labor	79 88	21 35

(Fuel and labor constitute more than two-thirds of the operating costs of these companies.)

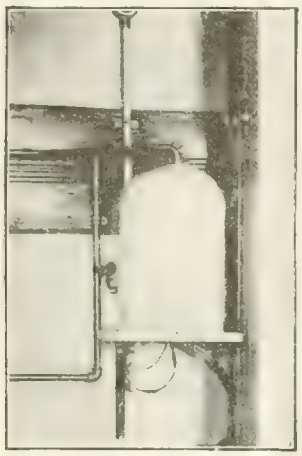
(Paper and labor are the largest [illegible] of newspapers.)

*Declines.

It is pointed out that newspapers have increased their subscription rates from 100 to 200 per cent and their advertising rates from 50 to 150 per cent. This was done without any state regulation or jurisdiction over their rates, while the utilities, whose costs of production had increased in equally large proportion, were unable to obtain relief except by recourse to the state regulatory body, which frequently entailed delays and postponements when emergency action was needed.

Economical Electric Water Heating for Barber Shops

QUICK and satisfactory service is afforded barber shops in Concord, Mass., by electric water-heating installations, of which that illustrated is representative. Every barber in Concord and Concord Junction is using electricity for this work. In one shop the tank photographed was installed complete with wiring for $48. The heating element is a General Electric cartridge unit rated at 1,000 watts, 220 volts, and the tank is 18 in. high and 10 in. in diameter, jacket-insulated and mounted on a low shelf in an unused corner. For convenience an ordinary three-heat switch was installed with the terminals changed so that the neutral wire can be used in getting 110-volt service for a low heat of 250 watts. The average energy consumption is about 150 kw.-hr. a month, the heating rate being as follows: First 50 kw.-hr. per month, 3 cents each; net 50 kw.-hr., 2½ cents each, and all over 100 kw.-hr., 2 cents each, making a bill of $3.75 per month.



ELECTRICALLY HEATED WATER TANK

Saving Effected by Leaving Disconnected Meters on Premises

THE meter department of the Iowa Railway & Light Company of Cedar Rapids, Iowa, has worked out for its convenience a system whereby the necessity for immediately removing meters on order for disconnection is obviated. It is believed that the system not only eliminates considerable work, but lengthens the life and reduces maintenance cost of meters and of meter loop.

When an order for disconnection of service is received the slip is marked with a rubber stamp on which four lines read, "Installed," "Removed," "Connected" and "Disconnected." Beside the line marked "Disconnected" a check is placed, completing instructions to metermen.

When the disconnection is made both the line wire and the shunt wire are placed together in the line binding post. The meter is then sealed, and in sealing a tag is fastened to the meter which reads: "This meter has been disconnected by the Iowa Railway & Light Company and must not be tampered with. If connection is desired, call the Iowa Railway & Light Company."

In the office of the meter department, when a disconnection order comes back with the notation "Disconnected," the meter record card (containing the meter number, address where located and space for removal date) is taken from the live-meter file, marked "Disconnected," together with the disconnection date, and placed in a convenient file. When an order for service comes in reference to this file shows at once whether it is necessary to take a meter to the address in order to make connection, for in all cases where a meter is merely disconnected a card will be found in the file.

If a new order for connection comes in from the address given on the card the card is taken from the "Disconnected" file and restored to the live-meter file. If after thirty days no connection order has come in the meter is taken out, and the card is marked "Removed" and placed in the closed-account file, indicating that the meter is again in the storeroom of the company.

Public Misinformed About Regulation, Says Missouri Commissioner

LACK of intelligent information and much misinformation characterize the present status of utility regulation, declared Noah W. Simpson of the Missouri Public Service Commission in an address before the annual convention of the Missouri Telephone Association. Commission regulation has developed with such rapidity that, while it is firmly established, it is by no means fully understood or appreciated by the general public.

The passing of municipal control of the utility to state jurisdiction has not been accomplished without opposition, Mr. Simpson pointed out. "You hear much nowadays," he said, "about the slogan 'Home rule' for local control of the utilities, but be not deceived, for you are only being presented with the old pill, sugar-coated, to the end that the state shall lose its jurisdictional control and the city politicians re-establish the old régime."

Alluding to the difficulties which have beset the commissions, he called attention to the fact that state regulation had to pass through the crucial period incident to the great war before it was firmly established and better understood by the public. "It is common knowledge that the component elements which go to make up the finished product of all utilities have enormously increased in value, yet there are those who would have these corporations furnish service at pre-war prices," Mr. Simpson continued. "The plain fact is that unless the regulatory bodies had provided increased operating revenues for these utilities they would soon have been bankrupt and the public without service."

Electricity Cutting High Cost of Living

Bread Price Drops

TODAY

the price of our 24-ounce loaf of bread

REDUCED TO 12 CTS.

This is the lowest retail price that has been named to housewives in any city in the country and is made possible by the decline in the flour market.

A WORD ABOUT OUR BAKERY

Until recently we were baking bread by the use of gas, but heeding the warning by the East Ohio Gas Co. of an impending shortage of natural gas, we entered into contract with The Westinghouse Electric & Mfg. Co. for the installation of an electric heating equipment. The results have exceeded our expectations, as the bread is uniformly and thoroughly baked, due to the absolute control of the heat.

Our bakery is the only large plant in the United States entirely operated by electricity and is the last word in efficiency.

You can eat the bread and feed it to your children with absolute confidence that it is produced under the most exacting sanitary conditions.

The Fisher Bros. Co.

AN INTERESTING announcement a few days ago by a prominent bakery in Cleveland, Ohio, shows how efficiency due to electricity is helping to bring down the price of bread.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Design of Flywheels for Reciprocating Machinery Connected to Synchronous Generators or Motors.—R. E. DOHERTY and R. F. FRANKLIN.—The authors assert that this problem has long been a matter of cut and try and has not been fully worked out theoretically. The purpose of this paper is to provide means for the calculation, with practical accuracy and expedition, of flywheels for reciprocating machinery connected to synchronous generators or motors.—Paper presented before the A. S. M. E. convention, Dec. 7, 1920.

Lamps and Lighting

Report of I. E. S. Committee on Progress.—The committee deals with all phases of lighting and illumination, covering some developments from foreign countries during the last year.—Report made at the I. E. S. convention, Oct. 18, 1920.

The Cooper Hewitt Quartz Lamp and Ultra-Violet Light.—L. J. BUTTOLPH.—It is said that the Cooper Hewitt quartz burner operates at a much higher temperature and hence at greater intrinsic brilliancy than the ordinary mercury-vapor lamp, and it is peculiarly rich in violet and ultra-violet radiation. These ultra-violet rays are screened out by ordinary crown glass, but are transmitted freely by quartz. The quartz lamp is of value in research work, and commercially is of great importance in photographic and photochemical processes and in the treatment of parasitic and tuber cular skin affections. Its therapeutic effects are similar to those of X-rays, but are less severe.—*General Electric Review,* November, 1920.

Generation, Transmission and Distribution

Notes on Electrical Calculations of Long-Distance High-Voltage Transmission Lines.—A. MCKINSTRY.—An extensive comparison of the various accurate methods for calculating voltage regulation and other characteristics of long-distance lines, including an extensive set of tables for determining the constants of the lines.—*Journal of Institution of Electrical Engineers,* London, October, 1920.

The Hydro-Electric Plant at Eget, France.—EYDOUX and LEBOUCHER.—The 35,000-hp. plant at Eget, in the Pyrenees, is remarkable because of its elaborate hydraulic construction. The extremely uneven run-off of the many little streams draining from the Lannemezan plateau makes a rational utilization of the water power very difficult. However, by building some large dams several natural lakes have been turned into an equal number of reservoirs, among them three of about 7,000,000 cu.m. (250,000,000 cu.ft.) capacity each, and a continuous all-year supply of 11 cu.m. to 13 cu.m. per second (390 to 460 sec.-ft.) has thus been safeguarded. Two of the reservoirs are interconnected by a channel of 3,100 m. (10,000 ft.) length and with a capacity of 3 cu.m. per second (105 sec.-ft.). This channel is entirely subterranean except where it crosses a chasm on a 39-m. (128-ft.) aqueduct. The water then is conducted to a small subterranean reservoir just above the generating plant, through another underground conduit, capable of carrying the whole water supply, and blasted 5,600 m. (17,700 ft.) through solid rock. The turbines are fed through seven closed-tube conduits. Seven 500-r.p.m. Pelton turbines of 5,000 hp. each are installed and work at a net head of 740 m. (243 ft.). Owing to the great head extreme care has to be taken to avoid dangerous water hammer in the tubes, and the turbines therefore are provided with a special type of highly damped governors. In each unit the generator is directly coupled to its turbine, and between them there is a 3,500-kg. (7,700-lb.) flywheel to smooth out the motion and keep sudden load variations away from the hydraulic system. The generators deliver 3,500 kw. each, at 50 cycles, 6,000 volts, and a power factor of 0.8. To facilitate repair work the stator is arranged so that it can be slid sideways till the rotor becomes entirely free for inspection. The generators are connected to two groups of 4,375-kva., single-phase transformers, with a ratio of 6,000/69,284 volts. The transformer windings are temporarily connected in delta on the high-tension side, but eventually will be changed to star connection, giving a transmission voltage of 120,000 volts. Relay-operated circuit breakers of a breaking capacity of 70,000 kva. are installed on the 6,000-volt side, and 120,000 volt electrolytic aluminum-cell protectors are part of the equipment. The plant and its construction are described in great detail in a most comprehensive and well illustrated article.—*Révue Générale de l'Electricité,* July 3, 10, 17 and 24, 1920.

Piling Storage Coal to Prevent Fire.—W. D. LANGTRY.—More care should be exercised in the storage of coal with respect to origin and size, the choosing of a suitable storage place, avoidance of breakage in unloading, segregation of different sizes, outside sources of heat and the mixing of combustible matter with the coal. The author advises against pyramiding the coal, but says it should be piled in layers as shallow as the available space will permit.—*Power,* Nov. 23, 1920.

Traction

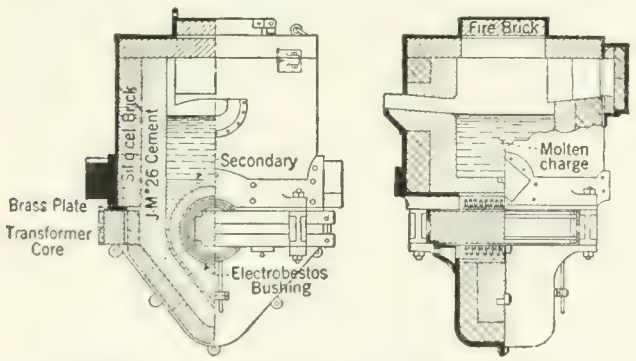
Electric Locomotives for the Austrian Railroads.—Two types of electric locomotives have recently been ordered by the Austrian government to be used on certain state railroads now being electrified. The power supply is 15,000-volt, single-phase alternating current of $16\frac{2}{3}$ cycles. The first type is a 1C + C1 locomotive for pulling heavy express trains over steep grades. It is provided with two single-phase double motors geared in a ratio of one to three to a counter-shaft which actuates the drive wheels by cranks and connecting rods. The motors are rated continuously at 370 kw. with a one-hour rating of 460 kw. at 575 volts. They are supplied from a 2,000-kva., 15,000/1,240-volt trans-

former with a number of taps in the secondary for speed control. This type of locomotive weighs about 116 tons. The other type is also intended for express service in mountain districts, but has a weight of only 69 tons and is of the 1C1 type. The latter type has the same kind of drive, but a gear ratio of 1: 4.24. Each locomotive is provided with two motors of 290 kw. continuous and 410 kw. one-hour rating, with interpoles shunted by resistances.—*Elektrische Kraftbetriebe und Bahnen,* Oct. 24, 1920 (also *Elektrotechnik und Maschinenbau,* May 2 and Oct. 31, 1920).

The Magdeburg-Leipsic-Halle Electrification.—HEYDEN.—This road is supplied from a steam plant which is described in the article. The plant is equipped with six single-phase turbo-generator units delivering 3,300 kw. each at 3,300 volts. The armature slots in the generators are closed by massive copper bars. These bars are interconnected at either end of the machine by heavy bronze disks so as to form a big squirrel-cage winding which very effectively damps out pulsations of the magnetic fields. This damper winding prevents dangerous voltages from being induced in the rotor winding by short-circuits and sudden load variations. The power is transmitted to the secondary stations at 60,000 volts, and the author also describes a set of sturdy 1,875-kva. transformers used for stepping up the voltage.—*Elektrische Kraftbetriebe und Bahnen,* June 14 and Aug. 14, 1920.

Installations, Systems and Appliances

The Electric Melting Furnace.—A symposium in which the early history of the electric furnace is discussed by Prof. Joseph W. Richards, and the development of the Greaves-Etchells furnace by F. W. Brooks, the Moore "Rapid Lectromelt" furnace by R. D. Thomas, the Weeks electric furnace by F. H. Auerbacher and the Ajax-Wyatt electric furnace by G. H. Clamer. Recent



SECTIONS OF AN INDUCTION TYPE BRASS FURNACE

developments and chief characteristic of each of these makes of electric furnace are treated. Sections showing the circuit arrangement and heat insulation used in an Ajax-Wyatt furnace are reproduced.—*Journal A. I. E. E.,* December, 1920.

Electrostatic Condensers.—V. E. GOODWIN.—The writer discusses the subject in broad manner, dealing with the fundamental characteristics of condensers and their relations to electric circuits containing inductance and resistance. He also includes a discussion of the effects of switching condensers on and off such circuits. He then describes some of the more important applications of condensers and illustrates the great demand there is in the electrical industry for this class of apparatus.—*Journal A. I. E. E.,* November, 1920.

Electrophysics and Magnetism

Ionization and Resonance Potentials of Some Non-Metallic Elements.—F. L. MOHLER and PAUL D. FOOTE.—The resonance and ionization potentials of phosphorus, iodine, sulphur, nitrogen, oxygen and hydrogen have been measured in four-electrode vacuum tubes by methods similar to those used previously by the authors. The results with hydrogen agree with the theoretical predictions of Bohr.—*Scientific Paper No. 400,* Oct. 14, 1920.

Sparking Voltages Between Spherical Electrodes.—ALEXANDER RUSSELL.—A theoretical study of the matter with experimental results which confirm the author's calculations. It is asserted that some commonly accepted values for sphere gaps are in error.—*Journal of Institute of Electrical Engineers,* London, October, 1920.

Electrochemistry and Batteries

Electric Versus Combustion Furnaces for Low Temperatures.—Electric furnaces have the advantages over other furnaces of temperature control, a reliable and permanent source of heat and lower maintenance cost. The greater cost of energy, on the other hand, is counterbalanced by economy in space, auxiliary equipment and operation, while the quality of the product is greatly enhanced.—*Chemical and Metallurgical Engineering,* Nov. 24, 1920.

Units, Measurements and Instruments

Multohm Resistance Units.—LILIENFELD and HOFMANN.—This is a new type of resistance unit for very high-resistance values, namely, from 0.1 megohm to about 10 megohms. The unit consists of a glass tube, closed at both ends and provided on the inside with a thin layer of carbon, usually running in a spiral from one end of the tube to the other. These resistances are said to be remarkably constant from one day to another, but they have a rather high temperature coefficient—0.0016 per degree Centigrade. The tubes have a diameter of 10.5 mm. (0.41 in.) and come in two sizes, 20 cm. and 54 cm. long (8 in. and 21 in.). These units stand respectively about 40 and 115 watts continuously in air and about three times as much in oil. Another type of resistance unit with a small temperature coefficient has also been devised, where the conducting layer is made of a mixture of metal oxides instead of carbon.—*Elektrotechnische Zeitschrift,* Nov. 4, 1920.

Telegraphy, Telephony and Signals

High-Tension Direct-Current Machinery for Radio Spark Stations.—ROGOWSKI.—A detailed analysis of the operating conditions of a high-tension direct-current generator when used to energize an antenna by means of a rotating spark gap. The machine is subjected to severe strains due to overvoltages caused by resonance phenomena, electric surges in the winding, etc. On the basis of analytical considerations the author explains certain severe breakdowns in a German radio station which occurred in a 5,000-volt double-commutator machine.—*Archiv für Elektrotechnik,* Sept. 20, 1920.

Status of Static Frequency Doubler in Radio Engineering Practice.—FREDERICK C. RYAN.—The system of sustaining wave generation based on the use of a radio or high-audio-frequency alternator and frequency multipliers is considered. Expressions for the secondary voltages of the unloaded ferromagnetic doubler of the polarized-core type are derived and explained.—*Proceedings Institute of Radio Engineers,* December, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Pupin This Year's Edison Medalist

ANNOUNCEMENT is made this week by the American Institute of Electrical Engineers of the 1920 award of the Edison medal to Dr. M. I. Pupin "for work in mathematical physics and its application to the electrical transmission of intelligence." The medal will be presented to Dr. Pupin Friday evening, Feb. 18, at a session of the midwinter convention of the Institute in New York.

Dr. Pupin is probably best known for the invention of the loading coil for telephone transmission. Of late years he has been devoting considerable attention to the study of wireless phenomena, and he has already made a number of contributions to the science of radio.

Utility Not Justified in Asking Customer to Finance Service Connections

THAT an electric light and power company "is not justified in demanding that a prospective consumer supply capital for the labor and material required to make a service connection" was held by the Public Service Commission of Pennsylvania last week in sustaining the complaint of Elias Lovell of Ashland against the Eastern Pennsylvania Light, Heat & Power Company's rule requiring a deposit of $25 before installing service.

The commission says it is "clearly a demand on the part of the company requiring the prospective consumer to finance a service connection." The service line of an electric company to the point of connection just outside the building of the consumer should be the property of and installed by the company at its expense, the decision says.

Milwaukee Power Restrictions Removed on Opening of New Plant

RESTRICTIONS on the use of power were removed in Milwaukee on Thursday, Dec. 23, when the new pulverized-coal-fired Lakeside power plant was formally placed in service. One 20,000-kva. generating unit is in operation, and the second unit is expected to be ready during the coming March. The first section of the plant now being completed consists of two turbo-generators supplied with steam from eight 1,306-hp. boilers operating at 300-lb. pressure with 200 deg. superheat. The superheaters are being placed immediately above the boiler tubes, and the economizers are mounted to one side against the boiler-room walls. The coal pulverizing and drying section contains eight pulverizers with a capacity of 6 tons per hour each. Provision has been made for storing 100,000 tons of coal in piles on the ground, 2,000 tons in cars and 3,500 tons in bunkers. Condenser water is taken from a circulating-water pond constructed at the lake through a 10-ft. tunnel designed to provide circulating water for an ultimate capacity of 200,000 kw. Ground was broken for the plant on Feb. 18, 1920, and the first unit therefore goes into service in a little more than ten months from the beginning of construction.

String of Hydro-Electric Plants Planned for Indiana on Tippecanoe

NEW YORK and Chicago financiers and several citizens of Indiana are planning to begin work in the spring on a number of dams and power units along the Tippecanoe River to develop electricity for several of the larger towns in northern Indiana. The plans, it is reported, call for the incorporation of the Tippecanoe Power Company with a capital stock of $3,000,000, which will be closely held. Contracts, it is claimed, already have been made for the entire output of energy. Among the others interested in the project are John A. Shafer of Indianapolis, an engineer, who has surveyed the project and prepared preliminary plans; Samuel Thompson, Mayor of Monticello, and Curtis J. Meeker of Monticello.

This first unit is expected to develop 20,000 hp. It is planned ultimately to build six other units of the same size on the Tippecanoe River. The corporation plans to build other dams near the mouth of the river, near Springboro, at Oakdale, Tioga, Norway, Buffalo, Pulaski and near Winamac. It also plans to direct much of the surplus water of the Kankakee through the Yellow River to the Tippecanoe River.

Application to Develop 2,500,000 Hp. on Colorado River

APPLICATION has been made to the Federal Power Commission by the Southern California Edison Company to develop 2,500,000 hp. on the lower Colorado River. The preliminary plans contemplate projects above Boulder Canyon at Marble Canyon and Diamond Creek.

The total possible development on the Colorado River is estimated at 4,000,000 hp., including sites along the Grand Canyon. The river has an annual run-off of 16,000,000 acre-ft. and drains an area of 250,000 square miles, a large part of which is in the higher reaches of the Rocky Mountains. Because of the inaccessibility of some of the power sites it has been proposed to construct first the one farthest downstream, which is that most easily available, and upon its completion to float the material for the next station above on the reservoir created by the lower dam.

The stations will probably be built for operation with heads not exceeding 500 ft. and will be without canal lines. Reference to this development and the utilization of the energy from it was made in the ELECTRICAL WORLD for Oct. 4, 1919, page 743.

Water-Power Applications Now in Excess of 10,000,000 Hp.

APPLICATIONS for preliminary permits or licenses under the water-power act now cover more than 10,000,000 hp. The horsepower which can be developed by the Southern California Edison Company's Colorado River project is estimated roughly at 3,500,000 hp. If that figure could be carried into the total the aggregate of horsepower covered by all applications would be in excess of 12,000,000. Even if the estimate on that project were scaled down 2,000,000 hp. the total still would be in excess of 10,000,000 hp.

The proposed development on the Colorado River is regarded as doubly important because of the fact that it is contemplated to store the entire flood-water flow of that river, thus giving relief to the Imperial Valley.

New Jersey Court Sustains Ousting of Utilities Commission

THE action of Governor Edwards of New Jersey in dismissing the four members of the Board of Public Utility Commissioners, charging them with neglect of duty, misconduct in office and favoritism to the corporate interests of the state, has been sustained by the Supreme Court of New Jersey. It is probable that the four commissioners will take an appeal to the Court of Errors and Appeals as the action of the Supreme Court sustained only the right of the Governor to remove the commissioners for cause and did not sustain the charges against the members of the board.

Governor Edwards has issued a call for a special session of the Senate this week to confirm members of a new board. When he dismissed the commissioners in October the New Jersey Senate refused to confirm his appointments on the ground that there was grave legal doubt as to his power to oust the board. In political circles in New Jersey it is rumored that the Senate will again refuse to confirm the new appointments pending an appeal by the four commissioners.

Steam Coal Prices in Heavy Decline

THE coal market is "saturated," declared an official of one of the large Middle Western coal sales companies last week. The poorer grades of steam coal have dropped from $2 to 83 cents a ton in the Central West, while the better grades that have sold at from $7 to $8 are now going begging at from $3.50 to $4. In some cases coal that sold at from $8 to $10 a few months ago is now going at $3 per ton.

"There is a greater supply than demand," said George W. Reed, vice-president of the Peabody Coal Company, in a public statement last week. "Industries have shut down all over the country. They have no further use for fuel. Conditions are beginning to readjust themselves. I would say that the drop in the price of coal is simply an indication of business getting down to normal competitive prices."

The high reconsigning and demurrage charges are having an effect in preventing the shipping of coal except to supply direct orders. Several operators at a meeting of the Illinois Coal Operators' Association in Chicago last week declared that coal is being piled up at the mines, where full production is in progress without purchasers. The indications in the entire Middle Western territory are that the wild speculation is past.

California Co-operative Campaign Emphasizes One Thing Each Month

A PROGRAM for field representatives of the California Co-operative Campaign has been outlined for 1921 in which special emphasis will be given each month to one subject. During 1921 the field men will continue the same lines of work but will give special attention to a single, particular phase of this work during each month of the year. This special effort will be to present the subject chosen for each month to meetings of the electrical industry in all localities throughout the state. Each subject will be presented in an address by a representative of the campaign, followed by discussion and such action as local conditions justify.

The following tentative program of subjects for the first six months of 1921 has been arranged: January, industrial and commercial lighting; February, convenient outlets; March, contractor-dealer accounting; April, financing hydro-electric development through self-interest; May, salesmanship and service to the public; June, responsibility to the industry.

December Financing Brings Year's Reported Total Up to $316,373,000

THE December financing of public utilities, so far as electric light and power companies are concerned, added $34,384,000 to the year's total, making $316,373,000 reported. There are two ten-million-dollar issues, both of which are to run for twenty years. One of these, offered by the Pacific Gas & Electric Company of San Francisco, yields 7.10 per cent; the other being 8 per cent interest and was sold by the Kansas City Power & Light Company at par. The Middle West Utilities Company offered $2,134,000 in twenty-year secured gold notes at 95.25, to yield 8.5 per cent—the highest yield that a security having as long as twenty years to run has carried. The accompanying table has an additional column this month giving, whenever the information was available, the "purpose of the issue."

Name of Company	Amount of Issue	Period	Class of Security	Purpose of the Issue	Rate of Interest	Per Cent Yield	Offered at
Metropolitan Edison Co.	$1,000,000	15 year	Refunding and improvement mortgage gold bonds	Refunding and new construction	8	8 5	95 82
Brooklyn Edison Co., Inc.	5,000,000	20-year	General mortgage gold bonds	New construction	7	7 25	97½
Pacific Gas & Electric Co.	10,000,000	20-year	First and refunding mortgage gold bonds	Refunding and new construction	7	7 10	99
Consolidated Gas, Electric Light & Power Co. of Baltimore	5,000,000	25 year	First and refunding mortgage sinking fund gold bonds	Refunding and new construction	7 5	7 75	97 25
Kansas City Power & Light Co.	10,000,000	20 year	First and refunding gold bonds		8	8	100
Consolidated Utilities Co.	250,000	5 year	Collateral trust note	New construction	8		
Puget Sound Power & Light Co.	1,000,000	5 year	Gold coupon notes	New construction	8	8	Par
Middle West Utilities Co.	2,134,000	20-year	Secured gold notes		8	8 5	95 25
Total	$34,384,000						

Niagara Power Applications to Be Heard January 24

THE various applications for water-power rights on the Niagara River will be the subject of a hearing before the Federal Power Commission on Jan. 24. This date was set by the commission at its regular meeting Dec. 27. The hearing will be conducted in the building of the Interior Department in Washington.

Higher Rates Wait on Improved Service

AN APPLICATION of the Wisconsin Traction, Light, Heat & Power Company for increased rates at Neenah, Wis., was denied recently by the Wisconsin Railroad Commission. No further consideration will be given to demands for increased rates, the commission told the company, until "it shall have been shown to the satisfaction of the commission that substantial progress is being made in the rendering of service and good faith shown. This decision is in line with one by the Illinois commission reported in the ELECTRICAL WORLD for Dec. 18 (page 1228).

Basic Rates for Government Electrical Workers

IN THE revised reclassification bill which a Congressional committee has now under preparation it is understood that the following basic rates have been agreed upon for electrical workers in the government service: Electrician, $1 an hour; foreman electrician, $2,340 per annum; dynamo tender, $1,380 to $1,500; electric substation operator, $1,680; assistant electric substation operator, $1,200 to $1,300; electric switchboard operator, $1,680.

Great Falls Development Reported Favorably

A FAVORABLE report as to the feasibility of utilizing Great Falls, on the Potomac, near Washington, D. C., for power purposes, was submitted to Congress Dec. 27. Gen. Lansing H. Beach, the chief of engineers, in his letter of transmittal, said:

"Major Max Tyler has reached the conclusion that a power development of from 45,000 kw. to 50,000 kw. is possible and that its costs will be such as to permit the delivery of intermittent power at a total cost, including all proper overhead and transmission charges, of about 5 mills per horsepower at substations in the city of Washington at a voltage of 6,600. This estimate includes the cost of the high-tension transmission line and of three local substations. Storage possibilities were found not to be very favorable unless an ultimate development of a total head of about 200 ft. is decided upon as desirable, thereby permitting the storage to be used twice, once in each stage of the development."

Owing to the illness of Major Tyler it was impossible to submit the entire report, but it is understood that the plan which will be recommended favors the continued operation of the large steam plant which is the present source of power for the District of Columbia and its vicinity.

On hearing that the engineers again have reported favorably on the development of water power at Great Falls, Senator Norris of Nebraska announced that he would press for consideration a bill providing for the early development of this water power. He favors government ownership of the plant which it will be necessary to erect. This is advisable, he believes, since the government is one of the large district's consumers of electric power in the District of Columbia.

President Edgar Receives Birthday Surprise



CHARLES L. EDGAR

CHARLES L. EDGAR, president of the Edison Electric Illuminating Company of Boston, was surprised by the 2,300 employees of the company last week, on the occasion of his sixtieth birthday anniversary, when a committee of fourteen, headed by I. E. Moultrop, presented him with a gold wrist watch suitably engraved, a set of sapphire and gold cuff links and an illuminated parchment expressing the great esteem in which he is held by those in the service of the organization. The women employees of the company gave the cuff links, and all shared in the other gifts. The parchment expressed the employees' gratitude that so many years of Mr. Edgar's life have been devoted to the development of the company and the wish that there may be many more of pleasant relations and even greater successes.

Referendum on Home Rule for Chicago

HOME rule for Chicago carried as far as Chicago itself will accept on a popular referendum vote is the latest version of the Illinois utilities commission situation. It is expected that Governor-elect Small will insist in his inaugural upon legislative action that will let Chicago at least establish a local transportation district. Mr. Small's campaign included among its chief policies the abolition of the present utilities commission and a return to home rule for the entire state. It has been expected in many quarters that the issue would simmer down to either home rule for Chicago or a separate commission to handle Chicago utility problems.

Standby Fuel Clause Established by Montpelier Company

THE Montpelier & Barre (Vt.) Light & Power Company, a Tenney property, has filed a fuel clause with the Vermont Public Service Commission providing that whenever during any month or part thereof in which power service is furnished by the company under its Schedule E it shall be necessary for the company to operate its steam generating stations to supply this power service, in whole or in part, then, in addition to the prices named in the schedule, there will be made and become payable a charge per kilowatt-hour obtained by dividing the cost of fuel at the generating station by the kilowatt-hours sold for power purposes. All additional charges to the customer due to the foregoing terms are to be made at the time the regular monthly bill is rendered and to be included as a part of the regular bill. Such charges are based upon the cost of fuel and the kilowatt-hours sold for power purposes during the calendar month immediately preceding the date of the bill.

Group Buying of Coal Suggested for German Utilities

IN OPPOSITION to the proposal for nationalization of the coal mines of Germany comes a counter-proposal from the German "coal king" Stinnes for co-operative combinations of large consumers of coal, such as electric light and power companies, gas plants, manufacturing plants and others, and for a corresponding number of coal mines sufficient for their supply. Each of these groups, it is proposed, shall have a board to regulate prices and distribution, and in these boards the consumers shall have the majority. It is further suggested that such consumer groups should gradually buy up the control of the coal mines.

University Extension Course for Metermen

A SHORT intensive course for electric metermen has been announced by the College of Engineering and the extension division of the University of Wisconsin, Madison, Wis., in co-operation with the Railroad Commission of Wisconsin and the Wisconsin Electrical Association. This course will be held at the engineering college laboratory from Jan. 31 to Feb. 4, 1921. The work will be adapted to the needs of the men and will be conducted by lectures and a graded series of tests or tasks. A fee of $10 will be charged each student to pay for power, supplies, and other incidental expenses.

Mexico to Develop a 100,000 Hp. Hydro-Electric Project

THE Government of the State of San Luis Potosi, Mexico, has just awarded to E. E. Thomas of Tampico a contract for the construction of a dam and water storage reservoir in the Rio Verde Valley to develop 100,000 hp. for hydro-electric and irrigation purposes. It is said that the dam will cost approximately $2,000,000 American money. Engineers are now making a survey. According to Mr. Thomas, actual construction work will start about Jan. 1, and it is expected that the work will be completed within two years.

The contract is the first of its kind to be given out since the beginning of the revolution ten years ago and the second that the State of San Luis Potosi has awarded in its history. All of the work will be under the supervision of American engineers.

San Francisco Electrical Development League Sells Utility Stock

THE Electrical Development League of San Francisco has recently organized a committee which is canvassing all the members of the electrical industry in the central portion of California to solicit subscriptions to the securities of the local power companies. The results of the first two weeks' work show 146 subscribers and total sales of 363 shares of stock. Stocks of the Pacific Gas & Electric Company, the Great Western Power Company and the San Joaquin Light & Power Company are sold.

Although the total amount of capital obtained in this way may not be great, the backing of the entire industry as well as of the general public is considered vital to the success of the tremendous programs of power development now under way and contemplated in California. In organizing its work the committee, headed by W. S. Berry, Western Electric Company, took into consideration the principles outlined by W. H. Hodge in his article on "Customer Ownership of Securities" in the ELECTRICAL WORLD for Nov. 20, 1920, page 1018. Plans are being made to undertake a similar stock-selling campaign in southern California.

New York State Water-Power Legislation Coming Up

ONE of the more important functions that the incoming New York State Legislature of 1921 will be called upon to perform is the repassage of the Ferris amendment to the constitution. This amendment has to do with the development by the state and by corporations of the water powers within the state and with their regulation when developed. The amendment to the constitution was passed by the Legislature of 1920, but in order to be voted on by the people at the next general election it must be repassed by the Legislature of 1921. The Ferris amendment is designed to provide an ultimate system of development of all of the state's water powers, to insure the encouragement by the state of their development, to promote the more general use of electricity in commerce and transportation as well as in heating and lighting, and to reduce the cost of production of electrical energy to a minimum.

Electrical Safety to Be Keynote of Western Inspectors' Meeting

CENTRAL-STATION men, manufacturers and other non-members of the Western Association of Electrical Inspectors have been invited to contribute to the sixteenth annual convention of the association, which will be held at the Hotel Statler, Detroit, on Jan. 25, 26, 27 and 28. The principal subjects to be brought up for discussion are the safe use of primary service on customers' premises, the grounding of electric circuits and apparatus, safeguarding electric fixtures, and ways and means of improving old and defective wiring installations. The tentative program prepared by Secretary W. S. Boyd, Chicago, is as follows:

TUESDAY, JAN. 25

Morning Session. — Reports of officers and committees; illustrated address, "The Electric Furnace," by Edwin L. Crosby, Detroit Electric Furnace Company; "The Location, Construction and Equipment of Transformer Vaults," by Hubert J. Clark, engineer Oklahoma Inspection Bureau (discussion to be led by Lee Granger, assistant superintendent overhead lines Detroit Edison Company); "The Underwriters' Laboratories," by George B. Muldaur, general agent Underwriters' Laboratories, Chicago; "Regulating Motion-Picture Theaters," by Washington Devereux, chief electrical inspector Philadelphia Fire Underwriters' Association.

Afternoon Session.—General subject, "Grounding of Electric Circuits and Apparatus": (a) "The History of the Grounding of Secondaries," by F. A. Barron, General Electric Company; (b) "The Central Station's Responsibility" (speaker to be announced later); (c) "The Electrical Contractor's Responsibility," by Emil Anderson, Standard Electric Company, Minneapolis; (d) "Municipal Co-operation," by Gerald J. Wagner, director of public service, Grand Rapids, Mich.; (e) "Grounding Rules" (speaker to be announced later). General subject, "Safeguarding Electric Fixtures": (a) "Manufacturing and Shipping Problems," by C. H. Hofrichter, secretary National Council of Lighting Fixture Manufacturers; (b) "Factory Inspection Problems," by Dana Pierce, vice-president Underwriters' Laboratories, New York; (c) "Installation Problems," by J. L. Wolf, secretary Lighting Fixture Dealers' Association of America, Detroit; (d) "Inspection Problems," by Victor

H. Tousley, chief electrical inspector, Chicago. "Inductive Interference with Signal Circuits," by W. J. Canada, director of engineering, N. E. L. A.

WEDNESDAY, JAN. 26

Morning Session.—"Effect of Electrical Inspection and Municipal Fire-Alarm Systems on Fire Insurance Rates," by F. A. Raymond, National Board of Fire Underwriters, New York; general subject, "Improving Old and Defective Wiring Installations": (a) "The Municipal Inspector's Method," by Ben W. Clark, chief electrical inspector, Detroit; (b) "The Underwriters' Inspector's Method," by F. G. Waldenfels, chief electrical inspector Chicago Board of Underwriters; (c) "Central-Station Co-operation," by L. D. Smith, general superintendent Minneapolis General Electric Company.

Afternoon Session.—"Electric Welding of Traction Rails," by H. M. Gould, electrical engineer Street Railway Commission, Detroit; discussion of inspectors' problems previously submitted to the secretary in writing.

New business reports of special committees, report of the nominating committee and the election of officers take place on Thursday, Jan. 27, and Friday, Jan. 28, is to be given over to inspection trips in and around Detroit.

Kansas City Plans Educational Electrical Show

AN ELECTRIC show that will be educational rather than spectacular is the aim of the executive committee of the Electrical Trades Exposition Company, which will conduct Kansas City's show next March. Exhibitors are to be required either to illustrate the development of the use of electric power or to educate those interested as to the reasons for results obtained from the processes on exhibition. A model electrical home is being arranged for, and the domestic science department of the public schools will conduct electric cooking demonstrations. A lighting plan that will demonstrate what can be accomplished by properly worked-out illumination schemes is also planned.

Government Engineers' Salary Bill Provisions

THE bill providing for the classification of salaries for civilian positions in the government service fixes the rate of pay at from $1,800 to $2,160 for all junior engineers, who are "to perform under immediate supervision the simplest kinds of work in engineering requiring professional training." The salary rates of the next group are from $2,340 to $2,880. Assistant engineers coming in that group are "to perform under general direction assigned work in engineering requiring professional training and previous experience, but not the exercise of independent judgment."

The range of annual compensation in the next engineer group is from $3,120 to $3,840. Engineers falling in that group are "to perform independently or with a small number of subordinates responsible professional work in engineering requiring extended training and considerable previous experience."

In the next grade the range of compensation is from $4,140 to $5,040. Those falling in that group are known as senior engineers, who are "to perform independent and highly expert work in engineering or to be responsible for the administration of a minor division of a large or a major division of a small engineering organization."

The salary in the next group is $5,400 and up. Those falling in that group are known as principal engineers, who are "to act as head of the major division of a large engineering organization, or as assistant head of a large engineering organization, or as head of a small engineering organization, or to serve as consulting specialist on the most important engineering plans, or to carry on the most advanced engineering research."

In the next group the annual compensation is to be $6,000 and up. The group covers those qualified to act as technical and administrative heads of a major engineering bureau or organization.

Vermont's New Engineer Governor Takes Office



VERMONT'S new state administration takes office in January. It will be headed by an engineer of national reputation, James Hartness, former president of the American Society of Mechanical Engineers, machine tool builder and inventor, amateur astronomer and aviator, and fellow of the American Association for the Advancement of Science.

Water Study Important in Large Steam-Plant Development

THE use of water in the operation of steam plants as a factor in any study of the water resources of a state was stressed by N. C. Grover, chief hydraulic engineer for the United States Geological Survey, in an address before the Kansas Engineering Society of Topeka on Thursday, Dec. 16. Mr. Grover pointed out that for each ton of coal used in a modern steam plant approximately 800 tons of water is required, and that in any locality depending on steam power the availability of water for such use will determine industrial development. The abundant supply of coal in various sections of the United States was discussed, but Mr. Grover warned the engineers that the supply from the thick veins of the Eastern fields would be exhausted in from one to two generations. Industry must then turn to poorer grades that will be mined at higher costs. The available water supplies in the Middle Western States will thus become a more important factor, as on this supply and its location will depend the possibility of establishing large plants that can produce power at an economical figure. The speaker urged that every study of water resources include the use of the supply for power production purposes and indicated his belief that as the cheaper fuel supplies of the East were exhausted a migration of industries closer to the fuel supplies of the West and Middle West would occur.

The committee on electrical engineering presented a report in which closer co-operation of the electrical engineers with the Kansas Engineering Society was urged, particularly in view of the study of water resources now being undertaken by the state. In this study all engineers are interested, the electrical engineers in utility work being especially concerned from the standpoint of future power supply.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Emergency Central-Station Service Helps Out Municipal Plants.—The city of Idaho Falls, Idaho, faced a serious situation recently when the freezing of Snake River caused a complete tie-up of the municipal power and pumping plants, cutting off the city's water supply and depriving it of fire protection. Faced with grave danger, the city sought and obtained emergency service from the Utah Power & Light Company's lines, and in a few hours the plants were again in operation.

Accidents and Electricity.—Although Wisconsin's record of accidental death and disability in 1919 was the worst in the history of the state, it is interesting to note the small part that electricity played as a cause. Out of a total of 14,995 casualties only 75 were attributed to electricity, and out of 2,870,803 days lost through accidents only 82,395 were chargeable to electrical accidents. Electricity brought up the rear in the list, with one-half of 1 per cent of the total casualties in the state.

A Long-Distance Concert.—Recently Louisa Tetrazzini, the grand opera prima donna, standing in her apartment in a New York hotel, sang four songs into a specially equipped telephone, tuned to transpose her voice to the telephonic receiving sets with which nearly all of the vessels of the United States Navy are now equipped. Amplifiers on board all ships of the navy at sea and in port within a radius of 400 miles had been rigged to project Tetrazzini's voice on shipboard. The crews were assembled at the hour set for the concert, and telephonic radio stations were ordered to suspend traffic for thirty minutes. The concert was officially reported a success.

Water Shortage and Oil Supply in California.—A record use of oil in 1920 in the manufacture of electrical energy is reported by the Railroad Commission of California. Steam-made electricity necessitated by the water shortage was responsible for an enormous increase in oil consumption, the commission estimating the total figures for the year's use by utilities selling gas and electricity at about 6,000,000 bbl., or 1,000,000 bbl. more than is used in normal years. Increase in the price of oil ranged from 70 cents a barrel to $2, varying according to location. A material reduction in the use of oil, however, is expected by the commission as a result of hydro-electric developments under way and in prospect.

Extensive Icelandic Program of Water-Power Development.—Magnus Gudmandsson, the Finance Minister of Iceland, has arrived at Copenhagen to obtain the consent of the Danish government to an act for the development of the copious water powers of the frozen island. An extensive program of hydro-electric development is favored by the Icelanders, but the capital for it must be raised elsewhere.

Wireless Telephony as a Police Aid.—The use of the wireless telephone as an aid in the prevention and detection of crime is being tested by the Police Department of St. Louis. A sending outfit with a range of 40 miles has been installed at the police headquarters and three automobiles have been equipped with receiving apparatus. By this means it is possible to change the orders of a squad while it is at work. One man in each automobile has the receiver strapped to his head at all times. If, for instance, a squad were sent out on a false clew and correct information reached headquarters after the men had left, it would be possible to stop the wild-goose chase and give the squad the proper orders.

Detroit Edison's New Service Building.—The ten-story service building of the Detroit Edison Company is nearing completion and will, the house organ of that company announces, be ready for occupancy early in 1921. It occupies a whole block at 2030 Second Avenue and is ten stories in height. The sales department will be on the first floor, the accounting department, laboratory, meter-testing department and various other departments on the second, third and fourth floors, and the executive offices on the fifth. The next three floors will house the construction engineering offices, drafting rooms, "trouble board" and so forth. On the ninth floor there will be an auditorium, a cafeteria and kitchen and women's rest rooms, and on the tenth a men's lobby, a classroom and private dining rooms.

Newfoundland as a Field for Hydro-Electricity.—The ancient British colony of Newfoundland has virtually no rural roads, and most of the inhabitants live on the coast. There is, however, an abundance of water power, and Lord Northcliffe, the English newspaper proprietor, has established large paper mills in the northeastern interior. An investigation by Canadian interests which hold options on power and pulp concessions on the south coast has recently led to a survey of the Bay d'Est River and the lakes tributary to it. These lakes, the surveyor reported, offer splendid facilities for water storage, as the level of some of them can be raised 25 ft. by inexpensive dams. From the lowest of the storage lakes to tidewater at the mouth of the river there is a fall of 500 ft., making possible the development of 75,000 hp. An industry capitalized at $10,000,000 will be established on the river if the plans now under consideration are carried out.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Ohio Association Committee Meetings.—The new-business co-operations committee of the Ohio Electric Light Association is scheduled to meet at Cincinnati on Jan. 20, the transmission and distribution committee at Columbus on Jan. 20, and the meter committee at Cleveland on Jan. 21.

Electric Club of Chicago.—Officers of this club for the ensuing year were recently elected as follows: President, W. H. Colman; vice-president, A. G. de Clercq; second vice-president, E. F. Kirkpatrick; secretary-treasurer, E. E. Williams; three-year trustee, W. E. Bischoff; directors at large, T. J. Rider, Jr., and Harold Almert.

Mechanical Engineers' January Meetings.—Among the meetings of the A. S. M. E. to be held this month are one at Atlanta, on Jan. 25, when water-power development will be discussed by B. N. Hall of the Georgia Railway & Power Company, and one at Philadelphia on the same date, when Julian S. Simsohn will deal with water treatment for boilers.

Birmingham Section, A. I. and S. E. E.—The program arranged for the meeting of this section on Jan. 27 includes a paper on "Alternating Current in Byproduct Plants," by W. V. Dunn, chief electrician Tennessee Coal, Iron & Railroad Company, Fairfield, Ala., and one on "Direct Current in Byproduct Plants," by E. R. Winters, chief electrician Woodward Iron Company, Woodward, Ala.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Philadelphia Section, Jan. 8; Cleveland Section, Jan. 10; Chicago Section, Jan. 15; Pittsburgh Section, Jan. 15; Birmingham Section, Jan. 27.

American Institute of Electrical Engineers—Akron-Cleveland, Jan. 14; Portland (Ore.) Section, Jan. 10; Boston Section, Jan. 11; Pittsfield Section, Jan. 20; Chicago Section, Jan. 24.

Wisconsin State Association of Electrical Contractors and Dealers—Milwaukee, Jan. 19 and 20.

American Washing Machine Association—Chicago, Jan. 19 and 20.

American Society of Civil Engineers—New York, Jan. 19.

Western Association of Electrical Inspectors—Detroit, Jan. 25-27.

Association of Municipal Electrical Utilities of Ontario—Toronto, Jan. 27 and 28.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section) — New York, Jan. 28.

Florida Engineering Society—Lakeland Fla., Feb. 7 and 8.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18.

American Physical Society—New York, Feb. 25 and 26.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Electricity for X-Ray Machines.—Electric service for motors used in operating X-ray machines should, the North Dakota Board of Railroad Commissioners has declared, be classed as power service and should carry the power rate, including the regular minimum monthly service charge based upon horsepower of connected load.

Abolition of Surcharge.—The Arizona Corporation Commission has ordered the Tucson Gas, Electric Light & Power Company to discontinue its surcharge on minimum bills. The company was authorized to collect a surcharge by an order issued May 25, 1918; but the commission as the result of an investigation made on its own initiative held that changing conditions made this increase no longer warrantable where commercial lighting business or residence consumption does not exceed 8 kw.-hr. or where municipal power falls within the minimum designated in the company's rate schedule.

Different Departments of Utility Must Be Considered Separately.—The Colorado Public Utilities Commission has declared in passing upon an application from the Trinidad Electric Transmission Railway for permission to abandon certain service that the expenses and earnings of the street-railway department of a utility which operates also electric and gas departments must be considered separately even though the utility has received valuable franchises and street-lighting contracts upon the understanding that the car lines could not be operated at a profit for some time, and notwithstanding that the return to the company as a whole is reasonable.

Service and Minimum Charges.—A service charge is fairer and more equitable than a minimum charge, according to an opinion of the New York Public Service Commission, Second District, because under the minimum charge the less energy a consumer uses the more he pays for having the privilege of using the service whether he requires it or not, while under a service charge the cost of having the service available for use is borne equally by all consumers and not entirely by the small consumers, as is the result with a minimum charge. The commission refused to approve a minimum bill of $2.50 for private consumers where in the year just past the bills of only four patrons exceeded that amount and where the increase would double the bills of three-fourths of the consumers.

Duty to Render Service.—Public Utilities may not refuse reasonable extensions for service, the Missouri Public Service Commission has declared, merely because the immediate compensation therefrom is inadequate, but are obligated to make extensions which will be at once self-supporting or which give assurance of ultimately becoming so, and others upon equitable terms.

Justification of Coal Riders.—In approving the inclusion of a variable fuel clause in the rates of the Missouri Public Utilities Company for seventeen places served by it the Public Service Commission of the state observed that the condition in which a utility incurring approximately one-half of its production expenditures for coal is thrown when a severe increase in the cost of fuel occurs justifies the application of variable rates equitably based upon the costs of fuel obtaining prior to the emergency.

Present Rates Continued at East St. Louis.—An order continuing in effect the present rates of the East St. Louis Light & Power Company, East St. Louis, Ill., and granting a 10 per cent advance in one rate of the Alton Gas & Electric Company, Alton, Ill., has been handed down by the Illinois Public Utilities Commission. The increase granted to the Alton company affects only users of small motors. Present rates were fixed a year ago. The order continues them indefinitely but imposes the burden of proof as to future fairness on the companies.

Service Charge Permitted Small Company Operating Several Businesses in Combination.—The Mountain Grove Creamery, Ice & Electric Company, a small company operating in combination several branches of business, has been permitted by the Missouri Public Service Commission, in the absence of proper evidence concerning the allocation of costs, to exact as a part of the minimum charge a monthly service charge of 50 cents, increasing its net income approximately $1,500 on property valued at $16,000 and operated at a claimed loss of $2,181 in eleven months.

Apportionment of Gas and Electric Charges Where Company Operates Two Departments.—In granting increased electric rates to the Napa Valley Electric Company, which also operates a gas department, the California Railroad Commission dwelt on the necessity of properly apportioning expenses common to the two divisions. The company's electric revenues now constitute more than 91 per cent of its total business, and its gas consumers number 105 out of a total of 769. These facts were carefully considered by the commission. The value of a leased electric line was not allowed to figure in the estimates of return, this line having been included in a prior application of the lessor, the Snow Mountain Water & Power Company, as a part of that company's property entitled to return.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Breaking of Dam Must Be Shown to Have Been Result of Negligence to Justify Award of Damages.—The Supreme Court of New Hampshire has laid down the principle, in White vs. Woodward, that where there is doubt as to the cause for the breaking of a dam it is not enough to establish that there was negligence in its construction and maintenance; before damages can be awarded to parties injured by the overflow, it must be shown that such negligence caused the dam to fail. (111 At. 494.)*

United States District Court Upsets Commission's Method of Valuation.—The United States District Court for the Western District of Missouri has decided in favor of the St. Joseph Railway, Light, Heat & Power Company in a suit brought against the Missouri Public Service Commission because the commission had fixed street railway fares and steam-heating rates on a valuation based on original cost, when obtained, and when not obtainable on average prices for a fixed period of five years before war prices prevailed. Holding this method of valuation to violate the Fourteenth Amendment of the United States Constitution, the court granted a permanent injunction against the commission, which has appealed the case to the United States Supreme Court.

Jurisdiction to Restrain Enforcement of Statutory Rate Must Await Action of State Commission.—Where a light and power company supplying electricity at rates fixed by statute but subject to change by a state commission has applied to the commission for an increase in rates, it cannot, according to a decision of the United States District Court for the Western Division of Wisconsin, in Wisconsin-Minnesota Light & Power Company vs. Railroad Commission of Wisconsin, pending action on such application, invoke the jurisdiction of a court of equity to enjoin enforcement of the existing rates as confiscatory; nor does the fact that the commission has acted in respect to certain of the rates unsatisfactorily to the company give the court jurisdiction to review all the rates, which are more or less interdependent and must be considered together to determine their reasonableness, in advance of final action by the commission. The court therefore refused to issue a preliminary injunction against rates in force. (267 Fed. 711.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

W. J. Tharp, the secretary of the Little Rock (Ark.) Railway & Electric Company, has been appointed secretary of the Arkansas Utilities Association, succeeding S. E. Dillon, manager of the public utilities of Hot Springs, who has recently resigned.

Frederick D. Gordon, who joined the organization of the Cumberland County Power & Light Company, Portland, Me., on Oct. 1 of this year, has been appointed general manager of the company, succeeding A. H. Ford, who resigned more than a year ago. Since that time the company has been without a general manager. Mr. Gordon was formerly general manager of the Androscoggin Electric Company, Lewiston, Me., with which he was connected for a number of years.



F. D. GORDON

Herbert T. Lewis on Dec. 1, 1920, took up the duties of district manager of the Robbins & Myers Company at Philadelphia, succeeding A. S. Tarr. Mr. Lewis joined the sales force in Philadelphia Sept. 22, 1918, and has rapidly worked up to his present position. Among his associates he is familiarly known as "Butts."

Richard G. Harris, who has recently been appointed Pacific Coast manager of the Standard Underground Cable Company, succeeds John P. Bell. Mr. Bell will hereafter devote his time to the growing demands of his export and import business. Mr. Harris has been connected with the company since 1909. He was at first a member of the staff of the general offices at Pittsburgh and employed on special development matters at its Perth Amboy (N. J.) factories. Later he was sales engineer with the New York office of the company. For the last eight years he has been manager of the Montreal office of the Standard Underground Cable Company of Canada, Ltd.

W. G. Stearns, for many years associated with the Standard Underground Cable Company on the Pacific Coast, has been appointed special sales agent, with offices at San Francisco.

Otto E. Osthoff, vice-president of H. M. Byllesby & Company, Chicago, who has recently returned from a tour of inspection of that company's properties in California, reports that, despite industrial recessions and readjustments, utilities in that section will not be affected because they are dealing in absolute necessities. This feeling, he states, is largely influenced by the fair and constructive attitude of the California Railroad Commission.

Robert D. Maxwell, S. E. Sutherland, Charles Smith, and W. G. Sheehan have recently been appointed district managers of the Crystal Washing Machine Division, Mallory Industries, which has headquarters at Chicago. Mr. Maxwell was formerly connected with the Studebaker sales organization of southern California both as branch manager and as distributer. He will have charge of the Middle West district. Mr. Smith will be district manager for the South. Until recently he occupied the same position with the Federal Motor Car Company. His headquarters will be at New Orleans. Mr. Sutherland, formerly with the Procter & Gamble Distributing Company, becomes district manager of the South Central States with headquarters at Cincinnati. Mr. Sheehan, who was recently discharged with the rank of major from the office of the chief of overseas material production under Brig.-Gen. R. E. Wood, will be stationed at Port Chester, N. Y., where the executive offices of the Crystal organization as well as one of its three factories are situated. Previous to his army career Mr. Sheehan was production manager of the Locke Insulator Company of Victor and Lima, N. Y.

Earl C. Lewis has been appointed assistant mechanical engineer with the Hygrade Lamp Company, Salem, Mass. Mr. Lewis is a graduate of the Massachusetts Institute of Technology and was formerly employed by the General Electric Company at its Lynn and Schenectady factories. For a year he was an inspector for the Factory Mutual Fire Insurance Company of Boston, and during the war he served in the United States Naval Experiment Station at New London, Conn., working on submarine detection and electric torpedoes.

R. L. Eltringham, formerly electrical engineer of the California Industrial Accident Commission, has resigned to become manager-secretary of the California Electrical Co-operative Campaign. His new duties began on Jan. 1, 1921. Mr. Eltringham, who is forty years old, has had an extended experience in electrical affairs. He operated one of the earliest electric lighting plants in Pennsylvania, his native state, when a youth and held various positions with pioneer lighting and street-railway companies in the East. Before the age of twenty he was assistant to the general manager of the Lakeside (Pa.) Railway Company. After a short experience with the Cramp Shipbuilding Company he was employed by the Baldwin Locomotive Company in its electrical department when the manufacture of electric mine locomotives was first undertaken in conjunction with the Westinghouse Electric & Manufacturing Company. He went West in 1901 and was employed by the Consumers' Gas Association of San Francisco and later by the Pacific Mail Steamship Company on electrical work. From 1906 to 1907 he was employed by the Commonwealth Edison Company of Chicago. He returned to California in 1908 to take charge of the electrical power work of the Empire Construction Company. Resigning that position in 1910, he became industrial power engineer of the Great Western Power Company of San Francisco, where he remained until in 1914 he accepted the position of electrical engineer of the accident commission. Mr. Eltringham has been active in the formulation and administration of the various electrical safety regulations of that commission, including the California utilization safety orders, the mine safety orders and the lighting safety orders. He is a member of the American Institute of Electrical Engineers and the Illuminating Engineering Society.



R. L. ELTRINGHAM

Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of
Electrical Apparatus and Supplies

Buyers' Market Predominates After Heavy Year

IN LIKE a lamb but out like a lion was all very well as a characterization of the electrical industry for the year 1919, but for the year just passed the conditions were exactly reversed. The electrical industry has slept off very quietly the last two or three months of the year 1920 and is entering the new year with prospects of much work to be done, especially in relation to a nation-wide building program.

Looking back, the year has proved prosperous for manufacturer and jobber, although, especially for the manufacturer, it has been a hectic year. Conditions of production have been unsatisfactory, to say the least. Labor shortage, independence and inefficiency; lack of raw materials, semi-finished products and coal; railway tie-ups and freight congestion caused by strikes, cold weather, snow and car shortage—these have been the main factors manufacturers have had to contend with in the face of a demand which it was beyond their power to satisfy. Of course, prices continued to rise beyond the levels of the previous year, for the electrical industry and for every other industry, and price at time of shipment was quite general.

But by the middle of the year money was beginning to get pretty tight and its cost mounted, banks were curtailing loans, manufacturers, fortunately, were having difficulty borrowing money with which to add to their already augmented capacity, when the public took it upon itself to stop buying what it did not need at prices which it thought were beyond all reason—and the house of cards tumbled to the ground. Silk, cotton, woolen and leather industries, followed shortly by the automobile industry, went begging for orders, retail clothing and apparel stores sliced big edges off their prices, building started to decline in certain sections, manufacturers, jobbers and retailers in lines outside of the electrical had to liquidate some of their growing stocks and business in general was on the decline. Credits and collections took on increased importance and were followed and pushed with avidity.

And, in turn, during the last quarter of the year the electrical industry began to feel the pinch. During the last two months business has dropped to a very quiet level, prices have started downward, stocks have built up in jobbers' hands even under cancellations of orders, and manufacturers, many with several months' orders on their books and those whose orders amount to very little, have begun to limit their production so that it is commensurate with the demand existing at this time. Liquidation of inventories is general.

Demand is off, building is conspicuous by its inactivity, labor is plentiful in almost every section, much capacity is idle, materials and apparatus unknown to stock all year can now be had immediately, and more cars are surplus than at any previous time in the last eighteen months. In other words, the sellers' market turned to the present buyers' market.

But through it all there are bright prospects for 1921, once the year has got fully under way. Hardly a city of importance but is vitally in need of apartments, hotels, commercial buildings and residences, and the country in general needs residences. Recent investigations into building-material prices and combinations in New York have resulted in exposures the outcome of which has been lowered prices and fines. So it would seem one of the obstacles to building in the past year—high prices of materials—has been overcome to an extent, and the building outlook when the warm weather next makes its appearance looks good. From several quarters, however, is heard the opinion that it will be midsummer before much building activity makes itself felt.

Exports Held at Unexpected Rates

THE matter of electrical exports has provided one of the surprises of the year. At the present time these are running at a yearly average of about $94,000,000, a gain of $4,000,000 over those of the year 1919. In spite of the high rates of exchange existing in most of the foreign markets, working against the purchase of material in the United States, this outlet has continued at a rate which is quite remarkable. It is true the higher prices probably had something to do with the good showing in dollars and cents, but the answer is that the market held up well.

Metals Broke Badly in Last Half Year

COPPER during the year reached the lowest point recorded since 1914. Opening high at 19 cents, it fluctuated in the eighteens till the last of March and during most of April was quoted at 19.25 cents. This was the highest point reached, and it was held by the producers for a month. A quarter-cent reduction brought it to 19 cents again, and this level continued until the last of August, three and one-half months. From then on the decline was gradual, except during October, when it declined 3½ cents, until the latter part of December. During this last month producers were quoting 14 cents for prompt shipment, but the outside market was shading at times as much as ½ cent.

Copper	—Dec. 30, 1919— £ s d	—Dec. 27, 1920— £ s d
London, standard spot	116 15 0	72 5 0
	Cents per Pound	Cents per Pound
Prime Lake	19 00 19 50	13 75
Electrolytic	18 75 19 00	14 00
Casting	18 50	13 00
Wire base	21 50 22 00	16 00 16 50
Lead, trust price	7 50	4 75
Antimony	9 62½	5 25
Nickel, ingot	41 00 42 00	43 00
Sheet zinc, f.o.b. smelter	11 50	11 50
Zinc, spot	9 00 9 10	6 00 6 10
Tin	59 50	33 00
Aluminum, 98 to 99 per cent	32 00 33 00	28 50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17 00 17 50	11 00-11 50
Brass, heavy	9 75 10 25	6 00 6 50
Brass, light	7 75 8 00	4 50- 5 00
Lead, heavy	6 00- 6 25	3 50 4 00
Zinc, old scrap	4 75 5 00	3 25- 3 50

Copper-wire base, net, at the mill reached its highest point, 23 cents, in March and, after holding for seven weeks, dropped to 22.50 cents for nearly five months, gradually easing off to the closing price of 16 to 16.50 cents. Insulated wires followed this course from October on.

Lead ran a strong race, reaching 9.25 cents a pound in New York in March and April, official price, but after fluctuating a bit in the eights it settled for an easy decline which started in August and finished at a present price of 4.75 cents. Much of the time when the prices were high the outside market was holding for a half cent or so higher. On the decline, however, that market trailed around one-quarter cent.

Early in December independent steel mills began cutting their prices to approach and finally to meet those quoted by the United States Steel Corporation. Pipe prices are said to be the only ones that now show a disparity.

Apparatus Shipments Ran Long

MANUFACTURERS carried over into the year very heavy bookings of motors, generators, turbines, transformers and other classes of apparatus. Stocks of motors in sizes from 1 hp. to 50 hp. virtually have not existed in manufacturers' or local warehouses all year, although in December production had begun to catch up to the point that some common sizes could be picked up for immediate delivery. Stocks of these popular sizes, from 1 hp. to 10 hp., became more plentiful in the hands of dealers and second hands. Shipments from factory during the year ranged up to six months, with many quotations around three and four months. Prices advanced around 15 per cent and for a time orders were received with price open.

Distribution transformers enjoyed a good year with production going to capacity. Here and there, however, material shortages proved very annoying to shipments, the most common of which were in long-fiber cotton, magnet wire, sheet steel and iron castings. Factory and local stocks generally were depleted, and shipments ranged at times up to eighteen weeks. Apparatus transformers ran up to ten months under good demand. Improvement was noticed in the standardization of ratings for special transformers.

Demand for generators and turbines increased after the first of the year with good capacity running in the shops and shipments running from six to twelve months, depending on size, some quotations requiring eighteen months. Difficulty was experienced early in the year because of a shortage of capable labor, but this was overcome later on.

Wire Supply Held Well

WIRE mills were able to keep the trade supplied with rubber-covered wire almost without fail throughout the year. Here and there shortages occurred because of rail tie-ups, of course; but the trade did not suffer from the lack. Bookings of the first few months gave evidence of double the 1919 rate, but the year came through with an increase of only about 12 per cent on rubber-covered. Quotations to the trade were as high as $14 per 1,000 in 5,000-ft. lots in New York, while in December just passed they had fallen to around $8.50.

Weatherproof-wire stocks in the sizes 6, 8, 10 and 12 were generally reported poor throughout the country, but those too have been replenished. Magnet wire in the smaller sizes was virtually off the market for many weeks, so great was the demand for it in the manufacture of small motors, transformers, control equipment, etc. Lamp cords and heater cord were gone from stock for the most part of the year too and were not back on the market in good supply till late fall.

Pipe Just Returning to Stocks

PROBABLY the shortest material in the wiring line was rigid conduit. Raw-material shortage was accounted for in the extraordinary demand for its basic material, merchant pipe, for the oil industry. Jobbers had no stocks of ½-in. and ¾-in. pipe all year, and it is just in the last two months that anything like stocks have accumulated. Prices have been high, quotations in New York to the trade of ½-in. black having been as high as $110 per 1,000 in 1,000-ft. lots, when available. Prices nearer $70 are in effect now. Outlet boxes have followed the pipe market quite closely as concerns supply and demand.

Big Increase in Lamp Sales

A PARTICULARLY strong year has been experienced in the sale of lamps. While sales of large types in 1919 amounted to 183,000,000, those for 1920 have been estimated at 230,000,000. Manufacturers have been concentrating their efforts on turnover of B agents' stocks, and they kept in force during the year the 5 per cent additional compensation rider on list value of lamp sales from these B agents' stocks, regardless of rate of turnover, instead of putting into effect a rider giving additional compensation based on five and six turnovers. This same rider is to be continued on into 1920 pending the collection of more data on turnover.

During the year lamp stocks were seldom filled up solid on B agents' shelves, so great was the demand. Transportation and raw material shortage were the chief factors in this condition of spotty stocks. On April 1 price increases varying from 10 to 15 per cent were applied on the common run of large lamps, while at the same time certain large sizes were reduced. To reduce stocks of in-between voltages manufacturers are making an effort to reduce the types produced to voltages of 110, 115 and 120 volts.

In the courts the United States Circuit Court of Appeals sustained the Langmuir gas-filled lamp patent (General Electric vs. Nitro-Tungsten) and the United States District Court upheld the Coolidge wrought-tungsten patent (General Electric vs. Independent Lamp & Wire), following which an appeal was filed.

Socket-Device Buying Heavy

FROM what was virtually an insatiable demand for heating appliances and motor-driven appliances during the first five months the market turned to one later in the year in which the price played such a large part that the public lost interest and stopped purchasing. Stocks turned from nothing to sufficient for the demand of motor-driven goods, while those of heating devices have not yet been filled, especially in hollow ware.

Consequently the unheard-of demand for fractional-horsepower motors receded to the point where some manufacturers are offering immediate shipments. Early in the year shipments were quoted over a year with price open.

Wiring-Material Stocks Spotty

IN CONSEQUENCE of the heavy building demand existing all over the country during the first six months of the year there was a call for wiring materials which kept jobbers' stocks virtually depleted. Transportation failures, of course, kept raw materials from the producers and kept finished product from the jobbers. Such items as rigid conduit, non-metallic flexible conduit, flexible armored conductor, knobs, tubes, cleats and schedule material were sold before being received by the jobber and frequently never entered the warehouse. They just bounced from incoming to outgoing trucks. Pyramiding of orders resulted, with shipments quoted months in advance at prices that should rule at time of shipment. Rubber-covered-wire stocks did not reach such low levels.

It was in July that manufacturers began to catch up, and shortly after building activity fell off a little. Thereafter demand gradually fell and shipments came in better, so that by late fall jobbers' stocks had built up again on most items. But the call was light and stocks became top-heavy by November, and with the inventory period in sight jobbers lowered their prices to liquidate.

Armored-Conductor Market Weak

SHORTAGE of steel strip, because of delivery and raw-material conditions, was a prime factor in the poor stocks of flexible armored conductor existing all year up to September. Demand indeed was heavy but by late summer it fell off. The present market is down to about $65 per 1,000 for 5,000 ft. of 2-wire No. 14 in New York whereas it had been up to around $110. Production increased about 25 per cent over 1919.

Pole-Line Equipment Sold Well

CENTRAL stations ordered a good volume of poles, pins, cross-arms, hardware and high-tension insulators during the year. Of course, a lot were for maintenance, but new extensions ate up a large quantity. Insulators all the year were on very long shipments, up to eight months, depending on type and voltage. Production was hindered because of the heavy turnover of labor in the kilns. Foreign buying of insulators and steel towers was very heavy.

Transportation was a deterrent factor in supplies of wood-pole materials in jobbers' yards. At the mills these generally were good, however, and in the fall months shipments came back to about normal conditions and stocks filled up. Better labor conditions in the woods are foreseen.

Hardware stocks suffered for most of the year and are only now getting back into shape. Demand could not be supplied easily because of steel shortage and car tie-up.

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

CHRISTMAS buying did fall off as compared with that of last year, as predicted in most sections of the country. Although it finished up strong, the light pre-season business kept the total down. Activity in the general run of electrical supplies is not great, especially as the inventory season is at hand. At the same time, many industrials are taking what they find to be a slack period to make repairs and replacements. This has been slower of accomplishment in the lumber camps of the Northwest, however, than was expected.

Stocks of virtually all supplies are in good condition, and naturally buying is of such a nature as to supply present needs only. Motors are rather easy to get in the smaller integral sizes. Large back orders of pipe are still on manufacturers' books. In New York the price of flexible armored conductor has eased off a lot.

Collections show no improvement, and no let-up in the energy required to keep them even on their present level can be permitted.

NEW YORK

DEMAND seems even lighter than has been the case all along, following the impetus which Christmas sales gave to certain lines such as appliances. The holiday trade as a matter of fact, though considerable, does not appear to have been up to expectations. Jobbers are busily engaged in taking inventories, and that is another reason for the quietness previously noted. As yet it is still too early to make a comparison between the size of stocks jobbers are carrying now and last year at this time, but as a general thing this year's inventory will run into much larger figures.

Prices on flexible-armored cable have broken to lower levels, but except for the wiring lines quotations are steady. Collections remain slow and are being hard pushed. Contractor-dealers are not very busy, but a fair amount of wiring and repair work is being carried on by industrials. Many of the latter are now no longer pushed to capacity and hence for the first time have opportunity to overhaul equipment thoroughly.

Rubber-Covered Wire.—Demand remains poor and stocks too large. In 10,000-ft. quantities No. 14 is quoted at from $8.50 to $8.35 per 1,000 ft. net.

Lamps.—Though a slight recession in demand is noted in some quarters recently sales on the whole are excellent. Stocks in most cases are well filled on all sizes, occasional complaint being heard of the supply of round-bulb and 100-watt lamps, however.

Flexible Armored Conductor.—Prices have eased off considerably, and some jobbers report fairly good sales at a level of $65 per 1,000 ft. for No. 14 two-wire, though others are still asking $80-85 net in 1,000-ft. quantities. Deliveries of any reasonable quantity are from stock.

Conduit.—Demand has fallen off considerably, with fairly good stocks of most sizes the rule. Prices cover a wide range, from $70 to $85 net per 1,000 ft. being quoted by jobbers on ½-in. black in 2,500-lb. lots.

Conduit Fittings.—Sales are in about the same proportion as for conduit, with a fair but not extra-heavy movement. Stocks are ample.

Tape.—Demand is light, and as a consequence good stocks of both friction and rubber have accumulated. Depending upon the grade and the manufacturer, friction tape ranges from 50 cents to 55 cents per pound and rubber from 41 cents to 50 cents in 100-lb. lots, net.

Heating Appliances.—Christmas demand caused stocks to move rapidly, but the holiday trade from most accounts does not seem to have reached the level of other years. Hollow-ware items are still spotty, some jobbers carrying over considerable stocks which arrived at the last minute, while others are cleaned out.

Schedule Material.—Porcelain has ceased to hold up the supply of some items as stocks are fully ample to meet the existing light demand.

Storage Batteries.—Manufacturers of starting and lighting batteries have made reductions in price of from 20 to 28 per cent, depending on type, effective Jan. 1 in general. One producer's cut has a low limit of 10 per cent. Lists have been reduced and with them the discounts.

Wireless.—Christmas demand for wireless equipment has been heavy. Individual pieces and small parts sell especially well for making up into sets, and unit equipments have found a good market. Prices show little change and stocks are good.

CHICAGO

The Christmas shopping season closed with a rush of buying on the part of the public, although the gross money volume was below last year's total. Estimates of the reduction run all the way from 10 to 35 per cent. In general electrical goods were favored in the buying. There was some price cutting by retailers of tree outfits, and some of them were observed to be offering lighting outfits below cost; but dealers finally were sold out. Supplies of heating appliances in dealers' hands were well cleaned out.

Construction is waiting for price reductions in building materials and possibly in the labor market, and until some stability in cost is established there promises to be no activity. Contractor-dealers have but little to do and jobbers' stocks are now well built up. The depletion of jobbers' stocks a few weeks ago was so pronounced that most producers have been enabled to operate at capacity up to the present, but in the last week or two some tendency toward curtailment has been noted.

Rigid Conduit.—Previously reported shortage of ¾-in. and ½-in. sizes has now been overcome, all sizes being obtainable in reasonable quantities from stock.

Non-Metallic Flexible Conduit.—Plenty of stock of all sizes is reported, and an expectation of reduced prices is noted. Factories are still producing in large quantities and jobber stocks are well filled.

Flexible Armored Conductor.—Demand is light, being confined for the most part to replacement requirements. Stocks are in position to handle all requirements. No talk of price changes is heard, current quotation on No. 14 two-wire being $85 for 1,000 ft.

Wire.—Ample stocks are on hand and consumption is below normal.

Schedule Material.—Ample shipments have been coming through from factories for some time, and, demand being light, jobbers' stocks are built up to a point about as high as desirable. Prices are thus far firm.

Transformers.—After the slump recorded a month ago, when farmers unanimously quit buying, there has been a gradual resumption of demand. The aggregate of orders placed has not been large, but a comfortable business is being done. Credit conditions in the Middle West are improving, which improvement should be at once reflected in the demand for transformers for farmers' lines.

Electric Heaters.—Business has been exceptionally good all through the fall, and factories are reported as being still busy. Jobbers' stocks are not so heavy as they should be and orders are continually being placed.

Electric Ranges.—Although actual sales are light inquiries are of such volume as to promise good business in the spring.

BOSTON

In the jobbers' field trade was well sustained until the close of the year. Accumulated back orders and continuous demands for replacing used-up material kept many houses busy, notwithstanding local dullness in the textile and other industrial lines where mills have been running on part time for weeks or else have been temporarily closed. The retail trade in electrical appliances bade fair at the end of last week to round out with an excellent showing. While the record sales of 1919 for the holiday trade were not reached in many cases there is good reason to believe that when the year's totals and the December figures are compiled 1920 will display a thoroughly satisfactory volume of business in comparison with earlier so-called normal years.

Stocks have been built up by the receipt of long-delayed shipments, and in most lines jobbers are well prepared to handle the new year's business. A general feeling prevails in the electrical industry that the readjustment period will be less trying and less prolonged than many other lines where prices were carried far higher. Prices last week showed little change, barring softening tendencies in annunciator, weatherproof and rubber-covered wire. Collections were quoted as unsatisfactory by leading jobbing houses last week, due to unemployment in industrial centers.

Wire.—Rubber-covered No. 14 wire was quoted at the week end around $9 per 1,000 ft. in 5,000-ft. lots, with plentiful supplies. Weatherproof base was 20 cents to 21 cents, and early this week lower quotations on annunciator wire were to be ready at the prominent jobbing houses. Demand is moderate.

Motors.—Distributers report improving stocks; and one prominent house had on hand for immediate delivery on Christmas Eve single-phase and three-phase motors of practically all standard sizes up to about 35-hp. rating. Prices were firm at the end of the week, although rumors of a moderate reduction to be forthcoming early this year are circulating about the trade.

Lamps.—Central-station buying has been excellent, and one leading lamp house reports that the 1920 business will show from 25 to 40 per cent increase over the year before among the electric utility companies on its books. Current requirements are being admirably met.

Flexible Armored Conductor.—The demand is moderate, with good stocks. Prices ran around $85 per 1,000 ft. on No. 14 single-strip at the close of last week.

"Nail-it" Knobs.—These sell around $32 per 1,000 in barrel lots and are not hard to obtain. Their movement is rather sluggish.

Radiant Heaters.—Protracted mild weather has helped sales remarkably.

Non-Metallic Flexible Conduit.—Prices held at recent levels as the week closed, with ample stocks and moderate demand.

Appliances.—Portable lamps, toasters, percolators and vacuum cleaners have moved actively in the past fortnight. Sharp reductions in prices have featured not a few retail sales, especially on portable lamps. Electrical toys were unusually prominent this year in the retail trade.

ATLANTA

Wholesale trade has reached its low ebb for the year, all jobbers reporting a heavy slump in the receipt of orders, due in a great measure, no doubt, to the approaching inventory period. The retail trade is making every effort to reduce its inventories and is holding off on orders until after the first of the year. No general feeling of pessimism, however, is voiced by the jobbing fraternity. On the other hand, their attitude is one of optimistic expectation, and they express confidence that the easing in the labor situation, willingness on the part of unskilled labor to accept a lower wage schedule and the reduction in the price of building material cannot but presage the return of building activities. Retailers who have allowed their stocks to reach a very low point will naturally place orders for replenishment during the first of the new year, and things should resume a more or less normal basis early in the spring.

The Federal Reserve Bank of this district states that it discounted $203,000,000 of agricultural paper as against $93,000,000 last year, which throws a light on the general credit situation throughout the territory. A considerable amount of this paper will be renewed, thus causing tight money for several months yet.

Wire.—Stocks of wire are reported in first-class shape with the demand only fair, rubber-covered being on an 18-cent and weatherproof on a 20-cent base.

Flexible Metallic Conduit.—Jobbers have allowed stocks to run quite low and will not reorder conduit until after Jan. 1. Such supplies as are on hand are moving slowly and factory shipments are reported good. Prices: Lots of 1,000 ft. to 2,500 ft., ½-in., $10.60; ¾-in., $13.78; 1-in., $24.38 per 100 ft.

Rigid Conduit.—Stocks in general have become somewhat spotty, shortage being reported in popular sizes of both black and galvanized. The demand continues to hold up fairly well, with a price reduction of approximately 12 per cent. Prices: Galvanized, ½-in., $8.30; 1-in., $16.60; 2-in., $35.50; black, ½-in., $8; 1-in., $15.70; 2-in., $34 per 100 ft.

Distribution Transformers.—Several jobbers continue to report difficulty in obtaining satisfactory shipments in the popular sizes, though one house reports a fair quantity on hand. In general, however, the transformer situation is not wholly satisfactory.

Schedule Material.—Stocks are in better shape than for some time past, even porcelain being on hand in sufficient quantities for all current demands. All material, however is moving slowly and no price changes are yet reported.

Stamped Steel Boxes.—Stocks show considerable improvement for the past few weeks and, as is true of all building material, are moving but little.

ST. LOUIS

Little has occurred in electrical circles here in the last week, but it is thought that the end of the holiday season rush and the completion of inventories will be followed by numerous changes. The demand for staple goods continues to be very dull, but the sales of seasonable goods and holiday specialties will bring the volume of business for December to satisfactory proportions, though jobbers do not expect to equal the December, 1919, volume. They stocked lightly and in most cases were able to clear off their shelves. A few reported shortages in some lines of appliances. Dealers were not heavily stocked with holiday specialties but were able to meet a fairly good demand.

Very little improvement can be noted in the construction situation. There is practically no housebuilding, and industrial jobs are generally small and unimportant. Plans for spring are usually conditioned on the status of prices and wages at that time. Collections have shown no change, and an average of about sixty days continues to be the rule.

Wire.—The decline in price reported last week has had the effect of increasing sales slightly. Supply is still in advance of demand, however. Contractor-dealers report an increase in the number of house-wiring jobs, most of them to be installed after the first of the year, and this also has speeded up sales.

Rigid Conduit.—Jobbers' stocks are unusually complete, supplies of the ¾-in. and ½-in. black having improved during the last week. The smaller sizes of the galvanized conduit are a trifle spotty, but demand has slowed up so that it will not be long before jobbers build up their stocks of these. Prices remain the same, ½-in. black being quoted around $80 per 1,000 ft. in lots of 5,000 ft.

Meters.—Stocks are not complete and jobbers have back orders on their books. Their regular customers are being taken care of, but deliveries to new customers range from one month to three and four months. Demand shows no indications of slowing down.

Motors.—Practically all sizes are easier than was the case six weeks ago. The sizes between 2 hp. and 15 hp. still remain scarcer than other sizes, but deliveries on these have shortened to around three months. Demand is quiet. There are large quantities of fractional motors to be had.

Raditors.—In spite of the cold weather that has prevailed during the past week demand has not quickened. Sales are good, however. Jobbers have uniformly large stocks but do not anticipate any trouble in turning them over before spring.

Knobs, Tubes, Cleats.—These are in good supply and can be shipped immediately in ordinary-size lots. Demand has fallen off considerably. Prices are firm. Representative quotations are $9.90 per 1,000 of the 3-in. x $\frac{5}{16}$-in. tubes.

Hollow Ware.—Christmas sales were good and jobbers were well able to meet demand with the exception of that for fancy percolators and curling irons.

Linemen's Tools.—Jobbers have not had any on hand for some time, but are promising delivery in about four months. There are many orders on the books, but inquiries and new orders have slackened.

SAN FRANCISCO

Building permits have increased in value, for the housing situation requires immediate relief whatever the cost. On the other hand, counter business has shown a considerable decrease because of late buying. Collections are fair to good, although light Christmas buying and heavy stock carried over by most dealers into 1921 will probably affect electrical credits and may result for several months at least in hand-to-mouth buying.

Railroad shipments are coming through in good time from the East. Generally speaking, California crops were of the bumper variety during 1920.

Line Material.—The largest electrical sales just now are for line material, and even heavier buying is anticipated. The Pacific Gas & Electric Company is the biggest customer of the moment. Railroad freight solicitors report many cars of insulators, poles and pole-line hardware in transit.

Lamps.—Jobbers cleaned out practically all their Christmas tree outfits, and most dealers report heavy sales.

Heating Appliances.—Radiator sales during Christmas week fell off. Sales of hollow ware, especially of urn-type percolators, were disappointingly low and will result in big stocks being carried over into 1921. It is frankly stated that present list prices are considered too high by the public, although virtually every upright toaster was sold and sales of high-priced flatirons were reported good by dealers who made special sales efforts.

Household Appliances.—Washing-machine prices seem to be decreasing make by make, the average price on the cylinder model now being about $160. Sales of washers during the holidays fell off considerably despite special-inducement campaigns. Ironing-machine business also has decreased, but it is expected that better delivery and a better knowledge of the line will culminate in 1921 sales that will run higher as compared with washer sales.

Ranges.—Range sales are slower. No special effort is being made now to sell ranges by the power companies, although expert solicitors will probably be active about March, when much new power will be available. Factory deliveries are much better, and the completion of orders on file has resulted in fair stocks on the Coast.

SEATTLE—PORTLAND

With but very few exceptions both jobbers and dealers in Seattle and the Puget Sound district report holiday electrical sales the lightest in years despite united efforts to accelerate them. The movement in hollowware, particularly percolators, toasters, flatirons, etc., was comparatively satisfactory, but not nearly so heavy as could have reasonably been expected. Vacuum cleaners and sewing machines just prior to the holidays showed a spurt, but even these sales fell far below original expectations. The movement of washing machines, generally speaking, was very disappointing; in fact, the volume of sales usually attributed to the Christmas season did not materialize. At present the electrical business, from both the jobbers' and the dealers' standpoint, is exceptionally dull. Stocks, as a whole, are in first-class shape, and in spite of rumors of price reduction affecting all electrical merchandise there have been no changes worth mentioning, with exception of rubber-covered wire, for several weeks.

Motors.—Inquiries from lumber mills and small industrial plants prior to the holidays have not resulted in the orders anticipated. Apparently prospective buyers are awaiting price declines, which jobbers predict will be very slow in coming. Shortage of fractional sizes is gradually being overcome, and at present stocks of all sizes are in fair shape. Demand for smaller sizes is fair, but the larger types are not moving.

Lamps.—The market is in fairly good condition, and both jobbers and dealers express satisfaction over the season's business to date. Movement of industrial types is at a minimum, most of the activity being in residential types.

Conduit.—Demand, owing to negligible amount of new construction, is very light and jobbers have accumulated a considerable stock of popular sizes.

Vacuum Cleaners.—A comparatively heavy movement was experienced just prior to Christmas, and both jobbers and dealers expressed considerable satisfaction, considering ruling conditions.

Wire.—Rubber-covered wire is still tending downward. Owing to very light demand along all lines stocks are accumulating. It is believed actual demand will not materialize until late spring and that the peak of demand will not be reached before next fall.

Schedule Material.—There is scarcely any call, and accordingly complete stocks are accumulating. There has been no definite change in prices recently.

SALT LAKE CITY—DENVER

Jobbers report stocks considerably heavier this year than in the corresponding period of 1919. Dealers, however, are not so abundantly stocked. Both conditions are partly explained in that dealers have been placing orders charily, showing a tendency in the past few months to order from their jobbers in extremely small consignments. As the year comes to a close electrical firms find themselves well stocked in practically all lines with factories well caught up in their orders. There is no intimation of a general recession in prices except in products manufactured from steel and copper. Conduit is selling at a considerably lower figure than it was a few months ago, and so is copper wire. No reduction is given on prices of appliances, and factories report that none can be expected in the immediate future. Manufacturers of washing machines and vacuum cleaners are guaranteeing stable prices to April 1 and some even to July 1.

Jobbers believe that a general price recession would not only be practicable from the manufacturer's point of view but also beneficial to the trade. The opinion is held in some quarters that present prices of washers and cleaners are unduly inflated, including certain fictitious values. Credit conditions continue unimproved and there are no positive indications that they will grow better after the new year is launched. Improvement along these lines in the Intermountain West waits upon federal legislation looking to the protection of the sheep, cattle and agricultural industries.

Motors.—Factories have almost caught up on orders. The demand is good, especially for pumping motors.

Lamps.—All dealers report stocks ample and demand brisk. Deliveries are good.

Conduit.—There is a tendency in some quarters to accumulative overstocks. The demand is light, since the building season is practically over.

Wire.—Prices are down to the bottom and deliveries are reported good.

Schedule Material.—Prices remain exceedingly high. This is the off season and the demand is very light.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Fire Does Not Halt Line Material Company

A report from L. E. Hendee, vice-president of the Line Material Company, South Milwaukee, Wis., states that the recent fire which wiped out the office did not halt the company's operations. All vital records were found intact in the safes, while the operating plant was undamaged. Mr. Hendee states that the company is galvanizing and shipping material.

Ward Production Department Not Sold

A statement has been received from P. H. Ward, president of the Ward Electric Company, Philadelphia, to the effect that there is no truth in the rumor that it has sold the manufacturing branch of its business to the Machen Electrical Manufacturing Company. Mr. Ward states that the error arose through negotiations between the Machen company and the Ward-Stoddard company, which formerly manufactured push-button switches for the Ward Electric Company.

Wesche Electric Plans to Increase Production

Announcement has been received from the B. A. Wesche Electric Company, Cincinnati, Ohio, manufacturer of motors and similar apparatus, to the effect that it is moving to another location, where it will have about 50,000 sq.ft. of production space and more machinery. This, it is stated, will enable the company to manufacture on a larger scale, increasing production several times over. The company expects to be located and operating by Feb. 1.

Pacific Coast Motor Pioneers Reorganized

The U. S. Electrical Manufacturing Company of Los Angeles has recently reorganized through the affiliation of the interests of H. G. Steele, formerly vice-president of the Pittsburgh Transformer Company, and C. E. Johnston of Los Angeles, Cal., vice-president of the U. S. Electrical Manufacturing Company. Mr. Steele, who is now the president of the U. S. Electrical Manufacturing Company, resigned from the Pittsburgh Transformer Company in the summer of 1919.

The U. S. Electrical Manufacturing Company, which is the pioneer manufacturer of electrical motors in the West, has been in existence for twelve years and now does a business of more than $2,000,000 annually. It is understood that plans for enlarging the business and the building of an additional factory are being made.

Star Brass Changes Name

In order that its name shall conform more nearly with the nature of its products, the Star Brass Works, 3114-26 Carroll Avenue, Chicago, manufacturer of spray cooling systems, painting and spraying machinery, has changed its designation to the Binks Spray Equipment Company, effective Jan. 1. Announcement is also made of the completion of a new plant and an office extension. Provision is made for new salesrooms, testing laboratories and increased manufacturing facilities.

Recommendations on Bluebird Claims

Receivers of the Bluebird Manufacturing Company, St. Louis, Mo., have filed a report in the Circuit Court in St. Louis showing the amount of claims against the corporation and making recommendations in regard to them. They recommend the allowance of claims totaling $839,777.22, referring to a special master another group of claims, totaling about $50,000, and the disallowance without prejudice of the claim of W. S. Ireland, former president of the company, for $4,603.87, based on expenses incurred by him in connection with the sale of the company to the Davis Sewing Machine Company of Dayton, Ohio.

One of the claims indorsed is that of J. B. Heydt for salary due him as an officer of the company. The receivers say that the salary should be paid with $2,154.50 in cash and the balance, $17,688.21, in preferred stock. The claim of James L. Coffield was reduced from $60,000 to $2,400.

The receivers report in favor of disallowing other claims amounting to approximately $78,000, including one of $73,659.18 by the Gardner Advertising Company, on the ground that they are not just. The receivers are J. H. Conrades, Benjamin Brinkman and Thomas Mellow. Henry A. Rosskopf was appointed by Judge Falkenhainer as special master in the case.

Universal Line to Go on Eight-Hour Day

Landers, Frary & Clark, manufacturers of the Universal line of electrical appliances and other metal lines, according to reports from New Britain, Conn., will operate on an eight-hour basis by the first of the year. Several departments, it is reported, have been operating on this schedule for a couple of weeks.

New Departure Wins Patent Suit

Decision has been handed down by Judge Garvin in the United States District Court granting a decree in favor of the New Departure Manufacturing Company, Bristol, Conn., in its suit against the Rockwell-Drake Corporation, the Marlin Rockwell Corporation and A. F. Rockwell, former president of the New Departure company. The court enjoined the defendants from manufacturing and selling double-row ball bearings which infringe and ordered it to render an accounting.

The validity of the patent was conceded, and the defendants admitted manufacturing the bearings covered by it. The issue was the construction of a contract claimed by the defendants as granting certain rights to manufacture the bearings in question. In deciding the case the court held that the contract was not violated.

Apex Prices Guaranteed to June 1

The Apex Appliance Company, Oakland, Cal., has announced that it will guarantee all dealers and customers against any decline in price up until June 1, 1921. Even then "it is problematical," the announcement reads, "if there will be any decline." This action is taken in order to impress upon the trade that there is no foundation for the prevailing opinion that Apex washer and ironer prices are coming down.

Westinghouse 1921 Fans Join All-Black Group

With its 1921 line the Westinghouse Electric & Manufacturing Company joins the group of manufacturers favoring the all-black fan. A dull-black finish for the blades and guards as well as the motor and base is the feature of the Westinghouse line. Previously the blades and guards were highly polished brass, coated with a transparent lacquer. The Westinghouse six-blade fans will be discontinued this year.

Otis Elevator Plants Operating Near Normal

Plants of the Otis Elevator Company, it is reported, are now being operated near normal on the accumulation of orders which were piled up earlier in the year when bookings were more than double plant capacity. For the past three months, it is understood, orders have been falling off, but the company is optimistic and believes that new construction cannot be held back in spite of declines in other markets.

Intermountain Electric's Annual Sales Convention

The annual sales convention of the Intermountain Electric Company was held at the Commercial Club, Salt Lake City, from Dec. 6 to 11 inclusive. One

of the features of the convention was a two-day series of demonstrations and lectures by representatives of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company, known as the "Better Merchandising Shows."

Among the principal speakers at the convention were Lafayette Hanchett, president, and C. B. Hawley, vice-president and general manager of the Intermountain Electric Company. Factory representatives of a number of the large electrical and automobile accessory companies were in attendance at the convention. C. C. Campbell, sales manager, had charge of the program.

The Requa Electrical Supply Company, Rochester, N. Y., has increased its capital stock from $50,000 to $100,000.

The Wateree Electric Company, Jersey City, N. J., has filed notice of increase in capital stock from $7,500,000 to $30,000,000.

The Capital Lampagraph Company, St. Louis, is planning to remove its main offices to Chicago. It also contemplates establishing a new plant at Indiana Harbor, Ind. The company manufactures electric lighting equipment, electrically operated phonographs, etc.

The Louisville Electric Manufacturing Company, 660 South Second Street, Louisville, Ky., has awarded contract for the erection of a one-story plant, 60 ft. x 150 ft., for the manufacture of portable electric tools.

The Exide Battery Depots, Inc., 101 West End Avenue, New York City, a subsidiary of the Electric Storage Battery Company, Philadelphia, has filed plans for the erection of a two-story building at Spring and Clark Streets, to cost about $115,000.

The Tubular Woven Fabric Company, Pawtucket, R. I., will open a Pittsburgh office in charge of Gray Jones, formerly of the Cutler-Hammer Company. This is effective Jan. 1, 1921.

The Conveyors' Corporation of America, Chicago, announces the appointment of the Hallidie Machinery Company, L. C. Smith Building, Seattle, Wash., as its representative in Washington and Oregon. The Hallidie company is twenty years old. Philip Rowe is president, W. S. Dyson vice-president, Archie McLean secretary, and George Henderson treasurer.

The American Brass Products Company, Pottstown, Pa., has filed notice of increase in capital stock from $150,000 to $250,000.

The Howell Electric Motors Company, Howell, Mich., is planning to double the output of its plant within the next few months. The company recently increased its capital stock by $250,000.

The Rumsey Electric Company, 1007 Arch Street, Philadelphia, in celebration of its twenty-fifth birthday, has issued a thirty-two-page booklet showing by illustrations the officers and personnel of the company and the various departments of its organization.

The Frank H. Stewart Electric Company, Old Mint Building, 37-39 North Seventh Street, Philadelphia, has published a 667-page catalog, No. 22. Descriptions of the chief characteristics of the various articles listed are given as a feature of the publication of this twenty-five-year-old supply jobber.

Foreign Trade Notes

ELECTRIC HEATING IN AYLESBURY, ENGLAND. The housing committee of the Borough of Aylesbury has decided that electrical heating apparatus shall be installed in the bedrooms of houses that are now being erected.

PROPOSED POWER DEVELOPMENT IN PUNJAB, INDIA. — Plans are under way for development of a hydro-electric plant in the chief centers of Punjab. The Punjab Hydro-Electric and Industries Association has been organized with headquarters at Delhi, and negotiations are under way for supplying electricity at Rawalpindi, Multan, Lyallpur, Jullundur, Sialkot and Gujranwala. The association contemplates developing electric power on four canal falls, to be operated as one system, which will supply electricity in considerable area of country north of the Chenab River.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN PORTUGAL.—The Portuguese Minister of Commerce, it is reported, has appointed a commission to study the matter of utilizing the water powers of the rivers of Portugal for the purpose of furnishing hydro-electric power for railway, industrial and lighting purposes. The proposed project would involve an extensive system of dams, with a view to conserving water from the winter rainfall to last through the summer. Two engineers, Senhores Fernando de Souza and Vicente Riberio, have been nominated by the representatives of the Portuguese National Railways to sit with the commission.

BRITISH EXPORT REGISTER OUT.—The export register of the Federation of British Industries has been published by that federation, 39 St. James Street, London, S. W. Among the 650 pages are given the federation's constitution, aims, etc., list of members with their manufactures classified, and advertisements.

THE AMERICAN CHAMBER OF COMMERCE IN LONDON, 8 Waterloo Place, Pall Mall, London, S.W.1, England, has issued a year book of this chamber for 1920, in which are listed the names, addresses and business classification of more than 1,000 American and British firms, including electrical manufacturers, interested in developing business between the two countries.

ELECTRIC PLANT AT EVANS BAY, NEW ZEALAND.—The City Council of Wellington, New Zealand, contemplates a number of improvements, among which are the erection of an electric power station, tramway extensions, new car sheds and cars, to cost about £664,887.

DEMAND FOR ELECTRIC LIGHTING EQUIPMENT IN NETHERLANDS EAST INDIES.—Trade Commissioner John A. Fowler reports that there is a steady demand for electric lighting installations up to 40 kw. for estates, sugar factories, machine shops and other industries in the Netherlands East Indies. Small lighting sets of 50-lamp and 100-lamp capacity are also selling as rapidly as they can be imported for residences and the smaller plantations. Lists of engineering and machinery importing houses handling this business have been prepared and placed on file in Bureau of Foreign and Domestic Commerce.

WATER-POWER DEVELOPMENT IN NEW ZEALAND. — Tenders have been asked for equipment for the initial installation at the new hydro-electric generating station at Lake Monowai, Southland, New Zealand, consisting of two 3,000-kw. units, together with accessory equipment. The plans provide for an ultimate capacity of six 3,000-kw. units. A set of specifications, drawings and tender forms covering this installation has been placed on file for consultation at the New Yok office of the Bureau of Foreign and Domestic Commerce, Department of Commerce, 734 Custom House, New York City. A brief description of the equipment may be obtained from any of the bureau's district and co-operative offices by requesting circular FE-194.

ELECTRIC MANUFACTURING BUSINESS IN GERMANY.—A survey of the situation of the electric manufacturing industry in Germany recently made by a director of the Siemens-Schuchert Company, one of the largest electric engineering and construction firms in Germany, shows that in 1920 not more than 30 per cent of pre-war production of high-tension cables will be turned out. The condition in the wire, motor and installation industries is also bad. But few orders are being placed for power-plant equipment, the owners apparently being uneasy over the question of socialization. In 1919, 70,000,000 marks' worth of lamps were produced. Before the war 50 per cent of Germany's production was exported, but at present less than 25 per cent is exported. Foreign competition, it is said, is much keener than before the war.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An engineering and trading company in India (No. 34,156) desires to be placed in communication with manufacturers of direct and semi-indirect lighting fixtures, switches, motors, farm-lighting plants, fans and heating appliances, etc.

An American residing in India (No. 34,162) desires to receive catalogs and approximate prices on Diesel oil engines of from 100 hp. to 1,500 hp. or more, both in two-cycle and four-cycle types, these to be considered for both industrial plant and central-station service.

The manager of a mercantile company in China (No. 34,164) is in the United States and desires to purchase and to secure an agency for the sale of electrical goods, etc.

The managing director of an engineering company in India (No. 34,168) desires to receive catalogs and general information for the purchase of modern electrical hospital equipment, both for electric treatment and for signaling, communication, etc., and also of electric passenger elevators.

A trading company in India (No. 34,171) desires to secure catalogs and quotations from manufacturers only of direct-current electric ceiling fans for 220 volts and 110 volts, and also of electrical novelties and toys.

New Apparatus and Publications

ELECTRIC FURNACE. — The Detroit (Mich.) Electric Furnace Company, issued a fourteen-page illustrated booklet describing its rocking electric brass furnace.

ELECTRIC FURNACE.—The Industrial Electric Furnace Company, Chicago, has published supplement C to bulletin 40, on repelling arc furnaces.

THERMOSTATIC METAL — The H. A. Wilson Company, 97 Chestnut Street, Newark, N. J., is circulating a book entitled "Wilco Thermostatic Metal," in which it describes the special process of the manufacture and the uses of thermostatic metal.

POWER TRANSMISSION.—The Baldwin Chain & Manufacturing Company, Worcester, Mass., has issued catalog F, covering its power transmission chains and sprockets, including roller chains, block chains, special chains, sprockets, etc. The company has issued bulletin No. 14, describing the selection of a chain drive and also bulletin No. 17, giving data on sprockets for roller and block chains.

POWER PLANT SPECIALTIES. — The Plant Engineering & Equipment Company, 192 Broadway, New York City, has issued a twenty-page catalog covering its "Peeco" specialties, including steam traps, separators, strainers, regulating devices, blowers, steam and electric pumps, meters, etc.

ELECTRICAL TESTING INSTRUMENTS. — "Hunting Down Electrical Troubles" is the title of a pamphlet issued by the Burton-Rogers Company, 755 Boylston Street, Boston, sales department for Hoyt electrical instruments, describing the use of the rotary meter, cell tester, cadmium meter and magneto tester in locating difficulties on storage-battery systems. The company has also issued a small pamphlet entitled "The Cadmium Test," describing in detail the reason and method of making the Cadmium test on storage batteries

ELECTRICAL INSTRUMENTS. — The Hoyt Rogers Company, 755 Boylston Street, Boston, Mass., sales department for the Hoyt electrical instruments, has issued a catalog of Hoyt electrical instruments, including dashboard, miniature switchboard, large switchboard and portable instruments.

OILERS. — The Eagle Manufacturing Company, Wellsburg, W. Va., has issued catalog No. 20, covering its different types of oilers.

ELECTRIC ARC WELDING.—The U. S. Light & Heat Corporation, Niagara Falls, N. Y., has issued bulletin 700, entitled "Electric Arc Welding," in which it describes "USL" arc-welding machinery.

PORTABLE LAMPS.—The Empire Lamp & Brass Manufacturing Company, 426 South Clinton Street, Chicago, has issued catalog No. 60, in which it describes and illustrates its different types of portable electric lamps.

SMALL TURBO-GENERATOR SETS.—The General Electric Company, Schenectady, N. Y., has published bulletin No. 42,010A, which supersedes bulletin No. 42,010, describing and illustrating the small Curtis steam-turbine generating sets. These generating sets have a capacity of 100 kw. to 300 kw. and are mounted on a common base with turbine and gearing.

New Incorporations

THE GREENVILLE (N. C.) STORAGE BATTERY COMPANY has been incorporated with a capital stock of $50,000 by W. G. Downing, W. T. Bryan and J. K. Proctor. The company proposes to manufacture storage batteries.

THE MARSHFIELD FARM ELECTRIC COMPANY, Marshfield, Wis., has been incorporated by R. T. Finucane, J. P. O'Connell and J. P. Adler. The company is capitalized at $20,000 and proposes to manufacture electric generating units and appurtenances for farms and isolated plants.

THE FENNIMORE (WIS.) PRAIRIE ELECTRIC & POWER COMPANY has been incorporated with a capital stock of $25,000 by R. M. Orchard, Anton Eisele and Emil Schwer.

THE SPRECHER MANUFACTURING COMPANY, Milwaukee, Wis., has been incorporated with a capital of $100,000 to manufacture lighting fixtures. The incorporators are R. J. Piehler, A. A. Sprecher and Peter W. Sprecher, proprietor of the Milwaukee Gas & Electric Fixture Company, 1910 Fond du Lac Avenue.

THE ADELPHI LIGHTING FIXTURE COMPANY, Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 by L. Newman, J. Fenner and I. Barnett, 1379 St. John's Place, Brooklyn, N. Y.

THE WRANGELL MINING, PULP & POWER COMPANY, Wrangell, Alaska, has been incorporated by William D. Grant, Donald Sinclair and others. The company is capitalized at $1,000,000 and proposes to supply electricty for mining purposes.

THE INSTANTO ELECTRIC COMPANY, Maysville, Ky., has been incorporated with a capital stock of $25,000 by E. H. Knapp, Clement Finch and Andrew Clooney. The company proposes to manufacture electrical devices.

THE A. J. FELZ COMPANY, Boston, Mass., has been incorporated by S. Felz, Hyde Park; E. M. Dangel and Morris Linsky. The company is capitalized at $5,000 and proposes to manufacture electrical equipment and supplies.

THE GENERAL RESEARCH CORPORATION, Providence., R. I., has been incorporated by Patrick P. Curran, Henry C. Hart and Karl Farkas, 147 Wheeler Avenue, Cranston, R. I. The company is capitalized at $300,000 and proposes to manufacture electrical specialties.

THE E. A. KOENEMAN ELECTRIC COMPANY, East St. Louis, Ill., has been chartered with a capital stock of $20,000 by Charles C. Koeneman, C. H. Chapline and Albert G. Ziesk, 214 Collinsville Avenue, East St. Louis, Ill. The company proposes to manufacture electrical devices, etc.

THE NEW ENGLAND PRODUCTS COMPANY, INC., Mianus, Greenwich, Conn., has been incorporated with a capital stock of $300,000 to manufacture machinery, electrical equipment, etc. The incorporators are: B. L. Marsh, G. G. Knowles and C. F. Hoyt, 307 Atlantic Street, Stamford, Conn.

THE W. J. McNELLIS COMPANY, Waterbury, Conn., has been chartered by D. J. Stevens, J. J. and W. J. McNellis, 198 Grand Street, Waterbury. The company is capitalized at $75,000 and proposes to manufacture electrical equipment.

THE ELECTRIC POWER EQUIPMENT CORPORATION, Trenton, N. J., has been incorporated with a capital stock of $25,000 to manufacture electrical equipment. F. W. Dinsmore, 709 Greenwood Avenue, is treasurer.

THE J. C. BOGGS MOTOR & LIGHT COMPANY, Lewisberg, W. Va., has been incorporated by J. C. Boggs, John A. Littlepage, Lewisberg, and W. A. Charleton, Hinton, W. Va. The company is capitalized at $50,000 and proposes to manufacture automobile lighting equipment and other accessories.

THE GOLD SEAL STORAGE BATTERY COMPANY, Green Bay, Wis., has been incorporated by F. J. Mankin, E. J. Bolza and T. J. Best. The company is capitalized at $300,000 and proposes to manufacture storage batteries.

THE WINNSBORO (TEX.) LIGHT & ICE COMPANY has been incorporated by Mrs. K. A. Campbell, R. C. Campbell and Mrs. J. W. Rhone. The company is capitalized at $60,000 and proposes to erect an electric light plant and ice factory.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 7, 1920)

1,361,991. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 11, 1917. Railway-vehicle motors.

1,361,992. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 11, 1917. Electric railway vehicles.

1,361,993. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 7, 1917. Booster.

1,361,994. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 7, 1917. Electric railway vehicles.

1,361,995. System of Control; Rudolf E. Hellmund, Swissvale, Pa. App. filed Oct. 13, 1917. Automatic regulation of electric-vehicle motors.

1,362,007. Brush Holder; Herbert G. Jungk, Pittsburgh, Pa. App. filed Oct. 8, 1917. Cannot move.

1,362,008. Telephone Receiver; John C. Kane, Detroit, Mich. App. filed Oct. 21, 1919. Radio.

1,362,018. Cell Post and Method of Mounting Same; Warren P. Loudon, Niagara Falls, N. Y. App. filed Jan. 26, 1918. Prevents escape of electrolyte.

1,362,020. Telephone System; Albon E. Lundell and Edgar H. Clark, New York, N. Y. App. filed Dec. 10, 1917. Automatic.

1,362,029. Commutator Cylinder; Chester B. Mills, East McKeesport, Pa. App. filed Dec. 8, 1917. End connector.

1,362,049. Explosion-Proof Device for Electrical Apparatus; Charles W. Starker, Pittsburgh, Pa. App. filed Aug. 30, 1916. Pressure valve.

1,362,059. Electric Condenser; Philip Thomas, Edgewood Park, Pa. App. filed Sept. 28, 1917. Outer layers protected.

1,362,060. Electric Heater; Frank Thornton, Jr., Mansfield, Ohio. App. filed June 29, 1918. Radiant.

1,362,072. Magnetic Ore Separator; Horace W. Arnold, Vancouver, Wash. App. filed Nov. 17, 1917. Drum type.

1,362,081. Double-Frequency Distributing System; Lewis W. Chubb, Edgewood Park, Pa. App. filed Jan. 10, 1917. Over common mains.

1,362,082. Manufacture of Copper Plates for Process Printing; Sherard O. Cowper-Coles, Sunbury-on-Thames, England. App. filed March 15, 1920. Electrolytic.

1,362,084. Electrical Commutator; Richard S. Dahl, Charlottenlund, Copenhagen, Denmark. App. filed Oct. 27, 1919. Core of insulating material.

1,362,096. Telephone System; Charles L. Goodrum, New York, N. Y. App. filed April 24, 1917. Telephone and telegraph messages transmitted simultaneously.

1,362,126. Telephone System; William H. Matthies, Hackensack, N. J. App. filed Feb. 20, 1917. Control of signaling.

1,362,138. Induction Coil; Edward J. Pratt, New York, N. Y. App. filed Nov. 15, 1917. Repeating coil.

1,362,140. Carbon Holder; Harold D. Regar, Reading, Pa. App. filed Dec. 13, 1919. For use in arc lamps.

1,362,159. Composition for Electrolytes for Electrical Etching; Joseph Henry Weeks, Rutledge, Pa. App. filed April 4, 1917. Formulas.

1,362,166. Process for Extracting Zinc from Ores; Frederick Laist, Anaconda, Mont. App. filed Jan. 5, 1920. From mixed ores.

1,362,206. Electrolier Structure; Robert J. Ward, Philadelphia, Pa. App. filed Jan. 17, 1920. Ornamental fixture for connecting table lamps, vacuum cleaners, etc.

1,362,221. Compensating Wire Support; Charles C. Blackmore, Dayton, Ohio. App. filed June 7, 1918. Spring takes up slack on telephone line.

1,362,227. Cigar Lighter; Dudley B. Clark, Bemus Point, N. Y. App. filed Aug. 6, 1920. Electrically heated.

1,362,289. Storage-Battery Separator; Daniel A. Grieb, Indianapolis, Ind. App. filed May 24, 1920. Slotted sheet.

1,362,294. Electric Storage Battery; Edward Hacking, Central Falls, R. I. App. filed Dec. 17, 1919. Lead plates and sulphuric acid.

1,362,295. Electrolyte for Electric Storage Batteries; Edward Hacking, Central Falls, R. I. App. filed Dec. 17, 1919. Pumice combined with sulphuric acid.

1,362,301. Motor-Control System; Walter L. Hamilton, Holyoke, Mass. App. filed June 17, 1920. For paper-machine motors.

1,362,303. Electric Incandescent Lamp; Francis Harrison, London, England. App. filed July 8, 1919. Means for placing the filament.

1,362,337. Protective Device; David T. May, New York, N. Y. App. filed Oct. 23, 1918. Telephone arrester.

1,362,349. Non-Arcing Commutating-Switch Device; Louis Paulero, Petersburg, Va. App. filed July 22, 1915. For electric hammers, etc.

1,362,351. Electric Heating Device; William A. Rankin, Chicago, Ill. App. filed Aug. 15, 1918. Ribbon adapted to be stitched.

1,362,356. Instantaneous Electric Water Heater; Louis J. Schneider, Milwaukee, Wis. App. filed March 15, 1920. Controllable by flow of water.

1,362,358. Automatic Controller Cut-Out; Greer M. Shearer, Chicago, Ill. App. filed Feb. 17, 1917. For cranes, hoists, elevators, bridges, etc.

1,362,359. Segregated Drive for Paper Machines and the Like; Newton Shuttleworth, Rugby, England. App. filed Sept. 2, 1920. Sections run in fixed but adjustable-speed relationship.

1,362,375. Winding for Electrical Apparatus; Magnus Unger, Pittsfield, Mass. App. filed July 16, 1918. Oil will thoroughly permeate.

1,362,380. Electrical System for Aëroplanes and the Like; Lionel M. Wolffsohn, Weehawken, N. J. App. filed March 13, 1917. Small weight.

1,362,383. Apparatus for Wireless Telegraphy and Telephony; William E. Beakes, New Orleans, La. App. filed April 19, 1919. Reduces effect of static.

1,362,386. Ignition System; Joseph Bijur, New York, N. Y. App. filed June 7, 1919. Hot ignition spark.

1,362,388. High-Tension Insulator; Francis O. Blackwell, Englewood, N. J. App. filed July 17, 1915. Suspension insulator.

1,362,432. Flashlight Attachment for Firearms; Cora M. Masters, Clarkton, N. C. App. filed Jan. 24, 1918. Hung below barrel.

1,362,452. Motor Attachment; Walter B. Uffert, Rochester, N. Y. App. filed Jan. 28, 1919. Automatically stopping when bearings become worn.

1,362,464. Telephone Attachment; Charles Baum and Edgar H. Talbert, Washington, D. C. App. filed Oct. 10, 1917. Lever released by insertion of coin.

1,362,491. Automatic Welding Machine; Otis A. Kenyon, New York, N. Y. App. filed Sept. 13, 1919. Feed mechanism.

1,362,492. Variable-Reactance Reactor; Friend H. Kierstead, Pittsfield, Mass. App. filed March 27, 1920. For controlling Birkland-Eyde arc furnaces.

1,362,497. TURBINE-DRIVEN SET; William J. A. London, Springfield, Mass. App. filed Sept. 13, 1917. Short length.

1,362,543. DYNAMO-ELECTRIC MACHINE CONSTRUCTION; Adolph E. Seinecke, Cincinnati, Ohio. App. filed Feb. 3, 1917. End-ring connection.

1,362,553. APPARATUS FOR CONTROLLING ELECTRIC CIRCUITS; Gustaf F. Bagge, New York, N. Y. App. filed May 15, 1915. Flasher sign.

1,362,554. STORAGE BATTERY; James Balzano, New York, N. Y. App. filed Nov. 20, 1919. Simultaneously charged and discharged.

1,362,574. LIGHT EXTINGUISHER FOR ARC LAMPS; Elmer A. Sperry, Brooklyn, N. Y. App. filed May 5, 1916. For preventing afterglow.

1,362,575. FEEDING MECHANISM FOR SEARCHLIGHTS; Elmer A. Sperry, Brooklyn, N. Y. App. filed Feb. 7, 1917. Electrode holders.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BIDDEFORD, ME. — The Biddeford & Saco Water Company contemplates the expenditure of $30,000 for replacing steam power with electricity at the pumping station. Steam power will be used as an auxiliary.

MONROE, N. H.—The Grafton-Caledonia Power Company of this place contemplates the development of electric energy to supply Monroe and a number of other towns.

GROVELAND, MASS.—At a recent town meeting it was voted to appropriate $2,500 for improvements to the municipal electric system for additional service.

WAKEFIELD, MASS.—At a special town meeting it was voted to appropriate $25,000 for rebuilding the municipal light plant.

NEW BRITAIN, CONN.—It is reported that the power house at the woodworking plant of J. Pinches & Son, 67 Church Street, has been damaged by fire.

Middle Atlantic States

LONG BEACH, N. Y.—The village trustees have filed application with the State Public Service Commission for authority to establish a system for furnishing light. Bonds to the amount of $200,000 have been voted, and it is proposed to construct a power house and overhead distribution system.

BLOOMFIELD, N. J.—Scott & Bowne, 80 Orange Street, have plans under way for the construction of a power plant. An addition to their local cod liver oil factory is also contemplated. The total cost is estimated at $80,000.

PERTH AMBOY, N. J. — The Perth Amboy Dry Dock Company, foot of Broad Street, contemplates the installation of an improved floodlighting system and a general plant-lighting system to allow for operations during a twenty-four-hour period.

WEEHAWKEN, N. J. — The Cunard Steamship Company, 24 State Street, New York City, will defer awarding the contract for its proposed new freight terminal at this place. The project includes a number of piers and warehouses, a large central electric power plant and electrically operated equipment. The cost is estimated at about $30,000,000.

PECKVILLE, PA.—It is understood that the Scranton Coal Company, Scranton, has plans under way for the rebuilding of its power plant and coal washery at this place, reported to have been recently destroyed by fire, causing a loss of about $250,000.

PHILADELPHIA, PA.—Plans have been filed by the Standard Engineering Company, Thirtieth Street, for the erection of a power house, 24 ft. x 35 ft. x 60 ft.

READING, PA. — Arrangements have been made by the Metropolitan Edison Company for a bond issue of $100,000, the proceeds to be used for plant extensions and betterments.

SCRANTON, PA.—The Delaware, Lackawanna & Western Railroad Company, Hoboken, N. J., is considering the erection of a large power station in Scranton and the electrification of pusher engines for service between this place and the summits, east and west of the city.

MARTINSBURG, W. VA. — Plans are under way for the rebuilding of the switchboard department of the Potomac Light & Power Company, recently destroyed by fire, causing a loss of about $20,000.

WINCHESTER, VA.—The Front Royal-Riverton Milling Corporation, Riverton, contemplates the erection of a dam across the Shenandoah River, for power development.

WASHINGTON, D. C.—According to report being prepared by Major M. C. Tyler, in charge of the local engineer office, the development of 45,000-kw. to 50,000 kw. from Great Falls is possible. Major Tyler's estimate also includes the erection of high-tension transmission lines and three substations in connection with this project.

North Central States

BLISSFIELD, MICH.—A special election will be held on Jan. 11 for the purpose of submitting to the voters a proposition to issue bonds to the amount of $30,000 for improving the electric light plant.

GRAND RAPIDS, MICH. — The Consumers' Power Company contemplates the erection of an addition to its power house to cost about $400,000. G. L. Erwin is manager.

KINDE, MICH.—The Central Light & Power Company, Bad Axe, is planning to furnish electrical service to this village.

OTSEGO, MICH. — The MacSim-Bar Paper Company, A. B. Thomas, president and general manager, is having preliminary plans prepared for the erection of a power plant. B. M. Baxter, Merian Building, Cleveland, Ohio, is structural and mechanical engineer.

TIPPECANOE, IND. — An organization to be incorporated as the Tippecanoe Power Company with a capital stock of $3,000,000 plans to begin work in the spring on the construction of dams and power units along the Tippecanoe River to develop current for several of the larger towns in northern Indiana. Surveys have been made and preliminary plans prepared by J. A. Shafer, engineer, 310 Odd Fellows' Building, Indianapolis.

ANTIGO, WIS.—The city officials contemplate the installation of an ornamental street-lighting system to include forty-six standards. G. O. Palmiter is city clerk.

TAYCHEEDAH, WIS.—Bids will be received by the State Board of Control, Madison, until Jan. 11, for furnishing for the Industrial Home for Women at this place equipment including two 50-kw. direct-connected, engine-type, 230-volt generating sets with duplicate balancer sets of 10 kw. each; switchboard and distribution system; two 600-hp. open-type feed-water heaters; two turbine-driven centrifugal circulating pumps, 300 g.p.m., 150-ft. head, or two direct-acting steam pumps, same service, etc. A Peabody, Capitol, Madison, is engineer.

SWIFT FALLS, MINN.—The city officials contemplate the development of water power at this place. The cost is estimated at $40,000. W. E. Skinner, 15 South Fifteenth Street, Minneapolis, is engineer.

THOMSON, MINN.—The Duluth Edison Electric Company of Duluth has made petition for right-of-way for the construction of a transmission line from the power plant of the Great Northern Power Company at this place to Duluth. It is proposed to erect the new line in the spring.

NEVADA, IOWA.—The Iowa Light & Power Company contemplates the erection of an independent electric plant in this city.

JOPLIN, MO.—The Empire District Electric Company, 414 Joplin Street, has been authorized to issue bonds to the amount of $1,725,000 under its first mortgage, the proceeds to be used for extensive improvements to its plant.

LEXINGTON, MO.—The Missouri Gas & Electric Service Company contemplates improvements to its plants at Richmond, Liberty, Orrick and Lexington.

ST. JOSEPH, MO.—The City Council and W. K. Seitz, city engineer, are making investigations as to the possibilities for securing electrical energy from Kansas City for this place. The estimated cost of the erection of a line direct to St. Joseph is $500,000. E. M. Lindsay is president of the council.

MOUND VALLEY, KAN.—Bonds to the amount of $25,000 have been voted for electrical improvements in the city. W. B. Rollins & Company, 210 Railway Exchange Building, Kansas City, Mo., are engineers.

Southern States

DURHAM, N. C.—The Southern Power Company, general office at 511 Fifth Avenue, New York City, has filed notice of $4,000,000 increase in capital for general expansion.

RALEIGH, N. C.—The Carolina Power & Light Company plans to make additions to its plant connected with the operation of the street railway. The cost is estimated at $51,600.

WINSTON-SALEM, N. C. — The street-lighting committee of the Chamber of Commerce has launched a campaign for the raising of $20,000 for an ornamental street-lighting system.

TYBEE, GA.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 12 for the erection of a radio building at Tybee Island.

GALLATIN, TENN.—The City Council of Gallatin is negotiating with the Union Traction Company of Nashville for furnishing this place with power. Plans include the erection of an 18-mile transmission line and the construction of a substation at some point between the two cities. The present power station at Gallatin is inadequate to meet the needs of the city but will be retained for emergency.

AMORY, MISS.—The City Commission contemplates the erection of an electric light and water plant, for which bonds have been issued.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by H. Carroll, city comptroller, until Jan. 3 for the purchase of $1,005,000 municipal light and power plant bonds of 1919, Series No. 2, and $1,000,000 of 1918, Series K. The proceeds from the sale of the first issue above referred to will be used for the installation of 20,000 hp. of additional machinery, penstocks and equipment at the Cedar River hydro-electric plant; for receiving transformers for this power to be used in Seattle, etc. The proceeds of the second issue will provide for a transmission line and receiving station in Seattle, in connection with the Skagit River project.

SEATTLE, WASH.—The Great Northern Railroad, King Street, has had plans prepared by Robert Herzog Company, engineers, for the erection of a fuel-oil plant for the generation of additional electric power.

ASTORIA, ORE.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 5 for the erection of a radio building at this place.

LOS ANGELES, CAL.—Bids will be received by the Department of Public Service until Jan. 18 for furnishing distribution and small power transformers. J. P. Vroman is secretary.

LOS ANGELES, CAL. — Announcement has been made by J. B. Miller, president of the Southern California Edison Company, that the Federal Power Commission has accepted its application for a preliminary permit to develop 2,500,000 hp. of electrical energy from the waters of the Colorado River. According to Mr. Miller the total possible hydro-electric development of the river is more than 4,000,000 hp.

MODESTO, CAL.—W. I. Carpenter, city electrician, and G. Freitas, city engineer, have been appointed by Mayor Ulrich to investigate the possibilities of Modesto generating its own electric power.

PASADENA, CAL.—The City Commission is considering the erection of a dam in San Gabriel with a power plant in Eaton's Canyon for an increase in the capacity of the water supply.

AMERICAN FORK, UTAH.—Estimates and plans are being prepared covering the cost of improvements to the street-lighting system.

AMMON, IDAHO.—The Utah Power & Light Company, Salt Lake City, Utah, has been granted a fifty-year franchise covering the right to maintain and operate electric light and power lines in this village.

STAR, IDAHO.—A delegation of farmers consulted the Public Utilities Commission as to the necessary steps to take to have a transmission line erected between this place and Nampo, a distance of 5 miles.

Canada

BRANTFORD, ONT.—Announcement has been made by Chairman Wedlake of the Hydro-Electric Commission of this place that the power house on Greenwich Street will be extended for the installation of duplicate equipment for increased service.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 10, 1921.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa. Annual meeting, Atlantic City, N. J., April 21-23.

AMERICAN ENGINEERING STANDARDS COMMITTEE. Secretary, P. G. Agnew, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, S. E. Dillon, Hot Springs, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto. Annual meeting, Jan. 27 and 28, Toronto.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Co., Montreal, Canada.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, M. B. W. Baker, Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

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ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-treasurer, E. Donald Tolles, 52 Broadway, New York City.

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ELECTRICAL MANUFACTURERS' CLUB. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

ELECTRICAL MANUFACTURERS' COUNCIL. Executive secretary, Frederic Nicholas, 522 5th Ave., New York City.

ELECTRICAL SAFETY COUNCIL. Secretary, Dana Pierce, 25 City Hall Place, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADE ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Canada.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill. Annual convention, Chicago, Ill., Dec. 9.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Arthur J. Binz, Houston, Tex.

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NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ASSOCIATION OF RAILWAY AND UTILITY COMMISSIONERS. Secretary, James B. Walker, Public Service Commission of the State of New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive manager, M. H. Aylesworth, 29 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, B. H. Conlee, Nebraska Gas & Electric Co., Beatrice, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND GEOGRAPHIC DIVISION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTH CENTRAL GEOGRAPHIC DIVISION, N. E. L. A. Secretary, H. E. Young, Minneapolis General Electric Co., Minneapolis, Minn.

NORTHWEST GEOGRAPHIC DIVISION, N. E. L. A. Secretary, L. A. Lewis, Washington Water Power Co., Spokane, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST GEOGRAPHIC DIVISION, N. E. L. A. Secretary, S. H. Taylor, Electric Railway & Manufacturers' Supply Co., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC RELATIONS SECTION, N. E. L. A. Chairman, J. E. Davidson, Omaha, Neb.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

ROCKY MOUNTAIN GEOGRAPHIC DIVISION, N. E. L. A. Secretary, A. C. Cornell, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, Guaranty Building, 522 5th Ave., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTHEASTERN GEOGRAPHIC DIVISION N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

SOUTHWESTERN GEOGRAPHIC DIVISION. N. E. L. A. Secretary, H. A. Lane, Oklahoma Utilities Association, Oklahoma City, Okla.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

TECHNICAL SECTION, N. E. L. A. Secretary, W. C. Anderson, 29 West 39th St., New York City.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vermont.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Annual convention, Detroit, Mich., Jan. 25-27, 1921.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, Wis., March 23-24.

Electrical World

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Interesting the Lowly in Investments

HENRY L. DOHERTY has embarked on a thrift advertising campaign which is noteworthy. Much might be said for or against the copy appeal of "Personal —but Not Confidential"; but we are not here concerned with the execution so much as with the motive. The admonition to save is always in order and when followed ends in profit. What is of consequence to the industry is that Mr. Doherty advises that the savings be invested in public utility securities. His appeal, moreover, is more altruistic than selfish, for he does not press the prospective investor to come to him or invest in the securities of his companies. "Go to any investment banker for counsel and advice," is the burden of his message, and, of course, every investment banker and public utility operator gains, if only indirectly, whenever a convert is made for public utility investments. In this respect the advertising campaign is like the quality of mercy, "it blesses him that gives and him that takes." Mr. Doherty is to be commended for his enterprise and his initiative, his faith in the industry, and withal his belief in the efficacy of advertising.

Financial Burdens and Low Rates

LAST week our statistical department submitted an estimate of the requirements of the electric light and power industry for the next four years. This forecast was predicated on the past performance of central electric stations and the actual, not the theoretical, cost of their equipment. If the rate of growth continues as it has during 1920 and the fourteen years prior to it, the electric light and power companies must spend on a conservative basis a billion dollars a year for new developments and extensions to existing systems. Whether it can raise that amount of new capital in addition to meeting maturing obligations is problematical on present rate schedules. There would be no doubt of the outcome if earnings were ample, but if that consummation is to be reached either labor and material costs must come down or rates must go up. It is idle to imagine that the industry can continue much longer on the present basis, temporizing with coal clauses and what not, when straight increases are not only essential but imperative. Managers may not like to face the issue, but it is futile longer to dodge the facts. Nothing entering into the manufacture of electricity has been reduced in cost during the past five years. Everything has gone up in price, but the average charge for the electricity produced has hardly budged from the pre-war basis. A few mills have been timidly added here and there when nothing short of cents would avail. It is time to forget self-pity, and if the wind is not tempered to the shorn lamb, then the lamb must accumulate enough fat to keep it from freezing. It is senseless to sacrifice one's self on the altar of public service needlessly. The electric light and power companies of the country should simplify their rate schedules and increase them at the same time.

Bushwhacking Politicians and the Utilities

POLITICIANS when sore beset often try to evade their pursuers by drawing a herring across the trail. Sometimes they succeed and sometimes they do not. Investigations now under way in New York City reveal the city administration in any but an enviable light. Ignorance and inefficiency are its chief characteristics. The situation reminds one of the story of a chef who while he made excellent doughnuts was an abominable cook. His soups were greasy, his meats tough and his vegetables soggy. On being reprimanded for spoiled and indigestible meals, the chef was able to point with pride to his doughnuts and save his pate. When, however, the magic of his doughnuts wore off and his menus finally became intolerable he was discharged. The public utilities of New York City, groaning under many years' burdens of rising costs, have applied to the Public Service Commission for relief, and in most instances increases in rates have been granted to them. Immediately the city administration, goaded to desperation by the Lockwood committee tries to shift the public viewpoint by attacking the utilities and the commission which granted them the increased rates. We doubt, however, if the herring is strong enough to throw the public off the scent. The administration may pride itself on the way it has whacked the public utilities, but that can hardly suffice to appease the public wrath. The doughnuts may be fine, but the major portion of the meal will not down.

Getting the Facts for Engineering Solutions

ENGINEERING attack upon his problems is given as the reason for Herbert Hoover's success in handling the tremendous task of feeding Europe. The engineering point of view is more and more held to be necessary for the proper solution not only of engineering problems but also of many others. It seems to give the most rational promise for bettering living conditions. "Get the facts first, then propose the solution," should be the rule. A survey of the transmission and distribution systems of the nation shows that there is need for the application of more consistent and thorough engineering. The mechanical structure has received much consideration, the electrical design has not been neglected, but to the economical design has not been given its due share of thought. Design in each one of these three classes, mechanical, electrical and econom-

ical, is necessary to successful results. The most economical line consistent with good service should be the end sought by the engineer in transmission and distribution layouts. The working out of this principle is the object of a series of articles on the application of engineering economics to the problem of transmitting electrical energy from the central station to the customer, the first installment of which is printed in this issue of the Electrical World. This week's article is devoted to the general methods of engineering attack upon these problems. The correct point of view is emphasized, and the methods of getting the facts are outlined. With the ever-growing realization of the value and necessity of conserving our national resources, this discussion of economical principles applied to a branch of electrical work that has been somewhat neglected should prove timely.

Power Transmission at 220,000 Volts

TRANSMISSION at 220,000 volts will be brought into the realm of actuality at a very near date. The subject has been up for several years, growing in interest with the realization that something superlative in the way of voltage is necessary for the larger work of long-distance transmission. In the Electrical World last week Messrs. Barre and Jollyman, engineers respectively of the two greatest California transmission systems, laid down the plans now under way for the next advance in voltage. Both the Southern California Edison Company and the Pacific Gas & Electric Company are facing situations where this radical step seems necessary. The former within a year or two will find the Big Creek 150,000-volt lines fully loaded, and before the stations can be further strengthened something will have to be done for the lines. Two new 150,000-volt transmission circuits would double the capacity, but the same thing would be accomplished at less than 20 per cent of the cost by increasing the present line voltage to 220,000. The latest equipment has been ordered with this transmission voltage in view—a generator capable of controlling the voltage on a 220,000-volt line when backed up at the far end by a 30,000-kva. condenser. The transformers can be connected for 220,000 volts, and a 30-mile section of one of the existing lines is being set apart and equipped for insulation tests. When certain practical questions have thus been settled a part or all of the main line is to be changed over.

There are several possible schemes for raising the voltage, choice among which will be made in accordance with the information derived from the experiments. The whole main transmission of 240 miles will probably be involved in the final change at no distant day. The Pacific Gas & Electric Company has also a transmission line of about the same length from its Pit River plant, with an ultimate capacity of 450,000 kva., to the districts along San Francisco Bay. The investigation of the economic conditions shows very clearly that 220,000 volts is fully justified for the work in hand. The obvious difficulties of dealing with such a voltage are the requirements for transformers, for circuit breakers, for insulators, and finally for means of dealing with the increased capacity and charging currents. Long experience with a solidly grounded neutral on the high-tension lines has brought conviction that the same plan should be carried out at 220 kv. The transformers will actually involve less insulation difficulty than some of those now in use on delta connection, and it is believed that the bushing problem has been successfully solved. The matter of circuit breakers deserves serious consideration, particularly with reference to the circumstances of their use, a study of which may lead ultimately to less strenuous requirements. The line voltage seems well within grasp as regards its insulation, but certainly the grading question should have the most thorough consideration before determining on the ultimate methods to be adopted. The charging current must undoubtedly be dealt with by means of synchronous condensers, or their equivalent, at the receiving end of the line. A 200-mile, 60-cycle, 220-kv. circuit requires more than 40,000 kva. charging current, which emphasizes the importance of condensance in one form or another. The first Pit River unit will be in operation by the end of the coming year, and that period will probably be marked by the actual initiation of the first commercial 220,000-volt line on one or the other of the great California systems that are here concerned.

The Growth of Industrial Motor Service

IT IS no small task to make a census of the industrial load served by central stations, but we believe that we have reached a fair measure of success in the work, the results of which we presented to our readers last week. The data accumulated cover the five years ended with Dec. 31, 1919, and show with extraordinary force the fundamental nature of the central-station industry as related to manufacturing. In 1919 there was sold to power users more than 22,000,000,000 kw.-hr. The use of power increased with particular rapidity during the war, but the causes underlying that increase are still operative, and unless the costs of fuel and of labor should change in a way altogether unexpected, a power demand of more than 30,000,000,000 kw.-hr. by the end of 1924 can be foreseen. In 1914 only 7,500,000,000 kw.-hr. was sold to power users, so that the decade involved will foot up to a fourfold increase.

The load thus gained is very unevenly distributed, bearing perhaps a closer relation to the completeness of electric distribution service than to anything else. This fact in turn shows that the chief hindrance to rapid growth of power load is in facilities for distribution and not in the legitimate demand for power. Such an upheaval in fuel costs as the last few years have seen will not subside for many years to come, if ever. It has completely upset the old balance between central-station service and privately operated plants. The cases in which the latter show any real economy are now so rare as to be almost negligible in the totals. Generation and distribution on a large scale give an advantage not only in first costs of energy but in diversity factor that is hard to overestimate. If the prosperity of the country goes forward, as there is every reason now to hope that it will, unimpeded, and the power projects now on foot are to a reasonable extent carried through, we are inclined to think that our estimate for the end of 1924 will fall materially short of the tremendous truth. The public has rapidly learned the advantages of central-station power under the stress of the last five years, and that factor in the situation cannot be evaluated in the discussion of mere statistics. It is time to be up and doing with power supply on a scale never before attempted.

Improved Power-Station Design Makes for Economy

OUR brief résumé of power-station design last week, prepared by Peter Junkersfeld, expresses with admirable conciseness the general drift of improvement. Stations today must be designed for high efficiency, and while there is a possibility that the fuel situation may relax it is very doubtful whether costs will ever again fall low enough to give an economic advantage to cheap plants of low efficiency. First cost may be at times burdensome in its addition to general expense, but with fuel 75 or 80 per cent of the cost of production capital charges where they signify improvements for real efficiency are well justified. Nevertheless, every care should be taken to make a dollar do a dollar's work, and the drift of practice leads directly toward this result.

The use of boilers of much greater capacity than those employed a few years ago has been accompanied by a realization that the furnace as much as the boiler plays an important part in efficient operation. Recent practice sets boilers particularly high with ample furnace space, and there is a healthy tendency to plan furnaces and stokers for readily available fuel rather than for the high grades of much-traveled steam coal which used to be considered necessary. Oil burners have been materially improved, but, as we have many times suggested, their use is special rather than general. The only point where Mr. Junkersfeld's paper shows practice to be lagging is in the matter of auxiliary appliances, like economizers, tending materially to promote efficiency. Designers have shown an inclination to avoid the constructional difficulties in economizers by adopting things easier to build but which do not perform quite so well in the matter of heat recovery. We think that constructors will have to take their medicine in this matter, just as they will be forced to do in superheating —a point in which American practice has been particularly slow to improve.

In electrical equipment as in boilers the tendency has been toward the bigger units and more substantial, somewhat simplified equipment. The accidents of a few years past have impressed upon the minds of engineers the need of blocking destructive short circuits and in particular installing means for cutting out an internally damaged generator before it can wreck or upset the station output. Finally, it is to be noted with satisfaction that all apparatus which can be successfully designed for outdoor installation is being located out of doors. We have been preaching outdoor substation work for the last decade despite the wagging heads of ultra-conservatives, and it is a pleasure now to be able to see the practice becoming general.

Where Fuel Should Be Conserved

ADVERTING to the general questions of conservation, so vigorously discussed by the American Society of Mechanical Engineers recently, it is undoubtedly true that our natural gas is going fast and that oil is fairly on the road. Over and over of late we have discussed the question of fuel-oil burning, always with a solemn warning that the impending scarcity is likely to make it uneconomical. What the government can do in this very serious situation is a little hard to say unless it can establish more rigid regulation of the quality of the fuel produced or can steady the production of the coal mines, which now are run chiefly on the principle of waiting until orders are received and then hustling.

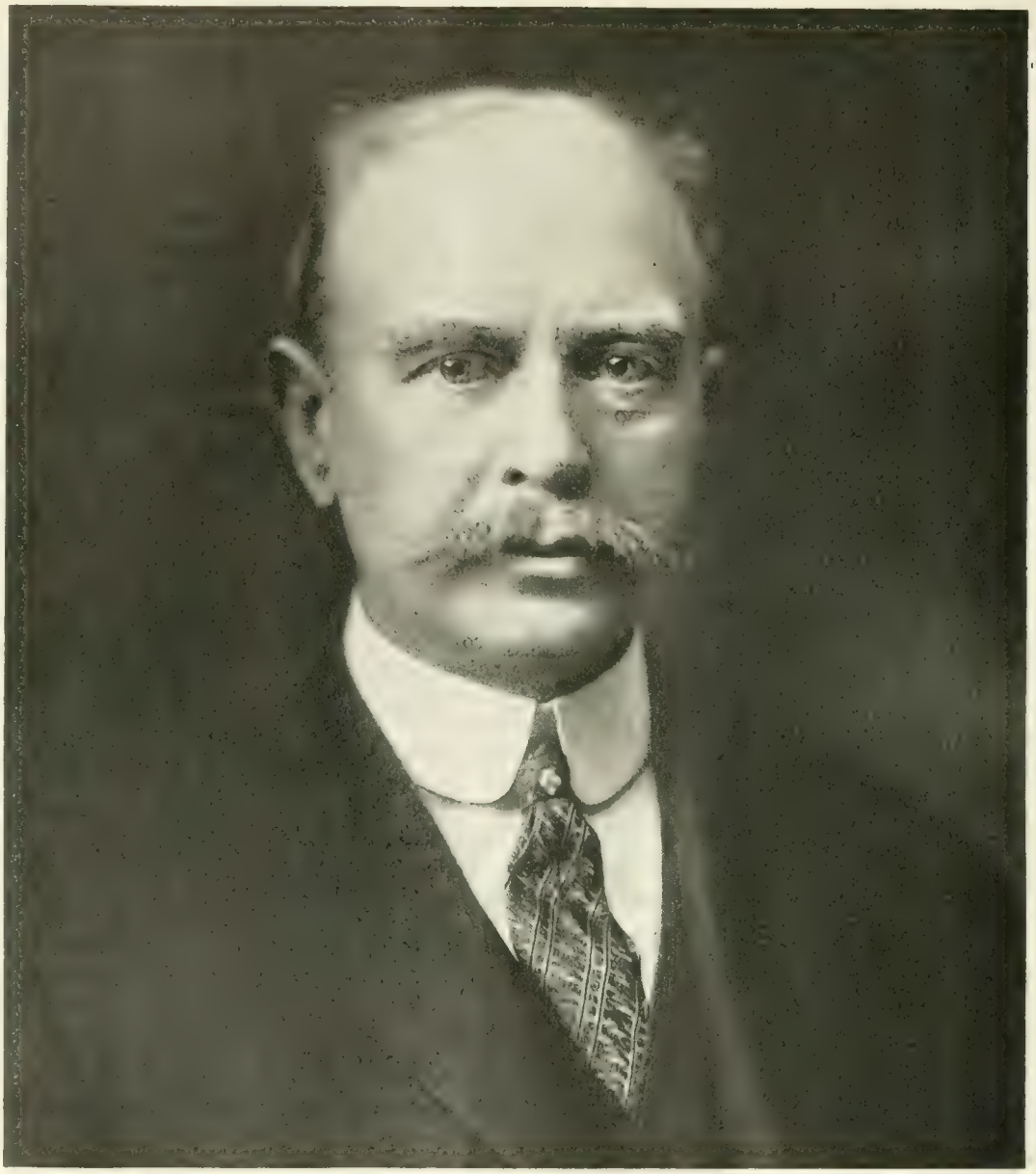
Perhaps the greatest opportunity, looking at the subject in the large, lies in the better utilization of coal through separating the volatile from the solid carbonaceous material by low-temperature distillation, using the former for byproducts and gas and the latter for fuel. This may ultimately not only save great waste but lead to a solution of the domestic fuel difficulty, admittedly very grave. Considering the fact that there is reckoned to be within known reach less than two hundred tons of unmined anthracite for each inhabitant of the country, something should be done and done quickly. If domestic heating and private plants were in the least comparable in efficiency with central-station working, there would be far less fear for the future.

Combining Canal and Power Projects in Germany

IT IS perhaps putting it too strongly to say that the German Republic is beating its cannon into waterwheels, but with the coming of peace, such as it is, there has been an awakening with respect to hydroelectric developments. Three combined canal and hydro-electric projects are in fact just now under consideration. Germany is far from rich in coal, and the supply available is cut down by the terms of peace so that use can be found for all the transmitted power which can be generated. At the beginning of this year the electrical industry was nationalized by empowering the state to take over any transmission system above 50,000 volts or exceeding 5,000 kw. in rating not already in use exclusively for private purposes. The indication is therefore that the German Republic will in the near future possess the entire high-tension system and be able to carry out a complete project of interconnection. The schemes now under way are technically of more than usual interest since they are in the main bound up with canal projects. The German rivers are extensively used for minor shipping purposes, long stretches of them being provided with mechanical haulage with this object in view.

One of the projects is on the Neckar, allowing an extension of the Rhine marine traffic over nearly 150 miles (240 km.), with the utilization of 5,650 cu.ft. (160 cu.m.) of fall a second. Another is a revival of the Rhine-Danube canal project long ago considered, and a third involves canal construction on the Moselle and the Saar. It is not easy to realize that the extreme headwaters of the Danube are in the Black Forest country within 25 or 30 miles (40 km. or 50 km.) of the Rhine, but such is the fact, and through parts of Bavaria canal navigation in the line of the Danube might be practicable.

While the economic outcome of the several schemes seems somewhat doubtful, yet in part at least the utilization of streams for the double function of navigation and power might succeed through the combination of these utilities, which alone would not find sufficient justification. The total amount of power available by the full development of these schemes runs high, to something like 10,000,000,000 kw.-hr. annually. None of the projects is as yet far enough advanced to be seriously disclosed in engineering details.



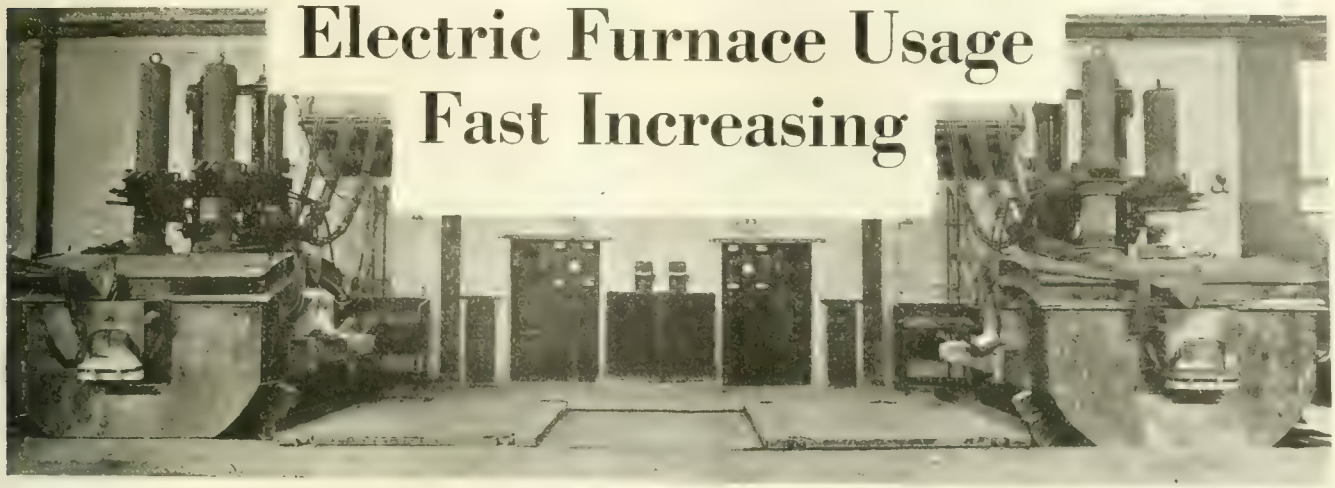
Louis Bell

Publicist and author; a consulting electrical engineer of international reputation who in his pioneer work laid the foundation for the later progress that has been made in electric power transmission and in illuminating engineering

MOST consulting electrical engineers engage in a designing and construction practice as well, but there are some who devote their time purely to consultation. They are to the electrical industry what eminent consulting physicians are to the medical profession. Among those who have achieved well-merited recognition in Europe as well as in the United States is Dr. Louis Bell, who for the past twenty-five years has been engaged in consulting engineering practice in Boston.

Dr. Bell was one of the first to give scientific and engineering attention to illumination. He is a charter member and past-president of the Illuminating Engineering Society and a past vice-president of the Illuminating Engineering Society of Great Britain. For years his book on the "Art of Illumination" was the only available volume on illuminating engineering. Furthermore, Dr. Bell for the last thirty years has been one of the largest and most respected contributors to the engineering literature of the industry. Besides the volume on illumination he has written "Electric Power Transmission," for years the standard treatise on this subject; "The Electric Railway" (with Oscar T. Crosby), the first systematic treatise on the subject, and "Power Distribution for Electric Railways," which has gone through a number of editions. The subject, however, to which he has given most attention and on which his work is probably best known is power transmission. He lectured on that subject at the Massachusetts Institute of Technology for ten years, and he was secretary of the power transmission section of the International Electrical Congress at St. Louis in 1904. He was editor of the ELECTRICAL WORLD from 1890 to 1892, when he resigned to become chief engineer of the newly organized power transmission department of the General Electric Company. In this capacity he designed and installed at Redlands, Cal., in 1893, the first three-phase transmission plant for general service and installed the first polyphase transmission plant for cotton-mill drive and for electric railway operation at Taftsville, Conn. His pioneer work in the early '90s in power transmission and in the development and application of the induction motor was of the greatest importance in placing these branches on an engineering and commercial basis. Before the war he conducted abroad investigations of electric lighting and central-station practice in Europe.

Dr. Bell was born Dec. 5, 1864, and was graduated from Dartmouth in 1884. Four years later he received his doctor's degree from Johns Hopkins University, where he had specialized in physics. That year he went to Purdue University, where he organized the course in electrical engineering. In addition to his very active work in the electrical field Dr. Bell finds time for studies in other lines, chiefly in relation to ordnance.



Electric Furnace Usage Fast Increasing

More than 220 Non-Ferrous Furnaces Installed During 1920—Total Connected Furnace Load Estimated at 880,000 Kva., of Which 410,000 Kva. Is in Commercial Furnaces—Electric Steel Output Reduced

ONE of the very striking features of electric furnace development in the United States during the past year has been the rapid rise of the non-ferrous furnace to a prominent position. This year's survey made by the ELECTRICAL WORLD shows that more than 222 non-ferrous furnaces were installed during 1920, adding a connected load of 24,405 kva. to the energy requirements of the country.

Steel furnaces have not maintained the pace set in the banner year of 1918, when ninety-seven installations were added, the past year showing an addition of only fifty-two installations, with a capacity of 183¾ tons, calling for 50,440 kva. in transformers.

On Jan. 1, 1920, it was estimated that a total of 491 furnaces of all classes were installed in the United States, of which 62 per cent were steel furnaces, 35 per cent non-ferrous furnaces and 1.5 per cent reduction-of-ore furnaces, while the remaining 1.5 per cent were used in special processes. The first of 1921 sees the situation somewhat changed, with an addition of 274 commercial installations, making a grand total of 765 furnaces in the United States. There are no records available of the changes in the number of special process furnaces, not listed as commercial furnaces, but it is probable that the number was small. Based on last year's totals and this year's additions (see Tables I and II) 356 steel furnaces, or 46.5 per cent of the total, and 394 non-ferrous furnaces, representing 51.5 per cent of the total, are installed. The 2 per cent left represents, as far as is known, the number of special furnaces.

TABLE I—NON-FERROUS FURNACE GROWTH HAS BEEN RAPID, JUDGING BY 1920 INSTALLATIONS

Name	No	Total Tonnage	Total Kva., Approx.	Material Handled
Ajax Wyatt (induction)	96	30 hourly	5,760	3 Red brass 93 yellow brass
Bailey (resistance)	55	368 24 hour capacity	5,075	Red and yellow brass, bronze, aluminum, glass, zinc, tin
Booth (rotating)	40	½ to 2	6,530	Principally brass
Detroit (rocking)	20	20 hourly	5,475	Bronze, brass, copper, aluminum, gray iron
Rennerfelt (three-phase)	7	2	875	Nickel alloys, silver, bronze, aluminum, yellow brass
Snyder (single-phase)	2	600 lb.	160	Monel metal
Snyder (single-phase)	1	1	450	Bronze
Snyder (single-phase)	1	300 lb.	80	Bronze
	222		24,405	

The 750 furnaces represent a connected load of 410,000 kva., which does not take into account the special furnaces for which no definite records are available. It is stated by an authority that the aluminum production for 1920 was 150,000,000 lb. with an energy requirement of 1 kw.-yr. for each 400 lb. produced. On a basis of a 100 per cent load factor and twenty-four-hour daily operation, a reasonable assumption for this process, this would call for 375,000 kva. transformer capacity. The aluminum industry is said to make up 80 per cent of the special furnace load. An estimate on this basis of the total special requirements would indicate a load of 470,000 kva. The entire electric furnace load of the country would therefore be placed at 880,000 kva.

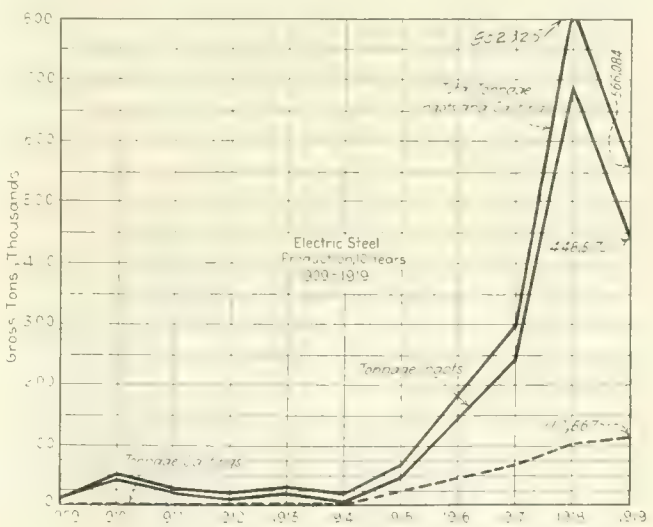


FIG. 1—TOTAL ELECTRIC STEEL PRODUCTION, INGOTS AND CASTINGS, FOR PAST TEN YEARS

In the year 1919, as shown by last year's survey in the ELECTRICAL WORLD,* ninety-two brass-furnace in-

*Jan. 17, 1920, issue.

TABLE II—ELECTRIC STEEL FURNACE INSTALLATIONS IN UNITED STATES DURING 1920

Name	No.	Total Tonnage	Kva. Approx.	Material Handled
Gronwall-Dixon	13	53	17,500	Scrap
Booth	2	4	1,600	Steel scrap
Heroult	11	40	10,000	Three manganese-steel castings, three ingots, four castings
Snyder	6	13½	7,290	
Rennerfelt	5	1½	725	High-speed steel, soft steel testing
Moore	4	9½	3,450	Castings
Ludlum	3	19	5,375	Castings, Tool Steel
Webb	2	7	1,600	Steel
Greaves-Etchells	6	6	2,900	Castings
	52	153¾	50,440	

stallations were made, while in the year 1920 there were 222 additional installations. The additional connected load of 24,405 kva. that this represents goes toward making up the estimated total connected load of 50,000 kva. for all non-ferrous furnaces now operating in this country.

Probably one of the principal reasons for this unusual growth has been the recognition of the value of electric melting of brass. It would be a conservative estimate to state that at least 75 per cent of furnaces of this type are working on red and yellow brass, while the other 25 per cent of installations are melting tin, aluminum, copper, nickel alloys, zinc, tin, glass, etc.

Many reasons have been advanced why the electric furnace is gaining ground in the brass foundry, but probably those of ease of temperature control and uniformity of product are deciding factors. That the basic reasons have been verified in practice is very evi-

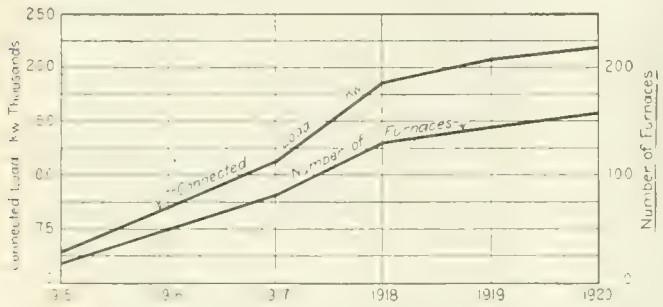


FIG. 2—ELECTRIC STEEL FURNACE DEVELOPMENT HAS MEANT A LARGE INCREASE IN CONNECTED LOAD

dent from the continued application of the electric furnace to such work.

Rolling and rocking arc-type furnaces are apparently predominating in non-ferrous work, judging by number and rating, but that does not mean that there are not strong advocates for resistance and induction-type furnaces. More general application of automatic electrode control to the arc-type furnace has been helpful in reducing the labor charge against the arc furnace. The absence of any electrodes has been a strong argument for both the resistance and induction types. Experimental work is still going forward with all types of the non-ferrous furnace, and with improvements in operation methods the field will no doubt be attacked with renewed vigor during the coming year.

One of the rather interesting points in connection with furnace development has been the demand for this

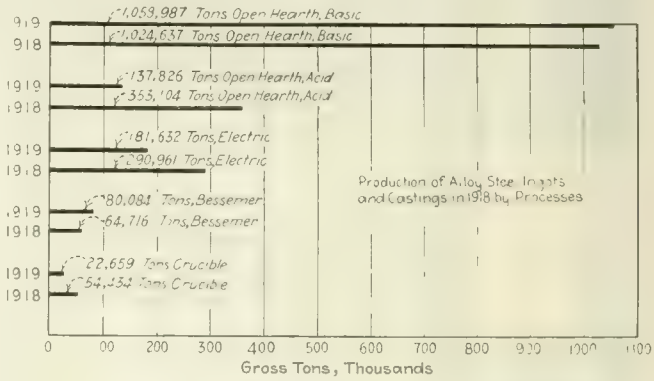


FIG. 3—ALLOY STEEL PRODUCTION BY PROCESSES FOR 1918 AND 1919

As shown by these curves illustrating the growth of the Heroult furnace, the number of furnaces and the connected load has assumed large proportions.

equipment in other countries. About fifteen equipments were sold abroad. Bailey furnaces went to the following countries: Norway, two for zinc; England, one for brass; Mexico, one for brass; Japan, one for brass; Canada, three for brass. Shipments of the Rennerfelt furnace were made to: Colombia, one for silver; Java, one for ore reduction; Sweden, one for tool steel. The Detroit furnace installed three furnaces in Japan and one in France.

TONNAGE OF ELECTRIC STEEL WILL PROBABLY SHOW DECREASE FOR 1920

While no authentic figures are yet available to show the production of electric steel during 1920, it seems to be the consensus of opinion that this year will be a decrease in output, not because of lack of advantages but owing to market conditions. As shown in Fig. 1, the production of steel by electric processes during 1919 decreased 236,241 gross tons from the year 1918, when the output was 802,325 gross tons. The output in 1919 was 566,084 tons, and in all probability it will not exceed 450,000 tons during 1920.

TABLE III—ELECTRIC STEEL AND TOTAL STEEL PRODUCTION IN UNITED STATES (GROSS TONS)

Year	Open-Hearth	Bessemer	Steel Ingots and Castings—Crucible	Electric	Miscellaneous	Alloy Steels Open Hearth, Bessemer, Crucible	Electric	Total Production	Per Cent Electric
1909	14,943,936	9,330,783	107,355	13,762	9,185	.....	.....	23,955,021	0.58
1910	16,504,509	9,412,772	122,303	52,141	3,194	.....	.....	26,094,919	0.2
1911	15,598,650	7,947,854	97,653	29,105	2,844	.....	.....	23,676,106	0.123
1912	20,780,723	10,327,901	121,517	18,309	2,853	.....	.....	31,251,303	0.058
1913	21,599,931	9,545,706	121,226	30,180	3,831	.....	.....	31,300,874	0.096
1914	17,174,684	6,220,846	89,869	24,009	3,662	.....	.....	23,513,030	0.102
1915	23,679,102	8,287,213	113,782	69,412	1,527	.....	.....	32,151,036	0.216
1916	31,415,427	11,059,039	129,692	168,918	604	.....	.....	42,773,680	0.395
1917	34,148,893	10,479,960	126,716	304,543	495	.....	.....	45,060,607	0.675
1918	34,459,391	9,376,236	115,112	511,364	329	1,496,891	290,961	46,250,284	1.74
1919	26,948,694	7,271,562	63,572	384,452	2,952	1,299,556	181,632	36,152,420	1.59

*Estimated

The extraordinary increase in use of electric steel furnaces was due in large part to war orders and the greater demand for electrical steel. No doubt the application of the electric furnace to making steel ingots and castings was advanced several years by the war. Nevertheless, the growth of this furnace business was in a very healthy state during the past year, and when production of steel is again pressed to the maximum the tonnage output of electric steel should reach surprising figures. Electric steel has become a staple product, and its quality and uniformity are effective arguments in keeping it one.

The electric furnace is becoming an important factor in power loads. The past year saw the addition of 47,970 kva. in steel furnaces, and yet the growth was probably not normal. The Heroult furnace alone has added 216,900 kw. in connected load, most of which has been added since 1915. It is estimated that the total electric furnace load in the United States is 360,000 kw., so it can be seen that the Heroult furnace dominates the electric steel business.

During 1920 the patent rights of the United States Steel Corporation on the Heroult furnace expired. Possibly this fact will tend to stimulate the production of electric steel by independent manufacturers who have heretofore had to operate under license rights if Heroult furnaces were used.

As shown in last year's survey, the total number of steel furnaces in the United States was 304, and with the installations of 1920 the total is 356.

There are now 174 Heroult furnaces installed, 156 of which are in the United States and the remainder in Canada. Of these 174 steel furnaces 100 are used for making ingots and seventy-four for steel casting, while three are used in miscellaneous works. The predominating size of furnace is the 6-ton rating, of which there are ninety-three in operation. The next size in popularity is the 3-ton rating, thirty-three of these having been installed. There have been only two of the largest, or 35-ton, size installed.

The predominating sizes of steel furnaces during 1920 were below 6 tons, the average being about 3 tons, although the Ludlum Furnace Corporation installed a 10-ton furnace for melting scrap.

About 75 per cent of the non-ferrous furnaces ranged around the 500-lb. capacity size, although a number of 1,000-lb. and 2,000-lb. (450-kg. and 900-kg.) furnaces were installed. As the majority of these furnaces are melting brass, which, except in the large foundries, is needed only in small quantities at a time, the small furnace is adapted for the work. There were ninety-six installations of the Ajax Wyatt furnace, ninety-three working on yellow brass and three on red brass. The total hourly capacity is 60,000 lb. (27,000 kg.).

Economics of Electrical Distribution

Application of Fundamental Underlying Principles to the Problem of Transmitting Electrical Energy from the Central Station to the Consumer—Indicates How the Most Economical Installations Consistent with Good Service Can Be Determined

By P. O. REYNEAU* and H. P. SEELYE†
Detroit Edison Company

TRANSMISSION and distribution systems represent a large part of the total investment in any central station, but their study from an economic point of view has seldom had sufficient attention. It is true that much valuable information may be found scattered through engineering literature, but there is a need of bringing together the factors involved in such a study and of discussing the subject as a whole. With this purpose in mind the authors have prepared a series of articles based on studies of actual problems encountered in practice. It is fully realized that this series cannot cover in detail the field of distribution and transmission economics, but it is hoped that the presentation of the fundamental underlying principles and the solution of a few problems will serve to indicate methods that can be applied quite generally to such problems.

What Can Be Obtained from Application of Engineering Economics

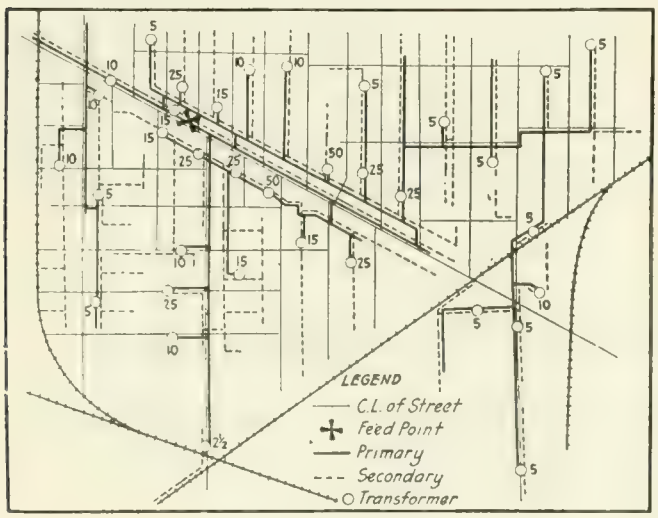
The results obtained are made obvious by comparing the two figures and by glancing at Table I, without going into the detailed computation required to ascertain the most economical design. An example of such computation will be given later. The table shows that with a smaller investment, reduced inspection and testing requirements a larger load can be carried. Neither is it within the scope of this series to consider unusual problems, such as transmissions at very high voltage, for example, or installations of special apparatus the use of which has not become accepted practice. Rather, the general purpose will be to make a few analyses that will indicate methods of finding the most economical design under every-day conditions with material of known characteristics and at known prices. Such analyses will, naturally, not only indicate the most economical installation with materials and construction methods already in use but will make it possible to determine where any economy can be effected by changes in these methods or materials.

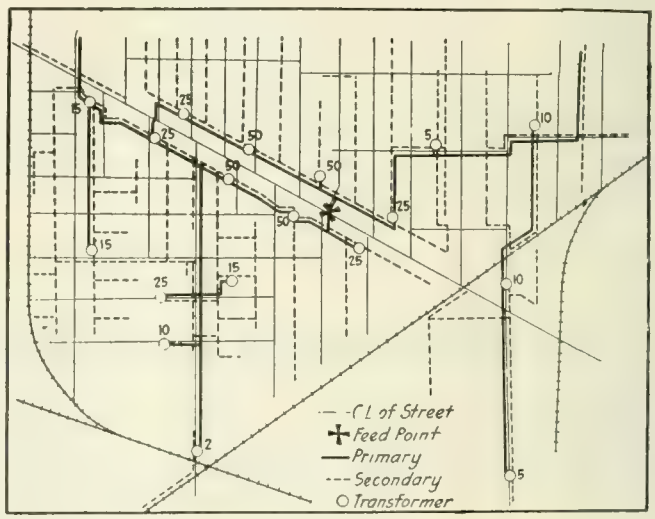
It is hoped that the methods presented will, on the one hand, show the magnitude of the savings possible by the use of engineering economics and, on the other hand, will be found simple enough in their application to be considered worth using in many places where more empirical or rule-of-thumb methods are used today.

Practically all problems of engineering design require for a complete solution treatment in three distinct stages. At first all the data must be obtained that can be determined with exactness. Such elements as mate-

*Distribution Engineer. †Distribution Department.

rial costs, strength of parts of construction, load tests, etc., are here included. Second, those elements which are not subject to exact measurement or computation must be decided upon. These are usually a development from practical experience over a number of years and are often matters of accepted standard practice. They are such items as probable increase in load, allowable voltage regulation, safety factors, standards of construction, etc. Empirical methods must here be employed. The third element is the most intangible—the good judgment of the engineer based on his knowledge and experience and applied to the particular problem in hand to utilize the first two elements so as to create an efficient and economical design best adapted to the situation. All these elements in their proper proportions are equally important in attaining the most satisfactory solution for any problem. Empirical methods, if applied blindly, may lead far away from the purpose for which they were originally intended. Judgment based on experience alone is liable to become a mere guess unless supported by exact knowledge and good practice. It would appear, therefore, that the further the exact data can be carried in a problem the less dependence need be placed on the more intangible elements, and hence the greater certainty of the best solution. The extension of this exact knowledge is the chief purpose of the study of the economic features of a problem. In many cases economy may be made the deciding factor between two or more designs apparently equally good from other points of view.





FIGS. 1 AND 2—A TYPICAL CIRCUIT IN THE SYSTEM BEFORE AND AFTER IMPROVEMENT

Exact Data

For any given system there are a number of limiting conditions which reduce the unknown factors in the design. There are certain standards, such as transformer sizes, wire and cable sizes, etc., which are established by the manufacturer. Other limitations are established by the accepted good practice of the profession in general. Moreover, each company has certain standards of materials and construction to which it is wise to adhere unless there is a clear advantage in making a change. The most complete information obtainable on all such data relating to the particular system in hand should be kept available for ready reference. Other items which can only be obtained exactly for the one locality or company, such as costs of material, labor and energy, should be determined as accurately as possible and be revised from time to time to conform to changing prices, wage scales and costs of production. This information can be readily kept up to date and tabulated or drawn up in curves. Then only such factors as are inherent to the particular line itself need be determined in making the design.

Empirical Data

Some of the empirical elements of the problem of transmission and distribution of energy are worthy of considerable attention. One of these is the element of "good service." It is understood that in any design or layout the greatest economy "consistent with good service" is the object. Just what is good service may be a matter of considerable question.

Good Service.—Good service is not dependent on the ideas of the engineer or the "server" as to what it should be. Service is good when it satisfies the one that is served. That man who at the receipt of his bill feels that he has received all that was due him is receiving good service. He is willing to exchange his money for what he has received from the server.

The human element is therefore the most important one in determining good service. Customers will expect operating conditions as good as or better than they have been in the habit of getting. Companies have, so to speak, educated their public to certain expectations, and they must live up to such expectations. It is evident, however, that it is impossible to eliminate all interruptions or conditions of poor regulation. In thickly populated districts with a high load density practically continuous service at good voltage is easily given. In outlying, scattered districts the cost of the same quality of service would be prohibitive. From the company's point of view the service must be of good enough quality to

TABLE I—EXAMPLE OF ECONOMICS MADE POSSIBLE THROUGH APPLICATION OF PRINCIPLES DISCUSSED IN THIS SERIES

	Before Change	After Change
Number of transformers	35	18
Transformer capacity, kva	492	412
Available increased capacity in excess of peak load of 350 kw., per cent	0	20
Wire removed, lb.	8,500	....
Wire installed, lb.	5,600	....

insure earnings and yet not so good as to necessitate too large expenditures. It is therefore necessary, before attempting to solve a transmission or distribution problem economically, to ascertain what quality of service is required from both the customer's and the company's point of view.

Good service can therefore be determined only in a general way and will vary with locality, company, kind of load, etc. It might be said, however, that with the modern refinement of methods and equipment and the nearly universal high requirement of the customer we are approaching more and more a condition when wide variation of voltage and long or frequent interruptions will hardly be permissible.

Increase in Load.—A second quantity which must be empirically determined is that of load increase. The variation of loads to be carried and the growth of energy demand that is prevalent in nearly all localities

TABLE II—INTERDEPENDENT FACTORS TO CONSIDER IN STUDYING LAYOUT OF AN ECONOMICAL LINE

(1) Load	Location Present size Probable increase and rate of increase Characteristics: Phase requirements Power factor Variation, daily, weekly, seasonal, etc., and relation to station variations and peak Unbalance factor Maximum Load factor	
(2) Route of Line	Investigation of advisability of possible routes, affected by: Available pole or duct space Purchase of right-of-way Difficulties in construction Interference with or from other lines, physically or electrically Convenience of operation Possible future extensions Effect on system as a whole Cost as compared with other possible routes	
(3) Physical Constants	Length of line Spacing Voltage—desired —available Resistance of line Reactance Voltage drop Regulation—desired —available	Under various line conditions as limited by: 1. Good operation 2. Standard practice 3. Routing 4. Economical considerations 5. Good service
(4) Costs	1. Determination of: Labor costs Material costs Energy loss costs 2. Application of those costs to determine the best line for the purpose	For all conditions considered
(5) Relations to System	General considerations that may affect most economical line found above under (4) owing to its being a part of a large system Financial considerations	

are always matters for considerable study in connection with a layout. There are cases where it is possible to design for a certain demand that can be assumed to remain constant for a period of years, possibly for the life of some part of the equipment. Such would be the case in planning lines to a large power installation where growth could be taken care of by new circuits. On the other hand, such a load as house lighting increases continuously, and its increase can be estimated only from the figures for the past few years and general business conditions. In any case the design must be for a system that will be most economical over its useful life—in other words, when the sum of the annual costs for all years under consideration will be a minimum. It is further necessary to study as exactly as possible the number of years to be cared for by the present design and minor changes that can be made at various times during that period for taking care of the changes in load. Generally the design should cover the expected life of that part of the equipment whose life is shortest and which would require a large expenditure for its replacement. Any considerable change necessary to care for larger load could then be made at the same time with relatively smaller cost. In some cases, however, where the probable increase in load is more definitely known the economical life of the present design can be accurately determined even well within the expected life of all the important parts.

Financial Conditions.—The condition of the money market may be another determining factor in an economical design. Often the difficulty in securing necessary funds for a job may require the engineer to spend less at the time of installation than is consistent with economy over the period the design covers. However, the condition should be carefully considered in order still to obtain the best design as limited by the money available.

Relation of Parts to Whole System.—The fact that the transmission or distribution line is only one part of the system transmitting energy from the turbine to the customer must be kept in mind. Its design will affect and be affected by existing or planned conditions in the other parts. It is therefore always necessary to treat a line not only as an independent unit for some specific purpose but also as a working part of the whole system.

Bearing in mind the general considerations brought out above, the most important points to consider in studying the layout of an economical line can be determined from Table II. Methods of obtaining the data outlined and their application to particular classes of problems, such as transmission lines, power lines, secondaries, etc., will be discussed in future installments of this series. From inspection of this table it may be seen that the five divisions in it are in one way or another interdependent, so that each one must be considered in relation to all the others. It is only by a careful study of the problem from all angles and a co-ordination of results that a satisfactory solution can be obtained.

The articles which will be presented in later issues will take up means for obtaining and analyzing some of the most important data necessary for economic study; that is to say, the cost of material, labor and energy.

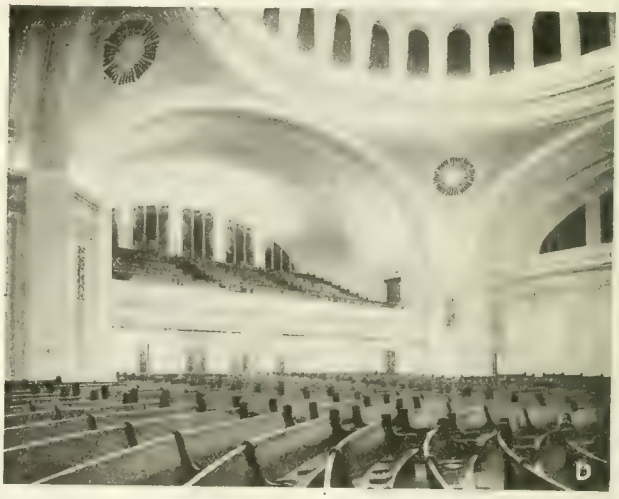
WE MIGHT *summarize our attitude toward investors in public enterprises in California by saying: We recognize your investment will result in common good. You are about to become a partner in an enterprise which will develop the community. We realize that the constitutions of the United States and of California and the laws enacted thereunder are designed to protect your investment against confiscation. We are in full accord with the spirit of these laws and propose to proceed in accordance therewith. Furthermore, we believe it to be sound policy and in the interest of the public that your investment be protected and that you be accorded reasonable returns thereon, recognizing, of course, that some risk attaches to all private enterprise. At the same time we inform you that you will not be permitted to make exorbitant profits nor will you be permitted to burden the consumers with poor service. Having said this to the investors, we should carry out our pronouncements honestly and consistently, not only as a matter of honor, but in the interest of the progress and development of the State.*—EDWIN O. EDGERTON, president California Railroad Commission.

Several Types of Lighting Which Are Giving Entire Satisfaction













A—Illumination is provided in this office without causing desk glare or eye fatigue from exposed brilliant filaments. The downward component of the light flux is directed through a textile diffusing medium, while the remainder of the flux illuminates the ceiling at about the same intensity as the lighting surface.

B—Fixtures which give combined indirect and diffused direct lighting are used in this drafting room, the usual objection to indirect lighting being offset by coating the ceiling with paint having a low absorption factor and practically no specular reflection. The units are hung low and carefully located, thus giving relatively high and uniform intensity at the work.

C—In this shop direct-indirect lighting is used without employing the ceiling as the reflecting medium. Instead the upper surface of the fixture redirects the lights, the lower bowl diffusing the direct light.

D—Cove lighting, while relatively inefficient compared with other forms of lighting, is often more effective in emphasizing architecture and illuminating large interiors like this.

E—Gas-filled lamps, the brilliant filaments of which are shielded from vision, illuminates this press room.

F—The R.L.M. reflector is becoming very popular in industrial plants, where ruggedness must be obtained, but not at the expense of good illumination.

Significant Developments in Illumination During 1920

Cost of Poor Lighting Is Very High—Street Lighting Is Still Improving—Ocular Advantage of Higher Intensities Is Shown—Use of Color in Lighting—Remodeling Old Fixtures Proves Practicable—Automobile Headlight Progress

By PRESTON S. MILLAR
General Manager Electrical Testing Laboratories

ONE of the silver linings of the war cloud was the throwing into relief of fundamentals as contrasted with the unrealities and superficialities which had formed so considerable a part of the scheme of things. The necessity for economy in production emphasized the importance of correct practice and sound engineering, the value of which was further demonstrated by the too numerous instances of poor performance growing out of failure to observe these fundamentals. Among other things, the practical value of good illumination as an aid to economy through increased production and enhanced safety gained a recognition under war-time stress which it had therefore failed to secure. One of the most significant evidences of this was the action of the United States Fuel Administration in exempting industrial lighting from fuel restrictions and curtailments, upon the theory that a given production would be attained with good ample illumination and with less expenditure of fuel than would be required for the same production under poor and low-intensity lighting.

A recent engineering estimate from liability insurance statistics has indicated that the annual loss occasioned by accidents attributable to poor illumination is equivalent to the time of 108,000 employees for one year. This statement commands attention even from the sordid viewpoint which ignores the humanitarian impulse to conserve life and limb. It imposes upon industry a duty so to improve lighting conditions as to avoid a large part of this annual waste of resources. In 1920 not a little has been accomplished in this direction, both in the direction of education and in the direction of actual improvement in lighting.

One of the most notable achievements of the Illuminating Engineering Society has been its assistance to legislators in the preparation of lighting requirements for safety codes which are influential in promoting good industrial lighting and in insuring correction of the lighting conditions which offer the greatest menace. Necessarily indefinite with respect to some of the elements of illumination which are difficult of codification, measurement and enforcement, the lighting codes have made a promising start in these particulars and have gone a little farther in the prescription of minimum intensity values for safety purposes—a matter which it is now practicable to cover by stipulations and measurements and therefore possible to police.

While it is a duty of industry to provide illumination adequate for the protection of workers, it is further the opportunity and privilege of industry to provide more effective illumination with a view to promoting efficiency and securing economy through facilitating operations and reducing spoilage. Reports from many sources indicate that manufacturers who have tried superior lighting are invariably convinced of its economic value, finding the small added lighting costs to be more than offset by the production economies effected. Obviously definite cost accounting to measure the advantages of good industrial lighting is difficult to obtain. Such figures as have been put forward, however, leave no room for doubt of the actual value of good lighting in the industries. Good lighting means of course light which is correct with respect to direction, diffusion and color and which is of ample intensity—intensity well up toward if not of the same order as the daylight intensity common in well-lighted interiors. With such lighting brightness and brightness contrasts are of values which promote ready and comfortable vision, shadows are helpful, not obstructive, and glare is avoided.

Big Advance in Industrial Lighting

Good industrial lighting has made a considerable advance during the past year. The manufacturers of lamps and lighting equipments have promoted the idea vigorously and central stations have devoted more attention to its promotion than formerly. For instance, a paper presented at the annual convention of the Illuminating Engineering Society called attention to a central-station campaign in Massillon, Ohio, which had attained such momentum that approximately 70 per cent of the industrial lighting of the town was brought into accord with modern ideas of good and effective illumination. The promotion of good lighting by commercial interests—constructive in its very nature—is of marked advantage to the industry of the country.

In the field of experiment a timely contribution has been made by C. E. Ferree and Gertrude Rand* to the literature of illumination by means of a report upon researches in the psychological laboratory at Bryn Mawr College. When illumination intensities are increased throughout and up to about the highest intensities contemplated for artificial illumination the eye's reaction is wholly favorable. Without any evidence of discomfort or strain there results increase in visual acuity, increase in speed of visual discrimination, increase in speed of adjustment for vision at different distances and increase in ability to sustain acuity. Furthermore, these experimenters find that whereas under low intensities of illumination astigmatic and aged eyes suffer diminution in effectiveness more than do normal eyes

*See ELECTRICAL WORLD, Nov. 6, 1920, page 910.

under relatively high intensities the disparity is less pronounced, so that the handicap of subnormal vision is of lesser consequence under high-intensity illumination. This experimental work, partly confirming general observation and partly supplying new data from which to deduce conclusions, offers a scientific basis for explanation of part of the economic advantage found to arise from improvement in industrial lighting conditions.

It is a happy augury of further advance in lighting practice that the National Electric Light Association and the Society for Electrical Development are undertaking to promote the application of the work of the Illuminating Engineering Society with a view to realizing in practice the advantages of good lighting which are now known to be attainable. The duplication and multiplication in important centers of population of industrial lighting exhibits patterned after that developed by the National Lamp Works of the General Electric Company bids fair to bring prompt and important results in improving industrial lighting. It is a method of attack which, if found successful, may be extended to other forms of lighting with like beneficial results. Wherever these demonstrations are given industrial managers have an opportunity to study for themselves conveniently and quickly the practical advantages attendant upon improvement in lighting. Opportunity to utilize these advantages is peculiarly favorable because incandescent lamps and central-station service stand out conspicuously among all commodities by reason of the fact that they have advanced little, if at all, in price since the pre-war period. The cost of electric lighting has been kept low and today is relatively lower than formerly.

In street lighting the combination in one lighting unit of a moderate-sized source for all-night service and of a larger source for intensive lighting during busy evening hours, as in the Saratoga installation, is one of the notable developments of the year. The installation of remote control of multiple street lamps from a central location throughout a large part of the borough of Manhattan, New York City, is another notable development not yet described in the literature of the art.

In the realm of commercial photometry the notable achievements of the year have been the more general employment of integrating spheres for the rating and tests of incandescent electric lamps in laboratories and factories and the very extensive growth in the use of the foot-candle meters for lighting inspection purposes. Another portable photometer for illumination and brightness measurements has been announced and will shortly become available.

Direct Measurement of Reflection of Walls

The determination of reflection factors has been the subject of research in recent years. In 1920 the crystallization of theoretical considerations and the development of data on the value of magnesium-carbonate, which is generally accepted as a standard, were witnessed. Several reflectometers have been designed or built which appear to be capable of rendering reflection factor values of an accuracy quite as high as is required.† This subject may now be considered to be removed from the realm of uncertainty.

Potent instruments for promoting improvement in illumination are the technical and commercial bulletins of manufacturers of lamps and lighting equipment, some among which attain a high standard of engineering excellence and most of which are notable for emphasis of the broader aspects of the subject with but incidental allusions to the particular commercial applications to be promoted. Such manufacturers' literature is, of course, up to date and occupies a field of peculiar usefulness to the electrical industry. During 1920 activities along this line surpassed those of previous years.

In the industrial lighting field it may be noted as especially significant that several of the leading manufacturers of porcelain-enameled steel reflectors have joined in a co-operative quality movement, building reflectors to a common and improved design (known as R.L.M.-reflector lamp manufacturers). These manufacturers have adopted a specification for their reflectors which in respect to efficiency, candlepower, distribution characteristic and workmanship is so high that they can comply with it only by most careful design and manufacture, and they are undertaking to put out under the R.L.M. designation only such reflectors as conform to these specifications. This is a movement in the direction of promoting good lighting which should be put to the credit of these manufacturers as promising advantage to the industry.

Tendency Toward Better Diffusion

The year witnessed two wholesome tendencies in reversion from practices which developed under war-time conditions to extremes perhaps not wholly compatible with good lighting. The first of these tendencies is away from the use of a minimum number of large lighting units toward the employment of a larger number of moderate-sized units. The other is the provision of a reasonable proportion of light flux upon the ceiling in industrial establishments with consequent increase in the general and more diffused lighting component, as witnessed by the development of translucent-neck porcelain-enameled steel reflectors and by the use of larger glass reflectors.

The high cost of labor and its war-time shortage led to development of lighting units designed to remain clean as long as possible and to be easily cleaned when soiled. This feature of design is now generally recognized as a first desideratum in all classes of service in which economy receives consideration. While some designs have sacrificed seemliness and beauty to the attainment of this one object, others have sought to secure it without detriment to the appearance of the unit and have met with measurable success. Today the market offers a fairly wide choice of industrial and commercial lighting units of reasonably good appearance and easy of maintenance.

In commercial lighting more attention has been given during the past year than formerly to the employment of color for practical as well as decorative purposes. Artificial daylight of a variety of hues is coming more and more into use where color matching is done and where it is important to display objects under a light of the hue which will reveal their characteristics to best advantage or in the manner in which they are later to be exhibited. For show-window lighting color filters for modification of hue in order to attain the most pleasing or effective display of wares are now offered as standard commercial equipments.

It has long been recognized that the greatest obstacle to the improvement of home lighting is the existence of improper fixtures designed without regard to illumination requirements and installed without reference to

†See ELECTRICAL WORLD, Sept. 4, 1920, page 467.

the purpose to be achieved by the lighting. In Chicago this problem has been attacked through the adaptation of old fixtures and the addition of equipment for directing and shading light sources in order to obtain suitable and pleasing lighting effects.

The Illuminating Engineering Society's "Rules Governing the Performance of Automobile Headlights on the Road and Specifications for Laboratory Tests of Headlighting Devices for Approval by State Authorities" in original or revised form have been adopted by six states. It is said that approximately 25 per cent of the motor vehicles of the country are now subject to regulation as to headlamps in accordance with this system. The same I. E. S. system has been embodied in the proposed "uniform traffic law" of the International Traffic Officers' Association. It is understood that the National Automobile Chamber of Commerce and allied associations contemplate adoption of the system. The rules referred to are directed at regulation of automobile headlighting. A more exacting specification has been drafted by the I. E. S. committee and adopted by the Society of Automotive Engineers as a recommendation to manufacturers to govern new equipment. It would appear that this subject has been brought during the year to a stage from which the adoption of nationally applied specifications will be a logical next step. The advantage of such a development in improved headlighting conditions will be obvious.

Effect of Load Factor on Station Costs*

Steam Stations Should Be Designed for a Definite Load Factor, and Operation Above or Below This Value Results in a Loss— Coal Rate Depends Also Upon Shape of the Station Load Curve

By PETER JUNKERSFELD
Engineering Manager Stone & Webster, Boston

THAT load factor has great influence in determining central-station energy costs is not a new thought. It is important, however, to emphasize the price which may sometimes be paid in increased fixed charges or increased operating expenses on central-station equipment as a result of incorrectly predicting, through inexperience, insufficient knowledge of the conditions or other causes, the average load factor at which the equipment will operate throughout its life. An operating organization can attain favorable total station costs only within the limits fixed by those who designed the power station.

The annual load factor is an indication of the number of hours per year that the dollar of capital expenditure in a steam station can be kept at work. The expense of using this dollar is just as great when it is working 100 hours or 1,000 hours or the full 8,760 hours per year. Interest and other fixed charges have no shutdowns, no lost time. The returns are, however, in direct proportion to the number of hours per year that this dollar is kept at work, or in other words to the annual load factor. For example, if the annual load factor of a power station is increased from 30 per cent to 60 per cent the fixed charges per kilowatt-hour are cut in half.

Load factor is the ratio of the average to the maximum output during any definite period of time. It is usually based upon an average demand for, say, fifteen minutes and upon output for a day, week, month or year. It may apply to a system having many generating stations and serving many communities, or merely to one power station, or even one unit in a power station.

The anual load factor of a central-station system nearly always changes very slowly. Special effort to secure a well-diversified business, together with the new uses of electricity which are constantly arising, contributes substantially to improvement in load factor.

The ordinary factory, working a forty-four-hour week with the usual lay-off for holidays, keeps a power station busy for only one-quarter of the 8,760 hours in a year. Residence and street lighting tend to improve load factor in the summer, but are less and less of a help as the days grow shorter until they finally change from a blessing to a burden upon the plant during the months when the lighting peak overlaps the end of the factory or business day. The cost of energy is made up of two principal elements, the fixed charges and the operating and maintenance expenses. Let us see first how the fixed charges are affected by load factor. In this case we must use annual load factor because fixed charges run on year after year. Suppose that one power station has cost $100 per kilowatt.

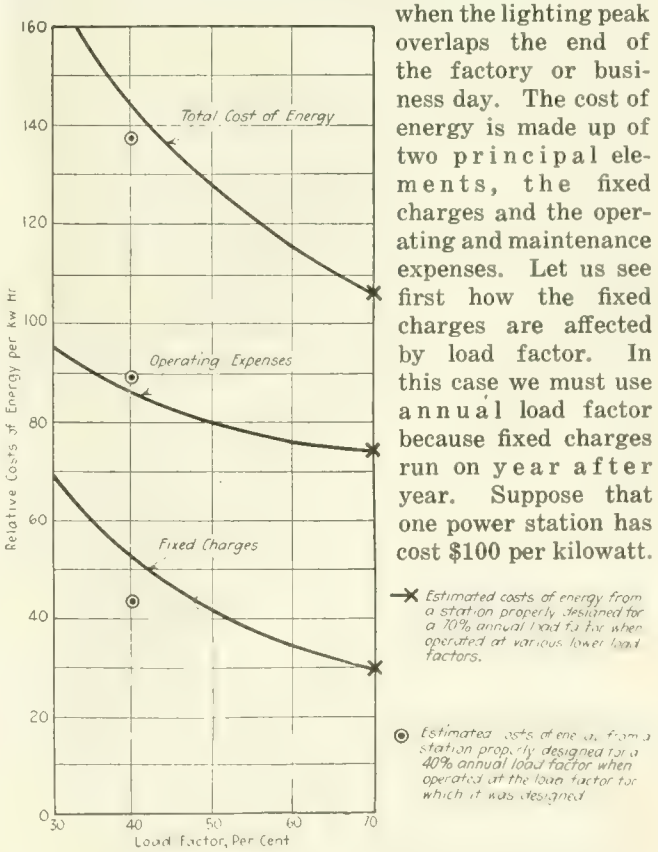


FIG. 1—RELATIVE GENERATING COSTS AT VARIOUS LOAD FACTORS

At 15 per cent per annum the fixed charge per kilowatt would be $15 each year. With an annual load factor of 30 per cent, the fixed charge per kilowatt-hour would

*Discussed before American Society of Mechanical Engineers, Dec. 10, 1920.

be 0.57 cent. If the load factor is increased to 70 per cent, we find this fixed charge per kilowatt-hour cut to 0.24 cent.

This comparison, of course, is not wholly a fair one, because a station properly designed to operate at a 70 per cent load factor would cost more to build (although less per kilowatt-hour to operate) than one of equal capacity but properly designed for a 30 per cent load factor. Its boilers would have been rated differently, turbines of different individual capacities and perhaps different efficiencies might have been selected, the condensers would have been designed more liberally, and higher efficiency equipment would have been selected wherever it would have been economical with the higher load factor. Even supposing that these features boosted the first cost $20 per kilowatt, we would still save probably one-tenth of a cent per kilowatt-hour in fixed charges and operating expenses in comparison with an attempt to impose a 70 per cent load factor on a plant properly designed for 30 per cent.

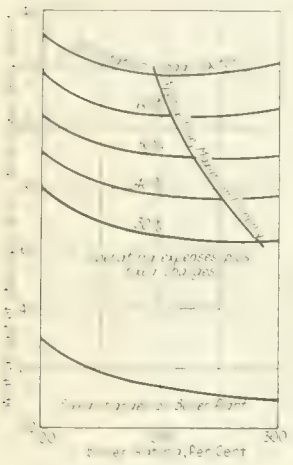


FIG. 2 BOILER RATING AS AFFECTED BY ANNUAL LOAD FACTOR

The curves in Fig. 1 show the relative costs of energy from a power station designed for a 70 per cent annual load factor when operated at various other load factors. At 40 per cent annual load factor a lower cost of energy is obtained from a station designed for a 40 per cent annual load factor. The lower fixed charges on the 40 per cent station more than offset its higher operating expenses.

Financial loss will result whenever it becomes necessary to operate a power station at a substantially higher or at a substantially lower annual load factor than the annual load factor for which the station was properly designed. The load factor of a system as a whole usually changes slowly even with a rapidly growing business. Where several stations supply a single system under a single management the load factor at each station should be adjusted so as to obtain the most efficient operation of the system as a whole.

Suppose that the station mentioned previously were one of several stations supplying a light and power system. Assume that at the time of its construction it was intended to operate on a base load at 70 per cent annual load factor, whereas the other stations supplying the system were to be operated only to carry peak loads, on account of their inferior efficiency. Assume also that within a few years on account of rapid growth of load another larger station, not previously contemplated, was built having the greater efficiency and that the station first mentioned no longer were operated on the base load but at a 30 per cent load factor. We at once see that we are then using an unnecessarily expensive tool where one costing $20 less per kilowatt would then do the work just as well and at less total cost per kilowatt-hour.

Similar financial losses may occur in a single power station supplying a rapidly growing load. When a new unit is installed in a power station it is important to know approximately how soon another will be required. Each succeeding unit is frequently larger than the preceding ones, up to the practical limit of size available for the particular purpose. The increased size is usually accompanied by increased efficiency. The units of highest efficiency carry the bulk of the load. The extra price paid for extra efficiency in a power-station unit sometimes proves uneconomical owing to another larger unit being installed earlier than anticipated.

The cost of an error of judgment or the extra expense due to an unexpected change in the annual load factor at which a station or unit is operated may therefore be considerable.

Load Factor Influences Central-Station Location

The location of a central station relative to its raw-material supply and relative to the point of delivery of its finished product should be influenced greatly by load factor.

In the selection of a site condensing water usually receives first consideration. Transporting it adds greatly to the station's fixed charges, while cooling it artificially causes inefficient operation. A very low annual load factor likely to prevail over a long period of years sometimes justifies artificial cooling of condensing water if the station may thereby be located near the load with a minimum investment in transmission lines or cable. With a larger annual load factor the additional operating expense due to cooling the condensing water might be so large as entirely to outweigh the fixed charge on the transmission line so that the plant would be located where condensing water is available. In weighing the relative costs the operating expense at either location must be added to the fixed charge before the more advantageous site can be determined.

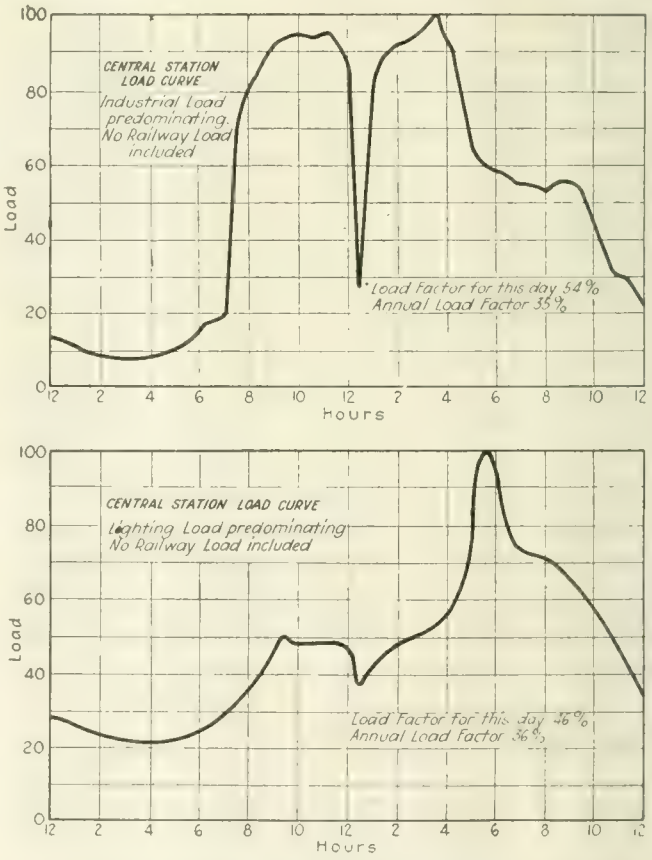


FIG. 3—SHAPE OF DAILY LOAD CURVE MAY HAVE LARGE EFFECT UPON OPERATING EXPENSE

Load factor determines the quantity of fuel consumed by a power station and has considerable influence upon the efficiency with which it is burned. Starting, stopping and standing by, as well as operating equipment only partly loaded, as is required at low daily factors, inevitably result in a high coal rate. It is the engineer's task carefully to weigh cost against efficiency and load factor so as to select equipment properly.

One of his problems, if the station be a new one, is to determine the boiler pressure. High efficiencies can be obtained with high boiler pressure. Construction cost, on the other hand, increases rapidly with increases in pressure. The economical pressure should usually be determined by the extent of the use of the equipment; that is, by the annual load factor.

An arbitrary assumption of steam pressure or an arbitrary selection of certain principal items of equipment may so definitely restrict the design that the full financial benefits of a consideration of load factor in the later selection of additional equipment may not be realized. The most far-reaching power-station engineering is done during the conception of the project, and it is at this time, when fundamental decisions are being made which will either help or hinder the engineering, construction and operation of the station, that load factor should have the greatest consideration. This means not only the immediate load factors but also the load factors that could reasonably be expected during the probable life of the equipment.

Reference has been previously made to the differences in boiler rating for which central-station boiler plants would be designed for operation at different annual load factors. This depends upon the cost of the boilers and combustion equipment, their efficiencies at various loads, the cost of labor and maintenance at various loads and the fuel required for banking and starting. Fig. 2 shows for a particular case, selected as an example, the effect of load factor on the most economical rating at which boilers should be operated to carry the station peak load. Note the manner in which the rating increases as the load factor diminishes.

The rating is only one of a number of boiler-plant problems which must be solved on the basis of load factor. The type and design of the boiler, the length of its tubes, the number of rows of tubes wide and the number of rows high, the combustion equipment, the location of the bridge wall and the baffles, and the size and shape of the furnace, should all be determined by reference to the total load factor on the station as well as the anticipated load factor on the individual boilers. The use of economizers even in large stations cannot be justified at very low load factors.

The economic selection of turbo-generator units may be made upon the basis of size, speed and other factors. The speed influences both the cost and the efficiency of the unit, and is very important in relation to the average annual load factor at which the machine will operate over a period of years.

Surface condensers also should be selected largely from the point of view of annual load factor. A high load factor anticipated for a unit for a long period of time would justify a condenser of large surface so as to obtain a high efficiency in operation.

The foregoing does not attempt to mention the many power-station appurtenances contributing to higher efficiency which should be omitted from the station designed to operate at low annual load factor, but which might be justified if the station annual load factor were higher. On the other hand, it should not be overlooked that there are some instances in which it is more economical to buy more expensive equipment for low load-factor conditions than for higher load-factor conditions.

Low Load Factor Occasionally Calls for Expensive Equipment

An example comes to mind in which it was necessary to transmit power through step-up transformers at about a 30 per cent annual load factor. The load curve was typical of a factory load in which the maximum amount

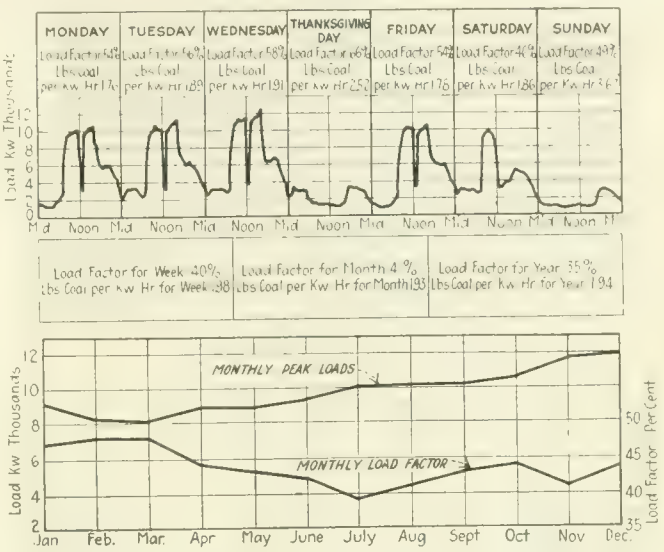


FIG. 4—COAL RATE DEPENDS BOTH UPON LOAD FACTOR AND SHAPE OF LOAD CURVE

The effect of designing a station for too high load factor is shown.

of power was supplied more or less continuously for about eight hours of the working day with a much smaller amount of power for the remaining sixteen hours. When it came to the purchase of the transformers, all of those offered had the same full-load efficiency. The transformers of the lowest bidder, however, had the highest no-load losses. The partial-load conditions to be met were discussed, requirements more clearly stated and certain changes in design suggested.

New bids were received, and the transformers finally selected were designed for the particular conditions, but at an advanced price. The increase was due to the additional cost of the higher-grade materials which were selected for use in the transformer construction and the changes in design which were made on account of the particular load conditions. The use of these materials and their additional cost would not have been justified if the transformers had been operated at a higher load factor as the full-load efficiency was not increased by the changes which were made. The additional cost of the transformers was saved in about two years because of the lower twenty-four-hour losses.

The engineers who design a power station fix the upper limit of its operating efficiency by the selection and arrangement of equipment. If this is properly done for the particular load and load factor, the total cost of power from that station, including the fixed charges upon the investment, will be a minimum if the station is properly operated and maintained. If the selection arrangement is not made wisely, the station thereafter will be handicapped either by excessive fixed charges or excessive operating expenses.

The influence of a change of load factor on operating

expenses has been briefly referred to heretofore, but it may be of some interest to point out its effects.

The expense of superintendence and station administration is more or less fixed for a given size of station so that a change of load factor would not influence it in total amount. Boiler labor may be considered as composed of two parts, one of which depends upon the capacity of the station alone and the other of which, for a station of given capacity, would vary with the daily load factor at the station. Mechanical labor would be influenced by daily load factor to a less degree, but would depend upon the number and size of the main generator units. The electrical labor would be influenced more by the number of feeders or the number of kinds of current distributed than anything else.

Fuel is usually an item of greater expense than all others, and, as pointed out previously, it is dependent upon load factor. Efficiency in the use of fuel is greater at the higher load factors. As an example of the effect of load factor upon station operating expenses, a hypothetical case may be taken of a station containing units of various sizes which might have operating expenses as shown in the accompanying table. Note the fuel expense as compared with the total.

OPERATING EXPENSES AS AFFECTED BY LOAD FACTOR IN A PARTICULAR CASE

	Operating Expenses Cents per Kw.-Hr.		
Annual load factor, per cent	30	50	70
Fuel	0 91	0 85	0.71
Labor for operation	0 10	0 07	0 06
Maintenance, material and labor	0.08	0.05	0.04
Miscellaneous, material and labor	0.04	0.03	0.03
Total	1.13	1.00	0.84

Load factor alone does not by any means determine the amount of fuel which a central station of a given size should consume. The shape of the daily load curve is of almost equal importance in its effect upon the efficiency with which the fuel is burned. The shape of the load curve is in turn dependent upon the character of the business served by the central station. This is illustrated by the two examples of central-station load curves given in Fig. 3. In both instances the lighting peak overlaps the day load, but on account of the predominance of factory load in the business on one of these stations an exceptionally favorable shape of load curve is obtained as well as a relatively high load factor for the day.

SHAPE OF LOAD CURVE IMPORTANT

It is interesting to note, however, that the load factor for the year is virtually the same in these two cases. This is due to the effect of the extremely low loads which obtain on Sundays and holidays. For these two conditions, illustrated by Fig. 3, having practically the same annual load factor, the better annual coal rate would be obtained with the one having the more favorable shape of load curve—that is, with the one in which the factory load predominates.

Fig. 4 shows how the load and load factor vary from day to day and month to month for a business in which factory load predominates. The beneficial effect of high load factor on Thanksgiving Day, for example, is much more than offset by the relatively small load on the station on that day. Note how the load factor for the week and for the month are practically the same. The load factor for the year is somewhat lower, owing to the variation in maximum demand throughout the various seasons. In general, the better coal rates are obtained with the higher load factors, although this is greatly influenced by peak load, quality of fuel and skill in operation, all of which are interesting subjects but beyond the scope of this discussion.

Customer Ownership Exceeds $100,000,000

Power Securities Now Distributed Among 150,000 Subscribers—Provides from 25 per Cent to 100 per Cent of Companies' Financial Needs

FINANCING electric utilities through the sale of securities locally to customers, employees and resident citizens within the past three years has developed into an important phase in the management of many central-station companies. To show the extent of this type of financing, what methods were used to market securities, how nearly the plan meets current financial requirements, and to estimate its future possibilities, the ELECTRICAL WORLD has made a survey among those companies which have been actively engaged in customer-ownership sales. Complete data received from forty-five companies show that the total par value of stocks, bonds and notes sold by them since they first started selling securities to customers is $50,294,450, distributed among 75,941 subscribers. Further information from four large holding companies which could not segregate the sales made by each of their controlled companies and from a number of other individual companies shows that the total sale of securities to customers has been in excess of $100,000,000, distributed to over 150,000 individuals.

Since Jan. 1, 1920, there has been $16,116,870 of stocks, bonds and notes sold, which is 31.3 per cent, or almost one-third, of all sales to date. Of the forty-five companies reporting, sixteen sold securities to customers for the first time in 1920, ten in 1919, six in 1918, six in 1917, two in 1916, two in 1915, two gave no date, and one company initiated its customer-ownership campaign in 1908. The majority of the companies, twenty-six, have instituted the plan within the last two years, indicating that this kind of financing is now being adopted rapidly. Statements from managers of many companies show that while they are not at this time conducting such a sale, they are laying plans for next year.

PREFERRED STOCK MOST GENERALLY SOLD

Of the combined sales by all companies, $3,974,250, not quite 8 per cent of the total, were bonds or notes. The remainder of the securities sold, with two exceptions, were in the form of preferred stock, which is naturally best adapted to the purpose, providing as it does a sound investment without maturity and making the holder a partner in the business. Thirty-eight companies sell this kind of security. Five sell notes, two sell bonds, one sells capital stock, and one common stock. Practically all companies offer customers the privilege of paying for the stock on an easy-payment plan over a period of eighteen months to two years. Sales are usually limited to five shares to a customer when installment payments are to be made.

The total of $50,294,450, including all stocks, bonds and notes, was distributed among 75,941 subscribers,

showing an average ownership per individual of $660. This figure covers sales for the entire period and is based upon the par value of the securities, which in most cases have been sold at a discount of from two to fifteen points. Therefore the actual cash investment per subscriber is close to $600. Subscription per customer subscriber of those companies which have operated only this year varies over a wide range and shows an average par value investment of $469. This should be modified somewhat owing to high sales per customer by two companies. The par value investment per subscriber in a customer-ownership program operated this year for the first time is approximately $350. However, this depends upon the locality and sales methods pursued. As a rule where a special bond department only conducts the sales the amount sold per customer is high, while the use of all employees as salesmen secures a much wider distribution. The ideal arrangement seems to be the combination of a security department working in conjunction with the employees. In this manner the territory is thoroughly covered.

Employees were used exclusively as stock salesmen by twenty-nine companies, bond department and special salesmen were used by seven companies, securities departments supplemented by all employees were used by seven companies, and two companies sold their securities over the counter. In nearly all cases commissions were paid to employees for stock sold, and during special campaigns bonuses were offered. Employees have been considerable purchasers of stock. Their individual subscriptions and the percentage of stock owned by them are small. This, however, is held by some to be desirable as it means that there is a better and wider distribution of the securities.

Sales Methods

In thirty-six companies the sale of stock is carried on continuously, while six companies reported the use of campaign methods over a given period. All companies emphasized the importance of a liberal advertising program in the newspapers backed up by personal efforts of the salesmen and employees. Continuous selling is favored as being the most effective method and best from a public policy standpoint.

ELECTRIC UTILITY SECURITIES SOLD TO CUSTOMERS, EMPLOYEES AND RESIDENT CITIZENS

Company	Date Started	Kind of Security	Interest Rate, Per Cent	Total Sales to Date (No.)	Amount (Par Value)	No. Subscribers	Average per Subscriber	Amount of Sales in 1920 (Par Value)	Method of Sales	Per Cent of Securities Held by Employees	Per Cent of Current Financial Requirements
Arkansas Valley Ry. Light & P. Co	1917	Preferred stock	7	11,685	$1,168,500	1,650	$708	$488,400	Employees	1.1	Variable
Binghamton Light, Heat & Pr. Co.	1920	Cum. part. prfd. Stock	7	1,575	157,500	666	236	157,500	Employees	3.0	Provides equity financing
Central Connecticut Pr. & Lt. Co.	1919	Cum. prfd. stock	6	400	40,000	120	283	22,950	Employees	.	Well in future
Central Illinois Public Service Co.	1919	Preferred stock		6,000	600,000	1,800	333	.....	Employees	5.0	...
Central Illinois Light Co.	1919	Preferred stock	6	3,177	317,700	605	524	.....	Employees	....	Small
Central Maine Power Co.	1908	Preferred stock	6	31,221	3,122,100	4,000	781	1,100,000	Stock dept. and employees	....	All
Charlottesville & Albemarle Ry. Co.	1915	Preferred stock	7	1,000	100,000	105	952	. . . .	Employees	....	Partial
Commonwealth Edison Co.	1919	Capital stock	8	40,000	4,000,000	3,500	1,140	.....	Investment dept. and employees	....	Partial
Connecticut Power Co.	1919	Two-year notes	8	. . .	200,000	281	712	.....	Employees	....	About 30
Consumers Power Co.	1920	Preferred stock	7	5,670	567,000	1,435	395	567,000	Employees	20.0	Small
Dayton Power & Light Co.	1919	Preferred stock	6	2,240	290,750	219	1,325	.....	Employees	68.0	20
Denver Gas & Electric Co.	1916	Preferred stock	6	12,000	1,200,000	.....	.....	.....	Employees		.....
Edison Electric Tel. Co., Brockton, Mass.	1918	Two-year notes	8	.	251,900	353	713		Employees	1.0	About 30
Greenville Elec. Lt. & Power Co.	1920	Preferred stock	7	1,500	150,000	.		150,000	Over counter	.	.....
Louisville Gas & Electric Co.	1920	Preferred stock	7	8,500	850,000	1,525	557	614,000	Investment dept.	3.6	Variable
Lockport Light, Heat & Power Co.	1920	Preferred stock	8	1,802	180,200	378	478	180,200	Employees	Small	All
Mahoning & Shenango Ry. & Lt. Co.	1919	Preferred stock	7	8,000	800,000	1,300	769	.....	Employees		Partial
Metropolitan Edison Co.	1920	Cum. part pfd. stk.	7	5,965	596,500	2,514	236	596,500	Employees	5.0	Provides equity financing
Mexico Power Co.	1920	Preferred stock	7	1,000	100,000	.....	.....	100,000	Over counter	....	All
Middle West Utilities Co.	1919	Preferred stock	7	22,600	2,260,000	10,000	226	.....	Employees	....	Partial
Minnesota Utilities Co.	1917	Bonds and preferred stock	5 7	1,523	775,000	190	4,079	187,300	Employees and stock salesmen	3.0	Full
Mountain States Power Co.	1920	Ten-year notes	8		72,650	200	363	72,650	Employees	3.0	Partial
Narragansett Electric Lt. Co.	1917	Preferred stock	8	13,335	666,750	3,000	222	416,750	Employees	....	Variable
New Jersey Power & Light Co.	1920	Preferred stock	7	800	80,000	331	242	80,000	Employees	0.6	Provides equity financing
North American Light & Power Co.	1920	Preferred stock	7		45,000		.....	45,000	Employees	.	.....
Northern Iowa Gas & Electric Co.	1920	Preferred stock	7	750	75,000	85	882	75,000	Employees	.	
Northern States Power Co.	1915	Preferred stock	7	99,212	9,921,000	14,500	684	3,411,700	Securities dept.	1.3	Variable, as high as 75
Ohio Service Co.	1918	Preferred stock	6	2,998	299,800	298	1,000	145,600	Employees	2.6	One-half
Oklahoma Gas & Electric Co.	1917	Preferred stock	7	6,024	602,400	830	725	259,600	Securities dept.	6.6	Variable
Otter Tail Power Co.	....	Bonds	6		927,000	400	2,320	80,000	Bond dept	....	About 75
		Stock	7	3,210	321,000	300	1,070				
Ottumwa Railway & Light Co.	1917	Preferred stock	7	600	60,000	200	300	.....	Special salesmen	....	Variable
Public Service Co. of No. Illinois.		Preferred stock	6	23,900	2,390,000	10,500	227	2,390,000	Investment dept. and employees	..	Partial
Puget Sound Power & Light Co.	1920	Five-year notes	8		1,000,000	2,000	500	1,000,000	Employees	40.0	Partial
Rochester Railway & Light Co.	1918	Preferred stock	7	17,061	1,706,100	2,893	609	203,800	Employees	8.6	50 to nearly all
Rutland Railway, Light & Power Co.	1920	Cum. Prfd. stock	7	458	45,800	193	237	45,800	Employees	1.1	Provides equity financing
San Diego Con. Gas & Electric Co.	1916	Preferred stock	7	19,454	1,945,400	745	2,610	500,000	Bond dept.	8.0	All
San Joaquin Light & Power Co.	1920	Preferred stock	7	15,000	1,500,000	1,400	1,070	1,500,000	Securities dept. and employees	7.5	About 25
Southern California Edison Co.	1917	Common stock	7	86,334	8,633,400	5,100	1,690	884,920	Bond dept. and employees	37.0	About 25
Southern Illinois Light & Power Co.	1920	Preferred stock	6	950	95,000	.....	.....	95,000	Employees	....	About 15 in future
Twin State Gas & Electric Co.	1919	Prior-lien stock	7	2,500	250,000	900	278	170,000	Stock dept. and employees	5.0	Variable
United Light & Railways Co.	1920	Preferred stock	7	625	62,500		.....	62,500	Employees	....	.....
Wilkes-Barre Co.	1919	Preferred stock	7	6,748	337,400	650	518	109,700	Employees	Small	Full
Western Illinois Utilities Co.	1918	Preferred stock	6	150	15,000	50	300		Employees	....	Small
Western States Gas & Electric Co., Eureka, Cal.	1918	Preferred stock	7	5,161	516,100	525	982	405,000	Special salesmen	1.0	Variable
Western States Gas & Electric Co., Stockton, Cal.	1918	Ten-year notes	6		900,000	200	4,500	.....	Company officials	....	All that year
Totals and average				470,128	$50,294,450	75,941	$660	$16,116,870			

All reports indicated that the sale of securities has become a permanent policy. Some companies which are not now offering stock to customers explained that it is because they have sold the entire available issue and must now turn down applications for stock. No company has reported the failure of a customer-ownership program. and all favor it as a valuable means of improving public relations.

Proportion of Requirements

The extent to which the sale of these securities meets current financial requirements varies with each company. Some state that it is small, while in several cases all new money is obtained in this manner. A particularly notable instance is that of the Central Maine Power Company, which for some time has raised all new capital by the sale of its 7 per cent preferred stock in the territory served. Other companies have financed all necessary new construction during the past eighteen months by this method.

Provides Equity Financing

One group of companies indicates that its sale of preferred stock provides an ideal means for equity financing and that it materially strengthens the position of the companies' other securities. The majority report that their object is to raise about 25 per cent of new capital by the sale of securities to customers. The viewpoint of a prominent investment banker is interesting. In his opinion customer ownership has brought the utilities through one of the most difficult financial situations in their history. It is the cheapest and best way of obtaining new capital. It facilitates long-term financing, and the electric utilities in the future should be able to meet from 25 per cent to 50 per cent of their financial requirements by the distribution of preferred stock to customers.

In making an estimate of the amount of stock that can be sold to customers, based on what has been done since 1916, due allowance must be made for the fact that during the war all sales of securities were subordinated to the Liberty loan campaigns. As a consequence customer-ownership programs suffered interruptions and a great deal of investment money was placed in Liberty bonds. However, the Liberty loan campaigns have been extremely valuable in creating millions of small investors who are now good prospective customer stockholders of the electric utilities.

Customer Ownership Increasing

Something over $100,000,000 of the electric light and power companies' securities, principally in preferred stocks, have been distributed among 150,000 customers —an average par value investment per subscriber of $666. Companies have been successful in several instances in doing all their financing by this method, which shows its possibilities. Thus far there has been no failure of the plan reported. Comparatively, it is as cheap as or cheaper than selling securities through the customary channels and naturally much better for the standing of the company in the community. The number of companies so selling securities is increasing, and those companies already engaged are committed to it as a permanent policy. Therefore it is safe to say that customer ownership is a fixed principle with electric light and power companies and that, properly directed, it can be made to provide from 25 per cent of their financial requirements up to the entire amount.

Recommendations for Niagara Treaty Revision

Additional Diversion of 20,000 Sec.Ft. Suggested, Making a Total of 80,000 Sec.Ft.—Momentary Diversion in Excess of Limit to Be Allowable

By Col. J. G. Warren, U. S. A.

INASMUCH as any large power development is dependent on the revision of the treaty with Great Britain proclaimed May 13, 1910, a careful study has been made by the War Department regarding changes which will be necessary in the treaty to permit additional diversion of water. As a result of this study the following suggestions were made:

1. That the wording of the treaty be altered to extend the jurisdiction of the International Joint Commission to include diversions from tributaries of boundary waters, except in the case of diversions from a tributary which are returned to the same tributary.

2. That the diversion of water from Niagara River below the Falls be specifically limited in the same manner as the diversion from the Niagara River above the Falls.

3. That the treaty provide for the construction and maintenance of remedial works of the nature outlined, such works to be built under the supervision of the International Joint Commission or of some other international body created for the purpose, the remedial works to be so designed and constructed that the scenic beauty of the Falls will be restored and preserved when 80,000 cu.ft. of water per second is diverted from the Niagara River above the Falls, the expense of constructing and maintaining said works to be borne equally by the high contracting parties.

4. That the limits of diversion from the Niagara River above the Falls which the high contracting parties may permit within their respective jurisdiction be raised from 20,000 cu.ft. per second on the United States side to 40,000 cu.ft. of water per second, and from 36,000 cu.ft. of water per second on the Canadian side to 40,000 cu.ft. of water per second.

5. That 20,000 cu.ft. per second of the water so diverted upon each side of the river shall be returned to the Niagara River at some point or points upstream from turning point No. 134 of the international boundary line (just above M. C. R.R. bridge), and that if any part of the remaining diversion be returned to the Niagara River at any point, an equal or smaller amount may be again diverted from any point further down stream.

6. That the limits given above be stipulated to apply to the amount actually diverted at any instant, and that accordingly the words "in the aggregate" and "daily" be stricken out of Article V of the present treaty wherever they occur; that it be recognized that small, brief, accidental violations of the provisions of a diversion permit must be allowed if the holder of the permit is to obtain the full value thereof, and that therefore such violations shall be permitted under such regulations as the International Joint Commission shall provide.

7. That five years after the completion of the remedial works the International Joint Commission, or some other body constituted for the purpose, shall inform the high contracting parties whether or not, in its opinion, further diversions of water from the Niagara River for power development can be made, either continuously or intermittently, without serious injury to the scenic beauty of the Falls and Rapids, the integrity of the river as a boundary stream, or appreciable lowering of lake levels; that, if this opinion be favorable to the further diversion of water, the commission or body shall indicate the amount of further diversions which may properly be allowed and the conditions by which permits should be limited.

[Several methods of utilizing additional diversions were discussed in the Aug. 14, 1920, issue of the Electrical World.—Editor.]

Determining Iron Loss of Sheet Samples

Testing of Sample Laminations Necessary to Secure a Uniform Manufactured Product — A Good Method for Industrial and Central Station Men and an Accurate One Where Laboratory Facilities Permit

By THOMAS SPOONER
Research Laboratory, Westinghouse Electric & Manufacturing Company

IN SPITE of the many improvements effected in recent years in the manufacture of electrical steel, the mills are still unable to make a product which is sufficiently uniform in magnetic quality. This is due to the very large number of variable factors which enter into the manufacture of steel. On the other hand electrical apparatus is built under specifications which require laminations of uniform quality, and as a consequence the electrical manufacturer must either have rigid magnetic specifications for the quality of his sheet material, or else must accept whatever the manufacturer supplies, test it himself and divide it into grades according to the quality in order that he may use it to the best advantage. In either case careful testing is required in connection with the purchase of sheet steel. Furthermore, on account of the large amount of sheet iron used in rebuilding and repairing electrical apparatus in industrial plants and central stations a substitution method is offered here which is sufficiently accurate for the purpose of making tests in such plants. An accurate method is also described for the use of the manufacturer of electrical apparatus who uses large quantities of sheet iron and who has the necessary laboratory equipment for very accurate testing. The usual magnetic test specification covers only two properties, namely, total iron loss (hysteresis and eddy current losses) and permeability. In this article only the former will be considered.

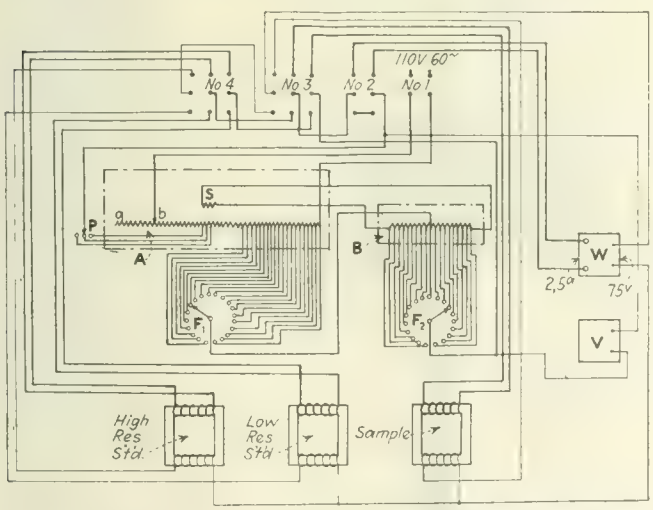


FIG. 1—DETAILED ARRANGEMENT OF SUBSTITUTION METHOD

In the following paragraphs various methods of testing commercial sheet steel for iron loss are described, including a substitution method for obtaining sine wave losses which may be used with any commercial 60-cycle voltage supply and requires no special apparatus except two simple regulating auto-transformers. Test results are given showing the accuracy of the apparatus, covering a period of more than three years, during which time no adjustment of the apparatus and no calibration of the meters have been made. The accuracy is quite satisfactory for commercial purposes.

SPECIFICATIONS OF THE A. S. T. M.

Test Specifications.—The most common apparatus for testing iron losses is that due to J. Epstein. It has been adopted as standard both in this country and several foreign countries. The material to be tested is sheared into long narrow strips divided into four equal bundles which are arranged in a hollow square with a primary and secondary winding surrounding each bundle (see Fig. 3). The sample is clamped in position by a single movement of the compression handle. The four primary coils are connected in series and to an alternating source of supply through the current coil of a wattmeter. The secondary coils are also connected in series and to the shunt circuit of the wattmeter and to a voltmeter. The voltmeter gives a measure of the induction in the sample, and with suitable corrections the wattmeter gives the iron loss. The American Society for Testing Materials some years ago adopted this method as standard (see A. S. T. M. "Triennial Standards" for 1918, page 268). According to its specification the standard core loss is "the total power in watts consumed in each kilogram of material at a temperature of 25 deg. C., when subjected to a harmonically varying induction having a maximum of 10,000 gausses and a frequency of 60 cycles per second." The samples themselves consist of 10 kg. of strips 50 cm. long by 2 cm. wide. The primary and secondary windings each consist of 600 turns. The proper voltage to give 10,000 gausses is calculated as follows:

$$E = \frac{4fNnBM}{4lD10^8}$$

in which

f = form factor of primary emf. = 1.11 for sine wave,
N = number of secondary turns = 600,
n = number of cycles per second = 60,
B = maximum induction = 10,000,
M = total mass in grams = 10,000,
l = length of strips in centimeters = 50,
D = specific gravity = 7.5 for high-resistance steel and 7.7 for low-resistance steel,
E = 106.6 volts for high-resistance steel and 103.8 volts for low-resistance steel, both for sine voltage.

For further details see the A. S. T. M. specification.

AN ACCURATE LABORATORY METHOD

If it were not for the fact that the wave form materially affects the iron losses, this method of testing would be very simple. For a discussion of the effect of wave form on iron loss see "Dependence of Magnetic Hysteresis Upon Wave Form," by M. G. Lloyd, *Bulletin* Bureau of Standards, Vol. 5, page 381.

In order to obtain sine-wave conditions a number of arrangements have been used. For research work and for standardizing secondary samples the Westinghouse Research Laboratory uses the following set-up (see Fig. 2): The direct-current motor *ShM* drives a three-phase alternating-current generator *G* and a harmonic booster *HB*, all three machines being on the same shaft. The booster *HB* generates a third harmonic and is in series with one phase of the generator *G*. This third harmonic may be introduced into the alternating-current circuit with any phase angle by rotating the field of the booster. Connected to the booster and generator is the auto-transformer *T*, which supplies the Epstein apparatus *E* through the wattmeter *W*. The secondary of the Epstein apparatus is connected to an alternating-

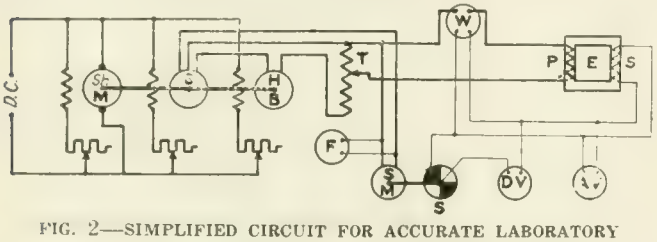


FIG. 2—SIMPLIFIED CIRCUIT FOR ACCURATE LABORATORY METHOD OF CORE-LOSS TEST

current voltmeter *AV*, a direct-current voltmeter *DV*, and to the shunt circuit of the wattmeter. The direct-current voltmeter is connected in series with a suppressor *S* driven by a synchronous motor *SM*. This synchronous motor, together with a frequency meter *F*, is connected to another phase of the generator.

The operation is as follows: The frequency is adjusted to 60 cycles by varying the field of the shunt motor. The voltage is adjusted by varying the field of the generator, and the form factor is adjusted by varying the field of the booster. The direct-current voltmeter *DV* is a two-to-one double-scale instrument. It is connected to the low scale and read on high, since every half wave is suppressed. When the form factor is correct the ratio of *AV* and *DV* will be 1.11, provided that the suppressor is adjusted in phase so that *DV* reads a maximum. The direct-current voltmeter is then opened and *AV* adjusted to the voltage value necessary to give a maximum induction in the sample of $B = 10{,}000$ gausses. The wattmeter is then read. The instrument losses in the shunt circuit of the wattmeter and the alternating-current voltmeter are subtracted, the difference divided by the weight of the sample in kilograms, and the result is the loss in watts per kilogram for the sample.

The above procedure requires considerable rather expensive apparatus and is somewhat complicated. As a consequence several alternative arrangements have been devised to simplify the procedure for commercial testing. If the generator is of sufficient size and is carefully designed so as to give a sine wave of voltage, the harmonic booster and form factor apparatus may be omitted for tests at $B = 10{,}000$ gausses. If results are required at higher inductions, however, the exciting current of the sample will distort the voltage wave due to the resistance and reactance in the primary circuit, thus giving erroneous results.

For the greatest simplicity it is desired to have an apparatus which can be operated from a commercial alternating-current circuit. Several methods for doing this have been devised. One of the best known is to have a standard sample the losses of which have been carefully measured on a sine-wave supply. The standard sample is then placed in an Epstein apparatus, the unknown sample in a second Epstein apparatus, and the primary windings connected in parallel to an alternating-current supply through the current windings of a differential wattmeter. The secondary Epstein coils are connected to the respective shunt windings of the wattmeter. By varying the resistance in the shunt windings so that the wattmeter reads zero, the loss in the unknown sample may be determined, since the losses in the two samples would be inversely proportional to the resistances in the wattmeter shunt circuits. This method has the advantage that the test results are nearly independent, over a considerable range, of the frequency, voltage and form factor of the supply circuit. It has the disadvantage, however, that a special and expensive wattmeter is required as no such instrument suitable for this work is on the market, at least in this country. Moreover, the two wattmeter elements must be identical or else a suitable correction factor applied.

SUBSTITUTION METHOD WITH SIMPLE APPARATUS

In order to obviate the necessity of using a special wattmeter, the following arrangement was devised some years ago for testing a sample by comparison with a standard (the loss of which is known). The only special apparatus required are two auto-transformers with a number of regulating taps for fine adjustment of voltage. If an alternating-current generator of any reasonable wave form the voltage of which may be varied is available, even these may be dispensed with. Switch 1 (see Fig. 1) connects the primary of the auto-transformer *A* to a commercial 60-cycle 110-volt or 220-volt line. If 220 volts is used, tap *a* instead of tap *b* is used. At one end of the transformer are a number of taps connected to every other button of a field-rheostat face plate F_1. On the core of the transformer *A* is a little secondary winding of three turns which is connected to the terminals of a second auto-transformer *B*.



FIG. 3—ASSEMBLY OF EPSTEIN APPARATUS

Taps from this second transformer are connected to a second face plate F_2. Specifications for the transformer windings are as follows:

Transformer A.—Total primary turns, 440; taps at 220, 315, 325, 335, also 420, 421 to 440; $E = 220$ volts; $I = 30$ amp.; frequency = 60 cycles; secondary turns, three.

Transformer B.—Total turns, 20; taps at each turn.

Three Epstein sets are provided, one for the sample to be tested, one for a high-resistance standard and one for a low-resistance standard. The standard samples are placed in their coils, wedged permanently in position and impregnated. No clamping device is supplied for the standard samples. These standard samples are

then calibrated for loss on a sine-wave supply as explained above. The wattmeter is a commercial compensated low-power-factor instrument having a current range of 0 to 2.5 and 0 to 5 and a voltage range of 0 to 75 and 0 to 150. Any alternating-current voltmeter with suitable range may be used.

The operating of the apparatus is as follows: Switch 1 is closed, thus energizing the transformers. Switches 2 and 3 are closed down. Switch 2 is used simply to prevent an accident happening to the wattmeter in case there should be a short circuit in the apparatus or in case switch 3 should be closed on the Epstein apparatus without a sample in the coils. Switch 4 is then closed, either up or down, depending on whether high-resistance or low-resistance material is being tested. Switch 2 is then thrown up and the rheostat contacts F_1 and F_2 are adjusted until the wattmeter reads the known loss of the standard sample. It will be noted that F_1 gives coarse adjustment and F_2 fine. If the correct voltage cannot be obtained, owing to a large difference in the supply from normal, a still further range may be obtained by changing terminal P to one of the other taps. When the wattmeter reads the correct value the voltmeter reading is noted. Switch 3 is then thrown up, voltmeter Vm adjusted to the same reading as before and the wattmeter read. This gives the loss of the unknown sample. It should be noted that the voltmeter is connected to the primary side of the Epstein apparatus and that the only energy used from the secondary circuit is that necessary to supply the wattmeter shunt circuit. This is automatically subtracted from the wattmeter readings since the wattmeter is compensated.

In order to save expense a 5-kg. sample instead of a 10-kg. sample is usually used for commercial work. The wattmeter has two scales, one for the 75-volt connection and one for the 150-volt. If the sample has a loss of, say, 3 watts per kilogram, the total loss will be 15 watts. This will be read directly on the low scale. However, if the reading is taken on the high scale and the decimal point shifted, the reading will be given directly in watts per kilogram. It will be noted that the transformer connection used gives a little more than 50 volts for the primary of the Epstein apparatus instead of a little more than 100 as called for by the A. S. T. M. specifications. This is due to the fact that the half-weight sample is used and so the applied voltage must be one-half.

Possible Source of Slight Errors

It will be noted that changes in the supply voltage will not introduce errors, since the voltmeter is maintained at the proper value by the contacts F_1 and F_2. Variations in frequency will not introduce errors unless they occur between the time the standard sample is checked and the unknown is tested. A 1 per cent change in the frequency under these conditions will produce an error of about 0.6 per cent in the iron-loss reading. However, the frequency of large commercial power plants is usually maintained fairly constant. If frequency changes are considerable, the errors may be reduced by frequently checking against the standard sample, or by using an iron-loss voltmeter for Vm.

The value of the form factor of the supply circuit is immaterial, provided that it does not change between the time of checking the standard sample and testing the unknown. An appreciable change would occur only if the supply generator were changed or there were large changes in the reactive load in the near neighborhood. If such conditions do exist, the remedy is the same as for changes of frequency.

It may be argued, since the voltmeter is on the primary side of the Epstein apparatus, that, as different samples are introduced for test, the variations in permeability, reluctance of joints, etc., will change the IR drop in the primary windings due to changes in the exciting current and thus produce errors since the secondary voltage would be correspondingly changed. This effect is small, however since the primary winding has a resistance of only about 0.4 ohm and the current is usually between 1 and 2 amp. Moreover, the power factor of the sample is low so that this IR drop is very much out of phase with the impressed voltage. The reason for using auto-transformers for regulating the applied voltage instead of resistance is to keep the effect of this variable exciting current negligible.

A moment's consideration will show that changes in the calibration of the meters produce no errors in the test results. The only variable left is then the standard samples. Experience has shown that when properly mounted these samples do not change appreciably over long periods of time.

Checks on the Substitution Method

The first installation of this type has been in service for more than three years and thousands of samples have been tested with the apparatus. Every few months a sample is tested by this method and then checked on a sine-wave apparatus. A summary of the results over a three-year period follows: Maximum error = + 3.0 per cent; arithmetical mean = 1.05 per cent; algebraic mean = +0.25 per cent; number of samples = 32.

A laboratory using a large generator, giving approximately a sine wave of voltage, but with no harmonic booster, gave the following results on the same samples: Maximum error = —5 per cent; arithmetical mean = 1.34 per cent; algebraic mean = —1.06 per cent.

The large maximum error of 5 per cent was found to be due to a fault in one of the measuring instruments and was immediately corrected. During this time the meters for the apparatus have never been checked or overhauled, no changes have been made in the apparatus and the standard samples have not been rechecked.

HYDRO-ELECTRIC *energy in large, steady and dependable quantities can alone be looked to for any substantial or immediate improvement in operative conditions or for any material reduction in the cost of supplying power. Any lower costs of producing electricity through hydro-electric plants should be shared in an equitable manner between the consumers who provide the market for the energy generated and the company which makes the economies.*

Electricity is as old as the stars. But it is only within recent years that it has been made to work for man as his willing and untiring slave. The work has been progressively successful, but many failures have resulted and much seemingly profitless experimentation has had to be done before each step in advance could be taken in safety and security. We acclaim the success of the plans but we forget the failures that had to occur before success could be achieved. We can be sure, however, that the knowledge we have today of hydro-electric development is worth all it cost.—C. P. CUTTEN, appearing before the California Railroad Commission on behalf of the Pacific Gas & Electric Company.

Readers' Views and Comments

Water Power and Adequate Electrical Supply in Switzerland

To the Editor of the ELECTRICAL WORLD:

SIR: In no other country on the European continent has electricity made such progress during the last few years as in Switzerland. The universal scarcity of coal and the steadily increasing prices for all kinds of fuel have induced the Swiss authorities, especially the Federal Railway Administration, to push energetically and by all available means the installation of electric power plants on a basis hitherto quite unknown. On the St. Gothard Line, for instance, the whole section from Erstfeld to the Italian-Swiss station of Airolo, including the Gothard tunnel, has been worked by electricity for the past six months, while electric traffic on the section from Airolo to Biasca—a few miles from Bellinzona—was put into operation in the early part of December, 1920.

The Swiss authorities, and particularly the Swiss Water Board, the latter in its annual report just published, recommend the installation of a large number of new power plants, among which some will be constructed with the special purpose of storing large quantities of water for the winter season. The unusual dryness of this winter—the greatest experienced since 1820—and the entire absence of fresh snow up to altitudes of 3,000 m. (about 10,000 ft.) has forced several electric railway lines to reduce considerably the passenger and freight traffic, while the lack of water power was also deeply and often seriously felt in many industrial establishments.

A considerable number of large concessions for new plants have already been granted. Prominent among these are those in the Canton of Aargau for the Swiss Federal Railways, the Wildegg-Brugg concessions and those of the Northeastern Swiss power works at Gippingen. Among other prominent power plants now under construction may be mentioned those of the Lake of Lungern, the city of Zurich, the Bernese power works, the Fribourg state works, the Bündner, Nitom, Amsteg and Barberine power plants, the latter three being constructed by the Federal Railways, and the new plants of the Société des Forces Motrices de Chancy-Pougny, with a total capacity of no less than 400,000 hp.

It is a well-known fact that the so-called "greater navigation" of this country depends almost entirely on the construction of large power plants. A Swiss intercantonal net of navigation is imaginable only if it obtains an outlet to the sea. This question is on everybody's lips at present. As a matter of fact, it must be stated that great progress has been made in the navigation works of the river Rhone from the Lake of Geneva to the Mediterranean. The French government has just submitted to Parliament a project for the utilization of the Rhone with a view to producing power, promoting navigation and storing of water on a large scale. The energy available for this purpose amounts to 760,000 hp., or about 5,000,000,000 kw.-hr. per annum. It is further intended to make the river Rhone navigable all the way as far as to the Lake of Geneva. The connection between the Swiss lake of Langen and the north Italian interstate network of navigation at Milan is also being studied at the present time.

The problem of consolidating all the large water-power plants of Switzerland for the purpose of reciprocal distribution, mutual assistance and application of superfluous energy has also found its solution in the establishment of the Swiss Power Transmission Company. Most of the central and northeastern power plants have already joined this company in order to get the benefits which such interconnection undoubtedly offers.

In connection with this growing industrial activity in Switzerland it may be stated that as a result the demand for all kinds of electrical machinery and appliances is increasing, and though the country itself produces to a large extent the required installations, yet there ought to be a market for improved American apparatus. It is well known and appreciated here that the United States is leading the world in this respect.

HENRY L. GEISSEL.

Münsingen-Berne, Switzerland.

Financing Has Its Problems No Less than Engineering

To the Editor of the ELECTRICAL WORLD:

SIR: In the world of engineering today's dream is often tomorrow's fact—but not always. Perhaps nowhere is realization likely to lag further behind conception than in some of the colossal plans for hydro-electric development that every now and then are painted in rainbow hues to the astonishment of the layman and the joy of the builder of newspaper "scare heads." One hears, for instance, of how the tremendous potential sources of water power running to waste in Iceland are soon to be harnessed. The Icelanders are to supply the world with fertilizer and no doubt to become an industrial people into the bargain, manufacturing shoes and cloth for export even if they themselves stick obstinately to moccasins and furs. It is a great idea, but who is to supply the capital? Similarly the falls of the Zambezi could supply unlimited power to the South African cities if some benevolent billionaire would build the dams and put up nine hundred miles or more of high-tension transmission lines. But will he? The British Ministry of Transport recently announced with a resounding flourish of trumpets the working out of a scheme for building a barrage across the Severn River which would revolutionize the supply of electrical energy to English industrial centers. Probably quite feasible from a purely engineering standpoint, the English electrical journals comment, but where are the funds and would it pay? From continental Europe come so many accounts of great projects of a hydro-electric nature that it is impossible at this distance to distinguish the practicable from the visionary, but it may be shrewdly suspected that the goats outnumber the sheep. By the hard, mercenary test of profit all hydro-electric development, large or small, at home as well as abroad, will in the final event stand or fall, and electrical engineers must qualify themselves not only to overcome the problems of construction but to shed light on how the equally important problems of finance are to be met.

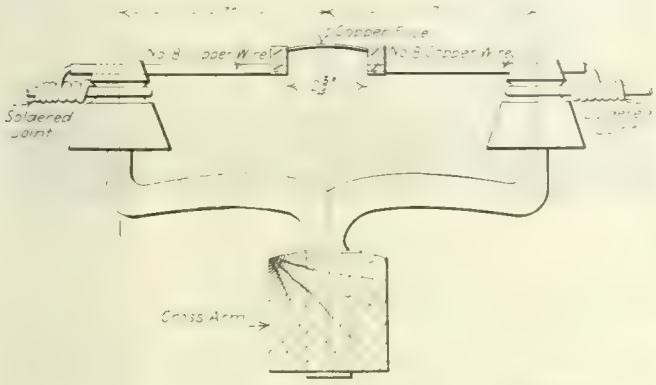
Brooklyn, N. Y. FRANK W. CHASE.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Safe and Economical Sectionalizing Fuse Block

SAFETY and lessened labor costs are attained by the type of section fuse shown in the illustration, which is used by the Denver Gas & Electric Company between banked transformers. The fuse mounting consists merely of an ordinary break arm on which the conductor is dead-ended from both directions. A piece of No. 8 copper is carried from each dead-ended conductor toward the center of the break arm, a gap of



VISIBLE FUSE BLOCK EMPLOYED BETWEEN TRANSFORMERS CONNECTED IN BANK

2¾ in. being left which is bridged by a copper wire fuse held in place by two small screw clips. This form of fuse has the advantage of (a) allowing inspection from the ground and elimination of unnecessary climbing by linemen, (b) elimination of the unsightly wiring to the ordinary fuse box, and (c) elimination of hazard that unnecessary wiring always creates for men called to work on the poles. The fuse is, of course, placed at the neutral point between banked transformers, and repeated blowing of fuses indicates the necessity of relocating the fuse.

R. A. HAMMOCK,
Superintendent of Distribution.
Denver (Col.) Gas & Electric Company.

Diesel Engines Used as Standby to Hydro Plants in Europe

ALTHOUGH water-power development has been more intensive in Europe than in the United States on account of the scarcity of fuel, Diesel engines have been installed at ends of trunk feeders or load centers served from hydro-electric plants as standby prime movers. These engines provide a source of energy without the ordinary standby losses, fully available within a few minutes' times and requiring few attendants for maintenance and emergency operation. A single operator will place such a plant in operation in two or three minutes for short breakdown service. From the accompanying table it will be seen that the size of the Diesel-engine plants ranges from 2,000 brake-horsepower to 5,200 brake-horsepower, two-cycle units being available in single cylinders as large as 2,000 brake-horsepower. One advantage of the Diesel engine is that it may be operated on very low-grade fuel. Tests indicate that

DIESEL ENGINES USED AS STANDBY PRIME MOVERS

City	Country	Size, Brake-Hp.	City	Country	Size, Brake-Hp.
Pont-a-Mousson	France	5,000	London	England	6,200
St. Chamond	France	3,000	Bombay	India	2,400
Villefranche	France	2,500	Bombay	India	3,150
Calais	France	3,300	Naples	Italy	4,650
Rive de Gier	France	3,500	Torre Annunziata	Italy	2,100
Frouard	France	2,200	Bremen	Germany	6,000
Assailly	France	3,000	Alexandria	Egypt	3,800
Le Boucau	France	3,000	Kom-Ombo	Egypt	2,125
Etupes	France	4,500	Hongkong	China	3,300
Bordeaux	France	2,400	Belfast	Ireland	4,000
Yegoryevsk	Russia	2,250	Montevideo	Uruguay	2,880
Yaroslav	Russia	2,380	Namtu	Burma	2,000
Moscow	Russia	2,200	Lugano	Switzerland	2,300
Nizhni-Novgorod	Russia	3,200	Uncia-Oruro	Bolivia	2,200

some of these engines will produce approximately 465 kw.-hr. per barrel of low-grade Mexican and California oil. It is claimed that these engines operate on 0.45 lb. of fuel per brake-horsepower.

During the war fuel oil was not obtainable in many sections of Europe, so in 1914 Sulzer Frères of Switzerland built a small tar-distilling plant at Winterthur to supply their Diesel-engine plants with tar oil. Many cities followed suit, extracting a light tar oil from coal before burning it under boilers. According to reports the engines operated very satisfactorily with this fuel.

St. Louis, Mo. E. B. POLLISTER.

Increasing Effectiveness of Sand-Blasting Condenser Tubes

IN SAND-BLASTING condenser tubes some practices developed through studies by the maintenance section have proved of great value to the Philadelphia Electric Company. The sand for condenser cleaning was formerly dried by being placed on a steel plate with a fire under it and stirred until dry. This method has been superseded by steam drying, which requires no attendance. The drier is a receptacle with sides and bottom made of screening of a mesh that will hold wet sand but will pass dry sand. In this receptacle is a steam coil for heating the sand. The wet sand is placed in the drier and the steam is turned on; then as the sand becomes dry it sifts through the screen to the dry sand bin below.

A difficulty which was encountered at first in connection with sand-blasting was the return flow of gases into the condenser header where the men were working. This condition has been overcome by connecting the suction of a blower to the far-header during the cleaning, thus effectively preventing any return flow.

The experience of this company, like that of many others, has shown that sand-blasting is the most suc-

cessful method of cleaning condenser tubes. But, though effective, the method is slow. Only about fifty tubes per hour can be cleaned with the single nozzle now in use. The efforts of the maintenance section have therefore been directed toward increasing the speed of cleaning, and a multiple nozzle is now being developed to clean several tubes at one insertion.

F. C. RALSTON.

Philadelphia (Pa.) Electric Company.

Flexibility of Pulverized Fuel Control

THE flexibility of pulverized-fuel firing was illustrated recently in the boiler room of the Milwaukee Electric Railway & Light Company. In this plant each of the 468-hp. boilers is fed with pulverized fuel through two independent burners. On the occasion mentioned the feeder pipe between the pulverized-fuel bin and one of the furnaces became partly plugged just above the burner. Notwithstanding this, the boiler was operated for at least twenty-four hours at 120 per cent rating by increasing the feeder speed on the other burner. During this period the efficiency of combustion was undoubtedly below the average as the coal which did come through the plugged feeder was not accompanied by the correct quantity of air, but nevertheless service was maintained. Heavy loads are taken on or dropped off these boilers by simply adjusting the rheostats of the motors which feed the coal to the furnaces. Variations in the calorific value of the fuel are compensated for in a similar manner.

S. N. CLARK.

Chicago, Ill.

An Automatic Disconnecting Switch for Small Substations

FOR small substations the automatic feature and economy of the "skeet" switch have been so successful that this type of construction has been adopted as standard for stations under 1,000-kva. rating by the Georgia Railway & Power Company. This type of switch, as originally designed by T. F. Johnson, superintendent of the electrical department of that company, and described in the ELECTRICAL WORLD for Dec. 13, 1919, page 1066, has been improved by the use of the switch head shown in Fig. 1. Fourteen of these small stations equipped with the "skeet" switch, as shown in Fig. 2, are now operated on the system of the Georgia Railway & Power Company.

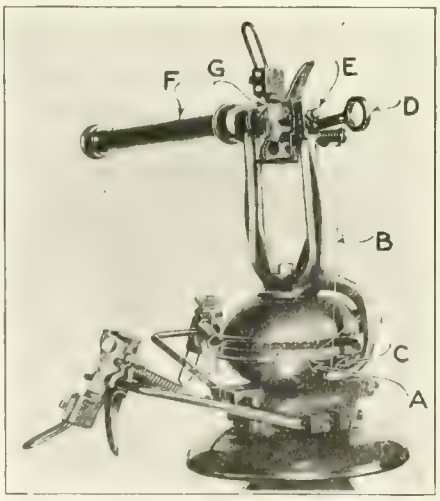


FIG. 1—HEAD OF "SKEET" SWITCH USED FOR AUTOMATICALLY DISCONNECTING SMALL STATIONS

The skeet head is an attempt to combine in one piece of apparatus the high-tension buses, air-break switch, fuse, switches for lightning arresters, disconnects for transformers, supporting structure, etc., at the same time reducing the number of insulators on a station to the minimum. This switch provides the protection of a fuse disconnecting switch, but at less expense owing to the smaller number of insulators and other parts of

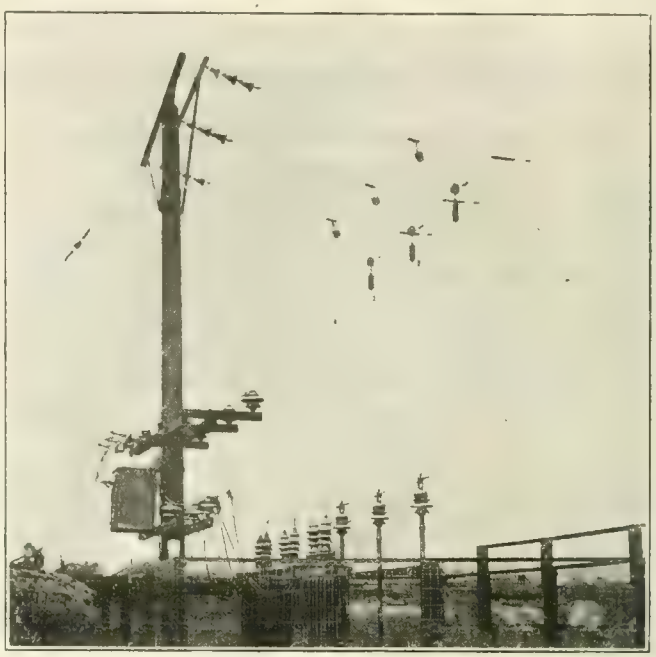


FIG. 2—AUTOMATIC DISCONNECTING SWITCH INSTALLED ON 150-KVA. SUBSTATION

A lightning arrester is usually placed at every substation. One has not yet been installed in the station shown.

substation structure required. A fuse disconnect switch requires supporting insulators for the fuse and a supporting frame, and moreover several sizes of switches must be carried in stock and several types of construction must be employed for different line voltages. The skeet head is the same regardless of voltage and only the usual dead-end insulators are required. Also the skeet head may be mounted directly upon the transformer bushing, thus reducing a transformer station to little more than the transformers and the skeet heads. This type of switch fills the gap between a fuse and an air-break switch, the chief advantage being its low first cost and the fact that the one type and size of head will meet all requirements on any small customer's substation. When it operates the melting of the copper fuse *A* forces an arc from the metal cap to the wire *B* about $\frac{1}{16}$ in. (1.6 mm.) at the point marked *C*. This relieves the catch *D*, which holds the pin *E* in normal position, so that a coiled spring in the tube *F* pulls the pin back suddenly and allows the Johnson switch *G* to be drawn up by the weights shown in Fig. 2, thus disconnecting the station from the line.

A quick snap in the breaking action of the switch is brought about by the amount of tension that is placed in the conductor marked (*b*) by the weight (*c*) in Fig. 3. A 15-lb. (6.8 kg.) weight will exert about a 7-lb. (3.1-kg.) pull on the skeet head (*a*) and provide the necessary quick start to prevent arcing and burning when the switch opens. The weight required, however, varies according to the height of the pole and the size of the conductor. The shorter the pole and heavier the line conductor the lighter the weight required, and the longer the pole and lighter the line conductor the heavier the weight to secure the desired spring action.

To insure operation when sleet is liable to form the connections of the switch leads to the line conductors are slid back from the vertical on the latter about 6 ft. (1.8 m.), so that when the switch operates the three switch conductors will swing away from the switch

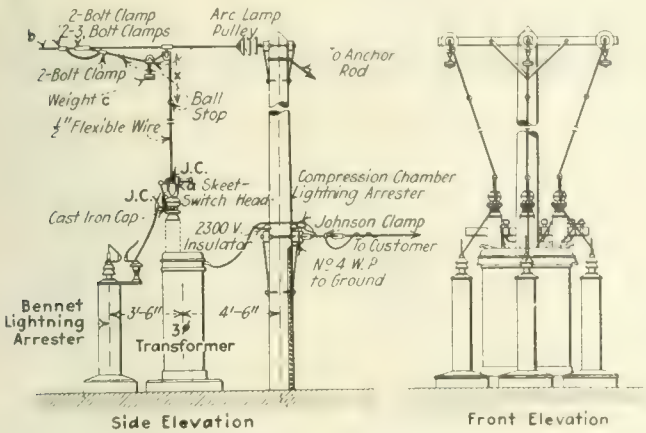


FIG. 3—CONSTRUCTION DETAILS OF AUTOMATIC "SKEET" SWITCH FOR SMALL SUBSTATIONS

Line Voltage	"V", Ft.	Height of Pole, Ft.
11,000	5	30
22,000	6	30
38,000	8	35
44,000	10	35
50,000	12	40
66,000	15	40
110,000	20	45

*Distance from supporting pulley to lower ball stop.

head and thus insure the same safe breaking distance that exists when the flexible cables are drawn through the pulleys by the weights in a vertical position under normal weather conditions.

It has been the experience of the Georgia Railway & Power Company that a substation using this type of switch costs when installed as shown in Fig. 2, excluding transformers and lightning arresters, about $300. This amount includes all material and labor required. While installations are now being made with the switch head mounted on iron posts, as shown in Fig. 2, it is planned to adopt the construction shown in Fig. 3 at an early date and mount the switch head directly on the transformer terminal, making a very simple and compact unit.

Accident Hazards in Laying Conduit Underground

HAZARDS are present at all times during the laying of underground conduit, both to the employees and to the public. Goggles should be worn by all men when breaking concrete paving. Properly designed bull-point chisels, asphalt cutters and handles should be provided. These tools are serious hazards when their heads become "mushroomed." The burrs or chips which break off have caused painful and serious injuries. Properly designed handles are necessary to prevent workmen being hit on the hands or head with the sledge. There should be frequent and regular inspection of all tools and those found defective should be sent to the shop for repairs.

Picks should never be allowed to become round on the end. This not only retards progress but also causes accidents by the tool slipping and striking the workman on the foot or shin. Men working with them should not be closer than six feet to each other. They should be warned when working near conduit lines containing power or telephone cables and water and gas mains on account of the danger of driving a pick into them.

Conduit should be piled pyramidically, not over 4 ft. high, on the ground nearest the point at which it is to be laid.

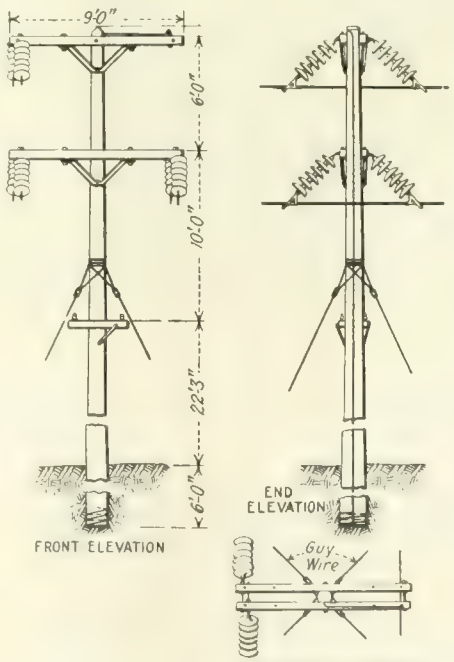
These remarks were made by H. W. Tueck, Commonwealth Edison Company, before the Public Utilities Section of the National Safety Council.

Two Transformers Used in Place of Damaged Balance Coil

THE diagram showing two transformers used in place of a damaged balance coil in the ELECTRICAL WORLD of Dec. 4, 1920, page 1121, would be satisfactory for an alternating-current system, but not for a direct-current system as stated. For a direct-current system the two outside wires connected to the three-wire load should be connected to the direct-current brushes of the machine and not to the slip-ring brushes as shown.

Construction Which Reduces Tension on Strain Insulators

TO AVOID the deterioration of insulators at points where tension assemblies are usually installed, the semi-tension assembly shown in the illustration can be employed as a substitute for the ordinary dead-end construction. In this assembly the conductor between the two strings of insulators is under tension so that a large proportion of the horizontal pull is taken by the conductor and the tension on the insulators is consequently lightened. In this assembly a clamp must be used that will hold the conductors up to breaking strength so that one-half of the assembly can swing to a tension position in case of a conductor break on either side. This gives a dead-end assembly when abnormal conditions require, yet leaves the insulators to carry a normal load no greater than that carried with a suspension assembly. This assembly can be used at railway and other crossings, at storm-guyed points and on spans greater than normal strength. Undue use of tension assemblies results in concentration of heavy normal strains at many points, while the use of the semi-tension assembly distributes the normal strains.



INSULATOR ASSEMBLY WHICH AVOIDS HEAVY STRAINS OF DEAD-END CONSTRUCTION

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Application of Demand Factor to Interior Wiring

IT HAS been found that in nearly all cases a demand-factor allowance may be safely applied to mains feeding a number of pieces of apparatus or a number of tenants in a building. In many cases a demand factor may also be applied to submains and it can sometimes be applied to the branch or final circuit where such circuit feeds a motor whose load is of an intermittent character. The carrying capacity of a wire as given in the code is based on the assumption that the conductor will carry its rated current indefinitely and in so doing will never exceed a certain temperature rise. However, where the current is on only for a short period of time, as in the operation of elevators, cranes, spot welders, etc., the current-carrying capacity of conductors as given in the National Electrical Code can be increased. The current-carrying capacities which have been found safe for different periods of time are given in the accompanying table for all common sizes of wire. This table is based on the use of three rubber-covered wires in conduit, with an ambient temperature of not more than 85 deg. Fahr. (35 deg. C.), and for other installations at ambient temperatures ranging from 85 deg. Fahr. to 125 deg. Fahr. (35 deg. C. to 52 deg. C.). Sufficient time must be allowed between the application of current to permit the conductors to cool down to the ambient temperature.

The information in this article is from the report of the Western Association of Electrical Inspectors' committee on demand factors, of which the chairman, Victor H. Tousley, is chief electrical inspector of the city of Chicago.

CURRENT-CARRYING CAPACITY OF CONDUCTORS FOR INTERMITTENT SERVICE

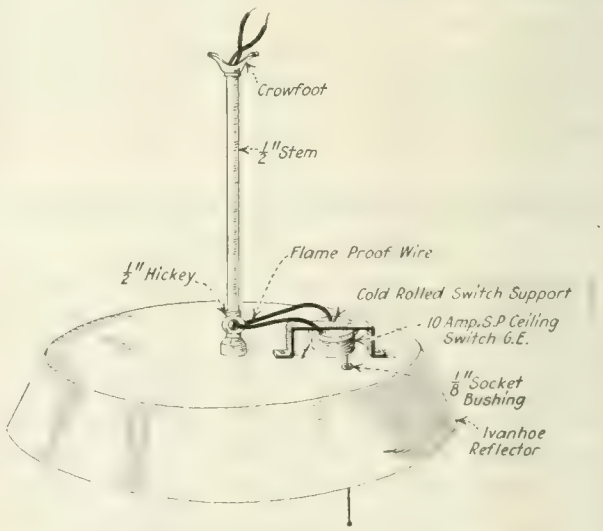
B. & S. Gage	N. E. Code Size Conduit for Three Conductors, In.	Carrying Capacity, Amp	Actual Temp. Rise, Deg. Fahr	Carrying Capacity, Amp., for 36 Deg. Fahr. Rise — Indefinite Time	Short Time in Minutes — 30	15	10	5
14	½	15	27.0	17	19	22	24	30
12	½	20	31.0	22	24	26	29	35
10	½	25	27.9	27	30	35	40	45
8	1	35	29.9	36	43	50	60	65
6	1	50	33.1	52	60	73	80	105
5		55		56	69	88	100	125
4	1¼	70	40.7	64	77	97	110	140
3	1¼	80	34.9	82	93	113	135	165
2	1¼	90	34.7	90	106	130	155	195
1	1¼	100	39.1	96	126	154	180	225
0	2	125	41.2	110	147	182	210	275
2/0	2	150	41.8	130	179	220	260	340
3/0	2	175	39.4	150	213	270	320	420
200,000		200		175	247	310	355	480
4/0	2½	225	57.6	180	256	325	395	515
250,000		240		205	297	375	455	585
300,000	3	275	45.2	238	345	435	535	690
350,000		300		265	395	500	605	790
400,000	3	325	42.1	290	440	555	690	850
500,000	3	400	48.1	345	529	660	800	1,090
600,000		450		390	610	750	915	1,225
700,000		500		430	680	830	1,025	1,400
750,000	4	525	44.8	450	710	870	1,080	1,450
800,000		550		465	745	905	1,120	1,525
900,000		600	. . .	495	810	975	1,210	1,665
1,000,000	4½	650	55.2	525	870	1,040	1,295	1,800

This table is based on the use of three rubber-covered wires in conduit where the temperature of the air does not exceed 85 deg. Fahr., and for other installations at temperatures from 85 deg. to 125 deg. Fahr., and it is assumed that the current will always be off a long enough time to allow the conductors to cool down to the air temperature

Factory Lighting Unit with Pull Switch Mounted on Shade

IN INSTALLING a lighting system using lamps of the higher wattages it is often desirable to connect a switch so that each unit may be controlled independently. In order to save time and extra wiring one large industrial plant has adopted the plan of placing the ceiling switch attached to a small bracket on the upper side of the metal shade, as shown in the cut. The supporting bracket is made of cold-rolled stock 1 in. wide x ⅛ in. thick and approximately 10 in. long (25 mm. x 3.2 mm. x 25 cm.). This material can be readily bent cold in a vise. These self-contained units are assembled with ceiling switch and flame-proof wiring complete and are carried in the electrician's stock ready for instant use.

This arrangement has been in use about two and one-half years and has proved its practicability in all details. In no case have we noted any breakage of filament due to the snap of the operating switch. It was found desirable to protect the operating cord where it passed through the metal shade with a ⅛-in. socket brushing.

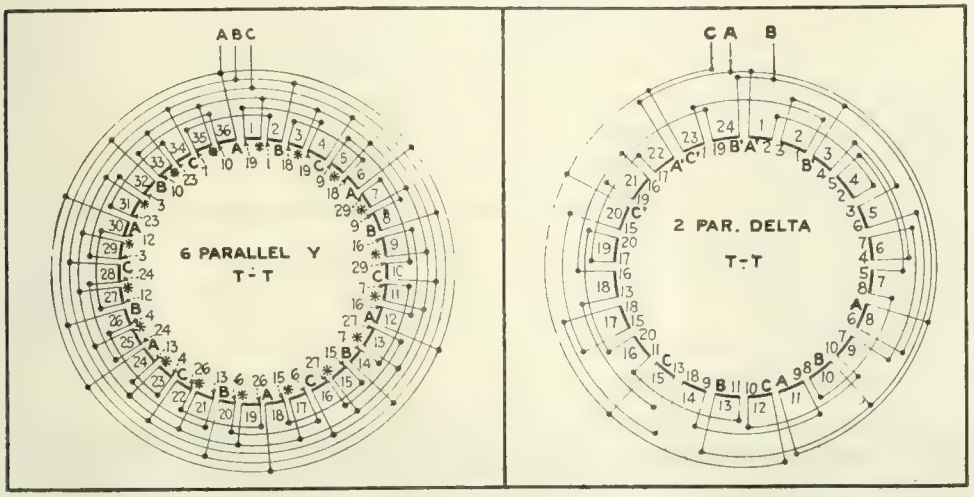


PULL SWITCH IS MOUNTED ON TOP OF REFLECTOR

I. H. GASKIN,
Shop Engineer.
Gillette Safety Razor Company,
Boston, Mass.

Increasing Speed and Horsepower of a Slip-Ring Induction Motor

A CHANGE of the speed and horsepower of a slip-ring induction motor was recently accomplished in one Eastern shop by rewinding both stator and rotor. The motor was a 50-hp., twelve-pole, 600-r.p.m., 220-volt, three-phase machine, and it was to be changed to a 75-hp., 900-r.p.m. motor. The connections before and after the change are shown in the accompanying table and diagrams. To develop the eight-pole stator winding the twelve-pole chord factor was first figured. With 180 slots and twelve poles the coil pitch is 180 ÷ 12 = 15 slots, or 1 and 16. Fifteen slots is therefore full-pitch, or 180 electrical degrees. Each coil, however, spanned only eleven slots or [(11 ÷ 15) × 180] = 132 electrical degrees. The chord factor was therefore, sin (132 deg. ÷ 2) = 0.914. If the motor were reconnected for a series-star connection, the line voltage would be 220 × 6 = 1,320 volts with this chord factor (0.914), and with full pitch it would be 1,320 ÷ 0.914 = 1.444 volts. Now if the poles were decreased from twelve to eight, the speed would increase from 600 to ((12 ÷ 8) × 600) = 900 r.p.m. If the magnetic conditions were the same, the horsepower would increase in the same proportion from 50 to ((12 ÷ 8) × 50) = 75 hp. This would mean that the voltage should be increased from 1,444 to [(12 ÷ 8) × 1,444] = 2,162 volts for the developed single-series star winding.

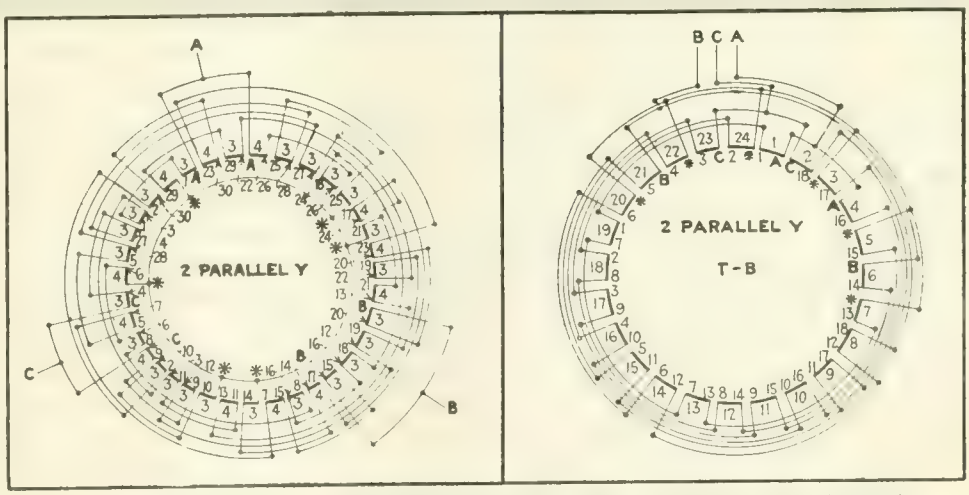


TWELVE-POLE STATOR (LEFT) RECONNECTED FOR EIGHT POLES (RIGHT)

To use the old winding for a line voltage of 220, it would have to be paralleled. For a star connection there should be 2,162 ÷ 220 = 9.83 parallel paths, which is impossible. The developed series-delta full-pitch connection would give 2,162 ÷ 1.73 = 1,254 volts. For 220-volt operation there would be 1,254 ÷ 220 = 5.7 parallel paths, which is also impossible. Therefore the stator had to be rewound.

In figuring the rewinding a series-delta winding for 440 volts was developed, as such a winding could be used in series on 440 volts or in two-parallel for 220 volts and the delta type of connection requires more turns, which would help get rid of the extra turns. The turns per coil required for such a winding and full pitch would be (440 ÷ 1,254) × 8 = 2.8 turns. Using a three-turn coil, the full pitch voltage would be ((3 ÷ 2.8) × 440) = 472 volts. This may be reduced to 440 volts by the proper chord factor, which is 440 ÷ 472 = 0.932. But 0.932 = sin 68.5 deg., and therefore the coil must span 2 × 68.5 deg. = 137 electrical degrees. But full pitch is 180 slots ÷ 8 poles = 22.5 slots, which equals 180 electrical degrees. Therefore the proper span is [(137 ÷ 180) × 22.5] = 17 slots approximately, which is a pitch of 1 and 18.

The area of copper was increased in the same proportion as the turns decreased. The original three No. 14 wires had an area of 3 × 4,106 = 12,318 circ.mils. Therefore the new wire should have an area of [(8 ÷ 3) × 12,318] = 32,848 circ.mils. Moreover, it had to fit the slot. The original No. 14 wire was laid three wide in the slot, giving a width bare of 0.192 in. Two bare No. 11 wires have a width of 0.192 in., and the area of one No. 11 is 8,234 circ.mils; therefore the number of wires in parallel per coil should be (32,848 ÷ 8,234) = 3.89, or four wires approximately, which would have an area of 4 × 8,234 = 32,936 circ.mils. With a coil two wide by six deep the height of the new coil is 6 × 0.091 = 0.546 in. against 8 × 0.064 = 0.512 in. for the old coil. The difference is only $\frac{3}{32}$ in., therefore the coil will fit in the slot. Accordingly the stator was rewound with 180 coils having three turns of four No. 11 wires in parallel wound too wide by six deep per coil and with a pitch of 1 and 18. The winding was connected two-parallel-delta with twenty-four phase groups, twelve groups having seven coils in series and twelve having eight coils, the eight-coil groups alternating with the seven-coil groups.



SLIP-RING ROTOR CHANGED FROM TWELVE POLES (LEFT) TO EIGHT POLES (RIGHT)

In developing the rotor winding it must be remembered that the horsepower varies with the ampere turns and the speed. As the speed will increase from 600 r.p.m. to 900 r.p.m. when changing from twelve to eight

DATA ON SLIP-RING MOTOR REWOUND FROM TWELVE-POLE TO EIGHT-POLE

	Stator		Rotor	
	Before	After	Before	After
Voltage	220	220	217	324
Ampere per phase	....	....	100 5	101
Horsepower	50	75	50	75
Revolutions per minute	600	900	600	900
Poles	12	8	12	8
Coils	180	180	120	120
Turns per coil	8	3	4	4
Size wire	3 No 14	4 No 11	3 No. 10	3 No. 10
Coils per group	5	*8-7	†4 3	5
No groups	36	24	36	24
Pitch	1-12	1-18	1-10	1-13
Chord factor	0.914	0.932	0 988	0.955
Connection	6-par.-Y	2-par.-D	2-par.-Y	2-par.-Y

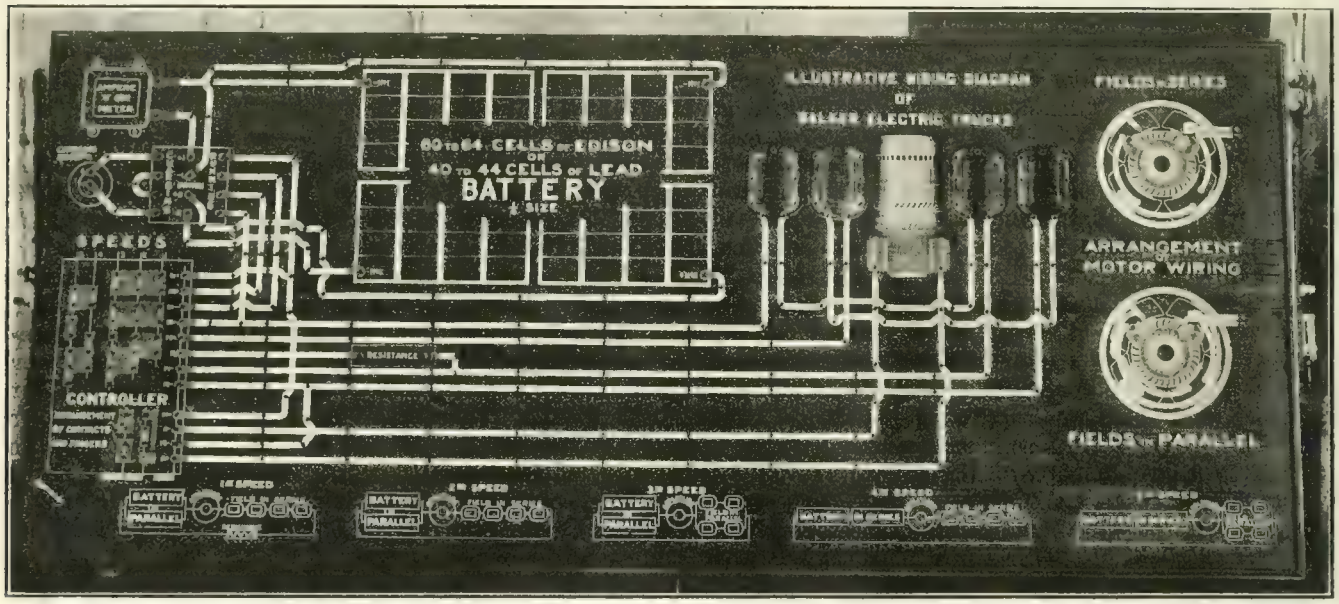
*Number of coils for successive groups is as follows: 8-7-8-7-8-7, etc.
† Number of coils for successive groups is as follows: 433, 334, 343, 433, 334, 343, 433, 334, 343, 433, 334, 343.

poles, the horsepower will likewise increase from 50 hp. to 75 hp. if the current and turns are not changed. Therefore the only change necessary was to increase the pitch to that required for eight poles, keeping the current and total number of turns the same as before. The voltage between collector rings was first calculated from the following formula: Secondary series voltage = (total secondary turns ÷ total primary turns) × primary series voltage. For the motor in question after the stator was changed the secondary voltage per phase was (120 × 4) ÷ (180 × 3) × 2 × 220 = 392 volts. The secondary was connected two-parallel-star, and therefore the voltage per phase was 392 ÷ 2 = 196 volts. As it was connected in star while the stator was connected delta, the slip-ring voltage was (196 × 1.73) = 340 volts. If both had been star or both delta, the value 1.73 would not have been used. If the stator were connected star and the rotor were delta, the result should be divided by 1.73 to get slip-ring voltage. After calculating the voltage the current per phase may be determined by the formula: (Hp. × 0.746 = 1.731 × volts × amp. × power factor. For this motor the power factor was 0.985 and therefore the secondary current would be (75 × 0.746) ÷ (1.73 × 340 × 0.985) = 96.5 amp. It was desired, however, to keep the current the same as before the change, or at 100.5 amp. Therefore a chord factor had to be found which would decrease the voltage and thus raise the amperes for the same horsepower. This chord factor should be 96.5 ÷ 100.5 = 0.96 if the power factor is considered unchanged. But 0.96 = sin 73 deg., therefore the pitch is ((73 ÷ 90) × 15) = 12.1, or twelve slots. This pitch, 1 and 13, gives a chord factor of sin [(12 ÷ 15) × 90] = 0.955, which gives a current of 96.5 ÷ 0.955 = 101 amp. and a slip-ring voltage of 340 × 0.955 = 324 volts. Accordingly the rotor was rewound with 120 coils of No. 10 wire three in hand, with a pitch of 1 and 13, connected two-parallel-star, there being twenty-four groups with five coils per group. After the motor was rewound and assembled and installed in the customer's plant, it operated with complete satisfaction.

Detroit, Mich. A. C. ROE.

Easy Plan for Teaching Men to Read Wiring Diagrams

TEACHING men to read a wiring diagram is greatly simplified by the illuminated diagram board shown here, which is in use in the electric vehicle course of the "automobile continuation school" conducted by the Chicago Board of Education. Telephone switchboard signal lamps are mounted in the board at various contact points and lines, representing conductors. The lamps are lighted in proper sequence, tracing the current flow from battery to motors and back to battery by turning the crank in the lower left-hand corner of the board. This drives a cylinder back of the board which is equipped with contacts similar to those on a sign flasher. This particular board illustrates the operation of an electric truck motor and control. An indicator on the left end of the board is used to shift the cylinder to the proper position for any desired truck speed, forward or reverse. The crank may be turned slowly so that the current flow is readily followed, or a pause may be made at each point. Energy for operating the lamps is furnished by a 10-volt storage battery.



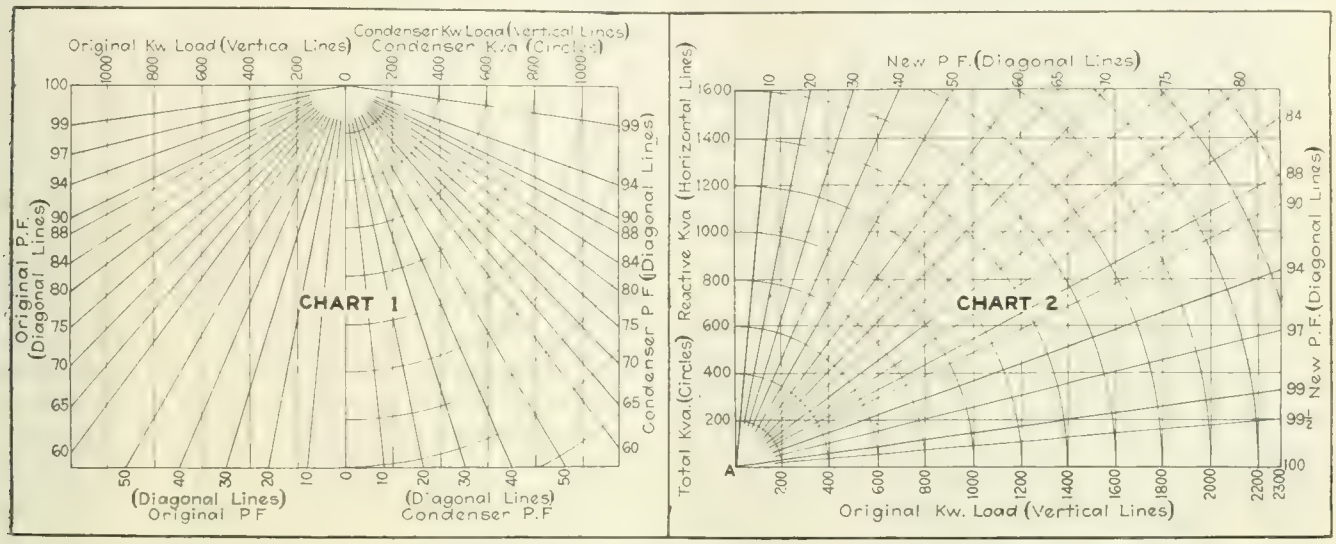
SMALL LAMPS LIGHTING IN SUCCESSION HELP THE EYE TO FOLLOW THE DIAGRAM

J. E. Dunlap of the Walker Vehicle Company is responsible for the design of the board. R. Macrae of the Commonwealth Edison Company is the teacher in charge of the electric vehicle course.

Charts to Solve Power-Factor Correction Problems

FOR determining the size of synchronous motor necessary to raise the power factor of existing loads to different values the charts shown here have proved useful. They give at a single setting a clear view of all the results to be obtained with different sizes of condensers, either floating on the line for power-factor correction or carrying a mechanical load. The charts also give without calculation the kva. under both the original and the corrected conditions and the various values of the power factor of the load and of the condenser itself.

The reproductions are intended as a guide for any one wishing to make similar charts. In making them the angles between the 100 per cent power-factor line and the line for other power factors may be determined from the accompanying table or any table of cosines.



CALCULATION OF SYNCHRONOUS-CONDENSER SIZES FOR CORRECTING POWER FACTOR IS SIMPLIFIED BY USING THESE CHARTS

Both of the charts should be drawn to the same scale and at least as large as 8 in. x 10 in. Chart 1 should be on cross-section paper and Chart 2 on celluloid or other transparent material.

METHOD OF USING CHARTS

General.—For all purposes superpose Chart 2 on Chart 1 letting the point *A* (Chart 2) fall on the intersection of the ORIGINAL POWER-FACTOR line and the ORIGINAL LOAD line on Chart 1. Place the base lines of both charts parallel and hold them in this position by weights or otherwise.

I. *To determine condenser size needed to produce any desired power factor without carrying mechanical load:* Follow NEW POWER-FACTOR line (Chart 2) to ZERO POWER-FACTOR line (Chart 1) and trace nearest circle to CONDENSER KVA. scale (Chart 1).

II. *To determine size of condenser necessary to produce any desired power factor when carrying a mechanical load:* Follow NEW POWER-FACTOR line (Chart 2) to vertical line (Chart 1), indicating CONDENSER KW. LOAD, and trace nearest circle (Chart 1) to CONDENSER KVA. scale (Chart 1). The power factor at which the condenser will operate may be found by tracing the radial line on Chart 1, which passes through the intersection of the NEW POWER-FACTOR (Chart 2) and the CONDENSER KW. LOAD (Chart 1) to the CONDENSER POWER-FACTOR scale (Chart 1).

III. *To determine the total kva. supplied without a condenser:* Follow NEW POWER-FACTOR line (Chart 2) to ORIGINAL LOAD LINE (Chart 2) and from intersection trace circle on chart 2 to TOTAL KVA. scale.

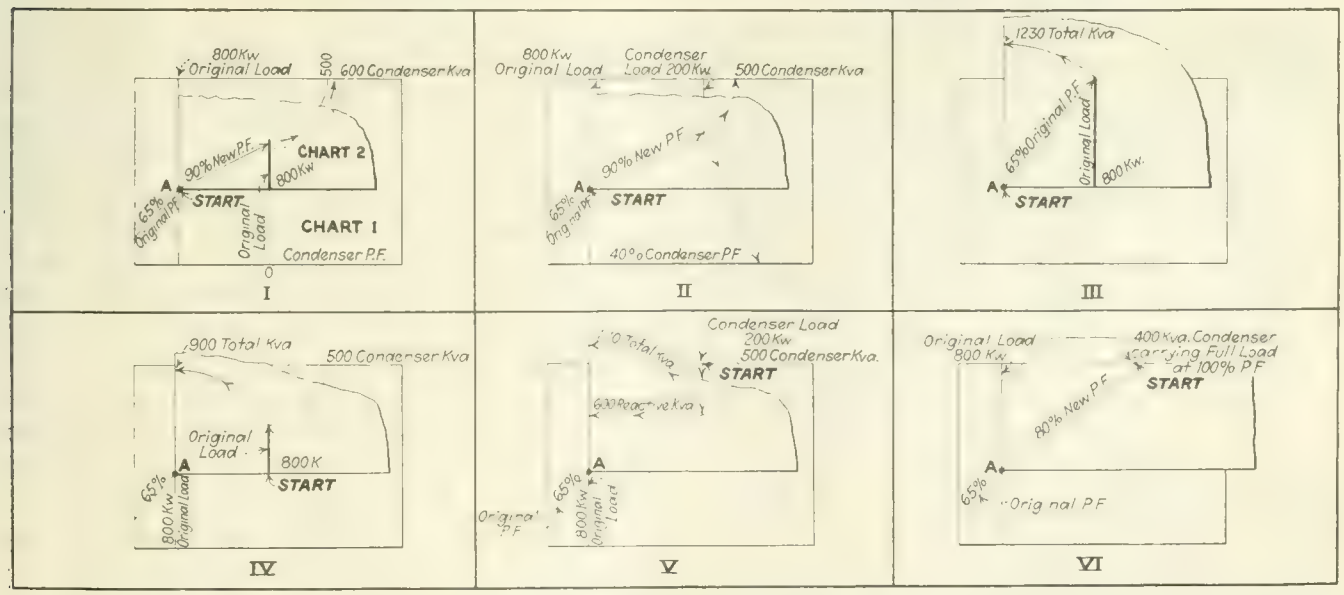
IV. *To determine total kva. supplied with condenser carrying no mechanical load:* Follow ORIGINAL LOAD ORDINATE (Chart 2) to CONDENSER KVA. circle (Chart 1) and from intersection trace horizontal line to TOTAL KVA. scale (Chart 2).

V. *To determine total kva. supplied with condenser carrying a mechanical load:* Follow vertical line indicating CONDENSER LOAD (Chart 1) to CONDENSER KVA. circle (Chart 1) and from intersection trace circle on Chart 2 to TOTAL KVA. scale (Chart 2).

VI. *To determine system power factor with condenser carrying full rating at 100 per cent power factor:* Observe power factor line Chart 2 passing through CONDENSER KVA. scale (Chart 1).

SIMPLIFIED DRAWINGS SHOWING SOLUTION OF VARIOUS CASES

Given a load (800 kw.) at a certain power factor (0.65)



I. Find condenser size unloaded to raise power factor (0.65) to certain value (0.90). Ans. 550 kva.

II. Find condenser size loaded (200 kw.) to raise power factor (0.65) to certain value (0.90). Ans. 500 kva.

III. Find total kva. without condenser. Ans. 1,230 kva.

IV. Find total kva. with unloaded condenser (500 kva.) Ans. 900 kva.

V. Find total kva. if condenser (500 kva.) loaded (200 kw.). Ans. 1,110 kva.

VI. Find total power factor with condenser at unity power factor. Ans. 0.78.

Chart 1 is drawn on cross-section paper, while Chart 2 is made on tracing cloth, celluloid or other transparent material. The small diagrams I to VI will give a pictorial idea of the method of solving different problems.

In choosing a condenser certain precautions must be observed. The condenser must not be operated at a power factor lower than that recommended by the manufacturer. Synchronous machines designed primarily as motors usually should not be operated at less than 50 per cent power factor. However, those which are designed solely for operation as condensers may be operated at power factors approaching zero. If other conditions justify it, the condenser should be operated at 71 per cent power factor, as under this condition the sum of power load and correction effect will be greatest.

POWER FACTORS AND CORRESPONDING ANGLES OF LAG OR LEAD

Power Factor, per Cent	Angle Deg.	Angle Min.	Power Factor, per Cent	Angle Deg.	Angle Min.	Power Factor, per Cent	Angle Deg.	Angle Min.
5	2	52	60	36	52	92	66	56
10	5	44	65	40	33	93	68	26
15	8	38	70	44	26	94	70	
20	11	32	75	48	35	95	71	48
25	14	28	80	53	08	96	73	45
30	17	28	82	55	05	97	75	56
35	20	29	84	57	08	98	78	31
40	23	25	86	59	19	99	81	54
45	26	45	88	61	39	99½	84	16
50	30	00	90	64	10	..	..	..
55	33	22	91	65	30	..	..	..

From a standpoint of gross economy, the cost of the condenser must be balanced against the possible benefits derived from raising the power factor, such as lower rates, released capacity of generators, lines, transformers, etc., and reduced voltage drop with consequent increased torque and efficiency of motors, etc. In practice it is rarely economical to raise an existing power factor above 85 per cent or 90 per cent on account of the excessive cost of corrective equipment large enough to give a higher power factor.

ALBERT RUDIN.

Matahambre, Cuba.

Standard Practice in Building Storage-Battery Mine Locomotive

MAXIMUM battery sizes, draw-bar pull, speed and horsepower which should be used for storage-battery mining locomotives were recommended by the Electric Power Club recently. The recommended specifications appear in the accompanying tables. The kilowatt-hour capacity of the battery shall be kept at or below the kilowatt-hour capacity of the maximum-size battery specified for any particular make and for any size of chassis.

RECOMMENDED CONSTRUCTION OF STORAGE-BATTERY MINING LOCOMOTIVES

Chassis Weight, Lb.	Draw-Bar Pull, Lb. Chilled Wheels	Speed, Miles per Hour at 80 Volts	Motor Horse-Power at 80 Volts
6,000	1,000	3½	11
7,000	1,500	3½	16
8,000	2,000	3½	22
10,000	3,000	3½	33

MAXIMUM SIZE BATTERY FOR MINE LOCOMOTIVES

	Size of Chassis — 6,000 Lb		7,000-Lb		8,000-Lb		10,000-Lb
Make of Battery	Type	No. Cells	Type	No. Cells	Type	No. Cells	
Ironclad Exide	MV-19	48	MV-19	48	MV 27	48	No
Philadelphia	WML-23	48	WML-23	48	WML-33	48	limita-
Edison	A-8	88	A-8	88	A-12	88	tion

Continuous Self-Baking Electrodes for Electric Furnace

CONTINUOUS self-baking electrodes are employed in an electric ferro-manganese furnace of the Southern Manganese Corporation, Anniston, Ala. These electrodes are formed above the furnace and fed down through tubes for days at a time without any shut-down of the furnace. The results of the operation of this furnace prove the following advantages for the electrodes: (1) Absolute continuity of operation as far as the electrodes are concerned; (2) smaller consumption of electrode carbon per given power supplied to the furnace; (3) lower cost of electrode per given power supplied to the furnace; (4) lower power losses in the electrodes; (5) greater regularity of operation of the furnace, therefore less wear and tear on workmen and management and greater uniformity of product.

The furnace on which this installation is made is an open-top furnace of the usual ferro-alloy type. The working space is 12 ft. x 20 ft. (3.6 m. x 6 m.), elliptical in shape. It is rated at 1,800 kw., three-phase, the electrodes being spaced in line. Primary current is received at 44,000 volts, 60 cycles, and is transformed to 68 volts. The three electrodes are each 32 in. (80 cm.) in diameter and extend up into the tamping house, 12 ft. (3.6 m.) above the charging floor. The total length, when a new section has just been added to the top, is 24 ft. (7.2 m.), and the weight, exclusive of the holder, is about 13,200 lb. (6,000 kg.) per electrode. The casing is formed of No. 18 sheet iron (1.05 mm.), riveted together to the correct diameter and provided with inwardly directed partitions. One section 46 in. (115 cm.) long weighs approximately 110 lb. (50 kg.). Welding one section of casing into place takes one welder and one helper four hours. Tamping in about 2,000 lb. (900 kg.) of electrode mix with pneumatic rammers takes two men four hours, with one helper to carry mixture. A new section is required at each electrode every five to fifteen days, according to the nature of the ore being reduced in the furnace and the current taken by the electrode. Holders and electrodes are suspended by wire cables controlled by hand in the controller house, which is located at the side of the furnace.

The ore used was Caucasian dioxide ore of high grade, 56 per cent manganese, with not sufficient iron for producing 78 per cent ferro-manganese and not sufficient silica to give a proper slag volume in the furnace. In nineteen days' running current was off the furnace twenty-four hours, but not on account of the electrodes. The electrode consumption amounted to 21 ft. 2½ in. (6.4 m.) on all three electrodes, representing 10,600 lb. (45,600 kg.) of baked carbon electrode consumed. During the same period the energy consumption was 723,300 kw.-hr.

In this period there were no abnormalities of any kind in the product, the slag, the labor required or superintendence. On the other hand, there were no interruptions of current whatever on account of the electrodes, no poor joints, no breakages, no stumps, no "graveyard" for discarded electrodes.

This type of electrode, called the "Soderberg" electrode, was installed by Electrokenrisk Industri, a company which has operated such electrodes in Norway. The information was presented by G. W. Richards before the recent Cleveland (Ohio) meeting of the American Electrochemical Society.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Power of Regulation Involves Obligation to Protect

AS PART of the publicity program now being carried on by the Consumers' Power Company of Michigan in connection with its sale of preferred stock to customers, J. B. Wootan, director of publicity, has addressed within the past two months the Rotary clubs, chambers of commerce and other business organizations in about twenty cities served by the company. In these addresses he not only presents the reasons for the sale of stock but discusses in an interesting manner questions of public relations.

Basing his remarks on the proposition that "the power to regulate involves the obligation to protect," he reminds the public that when it assumes the right to regulate public utilities it thereby takes upon itself the obligation to protect that utility in its rights and privileges. It is pointed out that the public utility is fundamentally a mutual interest proposition and that the public first recognized this fact when it assumed the right to regulate the utility. Drawing an analogy between the franchise of citizenship and the franchise of the public utility, Mr. Wootan states: "When the state gives me my franchise as a citizen it imposes upon me under that franchise certain duties and obligations, but it bestows upon me certain rights and privileges for me to enjoy. The state sees that I cannot meet my obligations nor perform my duties unless I am fully protected in the execution of my rights and the enjoyment of my privileges. Therefore it very wisely throws about me an arm of protection and sees to it that I am fully protected in these rights and privileges so that I am able to become and remain a good citizen.

"Now, the same state confers upon me a franchise, which is nothing more nor less than a permit to do business, to carry on a public utility, and under this franchise the state imposes certain duties and obligations for the utility to meet, but it also bestows certain rights and privileges for the utility to enjoy. It is impossible for the utility to meet these obligations and duties unless it is fully protected in the enjoyment of its rights and privileges, and it is at this point where the state's obligation begins. It is here that the state must see that 'the power to regulate involves the obligation to protect' and that unless the state performs its part of this contract the utility cannot fully perform its part.

"Under this franchise the first duty imposed upon the utility is that of rendering adequate public service. It can do this by one means only, and that is by means of an adequate rate for the service. Therefore, while the primary duty of the public utility is to render adequate service, the primary duty of the state is to see that it gets an adequate price for the service. Here is the principle of mutual interest visualized. The community must have adequate service. It can get it by paying an adequate price. It follows therefore that the only kind of a public utility that is worth while to a worth-while community is a prosperous utility. When the question is asked, therefore: 'Why is it, if your securities are so attractive to investors, that you have to come now and then to the city commission or state commission and ask for an increase in your rates?" It, of course, answers itself. One realizes that the first principle of good merchandising is to see to it that the selling price is right, and also that the public utility's selling price must be right or it cannot serve, and that if the price is right the rate of return must be right. Furthermore, it is not a favor the utility is asking of the community when it applies for an increase in its rate for service; rather, it is a favor the utility is doing the community, or, still better, it is the utility keeping faith with the community, because the utility knows when the rate falls below a fair level and the public holds the power of adjusting the rate."

In all of his addresses Mr. Wootan emphasizes as the crux of the whole proposition that the public utility was designed to be a business enterprise and never a political football, a public servant that must serve, and that when it is dealt with as a political football or anything else other than a business enterprise it cannot adequately function as a public servant.

The speaker does not talk stock selling. He does, however, go into the needs confronting the company and the community and describes what the company is doing to meet these problems.

Depreciation, Amortization, Obsolescence and Similar Topics

BY KASSANDRA

DEPRECIATION, amortization, obsolescence, deferred maintenance, sinking fund, periodic payments—some of these terms are used at times interchangeably as if they represented exactly the same thing. What is very important is that they all have a common basis in that at the start there is a capital expenditure of some definite amount, call it *A* or *X*, $100 or 100 per cent. Then we look forward to some future time or date when this amount, *A* or *X*, $100 or 100 per cent, or whatever it may be, shall (on the same basis) be something like *B* or *Y*, or $20 or 10 per cent, or nothing at all. When the amount is nothing at all, then the full life of the property has been reached. When the amount at the end of this period is the scrap value, again the period of time is the useful life of the property.

All these terms of depreciation, amortization, etc., have to do with the idea that at the end of some period of time the property will be worth less than at the start and that during the period of life it is desirable to earn or set aside, over and above the dividends or interest

or fair return to the owners for the use of their property, a sum of money which will put the owners in the same position they occupied at the start.

Here the question of inflation or deflation comes in. If I had property worth $1,000 ten years ago which provided me with an income of $50 a year, or enough to buy a good suit of clothes at the prices then obtaining, what should I have today to be in the same position—$1,000, which will give me $70 a year at present interest rate, or $701.35, which at present interest rate will give me $50, the same I used to get, or $1,300, which at present interest rate will give me $91, just about enough to buy the same suit of clothes I used to get for $50?

It is obvious that this is merely a question of the bargain made. If I had $1,000 to be repaid at a later date, the borrower must return that $1,000. If I rent a house to be returned in good order and condition, I am entitled to a return of that house and nothing more or less even if its value has changed.

Capital Must Be Figured on Dollar Basis

The general opinion is that an investor in a public utility has loaned dollars, whether he owns common stock or bonds, and is entitled to a return of his dollars and on his dollars irrespective of inflation or deflation. This, however, is a matter not yet settled. Let us, however, figure on the dollar basis, since the dollar basis clearly does apply to all bonds and preferred stock and also applies to all book values which are essential in dollars. The point is that the difference between the initial and the final book value (in dollars) must be provided for during the life of the property.

If a property is worth, or rather is on the book for, $100,000 in 1920, and is going to be scrapped for $10,000 in 1940, then $90,000 must be provided during the life between 1920 and 1940. The straight-line method, so called, assumes that one-twentieth of the $90,000 is provided each year and returned to the owners each year. In this case their investment decreases each year and the cash payment for dividends decreases each year.

The sinking-fund method assumes that some less amount is provided each year, but instead of being returned to the owners at once, it is invested in a sinking fund which earns interest so that at the end of the twenty years it provides, together with the scrap value, enough to return the whole.

As a matter of fact, however, the life of any property is uncertain, and what is more important, its value does not decrease regularly so much each year, but very irregularly. An orchard appreciates during the time the trees are growing. Any business appreciates while it is being built up. An automobile appreciates just after it is bought, then depreciates very rapidly (in sale value) the moment it becomes second-hand, then depreciates more slowly. In the fall, when there is no buying demand, a second-hand automobile is not worth so much as it will probably be worth the following spring. The man who holds it during the winter expects even the second-hand automobile to appreciate enough during the winter to pay for storage charges, although in the spring he knows that it will depreciate in price during the summer even if not used at all. It follows that even if we know exactly the total life of a piece of property, it is almost impossible to say just how much it depreciates each year. We can see this if we carry the idea one step further and attempt to say just how much the depreciation was each month or day or hour.

If I should buy an automobile for $2,000 and use it one month, I might not be able to sell it second-hand for $1,500 and yet I probably would not sell it for $2,100 if it had turned out to be what I wanted, because I would not want to take the trouble of buying another and running the risk that it would not be so good as the first one. It would be stupid for me to mark off $500 on my books the moment the car became second-hand, and in fact there can be no rules applicable to all cases. The amount to be marked off for depreciation in each day or month or year is clearly a matter of judgment. The only rule to be laid down is that the whole amount must be marked off during the whole period, though it is reasonable that there should be a definite plan. The straight-line method calls for marking off the same amount each year.

The sinking-fund method provides for marking off nothing until the end, but accumulating enough to do all the marking off at once. This may be done by putting the same number of dollars into the sinking fund each year, but it may also be done by setting aside a portion of the gross earnings, or of the net earnings, or of the surplus over dividends, provided only that more is set aside to accomplish the work at the end of the period. The sinking fund may be built up at the start at the expense of dividends. In this case the dividends will be, apparently, very large toward the end.

Vice versa, all the profits over operating expenses may be paid out in dividends at the start. In this case when the property gets old all the earnings may be needed for the sinking fund if it is to provide for the return of the property after its life has ended. The dividends, in fact, may turn into "Irish dividends."

The whole thing is a matter of judgment, not of rules or of mathematics, and the best judgment would seem to be to pay at first as dividends or return on the investment just enough to attract capital, but no more than enough; then to put all the rest of the earnings into the sinking fund or reserve. This method should be followed for several years at least. When a better idea is obtained of the probable life and actual earning power, then the dividend should be revised and, of course, a change in the dividend means a change in the amount available for sinking fund in reserve.

How Shall Sinking Fund Be Invested?

In the case of a utility, the change, when finally the life of the property can be more accurately forecast, may be in the rates or earnings instead of in the dividend. The question of whether a sinking fund or a reserve should be invested in the property or in outside securities is important, but important for reasons entirely different from those usually discussed. A sinking fund or reserve invested in bank loans or securities that are readily salable is just like keeping a big cash reserve. Such a cash reserve is extremely useful in case of a panic or squeeze, but if kept in a form to be really available, it is apt to command only a small interest rate—*i.e.*, to earn but a small return.

Except for availability in case of a panic, a reserve or sinking fund is best invested in the property itself. When so invested it is a little harder to see that it is earning interest just as much as the original investment, but it is earning interest just the same, even if the dividends are declared as a percentage on the whole investment. Often the actual reason for investing the reserve in the property is that in this way the surplus and reserve are mixed together and the books always

show a surplus. This is as it should be, since such a method by most laws permits dividends. In the case of a utility it is much more important that the return on the investment should be kept uniform so as to attract new capital than it is that the sinking fund or appropriation for reserve should be kept uniform. The commissioners can wisely provide for rates that will build up reserves in good times so as to keep rates lower in bad times; but, of course, it is essential that if reserve appropriations are kept low in bad times, they should be built up in good times.

One further point may be discussed, the claim of certain railroad people that utilities—or at least that their railroads—do not depreciate at all so long as they run. This is absurd, and yet the conclusion that no reserve need be accumulated has a modicum of reason in it. A railroad with its ties, tracks and equipment all half worn out may still function as well as if it were new, and its owners will be entitled to a return on their original investment. If, however, they are figuring that the road will last forever, they are taking a risk, and if the road disappears, they lose their all. It would be wiser for them to build up a reserve, and it would be wiser for the public (through the commissioners) to give them rates that will build up a reserve rather than have railroad rates and railroad dividends based on the theory that a railroad will last forever.

Turnpikes went, toll bridges went, some street railroads have gone, the waterworks of ancient Rome went. Why should American railroads last forever? This, like the other questions of depreciation, amortization and obsolescence, is a matter of judgment.

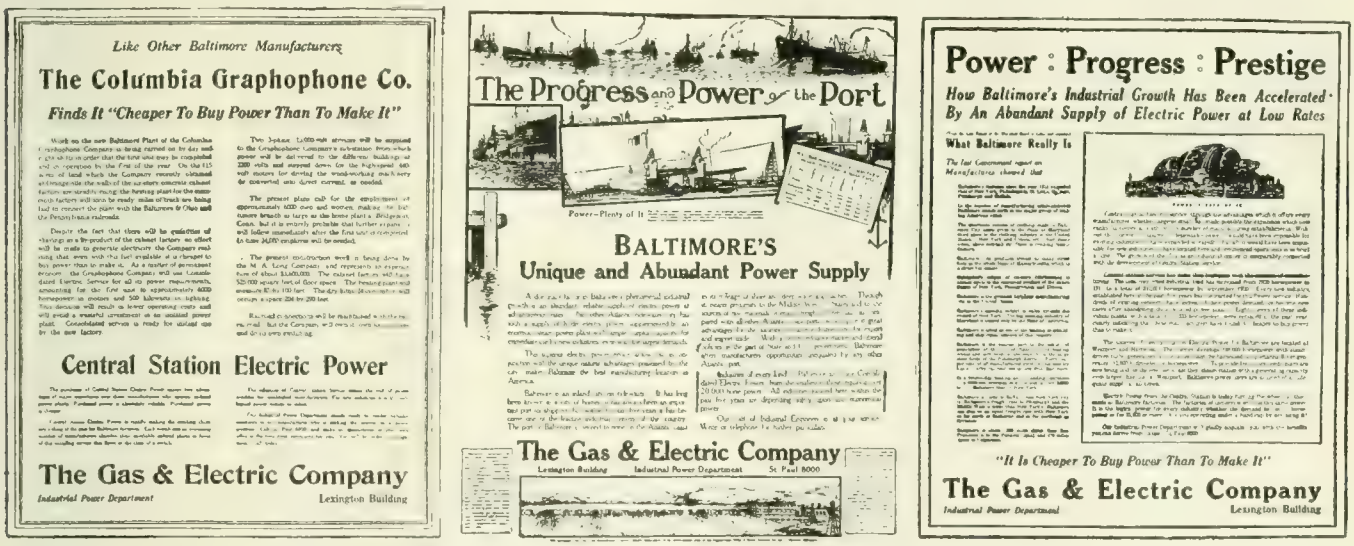
The owners of the property, together with the public and the commissions, whose power to fix rates make them the real owners, must figure the future as nearly as they can. They must fix rates, dividends and reserve or sinking fund so that in the final event every one shall have been treated fairly. Further, as fast as more definite knowledge of the future is obtained rates, dividends and sinking funds or reserves must be adjusted accordingly.

There is no general rule except that all these rates, dividends and reserves must be considered together as well as separately. Rates must be low enough to get the business and yet high enough to pay dividends and reserve. Dividends must be high enough to attract capital—the capital of the workingman who has saved. Sinking fund or reserves must be high enough to protect the capital of the man who has worked and saved, but sinking fund and reserve need not be figured on any mathematical basis, or, if so figured, the capital of the workingman must be preserved in accordance with the understanding under which he saved and invested.

The question of what should be done in view of various tax laws and also in view of various rulings of commissions is sometimes raised. This is something that cannot be dealt with generally. Each company, according to the tax laws by which it is governed and the rulings of its commission, must do the best it can and use its best judgment in each case.

City's Industrial Growth Depends on Power Supply

HOW the industrial growth of a city depends to a large extent on the adequacy of its electric power supply is the chief topic in a series of full-page advertisements which the Consolidated Gas, Electric Light & Power Company of Baltimore has been running in the daily papers as part of its industrial power campaign. In the three typical advertisements shown here the relation of power supply to the city's growth is emphasized and the details of an exclusively electrical installation in one of the large industrial plants are given to demonstrate that it is "cheaper to buy power than to make it." In all of the advertisements the progress and development of the city is coupled with the service rendered by the electric utility.



TYPICAL ADVERTISEMENTS USED BY BALTIMORE COMPANY IN ITS INDUSTRIAL POWER CAMPAIGN

Ninety per Cent of Employees Are Stockholders

NINETY per cent of the 1,200 employees of the Iowa Railway & Light Company have become stockholders in the company as the result of a recent "drive." Stock was sold to employees at a slight discount, while other subscribers paid the par value. Seven per cent preferred was offered to employees, who paid for it either in cash or on semi-monthly payments of $5 per share. For the past year the company has offered its preferred stock to customers on weekly or monthly payments and many are now holders of the securities.

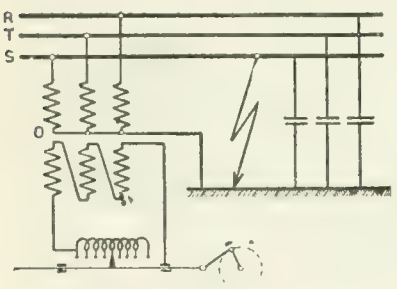
Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

The Arc Generator as an Engineering Mechanism.—Details of construction and control equipment for the Elwell-Poulsen arc generators for radio communication.—London *Electrician*, Dec. 3, 1920.

The Quench Transformer.—One of the reasons why a flash-over on a line insulator is so dangerous when it occurs on a transmission system of great electrostatic capacity is that the high charging current of the line tends to maintain a power arc across the insulator. An ordinary arcing ground suppressor cannot be relied upon to quench the arcing ground if the capacity exceeds a certain value. Professor Petersen in Darmstadt has found that arcing grounds are very effectively quenched if the transformer neutral is grounded through a large choking coil with an inductance such as to give resonance with the line capacity. The choking-coil current and the line-charging current then will both pass through the arc, but, being of opposite phase, will cancel out, leaving only a small residual current, which usually is not sufficient to sustain the arc. Another similar device, the so-called quench transformer, has been proposed by R. Bauch. It consists of an ordinary star-connected transformer, grounded at the neutral point, which is provided with an extra winding in the form of an open delta. The auxiliary winding is closed through an inductance coil as indicated in the figure. When a flash-over occurs on either line in the three-phase system, the field distribution in the transformer will be strongly distorted and an equalizing current will be set up in the auxiliary winding. This current, owing to the effect of the inductance coil, will have a strongly lagging phase displacement with respect to the primary voltage. A corresponding current will pass through the primary neutral to ground, and if the choking coil has the right value of inductance, the grounding arc will be quenched in much the same way as if the transformer had been grounded through a Petersen coil. The Bauch transformer is said to be very easily adjusted to suit the line capacity, but for systems where the capacity is frequently changed by switching operations an arrangement is recommended whereby the choking coil may be periodically changed from one extreme value of inductance to another within a time of three seconds. An arcing ground thus is quenched after three seconds at most, whatever value the line capacity happens to have at the moment. It is not necessary to use a special transformer for arc quenching, an ordinary three-phase transformer with a Bauch auxiliary winding giving just as good service even when it is at the same time used in ordinary operation. — *Elektrotechnische Zeitschrift*, Oct. 21, 1920.



BAUCH QUENCH TRANSFORMER FOR ARCING GROUNDS

Lamps and Lighting

Lighting of Shoe Factories.—A. L. Powell and J. H. Kurlander.—A study of the various operations performed in shoe factories, in order to determine how the lighting can best be laid out to meet manufacturing requirements. The writers hold that there is still room for investigation along this line.—*Transactions I. E. S.*, Nov. 20, 1920.

Calculation of the Lighting Installation.—A. S. Turner, Jr.—Three principal methods are explained for use in calculating illuminations, (1) point-by-point method, (2) flux-of-light method, (3) modified flux-of-light method. Extensive curves and tabular data for practical applications are included.—*Bulletin L.D.-117, Edison Lamp Works*, June, 1920.

United States Army Searchlamps.—Chester Lichtenberg.—A comprehensive article giving the most important development in army searchlamps, mostly portable, for such exacting service as locating airplanes.—*Journal Franklin Institute*, November, 1920.

Generation, Transmission and Distribution

Wooden-Pole Design.—H. Ott.—A line diagram, or abaque, is presented which permits a rapid determination of necessary cross-section of wooden transmission-line poles for given span, conductor area and pole length. —*Elektrotechnik and Maschinenbau*, Oct. 24, 1920.

German Power Practice.—Modern power-plant operation was discussed at a meeting of German engineers some time ago. One of them, in dealing with the insulator question, said that deterioration of cemented insulators of the pin and cap type is caused by the different thermal expansion coefficient of cement and porcelain. In modern insulators, however, the thermal expansion has been made almost equal by mixing the cement with crushed porcelain. Another engineer, in reporting on transmission-line practice, said that the greatest strain to be permitted in copper conductors is 16 kg. per square millimeter (22,700 lb. per square inch). For span length 250 m. (820 ft.) is an upper limit, and strain poles should be not more than 1 km. (0.62 mile) apart. Taking into consideration the tendency to develop corona, the speaker suggested the following data for high-tension lines:

Voltage	Area — Sq.Mm.	Area — Circ. mils	Distance Between Phases — Meters	Distance Between Phases — Feet
160,000	35	69,000	2	6 56
100,000	70	138,000	2.5	8 20
50,000	150	296,000	3	9.84

A number of important details, such as protective apparatus, methods of grounding, etc., were discussed by other speakers.—*Elektrotechnische Zeitschrift*, Aug. 26, 1920.

Coal - Saving in the Chemical Industry. — DAVID BROWNLIE.—Here are given the results of investigations carried out during the last nine or ten years into the working of the steam-boiler plants of sixty different chemical works in Great Britain. The net working efficiency of these sixty plants proved to be only about 58 per cent and it is contended that by scientific control this could have been readily made about 72½ per cent. Complete details of the sixty plants tested are appended to the article.—*London Chemical Trade Journal,* September, 1920.

Power Distribution in Southern Sweden.—HALDEN.—Skane and Blekinge, the two southernmost provinces of Sweden, are supplied with electrical energy from hydraulic power stations belonging to two companies, Sydsvenska Kraft A.B. and Hemsjö Kraft A.B., which have recently combined their interests. The Sydsvenska power company, having developed several falls in the River Lagan, with an installed machine capacity of 19,000 kw., distributed in 1919 about 110,000,000 kw.-hr. over its 50,000-volt lines. A part of this energy was delivered to Danish consumers by way of a 25,000-volt submarine three-phase cable between Helsingborg and Helsingor. The Hemsjö company at present controls about 10,000 kw., the figure soon to be raised to 52,000 kw. Last year's total of delivered energy was 40,000,000 kw.-hr. Even after a complete hydraulic development of all available water power, the energy supply in southern Sweden will not be sufficient to meet the demand, and it is therefore proposed to link up the private power distribution system in the south with the big state-controlled hydraulic power station at Trollhättan by a 120,000-volt trunk line.—*Elektrotechnische Zeitschrift,* Oct. 28, 1920.

Rapid Determination of the Current Distribution.—S. AUSTEN STIGANT.—A device for the rapid determination of the current distribution on the line side of a three-phase interconnected-star static balancer operating on a four-wire system.—*Journal Institution of Electrical Engineers, London,* October, 1920.

Pulverized Coal as Fuel.—LAWFORD H. FRY.—A brief survey of the principles involved in the use of pulverized coal as a fuel, showing that common sense and recognition of these principles are more important than adherence to any special type of installation. The author discusses the subject in relation to the use of powdered fuel in the cement and metallurgical industries and also on locomotives and stationary boilers.—London *Engineering,* Nov. 12, 1920.

Traction

Railway Electrification in Austria.—On July 23, 1920, the Congress of the Austrian Republic decided to begin immediately a systematic electrification of the Austrian state railroads. That day a bill was passed which contained not only a detailed program of the work but also a long technical supplement stating the more important engineering considerations of the proposition. The work is to start at once on certain important railroad stretches in mountain districts, aggregating about 652 km. (405 miles) and representing a total yearly transportation, according to 1913 statistics, of 1,765,000,000 gross ton-km. (1,080,000,000 ton-miles). The electrical energy consumption is estimated at 119,500,000 kw.-hr. a year. This first part of the electrification program is to be completed in the years 1920-1925 and the sum of 5,096,000,000 Austrian crowns has been reserved for the work. According to an estimate, the expense will be absorbed as follows: Power plants, 452,000,000 crowns; distribution lines and substations, 1,560,000,000 crowns; electric locomotives, 2,260,000,000 crowns; alterations of present plant and other costs, 824,000,000 crowns. The work is to be carried out with complete electrification in view, and it is proposed in the next twelve or fifteen years to extend the electrification to a second group of lines with a total length of 1,136 km. (700 miles), a transportation total of 2,213,000,000 ton-km. (1,350,000,000 ton-miles), and an energy consumption of 238,000,000 kw.-hr. a year. After completion of this second stage of the work, the electrification will embrace 40 per cent of all the state lines. The necessary electrical energy is to be supplied from a number of hydraulic stations, the state having acquired the water rights of twenty-four waterfalls aggregating 125,000 hp. During the first construction period four power stations will be erected, namely, at Spuller-See, Rutz, Stubach and Mallnitz, with a total generating capacity of 96,000 hp. The power is to be distributed at 50,000 or 60,000 volts to substations along the road. The system adopted is single-phase supply at a frequency of 16⅔ cycles, and a contact-wire pressure of 15,000 volts. A detailed account of the electrification bill and its technical supplement is to be found in the *Elektrotechnik und Maschinenbau,* Oct. 9, 1920.

Automatic Substations for Alternating-Current Railway Signal Power Supply—I.—H. M. JACOBS.—This is the first of two articles which describe the application of automatically controlled equipment to railway alternating-current signal substations for the purpose of maintaining an effectively continuous supply of power to the signals. The present article deals with that type of substation in which the reserve power supply is a secondary commercial source, either nearby or distant, and the concluding article treats of the equipment used in the substation in which a storage battery and converting apparatus constitute the reserve supply. —*General Electric Review,* November, 1920.

Installations, Systems and Appliances

Heat Losses Through Electrodes of a Six-Ton Heroult Furnace.—M. R. WOLFE and V. DE WYSOCKI.—The total heat in the cooling water required to maintain the electrodes at constant temperature was 123.1 kw. Since 650 kw. was supplied to the furnace, the total electrode loss is 18.7 per cent of the power used. It appears from the investigation that a total of 18.5 kw. was absorbed by the upper cooling contact holders, leaving 104.6 kw. absorbed in the lower water-cooled rings.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Motor-Control Equipment and Its Application.—G. J. KIRKGASSER and E. W. SEEGER.—This is the first of a series of articles on the principles and application of motor-control apparatus.—*Electrical Review,* Nov. 27, 1920.

Heat Content of Steel and Slag from an Electric Furnace.—A. M. KUHLMANN and A. D. SPILLMAN.—Calorimetric determinations of the heat content of liquid steel and liquid slag from a 6-ton Heroult steel-casting furnace; also determinations of the heat capacity of the solid slag.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Variable-Speed Induction Motors for Centrifugal Pumps.—M. L. ENGER and W. J. PUTNAM.—It is shown

that a large saving in the power required to drive centrifugal pumps might be made if designers and operators would employ variable-speed drive to control pump discharge and not rely entirely on throttling.—*Engineering News-Record*, Dec. 9, 1920.

Electrophysics and Magnetism

Electrical Phenomena Occurring at High Levels in the Atmosphere.—S. Chapman.—The author gives an account of a recent study of electricity and magnetism in the light of modern understanding of the constitution of matter.—*Journal Institution of Electrical Engineers*, October, 1920.

On the Electron Theory of the Metallic State.—G. Borelius.—The common theory assumes that conducting electrons move freely among the atoms of metal and have the same mean kinetic energy as gas molecules at the same temperature. It is said, however, that other consequences of this theory cannot be said to agree very well with experimental facts. By radical alterations in the fundamental assumptions the author discusses thermo-electric phenomena, the thermal and electric conduction and the magnetic and galvanomagnetic phenomena in the light of his revised theory.—*Philosophical Magazine*, December, 1920.

The Constitution of the Nickel-Iron Alloys.—D. Hanson and Hilda E. Hanson.—An investigation into the constitution of the nickel-iron alloys in which special attention has been given to (1) the determination of the effect of small quantities of nickel on the critical points of pure iron, and (2) an examination of Osmond's theory of the nickel-iron alloys and the determination, if possible, of the "stable" diagram of these alloys.—London *Engineering*, Nov. 5, 1920.

Units, Measurements and Instruments

Spark-Over Voltages Through Air.—W. S. Flight.—Published data connected with the spark-over voltages through air have been carefully examined and additional tests carried out where no information was available or the previous results were inconsistent. Some of the factors which must be taken into consideration are spark length, shape of the conductors, proximity of grounded objects, shape of the insulator, density of the air, impurities, rain, composition of the insulator, electrical characteristics of the circuit, duration of application of the voltage, initial ionization and dielectrics in series.—*Beama*, November, 1920.

Electromagnetic Heat Treatment of Carbon Steel.—Lancelot W. Wild.—The author first points out the necessity for a very accurate control of temperature during the heat treatment of carbon steel. The advantages of electric furnace heatings for this purpose are pointed out. One type of control of temperature for these furnaces is described, also a detector which depends upon the magnetic properties of the steel being heated.—London *Electrician*, Nov. 12, 1920.

Telegraphy, Telephony and Signals

Some Characteristics of the Frequency Doubler as Applied to Radio Transmission.—T. Minohara.—A general analysis is given of the theory of the ferromagnetic frequency doubler. The production of secondary circuit energy is secured either by the induction of a sinusoidal secondary emf. or by the production of a sharply peaked "impulsive" secondary emf. In each case secondary resonance is employed to emphasize the desired double frequency. The sinusoidal-wave and impulsive-wave systems are oscillographically studied and compared for different types of secondary load. The impulsive system is recommended as having higher efficiency wherever the frequency is sufficiently low to avoid excessive iron-core losses with that form of wave.—*Proceedings Institute of Radio Engineers*, December, 1920.

Automatic Telephony.—J. H. Reyner.—Three principal systems of automatic telephony are discussed as follows: (a) When the power required to operate it is supplied by electromagnets (Strowger and Siemens systems); (b) when the power is obtained by clutching electromagnetically to a continuously revolving shaft (Lorimer and Western Electric systems); (c) when no moving parts other than relays are employed (relay automatic).—*Beama*, November, 1920.

Miscellaneous

Physical Characteristics of Specialized Refractories.—M. L. Hartmann, A. P. Sullivan and D. E. Allen.—Tests of the electrical resistivities of nine commercially used refractory materials at temperatures up to 1,500 deg. C. Measurements were taken while heating up slowly and while cooling down slowly, the thermocouple measuring temperature being outside the specimens. The amount of temperature lag thus involved was approximately determined. The results are necessarily only approximate, but show the relative resistivities of the different materials and the general order of magnitude of their resistivities up to 1,500 deg. C.—Paper presented at the meeting of the American Electrochemical Society, Oct. 2, 1920.

Ice Diversion on St. Lawrence River.—Benjamin F. Groat.—The writer gives the results of his operation for two winters of a submerged weir construction for ice-diversion works in the South Sault Channel of the St. Lawrence River.—*Canadian Engineer*, Nov. 25, 1920.

The Work of the Société Hydrotechnique and Its Electric Map of France.—The Société Hydrotechnique was founded in France in 1912 for the purpose of carrying out research in hydraulic engineering. The society has established two research laboratories, in connection with the universities in Grenoble and Toulouse, where studies of a scientific nature are conducted. At the experiment station at Beauvert, not far from Grenoble, there are facilities for work on a scale comparable with conditions of practice. Investigations are now under way, for instance, on methods for water-flow measurement and for determination of turbine efficiency. We have recently referred to the valuable contributions to the theory of hydraulic surges which have come forth as a result of the work of one of the sub-committees of the Société Hydrotechnique. Another committee recently has worked out for publication a map of France containing all existing electric plants and distribution systems. The map is issued in eighty-six sheets, to the scale 1: 200,000, but there is also a smaller edition, in the scale 1: 500,000, which comes in four sheets. The output and voltage of every generating station is indicated on the map, as well as the type of current transmitted and whether the station is hydraulic or thermic. The electric map, however, does not give the topographical details, but is printed on transparent paper and is intended to be put on top of the ordinary map. The map covers more than 1,200 plants. It may be revised at any time by comparison with a standard copy which is constantly kept up to date by the committee.—*Comptes Rendus*, June 24, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Cincinnati Company Creates Permanent Financial Structure

LOOKING to the establishment of a permanent financial structure sufficiently flexible to meet varying conditions which may arise in the future, the stockholders of the Cincinnati Gas & Electric Company have approved the proposal of the company to authorize an issue of $50,000,000 prior lien and refunding bonds running forty years with sinking-fund provisions. The bonds will be issued at such times as the company's financial needs require and will bear such interest as the market conditions at the time of sale call for. Of the $50,000,000 issue $15,000,000 is set aside to refund present outstanding obligations.

In talking with a representative of the ELECTRICAL WORLD regarding the new issue, W. W. Freeman, president of the company, stated that it does not at present contemplate an extensive new construction program involving a large expenditure of capital. "This $50,000,000 authorization has been made," said Mr. Freeman, "to provide a more flexible form of security than we have outstanding at present. No definite interest rate has been stipulated, but under the provision of the bond the company can issue a series of the securities at an interest rate to conform with the then existing market conditions, which will do away with excessive discounts on a 5 per cent or 6 per cent bond when high interest rates are prevalent. A callable feature is also included whereby a series of the bonds bearing a high interest rate can be called in should conditions so indicate.

"This plan will enable the company to issue securities to meet new capital expenditures from time to time in the required amounts and at the necessary interest rates without having to draw up a new form of indenture each time."

Surcharge and Fuel Charge for Cambridge Maximum-Rate Customers

A SURCHARGE of 1 cent per kilowatt-hour and a fuel charge at the rate of 1¼ mills per kilowatt-hour for each dollar or fraction thereof in excess of $5 per long-ton coal cost at the plant of the Cambridge (Mass.) Electric Light Company were authorized to be added to the maximum net price of 9 cents per kilowatt-hour to domestic and commercial lighting customers by a decision of the Massachusetts Department of Public Utilities recently handed down. The above surcharge and fuel adjustment charge are permitted from Jan. 1 to June 30, 1921, inclusive, unless otherwise ordered. The company sought to increase its maximum net rate from 9 to 12 cents per kilowatt-hour, but this advance was opposed by the city of Cambridge on the ground that costs are receding and that in view of the company's past prosperity and improving prospects no change in maximum rate is necessary. The commission felt that some relief should be granted, as the company's net earnings since July 1, 1920, have been sufficient to meet operating expenses and interest charges only. The board held that customers paying the maximum price should, like other classes, share in the surcharge and fuel clause. At the hearing W. E. Holmes, general manager, pointed out that the cost of coal to the company was $12.07 per ton against about $4.50 in 1914.

Super-Power Transmission Survey for Northwest

A SUPER-POWER transmission survey for the Northwest is to be made by a special commission appointed by the American Association of Engineers. To select a committee to investigate the project and draft plans for it the following committee has already been appointed: J. C. Stevens, F. D. Weber, D. C. Henny, W. H. Cullers, Paul Lebenbaum, F. F. Henshaw, Percy A. Cupper, E. R. Cunningham, R. W. Barnes, O. Laurgaard, Thomas Pumphrey, R. H. Dearborn, William S. Turner and L. T. Merwin.

The plans also involve a survey, it is reported, of the available power on the Cowlitz, Clockamas and Deschutes rivers.

Providence Utility Waives Right to Increase Rate Under Fuel Clause

ALTHOUGH the Narragansett Electric Lighting Company of Providence, R. I., under an agreement made with the city in December, 1917, is entitled to increase its rates for service to domestic and other small consumers one-half cent per kilowatt-hour for the next six months, the company appeared before the Public Utilities Commission on Dec. 31 and asked permission to waive, temporarily at least, this right, which was granted.

Under a fuel clause that made the cost of $8 per long ton of coal of 14,500 B.t.u. the basis, it was agreed that for every decrease or increase of $5 or fractional part thereof greater than one-half in the cost of coal there should be a corresponding change in rates of 5 mills for each kilowatt-hour sold. Any such change to be effective for six months subsequent to the six months' period over which the cost of coal was computed. The price of coal to the company has averaged more than $10.50 for the past six months, and under the agreement the company would be entitled to an increase of one-half cent per kilowatt-hour for the next six months.

Instead of exercising its right to advance the rates accordingly at this time the company will file with the commission a revision of its present fuel clause under the existing rate, which will probably result in no advance being made to small consumers, but will secure

the company against any loss through some future arrangement.

This could be done by making provision that when the price of coal drops later on so low that a corresponding drop of a cent or more per kilowatt-hour in the price of electricity would be necessary allowance could be then made for the loss the company might temporarily incur by failing to take its present one-half cent increase.

Consulting Engineers to Consider Joining Federation at Annual Meeting

ON MONDAY evening, Jan. 17, the American Institute of Consulting Engineers will hold its annual meeting at the Engineers' Club, New York, at which time the ballots for vacancies occurring in the council will be counted and reports of officers and committees will be read. The report of a special committee appointed to investigate the advisability of the Institute's joining the Federated American Engineering Societies will be presented and discussed. The topic for general discussion will be "Engineering, Past and Future." An informal dinner at 6:30 p.m. will precede the meeting.

Growth of Customer Ownership in Byllesby Securities

LAST year's experience in selling securities of companies controlled by the Byllesby Engineering & Management Corporation to local customers affords a good indication of the rapid growth of this plan. O. E. Osthoff, vice-president of the Byllesby company, made this statement to a representative of the ELECTRICAL WORLD a few days ago, asserting that the aggregate of such sales for 1920 has been $6,200,000 par value, an increase of 83 per cent over 1919. The total for all the Byllesby companies since the beginning of the movement in 1915 has been upward of $14,500,000. The sales for 1919 were $3,388,100. Taken with 1920, the two years cover two-thirds of the total, while 1920 covers nearly half. This growth indicates clearly, Mr. Osthoff said, the position that the movement is taking in the utility field.

Retiring Illinois Governor Comes Out Against Commission Abandonment

ABANDONMENT of the Public Utility Commission at this time would leave in effect for an indefinite period schedules that were for the most part fixed at the peak of prices, retiring Governor Lowden of Illinois asserted in his farewell message presented to the first session of the Legislature on Wednesday.

"During practically the entire period of its existence, since Jan. 1, 1914" Governor Lowden said, "the commission has been compelled to solve not only the usual problems which concern an enterprise newly created but also extraordinary problems of an ever-changing character. The effect of the war in its relation to public utilities was not seriously felt during the first few months that it raged. The commission was called upon in many instances, particularly after the declaration of war by the United States, to increase the rates charged for the service rendered by the public utilities, if they were to continue to function efficiently in the performance of their duties to the public. Contrary to all expectations, the cessation of hostilities in November, 1918, did not retard the advance in prices, but they continued to increase until a very recent period. There are now many indications that the peak in prices has been reached, and that in the absence of unusual disturbances they will gradually approach the level of prices obtaining prior to the war. Should this prediction prove to be correct, we may reasonably expect that so far as rates are concerned the time of the commission will be as fully occupied in the near future in passing upon applications for the reduction of rates as in the last two years it has been in hearing applications for increases.

"Were the power to regulate rates by commission abandoned at this time," Governor Lowden declared, "schedules would be left in effect for an indefinite period which for the most part were fixed at a time when the peak in the prices of labor, materials and supplies entering into the cost of production was reached."

Recommends New Jersey Law for Right to Make Service Extension Rules

AN UNUSUALLY large number of complaints were received last year by the New Jersey Board of Public Utility Commissioners, it is stated in the annual report issued a few days ago, because of the refusal of utilities to extend facilities and supply service on application.

These complaints, it was stated, resulted from the utilities' policy of refusing to make service extensions unless the prospective customer agreed to pay the cost therefor. The board recommends that the law be changed so that it may after a hearing fix just and reasonable rules and regulations to be observed and followed by utilities in making extensions.

Daylight Saving Again Before New York Legislature

ANOTHER effort will be made at this session of the New York State Legislature to kill state-wide daylight saving. One measure would repeal daylight saving entirely, while another measure would provide for local option thereon.

The state seems rather clearly divided on this subject between the large cities and the rural districts. The Merchants' Association of New York City is actively engaged in an effort to procure daylight saving not only for New York but for the entire eastern district of the country.

Contractors' Executive Committee to Meet

THE annual meeting of the executive committee of the National Association of Electrical Contractors and Dealers will be held on Jan. 24 and 25. In addition to the appointment of committee chairman and the customary business there will be a further report on the investigation into overhead and its relation to the selling price. The first report was made at the annual convention this fall at Baltimore, and at that time the work of circularizing the manufacturers and jobbers on this topic was authorized. It is the results of this survey that will be presented to the executive committee meeting.

The association's special representative, L. W. Davis, has just returned from a two months' trip in the Middle West, where more than fifty new members were secured. He is now starting on an extended tour of the Far West, returning through the South in March.

One Commission for Electric Utilities Contemplated for New York State

CONCENTRATION of regulatory power over all electric light and power companies and gas companies in New York State in the hands of one commission is contemplated by Governor Miller, according to information made public this week. New York now has two commissions. The up-state or Second District commission has jurisdiction over all utilities except those of New York City, which comes under the First District Commission.

It is Governor Miller's present intention to ask the State Legislature for a law confining the activities of the First District Commission entirely to New York City traction lines. In that event the other New York City utilities will come under the supervision of the up-state commission, which has its headquarters at Albany.

This contemplated action is in line with the announced economy plan of the new state administration, which feels that the up-state commission is well equipped to handle the gas and electricity regulation for the entire state without division of authority as prevails under the present arrangement.

Power in the Rubber Industry, Topic of January A. I. E. E. Meeting

A MEETING of the American Institute of Electrical Engineers is scheduled for Jan. 14 at the Akron (Ohio) Engineering Society rooms, under the industrial and domestic power committee and the Cleveland and Akron Sections of the Institute, the topic of the technical session being "Application of Electric Power in the Rubber Industry."

The morning will be taken up with the meetings of the board of directors and committees, and the afternoon will be devoted to an inspection trip through the B. F. Goodrich plant.

Federal Power Commission Appropriation Cut to $100,000

INSTEAD of the $482,065 requested by the Federal Power Commission for its expenditures for the next fiscal year, the committee on appropriations allowed only $100,000. The item, as reported by the committee, has been approved by the House of Representatives, but an effort will be made to increase it when the bill reaches the Senate.

It is hoped that in the meantime the water-power act can be amended so as to allow the commission to expend this appropriation directly for salaries. Hearings on the Esch amendment to the act began Jan. 5. If the amendment is not passed before the sundry civil bill becomes a law a deficiency appropriation will be asked.

Unless additional funds are made available, Secretary Merrill has advised the appropriations committee, it will take four years to dispose of the water-power applications now before the commission. He points out that the commission is required to pass on every project with due consideration of the plans, the design and the relation of the scheme to other projects and to the general plan for developing the stream concerned for navigation, irrigation or power.

To make it absolutely sure that water-power leases shall not be allowed in national parks, the House of Representatives has approved a proviso that none of the appropriations allowed the commission for the coming fiscal year is to be expended in connection with any application which affects a national park.

A. I. E. E. Midwinter Convention Will Include Six Technical Sessions

THE seventh midwinter convention of the American Institute of Electrical Engineers, which will be held in New York City, Feb. 16-18, in the United Engineering Societies Building, 33 West Thirty-ninth Street, will include six technical sessions, visits to various power plants, a dinner dance and the Edison medal presentation, followed by a lecture. On Wednesday, Feb. 16, the morning will be devoted to registration and to arrangements for the visits to the power plants, which will be made on Wednesday afternoon. In the evening there will be a technical session. Thursday morning and afternoon will be occupied by technical sessions, and in the evening the usual dinner dance will be held at the Hotel Astor. There will be technical sessions on Friday morning and afternoon, and on Friday evening the Edison medal will be presented to Dr. M. I. Pupin. The subject of the semi-popular lecture on recent advances in science which will follow this presentation will be announced later.

The tentative technical program of the convention is as follows:

WEDNESDAY, FEB. 16

Evening.—Opening address by President A. W. Berresford; symposium of questionnaire on oil circuit breakers for the protective devices committee, by H. R. Woodrow; "Tests on Oil Circuit Breakers," by P. Torchio. (Moving pictures and oscillograph records of switches, at the instant of failure.)

THURSDAY, FEB. 17

Morning.—Sub-committee on wires and cables, standards committee: "Permissible Operating Temperatures of Impregnated Paper Insulation in Which the Dielectric Stress is Low," by W. A. Del Mar, chairman.

Afternoon.—Telephone and telegraph committee, D. McNicoll, chairman: "Multiple Use of Wires," by S. Rhoads; "Carrier-Wave Telephony," by F. B. Jewett and B. Gherardi.

FRIDAY, FEB. 18

Morning.—Instruments and measurements committee, F. V. Magalhaes, chairman: "A New Design of Current Transformer," by H. B. Brooks and F. C. Holtz; "Regulation of Frequency for Purposes of Measurements," by P. H. Smith; "A New Type of Differential Voltmeter," by E. D. Doyle; "Variation of Eddy Currents in Conductors of Different Stranding," by J. A. Cooke; "Mechanical Wave Analyses," by F. S. Dellenbaugh; "Stop Watches," by A. L. Ellis.

Afternoon.—Miscellaneous session: "Short-Circuit Current of Induction Motors and Generators," by R. E. Doherty and E. T. Williamson; "Hysteresis Phenomena with Superimposed Frequencies," by W. Fondiller; "The Longitudinal Flow of Heat in the Windings of Electrical Machinery," by C. J. Fechheimer.

Electric Light and Power Refunding in 1921 to Be Almost $100,000,000

A COMPILATION made by Dow, Jones & Company gives $305,110,350 as the total for all public utility bond and note issues maturing in 1921. From that compilation the ELECTRICAL WORLD has selected all of the issues amounting to $200,000 or more of electric light and power companies, as listed below. The sum of these selected issues, all of which is not necessary for electrical business, as a number of the companies are combination properties and there is no way of telling now for which branch the money was expended, shows that a little less than a third of the grand total, or $97,504,800, is the amount of securities that the electric light and power companies will have to refund in one way or another during 1921. The largest of these is $14,601,000 in three-year notes of the Puget Sound Traction, Light & Power Company, which falls due June 1. There are only six other issues for more than $3,000,000, the largest of which are $10,000,000 in two-year notes of the Toledo Traction, Light & Power Company, due Dec. 1; $8,254,700 in notes of the Consolidated Gas, Electric Light & Power Company of Baltimore, due Nov. 15, and $7,500,000 in one-year notes of the United Gas Improvement Company to be paid Feb. 1. June has the largest monthly total, $15,351,000, followed by November and December, with $14,426,700 and $14,143,100 respectively.

Due	Corporation	Type of Security	Rate	Amount
Jan. 1	East St. Louis & Suburban Co	Convertible	7	$2,116,000
Jan 1	American Gas & Elec Co	Notes	6	1,500,000
Jan. 1	Little Rock Ry. & Elec. Co...	One-year notes...	7	1,000,000
Jan 1	Middle West Utilities Co	Series D notes...	6	1,000,000
Jan 1	Pueblo Trac & Lighting Co	First mortgage..	5	990,000
Jan 1	Dallas Electric Co	Five-year notes..	6	750,000
Jan. 1	Pensacola Electric Co	Two-year notes..	7	500,000
Jan. 1	Toledo Heat & Lighting Co...	First mortgage..	5	336,000
Jan. 1	Decatur Trac. & Electric Co..	First mortgage..	5	212,000
Jan. 15	Southern California Edison Co	Debentures	7	1,000,000
	Total for January			$9,404,000
Feb. 1	United Gas Improvement Co..	One-year notes	6	$7,500,000
Feb. 1	Newburgh Lt., Ht. & Pwr. Co	First mortgage..	5	700,000
Feb. 1	Wisconsin-Minnesota Light & Power Co	One-year notes.	7	600,000
Feb. 1	Georgia-Alabama Power Co...	Two-year bonds.	7	525,000
Feb. 1	Greenfield El. Lt. & Pwr. Co.	Three-year notes	7	300,000
Feb. 1	Connecticut Company	Provisional deb..	5	250,000
	Total for February			$9,875,000
Mar. 1	Oklahoma Gas & Electric Co..	One-year notes..	7	$3,500,000
Mar. 1	American Gas & Electric Co...	Three-year notes	6	1,390,000
Mar. 1	Pub. Service Co. of No. Illinois	Debentures	6	1,000,000
Mar. 1	Merchants' Heat & Light Co...	One-year notes..	7	600,000
Mar. 1	Consolidated Power Co.	Three-year notes	6	468,000
Mar. 1	Richmond Lt., Ht. & Pwr. Co.	Two-year notes.	7	440,000
Mar. 1	Commonwealth Pub. Serv. Co.	Two-year notes.	6	300,000
Mar. 1	Dayton Electric Light Co.	First mortgage..	5	265,000
	Total for March			$7,963,000
Apr 1	Birmingham Ry., Lt. & P. Co.	Extension notes.	6	$1,200,000
Apr. 1	Manchester Tr., Lt. & P. Co..	First mortgage..	5	914,000
Apr. 1	Everett Ry. & Electric Co....	First mortgage..	5	825,000
Apr. 1	Portland Light & Power Co...	First mortgage..	4½	500,000
Apr. 1	Fox River Valley Gas & El. Co.	First mortgage..	5	350,000
	Total for April			$3,789,000
May 1	Lacombe Electric Co	First mortgage	5	$900,000
May 1	Missouri Elec. Lt. & Pwr. Co..	Second mortgage	6	600,000
May 1	Columbus, Delaware & Marion R.R.	First mortgage .	5	289,000
May 15	Monongahela Valley Trac. Co.	One-year notes..	7	2,000,000
	Total for May			$3,789,000
June 1	Puget Sound Tr., Lt. & P. Co	Three-year notes	7	$14,601,000
June 1	Chattanooga Ry. & Light Co..	One-year notes..	6	750,000
	Total for June			$15,351,000
July 1	Ontario Power Co. of Niagara Falls	Debenture	6	$2,770,000
July 1	Consolidated Ry. & Pwr. Co..	First mortgage..	5	1,401,000
July 1	Sioux City Gas & Elec. Co....	First mortgage .	5	1,000,000
July 1	Rochester Gas & Electric Co..	Improvement....	4	700,000
July 1	Cities Utilities Ohio W. Util	Joint issue	7	650,000
July 1	Wisconsin Pwr., Lt. & Ht. Co.	Three-year notes	7	200,000
July 5	Virginia Railway & Power Co.	Notes	6	200,000
				$6,921,000
Aug. 1	American Power & Light Co.	Ten-year notes..	6	$2,200,000
Aug. 1	Derby Gas Co.	First mortgage..	4	250,000
Aug. 15	Iowa Railway & Light Co.....	Two-year notes..	6	731,500
	Total for August			$3,181,500
Sept. 1	Rochester Ry. & Light Co.	Three-year general mortgage.	7	$3,900,000
Sept. 1	Aurora, Elgin & Chicago Co...	Three-year notes	7½	1,219,000
Sept. 1	Middle West Utilities Co.....	Series E notes...	6	800,000
Sept. 1	Standard Gas & Electric Co...	Three-year notes	7	710,000
Sept. 1	So. Carolina Lt., P. & Ry. Co.	Notes	7	650,000
Sept. 1	Oklahoma Gas & Elec. Co.....	Three-year notes	7	332,500
	Total for September			$7,611,500
Oct. 15	Hagerstown & Frederick Ry...	One-year notes..	8	$1,050,000
Nov. 1	Trumbull Public Service	Notes	7	$1,200,000
Nov. 3	Edison Light & Power Co.....	First mortgage..	6	623,000
Nov. 15	Consolidated Gas, Elec. Light & Power Co., Baltimore....	Notes	5	8,254,700
Nov. 15	Standard Gas & Electric Co...	Two-year notes...	7	4,349,000
	Total for November			14,426,700
Dec. 1	Toledo Trac., Lt. & Pwr. Co...	Two-year notes..	7	$10,000,00
Dec. 1	American Gas & Electric Co..	Two-year notes..	6	2,479,000
Dec. 1	Connecticut Power Co.	Two-year notes..	6	681,100
Dec. 1	Portland Ry., Lt. & Pwr. Co..	Notes	7	500,000
Dec. 1	Citizens' Gas & Electric Co...	First mortgage..	5	483,000
	Total for December			$14,143,100

Electric light and power utility bonds and notes maturing in:

January	$9,404,000	July	$6,921,000
February	9,875,000	August	3,181,500
March	7,963,000	September	7,611,500
April	3,789,000	October	1,050,000
May	3,789,000	November	14,426,700
June	15,351,000	December	14,143,100
Total for 1921			$97,504,800

Southern California Edison Not to Delay Construction Program

BELIEVING that present unsettled conditions should not delay the construction of additional hydro-electric generating plants or extensions to the existing transmission and distribution systems of the company, the officials of the Southern California Edison Company are proceeding actively with a fifteen-year construction program which calls for the production and distribution of nearly $200,000,000.

"We have found that there has been no slackening of the demand for power to expand industries and develop additional agricultural lands," R. H. Ballard, vice-president and general manager of the company, said to an ELECTRICAL WORLD representative recently, "and we anticipate an increased growth not only for this year but for many years to come. California has been dependent upon electrical service for many years, and as a result of the war and other conditions which have stimulated the growth not only of California but of the whole Pacific Coast we feel that it is the first duty of the electric utilities to go ahead with their developments. The tremendous increase in population on the Pacific Coast during the past decade and the favorable climatic conditions, which permit of high labor output, have brought about demands for power greatly in excess of the available supply. An additional reason for the future development of hydro-electric power is that the company has been operating steam plants at a higher cost than will result from hydro-electric plants.

"Although the unit cost of developments made at this time will be above normal, yet it is anticipated that, as prices are already declining, only a small portion of these developments will be made at the present higher cost, and this increased cost will be more than offset by increased economy of operation. The general plan of financing is to issue bonds to the extent of 75 per cent of the cost for general distribution to investors throughout the country and to sell stock locally to finance the remainder."

Water Power League to Hold First Annual Meeting Jan. 18

THE Water Power League of America will hold its first annual meeting in the Engineering Societies Building in New York on Jan. 18 for the election of officers for the ensuing year. After the regular business has been transacted the meeting will be thrown open to a general discussion of the power situation, both steam and hydro-electric. It is expected that there will also be considerable discussion of recent propaganda concerning the national park reservations.

Metric System Bill Introduced Into Senate

A BILL providing for the compulsory use of the metric system as the single standard of weights and measures in the United States has been introduced into the Senate by Senator Frelinghuysen of New Jersey. The bill was introduced at the request of advocates of the metric system. Senator Frelinghuysen explains that the introduction of the bill by him does not necessarily carry with it any support for the measure on his part, but he sees no reason why it should not be introduced so that members of Congress may acquaint themselves with its purport.

Failure to Appropriate Funds to Continue Muscle Shoals Work Causes Storm

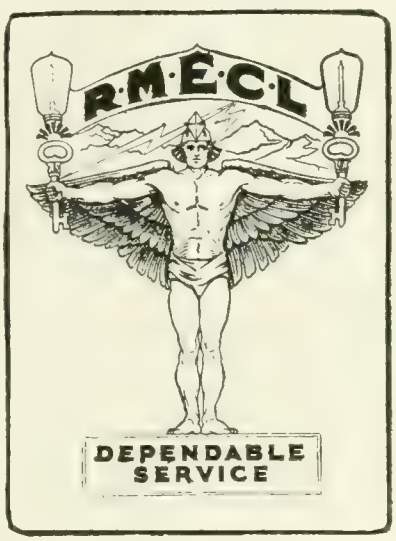
FAILURE on the part of the appropriations committee of the House of Representatives to provide funds for continuing work on the Wilson Dam at Muscle Shoals precipitated an acrimonious debate on the floor of the House on Dec. 30 and 31. An effort was made to put in an item of $10,000,000 for this project over the protest of the committee, but this failed. It is felt there is a better chance for securing its inclusion in the measure when it reaches the Senate. Prospects are that the matter will be the cause of one of the most spectacular legislative clashes that have taken place in years.

Those favoring the continuance of work on the Wilson Dam contend that the government has invested more than $100,000,000 in a project whose primary purpose concerns the national defence in making the country independent of outside sources for its supplies of nitrogen. A large plant is ready for operation, but cannot be operated economically until the development of the water power at Muscle Shoals. It is contended that the only way in which the nation can keep abreast with other countries in the matter of nitrogen fixation is for the government to operate this plant on a commercial scale during peace times.

The attitude of the committee is based largely on the need for retrenchment in government expenditures, although it is also openly charged that the Muscle Shoals plan is socialistic and would be an unjustifiable encroachment upon private enterprise. There are many ramifications of the discussion. Charges are made of gross inefficiency in the use of the money thus far appropriated for this project, while the matter of patents and the processes of nitrogen fixation are also involved. It was brought out that Col. Hugh L. Cooper, who is acting as a consulting engineer at the Wilson Dam, is contributing his services without charge. It was stated that he estimates that failure to make an appropriation for the continuance of the work would result in a loss to the government of $4,000,000. A statement by Colonel Cooper as to the power which will be developed if the dam is completed was made a part of the record. It was that the primary power per annum which could be developed is 700,000,000 kw.-hr. The secondary power per annum would be 1,470,000,000 kw.-hr.

At one point in the debate Representative Bankhead said: "Do you know that we are today standing barely upon the threshold of scientific investigations of electrical energy? It would be to the interest of the country if, for experimental purposes alone, the government had such a plant for the purpose of continuing these scientific experimentations in the great domain of electric chemistry into which we are just entering."

Rocky Mountain Electrical League Selects Emblem



THIS is the emblem selected from twenty-five in the prize contest to be featured by the Rocky Mountain Electrical Co-operative League on all officials, stationery and in all league advertising.

Engineering Council Activities Transferred to Federation

TRANSFER of the activities of the Engineering Council and the Engineering Societies Service (employment) Bureau was made this week to the American Engineering Council of the Federated American Engineering Societies. The American Engineering Council now has an office in Washington, D. C., at the McLachlen Building, Tenth and G Streets, with A. C. Oliphant as acting assistant secretary in charge. This office is available for the member societies.

The Engineering Societies Service Bureau is being maintained in the Engineering Societies Building, New York City, with Walter V. Brown in charge. Pending the development of a more permanent organization which may direct this activity, the secretaries of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers have been requested to act as a committee on management to conduct the service bureau. The committee on procedure of the executive board of the American Engineer-

ing Council, voting to take over the employment service, specified that the applicants should be arranged in two groups—first, those who are members of member societies of the Federated American Engineering Societies, and, second, all others. As a means of communicating with the secretaries of the member societies of the Federated American Engineering Societies, a bulletin listing positions open will be regularly issued. The first of these bulletins will be sent very soon.

The following committees of the former Engineering Council have been invited to act as committees of the American Engineering Council: Classification and compensation of engineers; co-operation with American Institute of Architects; National Board for Jurisdictional Awards in Building Industry; National Service Department; New York State government reorganization; patents committee; payment for estimating; Russian-American committee; types of government contracts.

Berlin Factories on Energy Rations

SINCE Nov. 15 an electrical energy rationing plan has been in force for all industrial plants in Berlin, Germany, consuming more than 250 kw.-hr. per month. No works supplied by the Berlin municipal power plants are permitted to use energy during the morning hours from 6 to 10 o'clock for other than lighting purposes unless they are working in shifts. This refers to plants using up to 1,000 kw.-hr. per month. All plants whose consumption is in excess of this figure must, if working three shifts, take 35 per cent of their total energy during night hours, that is, from 10 p.m. to 6 a.m.; otherwise they have to take an even 50 per cent of the energy during these hours. All works not connected to the municipal plants are allowed only 80 per cent of the total energy consumed during the period of Jan. 1 - Sept. 30, unless they are prepared to take 35 per cent of the energy during night hours.

These new measures have largely been dictated from economical considerations, because the coal supply of the Berlin power houses is largely of the hand-to-mouth order, while the long-distance energy obtained from Golpa—the big central station near Halle, using lignite firing—has not been properly utilized up to now. The practical result of the new order is the establishment of night shifts by most of the Berlin works, although some of the largest industrial firms, possessing power plants of their own, are not affected by the regulation.

Ontario Engineers Prepare Bill for Professional Recognition

AN ADVISORY committee appointed last winter by seven technical organizations in the Province of Ontario to discuss the subject of engineering legislation for that province has presented a report embodying a bill which follows closely the lines of acts now in force in nearly all the other provinces of the Dominion. As its main feature the control of engineering is placed in the hands of the profession itself, thereby avoiding control by government officials who may lack full understanding of the requirements. The provincial government, however, will have a share in choosing the personnel of the council which is to be created, thus providing a guarantee that the council cannot be controlled by any particular group. The different branches of engineering—not including the architects, whose association held that its interests would be better served by independent legislation—are given equal representation, so that no one branch can gain control. The branches are made partly autonomous, with power vested in the council to prevent too wide variations. Engineering only is intended to be covered by the legislation. Technical trades and similar occupations cannot be brought within its scope. Only by remaining distinct from these, it is held, can engineers attain full professional status. Provisions for the registration of those now practicing as engineers are, however, made reasonably broad, so that no fairly qualified individual can be debarred from his present pursuit of livelihood.

Harriman Tells What St. Lawrence Power Means to New England

BEFORE a recent meeting of the Boston Society of Civil Engineers, in discussing a paper on New England water-power resources by H. K. Barrows, a consulting engineer of Boston, Harry I. Harriman, president of the New England Power Company of the same city, commented upon the possibilities of the St. Lawrence River hydro-electric project and outlined additional phases of the proposed development. The speaker said that in the St. Lawrence 240,000 cu.ft. of water drop 221 ft. per second. Four or five dams would be built with effective operating heads of 35 ft. to 60 ft. On the St. Lawrence the maximum flow varies less than 25 per cent from the mean, owing to the 9,000-square-mile drainage area of Lake Ontario. The storage of this lake is so vast that it can be utilized to produce energy to equalize the low season of many New England and New York water powers and to supply the peak load of the winter months. If New England were to get behind the project, it would be entitled to about 6,500,000,000 kw.-hr. from the river plants, or say to 6,000,000,000 kw.-hr. at local substations.

In 1919 the railroads of New England used about 6,000,000 tons of coal on their 5,000 miles of track. Eighty per cent of this was consumed on less than 1,500 miles of track. The speaker said that $25,000 per mile should cover the track structures and substations, making about $40,000,000 to electrify the 1,500 miles which burn most of the coal in that section. Electric locomotives will add another $40,000,000, but in so far as these are used to replace obsolete steam locomotives their cost should not be charged to capital. Further, electrification probably will not proceed more rapidly than the steam equipment wears out. Accordingly, Mr. Harriman said, it seems fair to assume that the electrification of the main lines of the New England railroads will not cost more than $50,000,000.

The coal now burned by the New England main lines per year could be replaced by about 1,800,000,000 kw.-hr. from the St. Lawrence, costing about $18,000,000 and yielding a saving of from $20,000,000 to $30,000,000 for fuel outlay. The cost of electrification will be covered in a very few years of full operation. After that the New England roads will obtain their power on as favorable a basis as roads passing through the coal regions.

The electric utilities of New England generate about 2,000,000,000 kw.-hr. a year, of which more than 75 per cent is produced in steam plants. The present combined use of the railroads and utilities of the section is less than 3,500,000,000 kw.-hr., leaving 2,500,000,000 if the St. Lawrence supplies all of the energy.

There are about 18,500,000 cotton spindles in New England, and, allowing twenty-two spindles per horsepower, it is estimated that on the basis of a forty-eight-hour week these mills use something less than 1,400,000,000 kw.-hr. yearly. At least 25 per cent of these spindles are driven mechanically by water and therefore 1,000,000,000 kw.-hr. would replace all of the coal-produced energy in these cotton mills.

In New England there are about 2,100,000 woolen spindles with 4,200 cards. These spindles require about 200,000 hp. Much heat is needed in process work. Not over half the power required by the woolen mills can be supplied by the central station; hence about 175,000,000 kw.-hr. would be required by the woolen mills. The paper mills would use about 200,000,000 kw.-hr. from the St. Lawrence. The boot and shoe factories, wire and rubber-goods plants and brass establishments might utilize 100,000,000 kw.-hr. It is doubtful if the present industries of New England would use over 2,000,000,000 kw.-hr., and there would be a surplus of 500,000,000 if the railroads used 2,000,000,000 and the utilities 1,500,000,000. Enough is known, said the speaker, to assure that power can be delivered to the New England states in wholesale blocks from the St. Lawrence for less than 1 cent per kilowatt-hour.

British Government's 500,000-Hp. Tidal Scheme for the Severn

MORE details of the 500,000-hp. tidal-hydro-electric scheme fathered by the British Ministry of Transport and first reported by cable several weeks ago are contained in a recent issue of the London *Electrician*. This ambitious plan, which aims at the production of 500,000 hp. in a ten-hour day, with a peak load of 1,000,000 hp., at an estimated cost of a little more than 1 cent per kilowatt-hour, is based on the construction of a dam across the Severn River and the utilization of the tidal power. With the project are linked in plans for extensive highway and railway development and for a locked basin for shipping purposes, 27 square miles in extent, a very large portion of which would, it is held, be suitable for the accommodation of vessels of the largest size and which would be usable at all stages of the tide.

There would be two separate installations required, a great concrete dam across the Severn, within which sluices and turbines would be installed for utilizing the power of the tides and with which would be combined a road bridge and a railway bridge, and a high-level storage lake and tunnel with a pumping and turbine house on the banks of the tidal portion of the Wye River, which empties into the Severn. It is proposed that water be forced up from the low level of the Wye through a 40-ft. tunnel driven through more than a mile of solid rock. The sea water would be pumped into high-level reservoirs during the rising tide, and this stored water would be used to supply the turbines at ebbing tide. The site which has been selected for the barrage lies close to the line of the existing railway tunnel between south England and south Wales at a place where the estuary is about 2½ miles wide with low-lying country on each side.

It is held that the power available on the Severn exceeds all the other potential sources of inland water power within the United Kingdom and is also unique in combining all the conditions essential to the economic development of tidal water power on a large scale. These conditions present an exceptionally high range of tide, an estuary of large capacity, an ideal geographical situation in relation to the industrial centers of the country, and suitable land along the banks of the river for the development of industrial operations. The capital cost of the scheme is not explicitly stated, but the *Electrician* understands that £30,000,000 is about the figure, exclusive of expenditure for transmission lines.

In common with other English engineering and electrical papers, the *Electrician* thinks that its great cost removes the project from the category of immediate expediency. A later and independent report on the project by the Board of Trade puts the estimated output at only 260,000 hp.

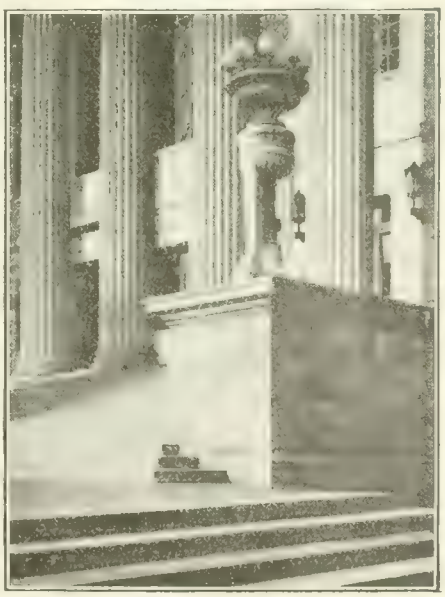
Utah Power & Light Would Further Develop Bear River

THE projects for which preliminary permits are asked by the Utah Power & Light Company are intended to supplement the present development on the Bear River. Permits have been asked to develop 21,500 hp. at Soda Springs, Lava Narrows and Mink River, the latter possibly being divided into two plants for public utility purposes.

This company is at present producing about 100,000 hp. on the Bear River in the Grace, Cove, Oneida and Wheelon plants. The head at the Grace plant alone is 525 ft. The projects now under application include a head of 85 ft. at Soda Springs, a similar head at Lava Narrows, and a head of 100 ft. in either one or two plants at Mink River. This gives a total head of 270 ft.

The importance of the plants to the complete Bear River system does not so much lie in the power developed as in the fact that at each of these plants there is contemplated a small reservoir which, in conjunction with the Bear Lake reservoir, will greatly add to the reliability of the system as a whole, making possible more accurate regulation of the flow of Bear River.

Adaptability of Modern Lighting Fixtures to Classic Architecture



In the famous municipal group of buildings at Springfield, Mass., the adaptability of modern electric-lighting fixtures to classic architecture is clearly indicated.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electric Ship Shows Marked Economies.—According to a telegram received at the office of the United American Lines the electrically driven ship *Eclipse*, operated by the United American Lines for the United States Shipping Board, is making a highly satisfactory performance on her maiden voyage since her conversion. The *Eclipse* left New York Nov. 11 for the Levant. She was the first electrically driven general cargo boat to sail from that port. The telegram says that the *Eclipse* arrived at Port Said Dec. 2, with machinery working efficiently. The new installation shows a considerable reduction in fuel and a satisfactory increase in speed.

Radio Messages Now Reach Offices Over Telephone Lines.—By the use of the telephone lines radio messages from overseas can now be automatically relayed to offices in any part of this country without going through the hands of the operators at the wireless receiving station. Development and experimental work carried on by the Radio Corporation of America will soon reach the point where transatlantic messages will be automatically transmitted from the receiving station to inland cities. Inasmuch as the line must be absolutely clear, special telephone wires will be reserved for this service. In a short time, according to an official of the Radio Corporation, an operator will be able to tap a telegraph key at Seattle and his message will be relayed to the wireless station at New Brunswick, N. J., and thence across the Atlantic to Europe. An amplifier is used at the receiving end to make the sounds as clear as possible.

Manitoba's Water-Power Resources.—Addressing the Manitoba Electric Association recently, J. M. Leamy, the power commissioner of the province, said that while Manitoba has great agricultural and mineral possibilities, in his opinion its power resources would figure as much in its development as anything else. There are nine power sites on the Winnipeg River. Two of these are now being developed and can produce 381,000 hp. Six of the other sites are in Manitoba, the ninth being across the border in Ontario. In other portions of Manitoba there is 100,000 hp. available from streams tributary to Lake Winnipeg, including the Saskatchewan River. The Nelson River, which is the outlet of Lake Winnipeg into Hudson's Bay, is estimated to afford 2,000,000 hp. This makes a total possible hydro-electric output of more than 2,600,000 hp. for the province, or, according to Mr. Leamy, eighteen times the amount of horsepower per capita that the United States, including all sections, has.

Lenin Still Dreams of Soviet-Controlled Electrification.—A press dispatch from Moscow says that Nikolai Lenin, the Bolshevist Premier, addressing the All-Russia Congress of Soviets, dealt in detail with measures for the economic restoration of the country. He declared that the restoration of transportation and of agricultural and industrial production was only possible if the government's program for electrification was realized, "An electrification plan," said Lenin, "has been elaborated, the financial cost of which is estimated at 1,500,000,000 gold rubles. We cannot cover this with the gold at our disposal, and we have no great stocks of provisions for sale. Therefore we must provide the cost of electrification by concessions to foreign capital and exports of timber."

The "Franklin" Substation of the Philadelphia Electric.—The latest substation to be put into operation by the Philadelphia Electric Company, at 52 North Sixth Street, has been christened the Franklin substation in honor of Benjamin Franklin. Construction work on this building was started last April, and the first rotary converter, rated at 1,500 kw., was started up seven months later. Two additional machines are to be installed this winter—one of 2,295 kw., the other of 3,315 kw. The latter will be the largest converter on the system. Eventually the substation will house five units with a total rating of nearly 16,000 kw. Only half of the structure has thus far been erected, but its early completion is promised. Energy for the substation is received at 13,200 volts from either the Schuylkill or the new Delaware power house, as desired, by looping in the tie feeders between these stations.

Protecting Electrical Plants Against Attack.—The alleged capture of a document purported to contain a carefully worked-out scheme for the destruction of the municipal power station of Manchester, England, by politically disaffected persons with engineering knowledge leads to a novel proposition from a London contemporary, the *Electrician*, designed to safeguard such plants, not against mobs, assaults by which would obviously be easily repelled, but against insidious methods of attack on the part of men with an understanding of switches and busbars whose object would be first to stop the plant and then to damage the machinery so that it could not be used. "Against such an attack," the *Electrician* says, "the only defence is a prevention of entry except to those who have real business within, admission only through small, well-protected entrances that can be closed by electrically operated portcullises if necessary, and the surrounding of the whole of the power-station area with such protection as would render unauthorized ingress difficult if not impossible."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Wisconsin Electrical Association.—The 1921 convention of the Wisconsin Electrical Association will be held jointly with the Gas Association on March 22, 23 and 24 next at Milwaukee. The gas program will take up the 22d, the 23d will be a joint session, and the Electrical Association program will occupy March 24.

Florida Engineering Society.—The regular annual meeting of the Florida Engineering Society will be held at Lakeland, Fla., on Feb. 7 and 8. In addition to technical papers and inspection trips to engineering works in the vicinity, it is expected that action will be taken by the society on matters of interest to engineers to be brought before the State Legislature.

Iowa Engineering Society Annual Meeting.—The annual meeting of the Iowa Engineering Society will be held at the Chamberlain Hotel in Des Moines on Jan. 18, 19 and 20. Every indication points toward a very successful meeting. A feature of the occasion outside of the usual technical and social program will be the manufacturers' exhibits. Special attention is being given to the planning of these exhibits with a view toward making them interesting and profitable. There are now approximately 1,200 registered engineers in the State of Iowa. This, coupled with the fact that the State Legislature meets in Des Moines in January, is arousing much interest in the meeting.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Philadelphia Section, Jan. 8; Cleveland Section, Jan. 10; Chicago Section, Jan. 15; Pittsburgh Section, Jan. 15; Birmingham Section, Jan. 27.

American Institute of Electrical Engineers—Akron-Cleveland, Jan. 14; Portland (Ore.) Section, Jan. 10; Boston Section, Jan. 11; Pittsfield Section, Jan. 20; Chicago Section, Jan. 24.

Iowa Engineering Society — Des Moines, Jan. 18-20.

Wisconsin State Association of Electrical Contractors and Dealers—Milwaukee, Jan. 19 and 20.

American Washing Machine Association—Chicago, Jan. 19 and 20.

American Society of Civil Engineers—New York, Jan. 19.

Western Association of Electrical Inspectors — Detroit, Jan. 25-27. (For program see issue of Jan. 1, page 58.)

Association of Municipal Electrical Utilities of Ontario—Toronto, Jan. 27 and 28.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section) — New York, Jan. 28.

Florida Engineering Society—Lakeland, Fla., Feb. 7 and 8.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see "News of the Industry," this issue.)

American Physical Society — New York, Feb. 25 and 26.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Rate Decisions in Utah.—The Public Utilities Commission of Utah has overruled a protest filed by the town of Milford against the rates of the Telluride Power Company. The company had furnished power to Milford for operating the municipal pumping plant at the rate of $60 a month in winter and $100 in summer during the irrigation season. On Jan. 1, 1920, the Telluride company raised its rate, which was the cause of the protest. The Perry Electric Light & Power Company has received permission to raise its lighting rate from 7 cents to 10 cents a kilowatt-hour. The Perry company buys its power from the town of Brigham City, which has recently been permitted to raise its rates to the Perry plant.

Steam-Heating Rates Advanced.—An order increasing the rate paid to the Union Electric Light & Power Company, St. Louis, for steam heat from an average of 57.6 cents per 1,000 lb. to 81.6 cents has been handed down by the Missouri Public Service Commission. The order affects 106 business firms and office buildings in the downtown district of St. Louis. It will increase the revenue of the company $246,000 a year, which is $65,000 less than asked. The company declared that its steam rates have been unprofitable for several years and that the rates asked contemplated no return on plant investment. It declared that the cost of producing steam last year was $1.10 per 1,000 lb. The users of steam combined to oppose the fixing of a rate by the commission. The rate fixed now supersedes contracts between the individual users and the company.

Rate Differentials as Applied to Domestic Consumers. — In handing down a decision fixing gas rates for the Rochester Gas & Electric Corporation the Public Service Commission for the Second District of New York made these observations on rate differentials as governed by the cost of fuel: "During the late war sudden and extreme fluctuations in the price of coal led to many proposals to establish rates with a standard base and varying upward and downward from that base as the price of coal should rise or fall. This device appealed particularly to large consumers of electric energy, came to be known as the 'coal clause,' and crept into the power rates of many electrical corporations; and such rates are now in effect. Applied to such consumers, generally large consumers, with officials having the information and experience necessary to calculate their expenses with this clause in view, such rates have not been the subject of complaint, and it must be assumed that they have operated equitably and to the satisfaction of the electrical corporations and the consumers as well. Whether they should be applied to the great mass of consumers may not present a different legal question, but certainly presents an entirely different problem as to justice and expediency. Underlying the rate provisions of the Public Service Commissions law is the principle not only that rates shall be reasonable but that they shall be published and to such a degree stable that the consumer may know in advance the price to him of the service to be rendered. This may to some extent be accomplished by the variable rate—that is to say, the period of stability may be such as to give the consumer the price for one, two and three months in advance by basing, for example, the rate for any quarter upon the experience of the corporation for the preceding quarter. This hardly accomplishes the purpose of accommodating rates to rapidly fluctuating costs. By the method suggested the rate for a given quarter would be based not on the actual costs for that quarter but on the costs for the preceding quarter. In the long run the price paid by the consumer would be the average based upon costs in the different periods, but to accomplish this result no such device as that proposed is necessary. All that is desirable in the proposed scheme can be provided by fixing at this time the rate for a definite and short period with the provision that at the end of that period the company may apply at the foot of this order for an increase, or the commission may, of its own motion or on complaint, reopen the inquiry with a view to making a reduction."

California Commission Increases Rate to Municipality.—What is in effect an order increasing the rates for electricity to be charged by the Western States Gas & Electric Company of Stockton by approximately 10 per cent has been issued by the California Railroad Commission. The order was made on a request by the company for a revision of its rate schedules based on increased costs of labor and materials used in the operation of the electric system serving portions of San Joaquin, Sacramento, Eldorado, Amador and Calaveras Counties. The increase in cost to the company of electrical energy brought from the Pacific Gas & Electric Company and the Great Western Power Company and resold amounts to $75,000 a year. The cost of gas and electricity has been increased $52,000 a year by reason of wage increases. The cost of oil has also increased from 75 cents a barrel to $2.30. The new rates ordered provide for an increase in the charge for electricity sold to the city of Stockton as a municipality. If the company elects to give the city a special rate, the loss must be borne by the company and not passed on to the other consumers, the commission declares, a municipality being no more entitled to preferential rates than are other consumers.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Contract Rates and Public Service Commission's Powers in Vermont.—The Supreme Court of Vermont has found, in Rutland Railway, Light & Power Company vs. Burditt Brothers, that, although the rate charged for electricity under an express contract between a public service corporation and one of its customers may be changed during the term of the contract by the Public Service Commission, such a corporation cannot of its own motion and without the consent of its customer or action on the part of the commission increase the contract rate by simply filing a revised schedule of rates with the commission. (111 At. 582.)*

Judicial Department Cannot Change Public Policy as to Utility Rates.—Declaring, in City of New York vs. Bronx Gas & Electric Company, that it has no authority to fix rates, the New York Supreme Court (special term, Bronx County) reiterates that the regulation of gas and electric companies as to their service and rates is vested in the Legislature and not in the judicial branch of the government, and where the policy of the state has been established by the Legislature the court has no authority to change it. An attempt to put into effect a gas rate of $1.75 pending an action to have the statutory rate of $1 declared confiscatory was, however, held by the court to be so excessive and unreasonable as to authorize an injunction *pendente lite*. (184 N. Y. S. 658.)

Maintenance of Power Plant Below Street Level Not Negligence.—In a damage suit brought by the Rainier Heat & Power Company against the city of Seattle the Supreme Court of Washington has determined that the maintenance of a heat and power plant at a level of 30 ft. below the street grades was not contributory negligence precluding the power company from recovering damages caused by the bursting of a water main, since the company had the right to make the excavation and was not required to anticipate danger from such a source. Whether the plaintiff's failure to provide drains required by city ordinances was contributory negligence was held to be a question for the jury, but such failure would not prevent recovery where the flood of water caused by the bursting of the main was so great that no proper drains could have prevented or lessened the damage. (193 Pac. 233.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

A. E. Wishon, whose appointment as general manager of the San Joaquin Light & Power Corporation, Fresno, Cal., took effect Dec. 1, has for several years held the position of assistant general manager, working with his father, A. G. Wishon, who has been general manager of the company since its organization, seventeen years ago and who was recently elected vice-president and managing director. The younger Wishon has virtually grown up with the



A. E. WISHON

electrical industry in the San Joaquin Valley. He started as an operator on Mount Whitney plant No. 1 and worked in different operating capacities before entering the School of Mines, from which he was graduated in 1908. After graduation he devoted a number of years to the study of the application of electrical power in the oil fields of California, and in 1910 he was placed in charge of the southern division of the San Joaquin Light & Power Corporation, which includes the oil fields. In 1912 he was made assistant general manager and transferred to the main office in Fresno. He has been very active in association work on the Pacific Coast, serving as president of the Pacific Coast Section of the N. E. L. A. last year. He is also the originator of the self-interest plan of financing public utility work locally, which he explained in the issues of the ELECTRICAL WORLD of Dec. 13, 1919 (page 1060), and May 1, 1920 (page 997). This program has created considerable interest throughout the West, where Mr. Wishon has been frequently invited to explain the self-interest idea. While visiting the East last spring he talked on this subject at several large gatherings of electrical men.

G. C. Brown, formerly with the Northern Electric Company at Montreal, has been appointed superintendent of manufacturing for the Habirshaw Electric Cable Company, Inc., Yonkers, N. Y.

J. W. Hall, for twenty years associated with the Pacific Gas & Electric Company, San Francisco, has tendered his resignation as local manager. J. H. Fagg, assistant manager of the San Joaquin district, has been appointed to succeed Mr. Hall.

T. H. Ceperley, who for the past twelve years has been chief operating engineer of the power station and substations of the Albany (N. Y.) Southern Railroad, has resigned his position on account of ill health and expects to spend the winter in the South. He will re-enter the electrical field in the spring. Mr. Ceperley was formerly with the Newburgh (N. Y.) Light, Heat & Power Company as chief engineer of the Newburgh plant, and prior to that with the Fonda, Johnstown & Gloversville Railroad in the same capacity.

J. H. Fagg, assistant manager of the San Joaquin district of the Pacific Gas & Electric Company, San Francisco, has been promoted to the position of local manager of the company, to succeed J. W. Hall. He will have charge of San Joaquin County and parts of the adjoining counties, extending from Jackson to Tracy, Byron, Brentwood and the Delta section as far north as Galt. Mr. Fagg has been associated with the Pacific Gas & Electric Company for seventeen years in its district offices at Sacramento, Maryville, Chico and San Francisco.

C. J. Rutland, who was recently appointed safety engineer for the Texas Power & Light Company's system, has been in charge of stores in its Dallas office during the past year. He has worked in various capacities in the departments of the company at Sweetwater, Paris, Bonham, Waco and Dallas and has been selected for his present position on account of a thorough knowledge of the company's activities and his popularity among his fellow workers. Mr. Rutland is now working on a new program of safety which will revive the old-time safety meetings over the entire system, which covers the industrial sections of the state. He succeeds E. B. Featherstone, who resigned as safety engineer some months ago.

H. R. King, who has been identified with the sales engineering division of the Western Electric Company for nearly twenty-two years, has resigned to become general sales manager and member of the board of directors of the M. S. Wright Company, Worcester, Mass., manufacturer of the Pneuvac vacuum cleaner. Mr. King is a graduate of the University of Michigan, class of 1894, and holds the degree of electrical engineer from that institution. Directly after graduation he became chief engineer of the Fisher Electric Company, a manufacturer of direct-connected electrical generating equipment in Detroit. In 1895 he was associated with Gilbert Wilkes in consulting engineering in Detroit, and in 1896 he opened his own engineering offices. In 1897 he went to South America and spent two years in Venezuela



H. R. KING

in special engineering development work. Mr. King's experience with the Western Electric Company dates from February, 1899, when he entered its power apparatus department in Chicago. In 1904 he became chief engineer of power apparatus, in which capacity he guided the development of a complete line of alternating-current generators and motors and many special direct-current generators. In January, 1908, Mr. King entered the sales field as assistant power apparatus sales manager at Hawthorne. Two years later he was transferred to New York as power apparatus sales manager. In this capacity he was largely responsible for the development of the so-called Western Electric specialties—washers, vacuum cleaners, etc. He worked on the theory that it was just as advisable to install motors in the home as in the factory, and the present widespread recognition of motor-driven home appliances is really a monument to his foresight. Last January he was appointed power and light sales manager, filling that position until his recent resignation.

S. J. Lisberger, formerly engineer of the San Francisco district of the Pacific Gas & Electric Company, has been placed in charge of the division of electric distribution and steam engineering of that company and will be responsible for engineering work on all distribution lines rated at 25,000 volts or lower and of all the company's steam generating stations. Mr. Lisberger was the subject of a biographical sketch published in the ELECTRICAL WORLD for April 3 last.

Paul M. Downing, who early last year was elected vice-president of the Pacific Gas & Electric Company from the position of chief engineer, has in the reorganization scheme devised by the new president, W. E. Creed, received charge of electrical construction, maintenance and reconstruction, together with the operation of all hydro-electric and steam-power houses and substations connected therewith, as well as the street-railway system at Sacramento and all water systems of the company. A fuller biographical sketch of Mr. Downing appeared in the issue of the ELECTRICAL WORLD for Feb. 24, 1920.



P. M. DOWNING

G. C. Heckman has been promoted to the position of superintendent of electrical construction of the Southern California Edison Company. Mr. Heckman was born in Fort Scott, Kan., in 1882, and after graduation from Hanover and from Purdue in 1903 he became electrical-mechanical engineer of the National Board of Fire Underwriters in New York City and gained an extensive experience with fire-fighting apparatus. From 1905 to 1908 he was employed by the General Electric Company as erector, at which time he went to the Hawaiian Islands and installed one of the first turbine-driven dredges ever placed in operation. In 1909 he was employed by the Southern California Edison Company, and since then he has been in charge of the actual installation of all the electrical equipment in that company's new generating stations and substations.

George S. Jones, vice-president of the Guaranty Trust Company of New York, has been elected a director of the Wagner Electric Manufacturing Company of St. Louis, to succeed the late James W. Bell, whose death was recorded in the ELECTRICAL WORLD for Nov. 20.

Irving W. Phillips, who has been associated with Stone & Webster for nine years in construction and maintenance work, has resigned to take charge of the electrical department of Perry & Whipple, mill engineers and architects, at Providence, R. I. Previous to his connection with Stone & Webster Mr. Phillips spent several years in the shops of the General Electric Company at Lynn, Mass., and in hydro-electric construction and operation on the Pacific Coast and in Mexico.

Frank Thornton, Jr., chief engineer of the Westinghouse Electric Products Company, has been appointed manager of the electric heating engineering department of the Westinghouse Electric & Manufacturing Company. Mr. Thornton was graduated from the University of Missouri in 1908 and spent a year studying in Europe. He joined the Westinghouse company in May, 1909, and soon became engaged in engineering work on electric heating devices. In 1918 the Westinghouse Electric Products Company was established at Mansfield, Ohio, and in February, 1919, Mr. Thornton was appointed chief engineer. In September, 1920, all of the engineering activities in connection with electric heating, including both appliances and industrial applications, were combined, and an engineering department was organized with Mr. Thornton as manager.

E. T. Millham has been appointed secretary of the recently organized Rocky Mountain Electrical Co-operative League at Salt Lake City. The duties of the field secretary require him to visit central stations, jobbers and contractor-dealers in the various towns throughout the territory embraced by the league, to promote the objects of the organization through educational methods, to enlighten the public on the subject of the advantages of the use of electricity and to develop the co-operative campaign in every way possible. Mr. Millham is well qualified to discharge these duties, having had a broad experience in electrical work, first at the General Electric Company's works at Schenectady and later with the Utah Power & Light Company and the Hurley Machine Company. His work during the past few years has brought him in close touch with the various branches of the industry throughout the territory which will be covered by the activities of the league. The acquaintance and knowledge of conditions thus acquired will be of considerable value in furthering its objects. Mr. Millham's headquarters will be at Salt Lake City.

Benjamin P. George, who has recently been elected president of the Electrical Credit Association, Central Division, and representative of that division on the Board of the National Credit Association, is treasurer of the Bardslee Chandelier Manufacturing Company of Chicago. Mr. George has been interested in credit matters for fifteen years and closely connected with the electrical industry as credit man for his company since 1908.



B. P. GEORGE

Obituary

Patrick Coyle, superintendent of the Charlestown (Mass.) Gas & Electric Company and in the employ of that organization for fifty-eight years, died recently at his home in Charlestown.

Edward Briggs, for many years connected with the engineering department of the Byllesby organization, died Dec. 10 at his home in Chicago, after a lingering illness. Mr. Briggs was a prominent member of the Byllesby Post of the American Legion.

William E. Francis, marine engineer of the General Electric Company, Schenectady, N. Y., died on Dec. 20 at his residence in Schenectady. Mr. Francis established the marine engineering department of the General Electric Company. During the war Mr. Francis had charge of the installation of turbine engines.

F. G. Jahn, inventor of the machine used for the cancellation of checks, the automatic overhead sprinkler system for extinguishing fires, and many electric motor and generator improvements, died at his home in Brooklyn, N. Y., on Dec. 1 last. Mr. Jahn perfected the stamp cancellation machines now used in post offices and years ago was connected with Thomas A. Edison in perfecting the first phonograph.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Billions Ahead for the Electrical Industry

FOR the last two weeks the newspapers have been able to find many prominent business men, bankers and economists who are willing to disclose the future. Some have been optimistic and some the other way. All, however, have seen one thing, and that is a tremendous business to be done to rehabilitate and build up to the country's comfortable requirements. The disagreement comes when some one tries to foretell when all this will occur.

Now it is true that the work in sight waiting to be done is tremendous. The sum spent during the war for machinery of destruction is small in comparison. There are billions for this and billions for that, and in the aggregate the figures are so big as to be almost terrifying.

Last week the ELECTRICAL WORLD showed, for instance, that the electrical industry will require in the next four years for new plants and appliances $10,371,000,000. A large proportion of this, of course, is for labor in plant construction and installation, but it is interesting to put beside this estimate the figure of $1,250,000,000 which represents the value of the combined output of electrical material during 1920, the largest year on record. Furthermore, the prices taken in the above estimates were not the "high" of 1920 but the "low" of 1912.

Now, where is all this business coming from? A large part is coming from new homes to be wired—the United States Chamber of Commerce estimates that the nation is 1,250,000 homes short at this minute. If the absurdly low figure of $100 per house is taken, already there is $125,000,000 unspent that should now be in operation. These homes will need lamps—millions of them—flatirons, vacuum cleaners, washing machines, fans, fuses, meters.

FARM AND RAILROAD NEEDS WAITING

There are thousands of farmers that are anxious to have electric service, and such installations quickly run into large amounts.

The railroads are now embarking on a plan for rehabilitating our national transportation system. Some roads will electrify, but that isn't the point. The railroads will spend billions of dollars and the producers of the equipment will be in the market for electrical material of all kinds.

For the past five or six years the amount of new street lighting has been pitifully small. This field will reopen soon, maybe this spring, and when things do break they will break big. Underground conduit, cable, lighting standards, globes, time switches and all the necessary equipment will once more be in demand.

Other items, such as new roads, factory extensions, electric railways, development of new territory, etc., will simply help swell the total.

When will it come? Nobody knows. It is pretty well agreed that the first quarter will be quiet; after that better things are expected to happen. The important thing, however, is not when it will occur. The important part is that it is coming and that therefore the electrical industry must be in readiness to avail itself of the golden opportunity just ahead.

There are raw materials to be secured, and some of these, especially copper and cotton, are so low that the prices can hardly go enough lower to make it reasonable for manufacturers to hold off for price reasons. Furthermore, the labor situation is in such a shape that manufacturers can, if they will, get more output per laborer then before and thereby secure lower production costs. In other words, manufacturers can today start on a factory-stocking proposition with production costs in a large degree commensurate with pre-war costs and in that way prepare for the business ahead.

Loom Prices Drop 30 per Cent

RECESSIONS in price of non-metallic flexible conduit amounting to 30 per cent were made just before the year closed. On Dec. 27 one producer made the cut which started the ball rolling, it is understood, and within two days the other producers were down to the 65 per cent discount, a change of 15 points.

With the low cotton market, the price of cotton materials entering into the make-up of loom has dropped considerably, in some cases as much as one-half, so right there is a cause for a lower price. It has been felt, too, that loom prices were still high and that lower prices at the opening of the year might have some effect on the very slack market now prevailing. There is plenty of labor available at cotton fabrication mills and plenty of cotton material at hand, but with the mills running light there is no reason for prices to stay up with the demand so low. It is a case of keep the mills running and the personnel together, and pocket the loss and be rid of it once and for all, starting the year with a clean slate.

Banks and Customers Still Need Light on Acceptances

TRADE acceptances have made it possible for the Western Electric Company to decrease its credit losses to the percentage shown in the following table, according to E. W. Shepard, general credit manager of that company, in an address before the twenty-fifth annual convention of the Electrical Credit Association, Central Division, in Chicago recently.

	Trade Acceptances	Open Accounts
1918 losses	0.03	0.39
1919 losses	0.07	0.27

The company's turnover was 15 per cent greater in 1919 than in 1918, and 1920 showed an increase of 12 per cent over 1919. The increase in turnover was obtained by discounting the trade acceptances. The net result has been to increase the net return on the company's investment by the use of trade acceptances.

Trade acceptances have been found to improve the credit rating of the company's customers with bankers, and they have also helped to make the customers appreciate the advantage of turnover. With the exception of the United States Government railroads and most municipalities, the Western Electric Company takes trade acceptances from all customers who do not take the cash discount or pay their bills net in thirty days. The time taken by a customer to pay his bill is not considered to be so important as knowing that he will pay it on a certain date. For this reason a customer who gives a trade acceptance and meets his obligations when due is considered as good a customer as one who takes the cash discount.

More trade acceptances are now being returned than ever before, but this increase is not out of line compared with overdue notes and open accounts. An overdue account is

easier to detect in a trade acceptance because it stands out more sharply in the records. The average time for the company's trade acceptances is forty-seven days for the first eleven months of 1920.

Trade acceptances are designed to allow the customer a sufficient time to sell his goods before paying for them and should therefore only be used for current due accounts. The Federal Reserve Bank will not rediscount trade acceptances which have been renewed, and if a customer cannot pay a trade acceptance when due, the proper way to give him additional time is by means of an interest-bearing note. Trade acceptances should not be used for the purpose of borrowing, nor should they be issued on past-due accounts.

Banks prefer to handle trade acceptances in as large amounts as possible, it is found. For this reason groups of orders, say for a month, should be grouped on one acceptance with an average date. By this means the Western Electric Company increased the average amount of its trade acceptances from about $800 in 1919 to about $1,000 in the year 1920.

Light Demand for Electric Ranges in the Northwest

DEMAND for ranges in the Northwestern States has fallen off perceptibly. Coupled with the general tendency of the public to spend money less freely than in the past two or three years, it is felt that the cost of the range is too high. At the same time, while the cost of wiring in a service, which amounts to from $60 to $75, is considered to be pretty high also, this is really not so much of a factor if the purchaser is willing to pay present prices for the range.

Power companies in the Northwest have not been pushing this business very hard recently because of a general shortage of power. Stocks of standard lines of ranges are reported in good condition, even though there have been increasing sales activities among the trade to move them. It is felt that cooking rates are reasonable and compare favorably with gas. In Portland, if the proposed increase in gas rates is granted, it would be reasonable to expect an increase in demand for electric ranges.

Independent Pipe Prices Decline

THE last day of the year saw the decline to Corporation price level of the last of the steel products manufactured by independent mills—pipe. This, of course, affects the price of rigid conduit, and the mills are now on card 44. So there comes to an end the two steel markets—the Corporation and the independent. It was about the middle of November that the equalizing of these two markets began when independent prices of tin plate were reduced to the Corporation level—the Industrial Board level of March, 1919—and from then on the spread of other steel products has gradually diminished until now there is but one market. During the present week, however, other independent mills have followed the course of the one which acted on Dec. 31.

Heating Device Schedule and List Prices Changed

WHILE an increase in license schedule prices of domestic heating appliances was made effective Jan. 1, 1921, the ELECTRICAL WORLD is informed that this change is to be rescinded, so far as it applies to hollow ware, as of Jan. 15. The action prompting the increase, it is learned, was taken in order to make the schedule prices a little more commensurate with manufacturers' prices, which are still above the schedule.

Already one manufacturer of heating devices has issued new price lists as of Jan. 1, showing about 10 per cent lower list prices, and it is known that other manufacturers will issue lower lists shortly. Still other manufacturers state that they will not lower their lists at this time.

Domestic Production of Copper in 1920

THE smelter production of copper from domestic ores during the year 1920 is estimated by H. A. C. Jensen of the United States Geological Survey to be about 1,235,000,000 lb., compared with 1,286,000,000 lb. for 1919. Production of refined copper from foreign and domestic ores for the year was about 1,573,000,000 lb., which is approximately 195,000,000 lb. less than for the year 1919. Apparent domestic consumption was about 910,000,000 lb.; in 1919 it was 877,000,000 lb. Stocks of raw and refined copper at the end of 1920 were about 874,000,000 lb., which represents a decrease of 30,000,000 lb. from those held at the end of 1919. Total imports of raw and refined copper for the ten months ended Oct. 30, 1920, according to the Bureau of Foreign and Domestic Commerce, were 407,437,515 lb. Exports of copper for the same period were 543,695,851 lb., compared with 516,627,775 lb. for the entire year 1919.

Continued decreased production, large stocks and low domestic consumption were due entirely to the generally depressed conditions of industry throughout the world, which did not permit the absorption of such great quantities of copper as had been hoped for. Low exchange and the great stocks of scrap and secondary copper available both in the United States and abroad also decreased the demand for new copper. The salient features of the copper industry during 1920 were a small hesitating demand, decreased production, continued small exports, particularly during the last half of the year, and labor troubles.

Metal Market Situation

COPPER has receded to a still lower level at which producers have made sales at 13 cents, delivered, in the first quarter. The outside market has gone as low as 12.50 cents, delivered, for nearby consumption, while some smaller producers are holding to a middle ground at 12.75 cents, delivered, for first quarter. A much better buying interest had developed by Wednesday. Speculators have been showing considerable interest in the market, but producers are unwilling to sell them large lots except at a premium.

Now that the year's end has passed and the immediate necessity of light inventories has been met as far as possible, it would seem that the present time offers manufacturers of electrical apparatus a propitious market for the purchase of copper stocks. It does not seem that copper will be available at a price sufficiently lower than that ruling at present to warrant consumers of large amounts holding off any longer for lower prices.

In line with a certain domestic demand which must rule during the coming year, a further foreign market appears in the offing as the result of the passing over the President's veto by the two houses of Congress of the Federal Finance Corporation bill bringing back to life this organization. This action, if backed by a sufficient appropriation, might result in large purchases of copper by the European countries so badly in need of it and so short of immediate funds.

NEW YORK METAL MARKET PRICES

	—Dec. 27, 1920—	Jan. 4, 1921—
Copper	£	£
London standard, spot	72 5 0	72 0 0
	cents per pound	cents per pound
Tin, spot	13 75	13 50
Lake, prompt	14 00	13 00
Casting	13 00	12 87
Wire bars	15 00 16 50	16 25
Lead, trust price	4 75	4 75
Antimony	5 25	5 20
Nickel, ingot	43 00	43 00
Sheet zinc, f.o.b. smelter	11 50	11 50
Zinc, spot	6 00 6 10	6 10
Tin	33 00	36 00
Aluminum, 98 to 99 per cent	28 50	28 50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11 00-11 50	10 50-11 00
Brass, heavy	6 00- 6.50	6 00- 6 50
Brass, light	4 50- 5.00	4 00- 4 50
Lead, heavy	3 50- 4 00	3 50- 3 75
Zinc, old scrap	3 25- 3.50	3.00- 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WITH jobbers busy counting up their stocks there is little trade in the electrical supply field. Inquiries are getting smaller and smaller and are now few. Buying is as low as it is expected ever to get. There is more shopping being done. Stocks in general are high, demand is light and money is scarce, consequently price is a big factor when it comes to making a sale today. Jobbers are more inclined to seek business than they were a short time ago. Where heretofore the dealer called up and begged for a few appliances from several jobbers today the jobber is calling up the dealer offering him trucking facilities on a purchase.

Over the year's end prices of conduit, loom and flexible armored conductor saw important recessions. One line of domestic heating appliances also dropped. The two steel markets lost their identity and became one. Collections continue long and require constant pushing.

NEW YORK

The arrival of the new year brings little immediate encouragement to the electrical trade in the way of a return of business. Hopes of increased demand have now been deferred until after the first quarter at least. Some jobbers even go so far as to say they expect slack conditions to obtain up to the half-year mark. Some houses have finished taking inventories, others are just now in the middle of this occupation. Reports thus far indicate a surplus varying from 20 to 100 per cent compared with the level of stocks at this time last year.

Price cuts continue to be made, the principal items affected this week being loom, locknuts, washers and bushings and armored conductor. Wire and conduit are also being shaded to their recent low levels by more jobbers. Collections continue unsatisfactory with no change.

Locknuts, Washers and Bushings.—Price decreases are reported as going into effect the first of this week amounting to about 33 per cent on ½-in. and ¾-in. sizes and about 8 per cent on the others.

Conduit.—Demand is slow and stocks are well built up in virtually all sizes. In quantities of 2,500 lb., ½-in. black ranges from $70 to $82, and 1-in. black from $155 to $160.50 per 1,000 ft., net.

Outlet Boxes.—Light demand and a plentiful supply are reported. The discount on black boxes ranges from 20 to 30 per cent and on galvanized from 15 to 25 per cent in quantities of 100.

Flexible Armored Conductor.—The market remains very weak with plenty of material available, though some jobbers have forced their stock to low levels. Prices are all over the lot, with some jobbers down to $65 net per 1,000 ft. for No. 14 two-wire and others ranging all the way up to $85.

Wire.—Stocks of both rubber-covered and weatherproof are large under the poor demand that is felt, though one or two houses report a slight pick-up in sales of rubber-covered wire. No. 14 rubber-covered ranges in price from $8.50 to $9.50 per 1,000 ft., in 10,000-ft. lots. Weatherproof wire base is 19 to 20 cents, with No. 14 in 250-lb. lots quoted from 27 to 29 cents.

Non-Metallic Flexible Conduit.—Buying interest is almost completely lacking, and stocks are large. Price reductions from manufacturers amounting to 30 per cent went into effect last week. Under the new schedule jobbers quote ¾-in. in 1,000 ft. lots from $27 to $29.50 and $\frac{7}{32}$-in. from $25 to $27 per 1,000 ft., net.

Poles and Hardware.—Demand is generally light. Stocks of poles, pins and cross arms are good at distribution points, deliveries to the East being made as quickly as two weeks. Cross-arms were reduced in price about 10 per cent early in December. Hardware stocks are small, though sufficient for current light needs. Deliveries range two to three weeks. Price decreases averaging 10 to 15 per cent have been made by different manufacturers during the month of December.

Distribution Transformers.—Demand in this territory varies from fair to very good. Deliveries are improving and range from twelve to fifteen weeks on the smaller capacities up to fourteen and twenty weeks on large sizes. These figures compare favorably with a few months ago, however. Stocks are spotty, but are beginning to build up, almost half the sizes now being in stock. Prices are steady.

Fuses.—Stocks are ample to care for the present slow demand. In standard packages, N.E.C. standard 3 to 30 amp., 250-volt non-renewable fuses are quoted from 12.50 to 15 cents each, net.

CHICAGO

Because most concerns in the district are doing nothing but taking inventory, and also because there have been absolutely no developments in the way of price changes, any attempt to mention specific items or classes of materials in a trade review is superfluous this week. The industry locally is vitally interested in those factors which bear on the future of the electrical industry and which are outside the control of the industry.

Chicago has an enormous building program laid out which will go ahead in 1921 if price adjustments are made in time to permit the letting of contracts early in the year. The estimated total of $150,000,000 worth of work ready to go ahead includes two department stores, six theaters, five office buildings, six hotels, four club houses, several university buildings and $9,000,000 in public school buildings. There is also the vast project of electrification of the Illinois Central terminus as well as innumerable private-home building enterprises which will certainly go ahead just as soon as the men who are in control of expenditure think that prices have been stabilized sufficiently to justify such action.

Concerning non-employment it is a significant fact that those industries which first started to take up the slack and get their production costs and selling prices down to a reasonable base, considering their probable future, are right now resuming operations. This is held to justify the opinion that all other industries, just as soon as they effect their necessary readjustment, may do likewise and that there is nothing to fear in the way of a long-continued period of widespread depression.

Collections for December are going to look a little better than they did in November. This is on account of extra collection efforts put forth with the approach of the new year. Money is still very tight and is not to be collected unless vigorously gone after. The volume of outstanding accounts on the books of both manufacturers and jobbers is steadily declining, as the sales right now are at a low mark, while old accounts are being steadily reduced.

What the attitude of the public as a whole is going to be toward buying is the main interest just now. In its relation to the electrical industry, the future of construction is the most important factor, as, without new apartments, hotels, office buildings, etc., the market for equipment will be limited. In this connection prices of building materials are the leading question. Lumber is down in the local market to a point about equal to pre-war prices, if increased freight rates are taken into consideration. Most other materials still remain up toward the top of the price range and, with the exception of copper wire, electrical equipment is there also.

BOSTON

Jobbers report a better feeling in New England mill circles as the business year opens. Many plants which were shut down have reopened for part time or full time operation, and greater interest is seen in betterment work along engineering lines. The volume of orders has not increased much as yet, but field men from prominent jobbing houses note a turn for the better in local districts. Building and engineering contracts for 1920 to Dec. 29 in New England totaled $304,230,000, about 25 per cent larger in amount than for the same period of 1919 and nearly 50 per cent greater than in 1916, the second best year in the past two decades.

Jobbers' stocks are uneven but are still overloaded in many lines. One good-sized house had $500,000 worth of material on hand at the week end and was buying only immediately scarce products. Collections are poor and borrowing to discount bills is being practiced in some jobbing circles. With the exception of rigid conduit deliveries are very satisfactory. Prices broke sharply last week in flexible-armored conductor and non-metallic flexible conduit; wire continues weak, and one of the largest appliance manufacturers has marked down some of his leading products about 10 per cent, effective Jan. 1. Industrial heating equipment is firmer.

Flexible Armored Conductor.—No. 14 single-strip is off sharply to about $65 to $68 per 1,000 ft. Large quantities are selling for considerably less, with no fixed price for stated amounts.

Non-Metallic Flexible Conduit.—Prices are weak owing, it is believed, to the slump in cotton quotations. On Monday the $\frac{7}{32}$-in. size in 1,000-ft. lots brought $22 and the $\frac{5}{16}$-in. size $25 per 1,000 ft. Plenty of this material is to be had and the demand is moderate.

Motors.—Barring rather spotty stocks it is easy to pick up sizes required if quantity orders are not sought. Prices are firm, although some rumors of a moderate readjustment are in the air.

Meters.—Central-station buying keeps up well, and low stocks or none at all in some cases are the rule.

Appliances.—Landers, Frary & Clark announced reductions in list prices Jan. 1, of which the following decreases are representative: Grills and ranges, $0.75 to $2.50; heating pads, $1; immersion heater, $1; irons, $0.25 to $1.25; percolators, $1.50 to $3.50; toasters, $0.75 to $2; water heaters, $0.50; disk stoves, $1.50. A fair holiday business is reported among retailers.

Industrial Heating Equipment.—Prices were advanced by Landers, Frary & Clark Jan. 1 on glue pots and soldering irons. On the former the lists were increased from $1 to $3.50 and on the latter from $1.75 to $2.75.

Wire.—Rubber-covered wire is weak, No. 14 selling at $9 per 1,000 ft. in 5,000-ft. lots. Weatherproof base is 20 cents and bare base 17½ cents. Stocks are on the whole in excellent shape for meeting increased demand.

Rigid Conduit.—Pipe is easier in price, ½-in. black being quoted at $78.20 per 1,000 ft. in 10,000-lb. lots, with $83.30 for galvanized. Deliveries are somewhat slow and stocks are spotty. Quotations fell about 10 per cent last week. The demand is moderate.

Knobs and Tubes.—Easier deliveries are reported. Prices are running around $11.50 per 1,000 on 3-in. tubes and $32 per 1,000 for "Nail-it" knobs in barrel lots.

ATLANTA

The closing of the calendar year has brought with it the usual decline in business activities, the buying public apparently satisfying its requirements in the pre-Christmas period. Jobbers are receiving a minimum of orders, whereas the retailers are buying only for immediate current needs, making every effort to reduce stocks for inventory.

Jobbers and retailers alike report that stocks in the main are considerably lower than for last year and will make no effort to replenish before the middle of January. The final résumé of building activities in Atlanta for 1920 shows a grand total of $13,342,011, the activities being divided into the following classes: Dwellings, 38; apartments, 39; churches, 11; commercial houses, 124; factories, 11; public buildings, 9. However, December permits were low, with a valuation of only $269,000. Much of this construction is still under way, which means that building supplies will be in demand for some time to come in the South.

The opinion that general business conditions will improve is reflected by the opening up of textile mills that have been closed down, while oil mills will recommence operations shortly after the first of the year. Little or no curtailment is reported from other classes of manufactures, and while some wage reductions are reported non-employment is not heavy. The electrical trade reports indicate that all houses had a most satisfactory holiday trade, with business well in excess of that of last year but not quite up to the estimates of the early fall. Collections continue rather slow, though those from municipalities show improvement, owing to collection of 1920 taxes.

Flexible Armored Conductor.—All jobbers report very good stocks, but they are moving slowly, which probably accounts in a great measure for the sharp price break to be noted this week. One large jobber is quoting two-wire No. 14 double strip in lots of 10,000 ft. at $75 to $80 per 1,000 ft.

Cross-Arms.—This week has seen an unusually good movement of cross-arms and pole-line material; in fact, the movement of this class of supplies has been better than any other line for the past ten days. No price reductions are reported, though jobbers are anticipating such in the very near future. Prices: Standard fir arms, two-pin, 4-ft., lots of 1,000 linear feet and over, 62 cents each; four-pin, 4-ft., 83 cents. N.E.L.A. fir arms, two-pin, 3-ft., 93 cents each; four-pin., 5-ft. 7-in., $1.41 each. Pins, 1¼ in. x 8 in., $2.50 per 100; 1½ in. x 9 in., $4.20.

Wire.—No further reduction in the price of wire is noted, rubber-covered moving fairly well, while weather-proof is more active. Stocks are on hand in practically all sizes in quantities sufficient to take care of reasonable current demands.

Rigid Conduit.—Activities in this line continue to hold up much better than was expected and stocks have become somewhat spotty because of jobbers' failure to reorder. Prices remain steady.

Safety Switches.—Jobbers report very heavy stocks in all sizes, due to overestimating their demands. Popular sizes are moving quite well, and the new ruling which practically prohibits open switches in boxes will still further stimulate sales.

Motors.—Scanty stocks have been accumulated, and popular sizes are still hard to obtain promptly. Manufacturers express the opinion that they will not catch up on all back orders before midsummer.

ST. LOUIS

The past week has proved itself to be a more than ordinarily quiet one for both jobbers and dealers. Until Christmas sales of holiday and seasonable goods helped to compensate for the decrease in sales of staple lines, but following Christmas the demand for appliances and seasonable items dropped off sharply. It is expected that this will be only a temporary manifestation inasmuch as dealers have stopped ordering so that they may hold down their inventories and will commence to stock up again as soon as they have finished taking these. Dealers report that there is very little retail buying. A central-station company which is putting on a sale of appliances, lamps, etc., reports good sales, however.

The Federal Reserve Bank of the Eighth District, in its report for December, asserted that the Christmas trade had been the poorest since 1913. Electrical jobbers and dealers, however, while reporting a volume of business overshadowed by that of last year agreed that the season had been satisfactory in view of general conditions. Credit

conditions show no change. The average maintained is around sixty days. Very few customers' notes are being accepted.

Outlet Boxes.—Stocks have bettered appreciably, though some jobbers still report a little difficulty in getting delivery from manufacturers. Prices have not changed, the maximum discount on the black boxes remaining at 40 per cent and that on the galvanized at 35 per cent.

Vacuum Cleaners.—Dealers continue to dispose of these appliances and are placing orders, though not so heavily as a month ago. Immediate delivery can be made on fairly large quantities.

Washing Machines.—Christmas sales were low. Dealers reported public sentiment in favor of a substantial reduction in prices and feel that demand will continue to be light until this reduction is an accomplished fact. Production of washing machines in this territory has been cut considerably because of continuing high costs and the dead market. Both manufacturers and jobbers have accumulated large stocks.

Insulators.—Stocks of glass insulators are still spotty. Jobbers have been unable to complete their reserve stocks, in spite of better deliveries from manufacturers, because of the continued strong demand. Stocks of porcelain are little better, and jobbers do not expect to be able to build up complete stocks for several months to come.

Locust Pins.—Jobbers have large stocks, and sales remain light, though rural demand is showing flashes of activity. The 1¾-in. x 8-in. pins are quoted around $30 per 1,000 in lots of 5,000 and the 1½-in. x 9-in. pins around $60.

Wire.—The market is more unsettled than ever. Any quotations that are made are nominal. Stocks have not shrunk appreciably in the last week.

Heaters.—Sales are still good, though they have dropped off slightly since Christmas. A sale by a central-station company brought forth a particularly good response this past week.

Flexible Armored Conductor.—The number of sales is fairly large, though a smaller volume is reported, there being a quite noticeable decrease in the size of individual orders.

SAN FRANCISCO

Non-employment is increasing, and for the first time in several years additional clerks, salesmen and solicitors are available. It is expected that sales of the larger household appliances, which have lain dormant in several sections through lack of proper selling efforts, will again be vigorously pushed.

Switches.—More drastic observance of state safety regulations will cause an increased demand for safety switches, although, as these are not required where there are voltages of less than 150 volts to ground, there will still be a big field for the sale of ordinary knife switches.

Farm Plants.—Probably because of severe weather conditions which prevent active solicitation by field salesmen farm-plant sales have decreased. A few sales have been noted here and there. A new field of sale for farm plants has been found among theaters in the interior towns where the current frequently is cut off for short periods of time.

Telephones.—A considerable amount of telephone extension has been planned or 1921, especially among the towns of the lower San Joaquin Valley. Factory deliveries are improving.

Insulating Material.—Deliveries of insulating material are better despite increased demand among the motor-repair shops. New fields of sale among auto-repair shops and railroad-car repairing shops are now being supplied.

Lamp Cord.—For the present no attempt will be made to enforce regulation of the use of ⅜-in. fixture cord. The fixture manufacturers state that it is difficult to make loops with a heavier cord. There are still big Coast stocks of the ⅜-in. style.

Line Material.—For many months to come this will be one of the greatest selling lines because of big power projects and the great amount of necessary house and building wiring that is being held up.

Cross-Arms.—Local stocks of cross-arms are better than they have been for years. Decreasing business by local lumber companies has resulted in a crop of vigorous competitors for cross-arm business.

SEATTLE—PORTLAND

The annual depression is on and sales of both jobbers and dealers are at a minimum. Overstocks in several lines are noted, an oversupply of hollow ware being especially prominent. During the past week a few minor reductions in prices were made, but the changes were inconsequential. Sales during December, aside from strictly holiday business, were about the same as last year; holiday sales were much lighter. In spite of present conditions the majority of electrical concerns insist that a change for the better will develop within thirty to sixty days.

The Pacific Northwest lumber industry enters the new year with the lightest order files in its history and the heaviest inventories of the past decade. With financial conditions temporarily retarding new construction adverse exchange operating against exports and advanced freight rates restricting the use of West Coast lumber in markets east of the Mississippi River, the outlook for the first quarter of 1921 is not encouraging. In the electrical industry credit continues to tighten. Collections are no better, although intense activity on the part of collection departments in some instances has shown favorable results.

Jobbers report that Christmas tree outfits were ordered very lightly last year, but that in spite of this there was an oversupply. This also applies to heating appliances, which were ordered heavily and did not move. Large stocks will be carried over. Wire continues to show a downward tendency and Thor washing machines have been reduced to prices prevailing previous to the recent raise. Porcelain stocks are improving. Galvanized conduit in large sizes is still scarce, but stocks of black conduit are in good shape.

Motors.—The stock situation is very much relieved. In the case of some of the larger sizes there is at least six months' stock on hand. On smaller sizes, in which there is more active demand, the manufacturers are less than six months behind on orders. Fractional horsepower motors are still very difficult to get.

Lamps.—Stocks are reported the largest in history. Lamp sales eased up somewhat in November but improved again in December and are good at the present time. Industrials this year have been buying more lamps than heretoore, principally in type "C" sizes.

SALT LAKE CITY—DENVER

Electrical dealers and jobbers are starting the new year with a determination to make business good. The tide of pessimism seems to be stemmed successfully, and it can be said that the general business morale is excellent. Business is not actually much improved, but most electrical merchants are backing up their faith by making out budgets that contemplate a bigger volume of sales in 1921 than in 1920.

The big topic in salesmen's conventions is ways and means for stimulating sales in this buyers' market. Extra service and constructive help to dealers will be the big 1921 issue from the jobber's point of view. Dealers in turn recognize that merchandise is not any longer at a premium and that many things will have to be resorted to to create a productive consumer demand.

No material price reductions have been reported from manufacturers, and consequently no general recession is noted on the consumer market. In scattered cases dealers have had to make cuts in order to liquidate and make peace with their creditors, but the general tone of the market is stable. The credit situation continues to be difficult and involved. Collections are extremely slow, with little prospect of immediate improvement. Building activity is virtually at a standstill. It is thought, however, that the fall ing market in building materials will have a stimulating effect by spring.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Mohawk Electrical to Move to Much Larger Quarters

In following out the policy of publicity in advance, the Mohawk Electrical Supply Company, Syracuse, N. Y., A. M. Little, president, announces that the company is going to move along in April into what he characterizes as one of the finest buildings employed in the electrical supply jobbing business in the United States. The company has taken over a six-story and basement building, 50 ft. x 100 ft., at 529-533 South Clinton Street, of brick, steel and concrete, giving two and one-half times former capacity for stock, equipment and general facilities.

Big Pacific Wire Order Goes to Anaconda

Ten million pounds of copper will be required to fill the order which the Anaconda Copper Mining Company, Great Falls, Mont., has just received from the Pacific Gas & Electric Company, San Francisco, Cal., for transmission wire for the power company's new 220,000-volt lines. The finished cable will have a 500,000-circ.mil. cross-section, made up of seven-conductor, seven-rope lay strand, and is the largest rope strand which the company has had to build. An additional order of 3,500,000 lb. is expected to be placed during January, with a further quantity of 5,000,000 lb. before the year is out.

The cost of the cable will be about $1,750,000, based upon 14-cent copper. During the first quarter of the new year the power company will make payment of the cost of the copper involved, the balance, representing fabricating costs, to be paid as deliveries of the cable are received. Shipments will be started in May or June and will be continued at the rate of over 1,000,000 lb. a month.

It is interesting to note that this is the only company making bare copper wire west of the Mississippi and that by so doing the freight costs of sending raw wire materials East and finished wire West are eliminated.

Edison Storage Battery Plant Not Closed

Announcement was made this week by Charles Edison, chairman of the board of directors of Thomas A. Edison, Inc., that the storage-battery works were not included in the Edison shutdown on Dec. 29. Only the phonograph instrument works were closed on that date. The storage-battery works and the divisions of the Edison industries, it was stated, are continuing operations.

Gregory Cuts 100 per Cent Stock Melon

The Gregory Electric Company, Chicago, one of the largest dealers in used electrical equipment in the United States, has been authorized by the Secretary of State at Springfield, Ill., to increase its capital to $1,000,000. This increase in capital stock, the company states, has become necessary through the increase in business. At a meeting of the board of directors on Dec. 24 a stock dividend of 100 per cent was declared.

All-Electric Vehicle Show for New York

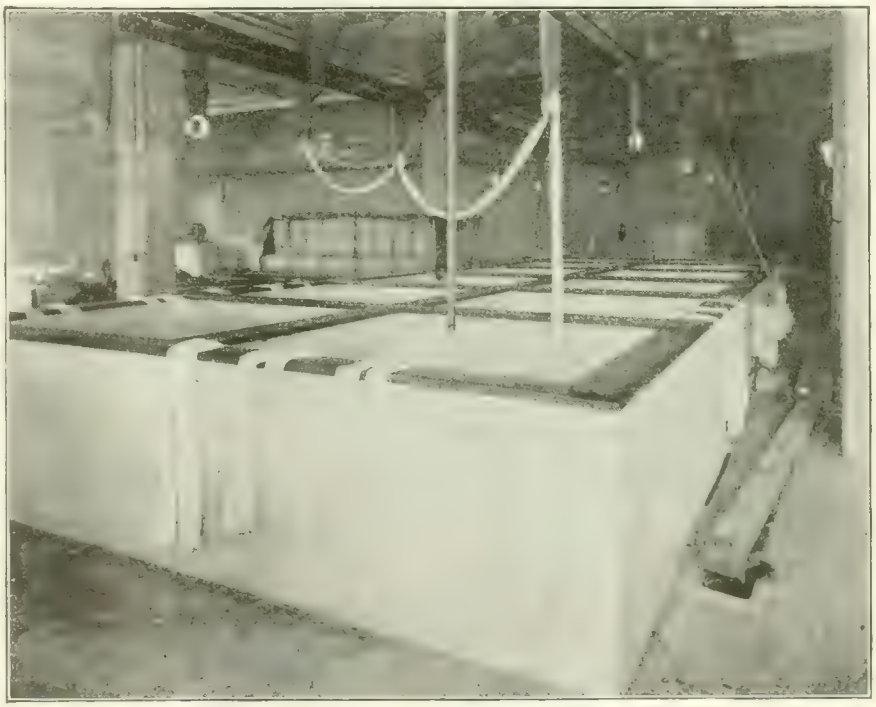
Following what was felt to be the need for an all-electric vehicle show the New York Edison Company is to stage a two weeks' show of electric storage-battery vehicles in its showrooms at Fifteenth Street and Irving Place from Jan. 29 to Feb. 12. Leading manufacturers of electric vehicles and accessories have accepted the invitation sent out by the Edison company so that there is assured what is said to be the first electric vehicle exhibition of its kind. During the week of Jan. 29 street trucks and passenger cars will be displayed, while the following week will be devoted to industrial trucks. Batteries and accessories will be on display both weeks.

Japan Orders 1,000 Steel Towers

An American fabricating company is to supply about 1,000 steel towers for transmission lines for the Nippon Electric Power Company, Osaka, Japan. The Blaw-Knox Company, Blawnox, Pa., has received the order for 6,000 tons of steel towers at a figure of about $800,000 for this 140-mile line of 160,000-volt parallel circuits. Fabricating will begin at once, and shipment will be made in the late spring or early summer.

Insulation Producer Operates Own Bleachery

The bleachery of the Irvington Varnish & Insulator Company, Irvington, N. J., which was installed a year ago for bleaching and finishing cotton fabrics for use as electrical insulation, has a capacity of 1,500,000 sq.yd. per month. It is stated that this is the only company producing cotton insulation, not only in the United States, but also in the world, which has its own bleachery. The building is one story in height and covers an area of 100 ft. x 200 ft. The company has fifty-six cooling towers in operation and has ten more under construction. A new 200-hp. boiler also is being added.



CAPACITY PER MONTH IS 1,500,000 SQUARE YARDS

New Record in Electric Bake Ovens

What is claimed by the manufacturer as a new record in large electric bake ovens has just been completed for the B. Manischewitz Company of Cincin-

nati, Ohio, by William F. Schaller, engineer for the Ideal Electric Traveling Oven Company, Inc., of San Francisco. The oven is 62½ ft. long and 9 ft. wide. The temperature, it is claimed, averages 650 deg. F. during operation under an average load of 100 kw. This new oven, which has a baking capacity of 9 barrels of flow per hour, is used for baking matzos.

Baker R & L Sees Prosperous Times Ahead

As the result of reports of all kinds the Baker R & L Company, Cleveland, builder of electric trucks and tractors, views the near future optimistically. The company is stocking on trucks and tractors in anticipation of large quantity orders on which it is now working.

The company's belief in prosperous times ahead is evidenced by its additional investment of nearly $250,000 in finished Baker trucks and tractors since business began to slacken up.

The Power Plant Engineering Company, Seattle, Wash., has been incorporated and offices have been established in the L. C. Smith Building. The company is composed of engineers experienced in power-plant installation and operation, and it is in a position to contract for, design and install all power equipment. It also has the exclusive agency for the Santmyer powdered coal equipment. W. J. Santmyer is president, R. S. Whaley is vice-president, and A. E. MacInnis is secretary-treasurer.

The Hochbaum - Rylander Electric Company, 539 Central Avenue, Newark, N. J., manufacturer of electrical products, has filed notice of dissolution under the laws of New Jersey.

The Page Steel & Wire Company, manufacturer of steel suspension and guy wires, has taken over the tube business of the Connecticut Tubing Company and has moved the equipment to its Adrian (Mich.) plant, to which a one-story addition, 50 x 286 ft. will be added at a cost of about $60,000.

The National X-Ray Reflector Company has appointed Cochrane, Stephenson & Company, Ltd., of Winnipeg, Can., as its representative for western Canada. The firm will act in the capacity of sales representative for the complete line of X-Ray products. Mr. Cochrane was for twelve years sales manager of the Northern Electric Company in western Canada.

The Woodrow Manufacturing Company, Newton, Iowa, washing-machine manufacturer, has completed a film for distribution to dealers as an aid to their local advertising. The film, which is 1,200 ft. long, shows the progress of the art of washing clothes from the days of Eve to modern times.

The Sterling Lighting & Fixture Company, Buffalo, N. Y., has filed notice of increase in capital stock from $2,500 to $25,000.

The General Electric Company, Schenectady, N. Y., is having plans prepared for the construction of its proposed plant on Elmwood Avenue between Sixty-eighth and Seventieth Streets, Philadelphia, to cost, including machinery, about $500,000. The building will be about 80 ft. x 600 ft. and will be used for the most part for the manufacture of switchboard equipment.

The Western Electric Company moved its supply division in Alanta into a new five-story office and warehouse on Nov. 23. This new warehouse, which provides 60,000 sq.ft. of space, is near the center of the business district of Atlanta, convenient to the company's local supply customers. The company's supply department offices were formerly in the West End suburb of Atlanta, where the stocks of telephone equipment will still be maintained. The new warehouse is equipped with gravity conveyors and dumbwaiters so as to make the handling of material convenient and rapid. It also has a large conference and display room where customers can inspect equipment. About 200 clerks and salesmen are required, with offices on the top floor. Branch offices are now maintained in Jacksonville, Fla., New Orleans and Savannah, Ga. H. W. Hall is district manager of C. A. Cabaniss is sales manager.

The Engineering Business Exchange, 30 Church Street, New York City, announces the opening of a Pacific Coast branch with James T. Whittlesey as director and with offices in the Claus Spreckles Building, San Francisco. Mr. Whittlesey was long a prominent figure in the street-railway field, and since his removal to California eight years ago he has been engaged in general consulting practice.

The Thompson Electric Company, 226 St. Clair Avenue, N. E., Cleveland, Ohio, announces that it is once more on a production basis and expects to be able to make prompt shipments from now on.

The Bowen & Bartlett Company, Inc., 1201 South Sharp Street, Baltimore, Md., has increased its capital stock to $200,000. The company manufactures washing machines.

The H. B. Sherman Manufacturing Company, Battle Creek, Mich., has acquired an electric motor plant at Quincy, Ill., which it will move to Battle Creek. The company, it is understood, will build a new plant as soon as business warrants. It manufactures brass and bronze castings.

The National Council of Lighting Fixture Manufacturers and the Lighting Fixture Dealers' Society will meet in Buffalo, N. Y., during the week of Feb. 14.

Foreign Trade Notes

BULGARIAN CHAMBER CONSIDERING WATER POWER DEVELOPMENT.—The Bulgarian Chamber, which is considering a bill to regulate water syndicates, according to the London *Electrician*, is also giving its attention to the question of developing water power. Investigations have been made as to the utilization of the water power of a number of rivers, and the Board of Trade *Journal* states that the results show that the water-power resources of Bulgaria are capable of developing more than 1,000,000 hp. Railways and industries will consume only 130,000 hp. to 150,000 hp., and the remainder will be available for agricultural purposes and lighting. An extensive irrigation scheme is also contemplated, including the irrigation of the plain of Deli-Ormana by means of electrically driven pumps. The projects to be taken in hand will include the construction of about seventeen barrage reservoirs, building electric power stations and also canal systems in the Plains of Thrace, Stara Zaroga, Yambol and Sliven in southern Bulgaria, and in northern Bulgaria on the lower courses of the Rivers Isker, Vid, Ocem, Rositza, Yantra and others, as well as the Plains of Kustendil, Radomir, Doupnitza and Nevropol. A Supreme Water Council has been established at the Ministry of Agriculture and State Property to execute.

THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT has announced for the past business year net profits of 47,705,000 marks as against 27,031,000 marks in the preceding business year. Inflation of currency in Germany, it is stated, has been reflected by an extraordinary inflation of business profits during the period before the great reaction in prices.

TENDER DATE POSTPONED FOR THE NORWELL HYDRO-ELECTRIC PROJECT.—Owing to the delay in the transit of the specifications of the electricity commission of the State of Victoria, Australia, for the Norwell hydro-electric project, the commissioners have postponed the date for delivering the tenders to the secretary of the commission in Melbourne, Australia, from Feb. 24 to March 31, 1921. These specifications are now on sale at the bureau's district offices, 734 Custom House, New York City, and Room 1124, First National Bank Building, Chicago, Ill.

HYDRO-ELECTRIC PLANT IN NEW SOUTH WALES.—Announcement has been made by the Prime Minister that it is proposed to establish a hydro-electric power plant on Murray River at Albury, New South Wales, Australia, to generate electricity in connection with the industrial development of the border districts in New South Wales and Victoria.

PRODUCTION OF ELECTRICAL APPARATUS IN POLAND.—The manufacture of electrical supplies in Poland is in its infancy. According to the latest statistics available there are twelve plants, employing about 1,200 workmen, manufacturing electrical products, including supply apparatus, electric motors, cable, carbon lamps, carbons for arc lamps, insulating tubes and similar products.

GERMAN ELECTRICAL GOODS IN THE FAR EAST.—German manufacturers, according to Trade Commissioner Lundquist, are furnishing a number of electrical houses in Bombay, India, with electrical apparatus, including wire, wiring supplies, fixtures, meters, motors, etc.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An engineering company in India (No. 34,172) desires to secure catalogs with a view to purchasing decorative electric lamps, such as are used for Christmas trees, with cords for 220-volt circuits; electric signs and flashers, fancy crystal shades (electrical glassware), and opal glass-ball shades, 6, 8 and 10 in. in diameter.

A commission merchant in Turkey (No. 34,175) desires to enter into communication with firms with a view to securing agencies for the sale of metallurgical products, transmission belts, machinery, motors pumps, turbines, etc.

A manufacturing company in Spain (No. 34,179) desires to purchase and secure an agency for electrolytic copper-wire bars with a guaranteed minimum combustibility of 98 to 99 per cent. Copper blocks for laminating are also desired, and copper and brass in all forms, etc.

New Apparatus and Publications

TAILORS' IRONS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has recently issued publication 877, describing its electric tailors' irons.

INSTRUCTIONS FOR CARE OF TRUCKS AND TRACTORS.—The Automatic Transportation Company, Buffalo, N. Y., is distributing a book of instructions (form 504) for care and operation of "Automatic" industrial trucks, tractors and engines; also bulletin No. 28, on its "Automatic" storage-battery industrial trucks, etc.

STORAGE BATTERIES. — The Electric Storage Battery Company, Philadelphia, has issued a small booklet (form 1483) giving instructions for installing and operating the "Ironclad-Exide" battery in storage-battery industrial tractors; also a small booklet entitled "Facts for Consideration in Selecting a Battery for Electric Industrial Truck and Tractor Service."

CONDULET FIXTURE JOINTS. — The Crouse-Hinds Company, Syracuse, N. Y., has issued bulletin 1,000R, covering its new types of condulet fixture joints and extensions.

MOTORS.—Howell Electric Motors Company, Howell, Mich., has issued bulletin No. 300, describing types A and B Howell polyphase motors.

SNAP SWITCH. — A new toggle-snap switch, No. 8171, single-pole, porcelain-base, surface type, made by Harvey Hubbell, Inc., Bridgeport, Conn., is described in bulletin No. 16-18.

METERS.—The Metric Appliance Corporation, 299 Broadway, New York City, has issued two folders describing respectively the "Mac" pocket ammeter and the "Mac" storage-cell tester.

WASHING MACHINES.—The One Minute Manufacturing Company, Newton, Iowa, is circulating an illustrated booklet on its various types of washing machines manufactured by the company.

LIGHTING FIXTURES.—The St. Louis Brass Manufacturing Company, St. Louis, has announced its annual catalog No. 8, for 1921, listing the types, sizes and prices of the lighting fixtures manufactured by the company.

QUARTZ LAMP AND ULTRA-VIOLET LIGHT.—The Cooper Hewitt Electric Company, 95 River Street, Hoboken, N. J., has issued bulletin 86, describing its laboratory outfit for Cooper Hewitt quartz-mercury-arc lamp as a source of ultra-violet light for bacteriological, chemical and industrial purposes as well as for research work. Technical bulletin No. 102 published by the company describes the Cooper Hewitt and ultra-violet light. Illustrations are also given showing energy distribution and transmission curves and energy distribution and reflectivity curves.

HEAVY OIL ENGINES.—The Dodge Sales & Engineering Company, Mishawaka, Ind., has published a small catalog describing its heavy oil stationary engines, heavy oil marine engines and heavy oil engine-driven electric generating units.

New Incorporations

THE ELECTRIC COMPANY OF DELAWARE has filed articles of incorporation under the laws of the State of Delaware to operate a central station. The incorporators are F. M. Holbrook, H. I. Conklin and J. J. Noel, all of Wilmington, Del.

THE INSTANTANEOUS ELECTRIC HEATER CORPORATION, Buffalo, N. Y., has been incorporated by R. McLelland, A. E. Choate and J. G. Herb, all of Buffalo, N. Y. The company is capitalized at $500,000 and proposes to manufacture electric heaters.

THE SPECIAL MOTOR & MACHINE COMPANY, New York, N. Y., has been incorporated by F. F. Baum, J. W. Brautigan and C. R. Baird, 24 East Twenty-third Street, New York City. The company is capitalized at $30,000 and proposes to manufacture electrical and mechanical equipment.

THE BREVARD ELECTRICAL CORPORATION, New York, N. Y., has been incorporated by P. Brevard, F. L. and W. H. Reid, 128 Broadway. The company is capitalized at $200,000 and proposes to manufacture electrical equipment.

THE BEREGH MANUFACTURING CORPORATION, 461 Eighth Avenue, New York, N. Y., has been incorporated by J. J. Donovan, F. W. Saltzsieder and T. J. Beregh. The company is capitalized at $20,000 and proposes to do a general electrical and mechanical engineering business.

THE AUTOMATIC ELECTRIC HEATER COMPANY, Wilmington, Del., has been chartered with a capital stock of $600,000 by R. E. McCloskey, C. B. Cutten and S. L. Mackey, for the manufacture of electric heaters.

THE GRIFFITH SALES COMPANY, New York, N. Y., has been chartered with a capital stock of $50,000 to manufacture electrical and gas appliances. The incorporators are F. W. Doty, F. J. Page and J. H. Olsen, 1328 Broadway, New York City.

THE TIFFANY ELECTRIC COMPANY, East Orange, N. J., has been incorporated by Walter A. Morton, Harold Brabgs and Earl H. Tiffany, 422 North Walnut Street, East Orange. The company is capitalized at $30,000 and proposes to manufacture electrical specialties.

THE SHERMAN ELECTRIC COMPANY, Moro, Ore., has been incorporated with a capital stock of $200,000 by C. H. Howell, C. A. Buckley, R. H. McKean, A. M. Wright and N. W. Thompson.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 21, 1920)

1,362,587. PRINTING-TELEGRAPH RECEIVER; Edgar W. Adams, East Orange, N. J. App. filed Feb. 14, 1918. Receiving printer.

1,362,588. ELECTRIC SYSTEM OF DISTRIBUTION AND METHOD OF OPERATING THE SAME; Edwin W. Allen and Edward Taylor, Chicago, Ill. App. filed Sept. 8, 1919. Automatic prime-mover plant.

1,362,592. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Nov. 21, 1917. Duplex.

1,362,593. ELECTRICAL SYSTEM OF DISTRIBUTION; Thomas A. E. Belt, Schenectady, N. Y. App. filed April 16, 1920. Automatic hydro-electric plant.

1,362,596. SEMI-MECHANICAL TELEPHONE SYSTEM; William G. Blauvelt, New York, N. Y. App. filed April 11, 1917. Semi-automatic.

1,362,597. TRANSMITTER SUPPORT; William T. Booth, East Orange, N. J. App. filed Feb. 28, 1918. Breast plate.

1,362,605. SELECTING SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Dec. 29, 1916. For producing messages in different forms simultaneously.

1,362,607. TELEGRAPH SYSTEM; Andrew D. Dowd, Hoboken, N. J. App. filed March 29, 1918. Printing telegraph.

1,362,609. ELECTRIC HEATING APPARATUS; Raymond P. Dunning, Schenectady, N. Y. App. filed June 21, 1920. For heating rivets.

1,362,610. ELECTRIC HEATING APPARATUS; Raymond P. Dunning, Schenectady, N. Y. App. filed June 21, 1920. Rivet heater.

1,362,612. WIRELESS RECEIVING SYSTEM; Lloyd Espenschied, Hollis, N. Y. App. filed May 15, 1916. Protected from disturbing oscillations.

1,362,613. MEANS FOR NEUTRALIZING INTERFERING DISTURBANCES; Lloyd Espenschied, Hollis, N. Y. App. filed Dec. 5, 1918. For plurality of transmission circuits.

1,362,622. ELECTRIC HEATER; Allan B. Hendricks, Jr., Pittsfield, Mass. App. filed April 26, 1920. Induction type.

1,362,624. RAILWAY SIGNALING AND FREQUENCY SELECTIVE DEVICE FOR USE IN CONNECTION THEREWITH; John S. Holliday, Wilkinsburg, Pa. App. filed July 12, 1916.

1,362,637. ELECTRICAL SYSTEM OF DISTRIBUTION; Claude W. Place, La Grange, Ill. App. filed March 17, 1920. Automatic hydro-electric plant.

1,362,639. PRINTING MECHANISM; Paul M. Rainey, Glen Ridge, N. J. App. filed Nov. 3, 1917. Printing telegraph.

1,362,648. TELEGRAPH SYSTEM; Adolph R. Swoboda, Newark, N. J. App. filed April 22, 1918. Leak-nullifying means.

1,362,663. COMMUTATOR; Thomas Zimmerman, Niagara Falls, N. Y. App. filed April 17, 1914. To withstand high speeds and temperatures.

1,362,674. SWITCH-BOX MOUNTING; Nils T. Clements, Superior, Wis. App. filed June 17, 1919. Mounted in walls.

1,362,734. LAMP HOLDER OF THE EDISON TYPE; Antonio Piazzi, Gallarate, Italy. App. filed Aug. 19, 1918. Readily taken apart.

1,362,737. SEPARATOR FOR STORAGE-BATTERY PLATES; George W. Pleis, Philadelphia, Pa. App. filed July 23, 1919. Will not warp.

1,362,770. ELECTRICAL APPARATUS FOR INTERNAL-COMBUSTION ENGINES; Joseph Bijur, New York, N. Y. App. filed Nov. 24, 1915. Starting motor.

1,362,771. ELECTRICAL APPARATUS FOR AUTOMOBILES AND THE LIKE; Joseph Bijur, New York, N. Y. App. filed Oct. 16, 1916. Dynamo.

1,362,772. ACCESSORY FOR MOTOR VEHICLES; Joseph Bijur, New York, N. Y. App. filed Aug. 10, 1917. Dynamo-electric machine.

1,362,794. ART OF CHARGING STORAGE BATTERIES; Arthur H. Hoffman, Ames, Iowa. App. filed April 3, 1917. Driven by small windmill.

1,362,842. GYRO-COMPASS; Sidney G. Brown, North Acton, England. App. filed Feb. 12, 1920. Repeaters.

1,362,844. SYSTEM OF ELECTRICAL DISTRIBUTION; John B. N. Cardoza, Virginia Beach, Va. App. filed Oct. 17, 1919. Battery control.

1,362,876. SYNCHRONIZING APPARATUS; Ladislav O. Kozar, Middletown, Pa. App. filed Jan. 30, 1917. Maintains synchronism.

1,362,892. TOILET ARTICLE; Elmira Page, Louisville, Ky. App. filed Aug. 17, 1920. Electrically heated comb, curling tongs, etc.

1,362,898. ELECTRIC CONTROLLING MEANS; William Schwagermann, Yonkers, N. Y. App. filed April 25, 1916. For controlling storage-battery system.

1,362,906. COMBINATION FIXTURE HANGER AND CONCEALED SWITCH HOLDER; Wallace R. Wallick, Lincoln, Neb. App. filed Aug. 18, 1919. For lighting fixtures.

1,362,921. LIGHTING SYSTEM; FOR AUTOMOBILES; Henri J. Bourbonnier, Montreal, Quebec, Can. App. filed May 10, 1916. Lamps in series or parallel.

1,362,959. POLYPHASE INDUCTION MOTOR; John B. Price, Fort Thomas, Ky. App. filed Nov. 7, 1918. High starting troque and low starting current.

1,362,962. ELECTRIC WELDING MACHINE; Cleveland Redfield and Charles C. Hartley, Ogden, Utah. App. filed April 15, 1919. Spot-welding plates or sheets.

1,362,992. WATER-TIGHT PLUG AND RECEPTACLE; John W. Haywood, New York, N. Y. App. filed Feb. 27, 1919. Used on ship.

1,363,000. OZONIZER; William G. Lindemann, Milwaukee, Wis. App. filed Aug. 4, 1919. Generating ozone from stream of compressed air.

1,363,019. ELECTRIC LAMP FIXTURE; Ralph H. Sheldrick, Waterbury, Conn. App. filed June 26, 1920. Wall bracket.

1,363,032. WIRELESS SYNCHRONIZER; Ernest Bancroft, Sonoma, Cal. App. filed Dec. 19, 1919. For timing oscillations.

1,363,037. METHOD OF AND MEANS FOR PRODUCING ELECTRIFIED JETS OF GAS; Robert H. Goddard, Worcester, Mass. App. filed Oct. 4, 1917. Change in velocity will not affect.

1,363,052. TREATMENT OF ZINC SOLUTIONS; Frederic Petersson, Balham, England. App. filed July 13, 1920. Electrolytic.

1,363,074. METHOD OF INSULATION FOR HEATING DEVICES; John J. Zwerling, San Francisco, Cal. App. filed May 20, 1920. Insulating coating.

1,363,078. PROPELLING MEANS FOR BOATS; Asher R. Bauer, Allentown, Pa. App. filed June 2, 1919. Contact rail on bank.

1,363,108. ELECTRIC STOVE; Hugh W. Gasaway, East Pleasant Plain, Iowa. App. filed June 15, 1920. For toasting bread.

1,363,124. LIGHTNING ARRESTER; Thomas L. Keller, Bristol, Pa. App. filed May 8, 1919. Prevents lightning from leaving main line.

1,363,132. FLASHLIGHT: Thomas E. Lander and John Hamerstrom, Kansas City, Mo. App. filed Jan. 2, 1920. Attachment for holding one or more.

1,363,156. METHOD OF ELECTRICALLY WELDING TOGETHER THE EDGES OF THIN METAL PLATES, Thomas E. Murray, Brooklyn, N. Y. App. filed July 3, 1920. To prevent relative displacement.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LITTLETON, N. H.—The White Mountain Novelty Company plans to build a woodturning factory and a power plant. A. A. Pennock is manager.

Middle Atlantic States

BOSTON, N. Y.—The State Public Service Commission has authorized the Depew & Lancaster Light, Power & Conduit Company, Lancaster, to construct an electric plant at this place.

BUFFALO, N. Y.—The City Council is considering the installation of electrically operated, high-tension, pumping equipment at the Colonial Ward pumping station in connection with the fire department. The cost is estimated at about $400,000.

COLDEN, N. Y.—The Depew & Lancaster Light, Power & Conduit Company, Lancaster, has applied to the State Public Service Commission, Second District, for permission to construct and operate an electric light, heat and power plant in Colden.

NORTH TONAWANDA, N. Y.—The Tonowanda Power Company contemplates the extension of its lines in the Witmer Road section. E. F. King is manager.

HOPEWELL, N. J.—The Borough Council has plans under way for improvements to the street-lighting system.

JERSEY CITY, N. J.—The Board of Commissioners, Hudson County, has plans under way for improvements and extensions to the county electric light and power plant at Snake Hill. T. J. Wasser is county engineer.

JERSEY CITY, N. J.—The Fulton Terminal Lumber Company, recently organized with a capital of $1,000,000, contemplates the erection of a lumber plant and power house. Plans also include the installation of electric motors, motor drives for woodworking, etc. B. F. Fitch, 61 Broadway, New York City, is interested.

LAKEHURST, N. J. The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the establishment of a signal system, also an electric distribution system, including a series street-lighting system with underground ducts, street-lighting standards, transformers, etc. (Specification 4348).

ALTOONA, PA.—Petitions are being circulated for extensions to the street-lighting system on various streets of the city.

HARRISBURG, PA.—The City Council is arranging an appropriation of $16,959 for the municipal electric bureau to be used for underground line extensions, installation of street lamps, etc.

LEWISTOWN, PA.—The Penn Central Light & Power Company has plans under way for the erection of a transmission line on West Hale Street.

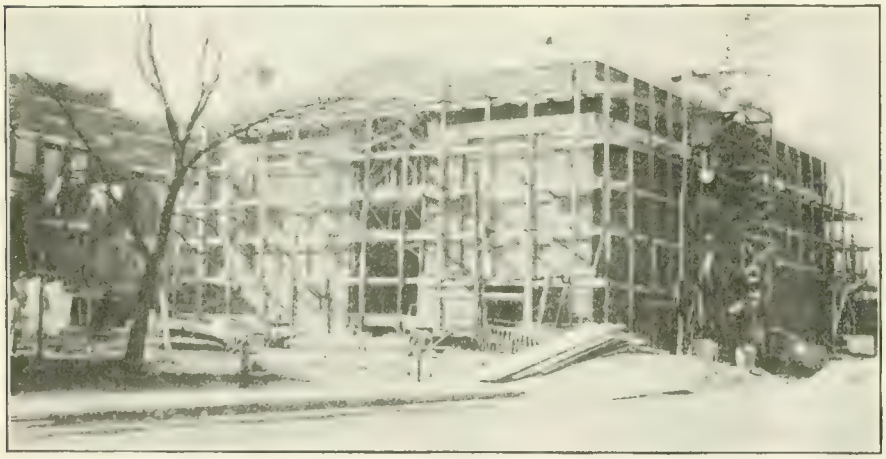
MILLVALE, PA.—The Duquesne Light Company, Pittsburgh, has purchased the borough electrical plant, and according to terms of the sale will install modern equipment. The light company is also considering the installation of an ornamental street-lighting system.

PHILADELPHIA, PA.—The Mayor recently signed an ordinance providing for the substitution of incandescent electric lights for 1,062 gasoline and ten gas lamps in the Twenty-third and Thirty-fifth Wards.

PHILADELPHIA, PA.—The Department of City Transit, Chestnut Street, has plans under way for the erection of a number of electric plants for the operation of the Frankford elevated railway system. W. S. Twining is director of city transit.

BALTIMORE, MD.—The Department of Lamps and Lighting contemplates the installation of an ornamental street-lighting system on Columbia Avenue, Harford Road, Hanover Street and a number of other main thoroughfares during the coming year. J. J. Hanson is superintendent of the department.

BALTIMORE, MD.—It is understood that the United Railways & Electric Company has plans under way for the construction of a new electric substation.



UNITED ELECTRIC COMPANY, SPRINGFIELD, MASS., SUBSTATION UNDER CONSTRUCTION

BOONSBORO, MD.—The Hagerstown & Frederick Railway Company, Hagerstown, is arranging for the Antietam Light & Power Company, Fairplay, to distribute power to Boonsboro, Keedysville and Sharpsburg.

HARRISONBURG, VA.—The board of directors of the Rockingham Memorial Hospital contemplate the erection of a new power house at the institution. C. M. Robinson, Times-Dispatch Building, Richmond, is architect.

North Central States

SAULT STE. MARIE, MICH.—The city officials plan to extend the lighting system on Portage Avenue. T. J. Watchorn is commissioner.

IRVINE, KY.—The Irvine Light & Power Company contemplates the expenditure of $10,000 for improvements to its plant.

FRANKFORT, IND.—The City Council has authorized an issue of $175,000 bonds for the erection of a municipal light plant.

FREEBURG, ILL.—The City Council contemplates the erection of an electric lighting plant in the spring to cost about $30,000. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

OLNEY, ILL.—The board of directors of the Olney Sanitarium are having plans revised for the construction of a new power house at the institution in connection with a new hospital building. The cost is estimated at about $100,000. L. H. Osterhage and B. Sutton, Second National Bank Building, Vincennes, Ind., are architects.

SPRINGFIELD, ILL.—The City Council plans to install an ornamental street-lighting system in the downtown section and place underground wiring in the business district.

MANITOWAC, WIS.—The Manitowac Shipbuilding Company, Sixteenth Street, will soon award the contract for the erection of a round house and power house on Eighth Street, to cost about $75,000.

HEIBERG, MINN.—The J. F. Heiberg Electric Light & Power Company contemplates repairs to its plant and dam at this place. The company also plans to extend a transmission line to Ada.

MINNEAPOLIS, MINN.—The city officials are awaiting legislative action in regard to the construction of a 375-hp. power plant on the Mississippi River for the operation of an ice plant to be erected at this place.

WORTHING, S. D.—The town board has been petitioned to issue $12,000 in bonds for the erection of a transmission line to Harrisburg to connect with lines from Sioux Falls.

MINATARE, NEB.—The city officials contemplate the purchase of electric motors, two centrifugal pumps, gas engines, etc., to cost about $40,292. R. O. Chambers is city clerk.

Southern States

LEESBURG, FLA.—The Grass Fiber Pulp & Paper Company contemplates the installation of an electric light and power plant.

ST. PETERSBURG, FLA.—The St. Petersburg Electric Company contemplates extension to the street-lighting system.

ST. PETERSBURG, FLA.—The Williams-Beers Ice Company contemplates the erection of an electrically operated ice manufacturing plant to cost about $100,000. H. Beers is engineer.

MONROE, LA.—A proposition to issue $140,000 in bonds will be submitted to the voters for completing the erection of the electric light, power and water works system.

ST. JOSEPH, LA.—Bonds to the amount of $20,000 have been voted for the installation of an electric light plant.

AMARILLO, TEX.—The Fort Worth & Denver City Railroad Company is having plans prepared for the installation of a new turntable and power plant, etc., at this place, to cost about $100,000.

CHILDRESS, TEX.—The Fort Worth & Denver City Railroad Company is having plans prepared for the erection of a power plant, extension to yards, addition to machine shops, etc., in Childress, to cost about $500,000.

FORT WORTH, TEX.—The Fort Worth & Denver Railroad Company, F. E. Clarity, vice-president and general manager, Denver Record Building, is having plans prepared for enlarging power plant, replacing present turntable with a 90-ft. turntable, etc., at a cost of about $150,000. R. C. Gowdy, Denver, Col., is chief engineer.

Pacific and Mountain States

OROVILLE, CAL.—The Hutchinson Lumber Company contemplates the erection of an electric power plant in connection with its new mills, estimated to cost in excess of $1,000,000. C. O. Griffith is in charge.

MATHESON, COL.—The Farmers' Electric Light, Power & Coal Company, recently incorporated for $100,000, contemplates the erection of a power plant at this place, to furnish light and power to four adjoining towns. O. M. White, president of the State Bank of Matheson, heads the company.

Canada

LONDON, ONT.—The Public Utilities Commission, Hydro Building, contemplates the erection of a substation at East London to cost about $35,000. Transformers, lightning arresters, etc., will be required. E. V. Buchanan, Hydro Building, London, is engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the General Purchasing Office of the Panama Canal, Washington, D. C., until Jan. 17 for furnishing one voltmeter and 5,000 ft. of high-tension ignition cable to be 19 No. 27 A.W.G. tinned wires, stranded, single conductor and of three-layer insulation.

Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
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Thirty Years of Industrial Service in the Editorial Chair

WHEN a man devotes thirty years of his life to constructive service, encouraging, admonishing and leading his industry, the plaudits of others seem empty beside the monument he himself has erected. Nevertheless, we feel impelled to comment on the work of Henry W. Blake, who has just rounded out thirty years of service as editor of the *Electric Railway Journal* and who still conducts it with unflagging zeal and ripened ability and with an accumulated knowledge and experience which in his own field leave him without a rival. When Mr. Blake began to edit the *Street Railway Journal*, as it was then called, horses supplied the chief power for surface railways in every city save a few metropolitan lines where underground cables were employed. The electrical era in city traction was just dawning, making possible the long-distance suburban service, the interurban lines and the great city subway systems of today, and Mr. Blake's opportunity for service expanded with it. For well-nigh a generation he has literally written himself into the electric railway industry and made it his heavy debtor.

Taking the Consumer Into Partnership

RESULTS of the survey which the ELECTRICAL WORLD has conducted on the matter of sales of securities to customers which appeared in last week's issue give very striking evidence of the practical importance of the policy and its immediate success. No less than fifty million dollars' worth of sales of securities in this way are definitely reported, with clear indications that at least an equal amount has been sold outside of the definite program to which attention is specially addressed. Almost a third of these heavy sales have been made within the last year. The total number of customer-owners certainly runs over 150,000. These are figures of the most impressive and encouraging character. They show that a company needing added capital can go to its customers with a substantial feeling of security. A very large proportion of the securities thus sold consisted of preferred stock, which seems to have proved the best adapted for this particular kind of distribution. One company for some time past has raised all its new capital in this way, while others have only attempted to place a limited proportion, generally about 25 per cent, among customers. On the whole, sales were in the hands of employees and stock was sold by them on a commission basis. In a few instances only were there definite stock-selling campaigns, but very generally there was liberal advertising of the company's plans. All these facts go to show that the sale of securities to the consumer is becoming a definitely settled policy and one which seems to work admirably. Customer ownership is steadily increasing, and there has been no instance reported in which good results have not been reached when a definite effort was made thus to take the public into partnership.

How Can Fit Commissioners Be Retained?

THE retirement of Edwin O. Edgerton from the California Railroad Commission, of which he had been a member for eight years and president since 1918, is a matter for sincere regret by those connected with public utilities not only in California but in every part of the country. For Mr. Edgerton, through his ability, his judicial mind, his grasp of the problems that came before him both in their details and in their wider scope and meaning, proved himself an ideal public service commissioner. No candid observer who studied his decisions or attended to his philosophy as expressed in many public addresses could suspect him either of indifference to the interests of utility customers and the public at large or of hostility to honestly managed companies that furnish transportation, lighting, power and other prime essentials of modern life. It will be too bad if because of inadequate compensation, partisan activity or any similar reason the services of such men as he—and we are glad to think that there are many such on the public utility boards of the country—shall be lost when there is any possibility of retaining them. The nation needs commissioners of this caliber, and new men, however able and fair-minded, cannot start with the ripe wisdom that long experience in any position brings to the fit.

What Housing Means to the Industry

THE United States Chamber of Commerce has canvassed the housing situation and finds that the country is short about 1,250,000 homes. That a shortage exists almost every one knows; that it amounts to so large a total is informative. Granting that every one of the homes will be electrically lighted and equipped, an assumption by no means visionary, what does it mean to the electrical industry? Based on so modest an outlay as one hundred dollars for labor, material and equipment, to light the homes will represent an expenditure on the part of the owners of more than one hundred million dollars. Another hundred million will be spent if electrical conveniences and labor-saving appliances are installed, and in bringing electric service to the homes and metering it electric public utility companies will have to expend still another hundred million, not counting additions to power-house equipment necessary to generate the energy. Thus, in round numbers, the present housing shortage

when alleviated will represent a conservative expenditure within the electrical industry of half a billion dollars. This business will be thrown into the lap of the industry by outsiders, and that it exists potentially should be a source of comfort to contractor, jobber, manufacturer and electric public utility manager alike. When solicited private, public and industrial business is added to these findings the total should transform every pessimist into a radiant optimist.

Original Design Will Limit Station Economy

THE upper limit of economy possible on any central-station plant is fixed by original design. This too little recognized fact was dwelt on in an article by Peter Junkersfeld on the effect of load factor on station costs in the Jan. 8 issue of the ELECTRICAL WORLD. Boiler, turbine and auxiliary equipment all have very definite limits between which operation must be carried out if efficiency is to be secured. A plant designed for operation at low load factors in which the carrying of high peaks by forcing equipment beyond its economical limit is permitted may be efficient because the forcing covers such short periods of time that the inefficiency is not reflected perceptibly in operating costs. A radical increase in load factor continues the operation at inefficient ratings until a marked effect on costs is shown. With the operating conditions fixed by original design there is no possibility of reaching high efficiency under the new conditions. The prime factor in design is the recognition that mechanical equipment, like human beings, has very definite limits both up and down, outside of which inefficiency is bound to result. This recognition must be carried into effect by a thorough and conscientious study of conditions of operation that will be met both during the early operating years of the new plant and in the later years as the community served develops. The provision for the later years should consist largely in avoiding limitations to the extension of the plant in the original designs, or, stated in another way, in providing space for extensions and opportunity for changes in equipment to meet new conditions without the expenditure of large sums of money that may not bring a return for several years.

Long-Distance Radio Telephony

THE advances which have recently been made in radio telephony are well described in the article this week by Dr. J. H. Dellinger. These advances have been most surprising. They have come, of course, after much international experience already obtained with radio telegraphy, and therefore after much pioneer work in radio methods had already been carried out. As is mentioned in the article, one of the most striking recent demonstrations was given by the American Telephone & Telegraph Company in New York to the delegates of the International Communication Conference. A ship in the Atlantic Ocean, not very far from Long Island, equipped with a radio-telephone set, was able to maintain conversation with a radio station on Santa Catalina Island, off the Pacific Coast, near Los Angeles, using wire telephony across the continent as a link in the radio chain. By connecting in the land-line wires to the room in New York City where the delegates were in attendance, they could all listen in to the conversation from the Atlantic at sea to the Pacific at sea and hear deep answering unto deep.

It does not seem unlikely that radio-telephone concerts may be given on ships at sea, at regular hours, according to a definite schedule, in the not far distant future, by virtuosi calmly executing their art in their own rooms on shore. A very noteworthy advantage of radio telephony over wire telephony is that it appears to have very little distortion. That is to say, the attenuation of the high-frequency tones is sensibly the same as that of low-frequency tones. Consequently, as far as the voice can be carried its timbre remains substantially unchanged. It may be faint, but it remains pure and is therefore susceptible of restoration in volume by amplification. On the other hand, as is well known, the attenuation on land lines, and especially on cabled land lines, of high-frequency tones is greater than that of low-frequency tones. Hence over a long land-line circuit the speech at the receiving end of the line becomes not only weakened but also modified in character. It is apt to be drummy as well as faint, so that the characteristic timbre cannot then be restored by amplification. This absence of distortion from radio telephony is bound to be of great help in the worldwide extension of the radio telephone.

Economic Forces Are at Work

AT THIS time of year business prognosticators are busy making mental observations of themselves at the end of the next twelve months. The pessimist who looks in the mirror that curves outward sees himself elongated and emaciated. The optimist who looks in the mirror that curves inward sees a happy, rotund figure. Business, which is so closely allied with the weaknesses of the human mind, is influenced by past performance, and as a result the good that may come in 1921 is bound to be tainted at the start with some of the wrong thinking of 1920. If, however, we can come quickly to the realization that the days of abnormal profits have passed and that the period is here for building and selling along lines of economic needs according to the old-fashioned standards of merit and service, something like 120 degrees of the right-about-face in the direction of future business activity will have been made. War profits and war exigencies that involved all American industry for so long are now back of us. Today requires, and all this year will require, the energy and straight thinking of business men in the repair of the industrial fabric. It already has shown the result of enforced wear, brought about by high prices and the urgent need for the greatest economies. The railroads have turned their attention to this work; the public utilities, with here and there some results, have pleaded for the needed return to make it possible, and the electrical manufacturer and his agencies of distribution are squarely facing their new problems. The most severe of the inevitable storms, the transition from a sellers' to a buyers' market, has come and gone, and what little wreckage it caused has been cleared away. The clouds are now opening up, and here and there blue sky is seen in demands for supplies and equipment to be used in filling deferred building programs. With the needs of the electrical industry in electrical equipment and supplies something like $2,600,000,000 a year for the next four years, the future for the electrical manufac-

turer is assured. His success is just as certain as was the triumph of the cause for which this country fought in 1917 and 1918, and the date of its realization will depend, just as the success of that struggle did, on the speed and completeness with which preparedness is achieved for the overcoming of obstacles that unforeseen conditions at home of today and tomorrow and the political confusion of Europe may throw in the way. Economic forces are now at work. Intelligent recognition of this fact and a substitution of common sense for extravagance and speculation are the only safeguards that business in 1921 will require.

Non-ferrous Electric Furnace Loads

LARGE blocks of power, at high load factors, with good power factor and with fluctuations causing no serious strain on the system, are in sight in the near future if the central-station industry takes full advantage of the opportunities offered by the electric furnace. In the main all that is required is for the manufacturer and the central station both to realize that their interests lie in the same direction and the apparent difficulties blocking the progress of the electric metal melting processes will be easily removed. In a recent issue of the ELECTRICAL WORLD E. L. Crosby emphasized particularly the possibilities of immediate development of non-ferrous electric furnace load. When it is recognized even now that the electric process for this work is by far the most economical if proper provisions are made both by the manufacturer and the power company, is it not reasonable to expect immediate growth on a large scale in the electrification of that branch of industry? Mr. Crosby gives us the essential requirements for such a course—the central station must furnish lines with plenty of capacity to provide fair regulation and efficient operation for itself by keeping energy losses within the economical limit. These lines must be independent from lighting circuits in order to avoid fluctuations which, though quite permissible on industrial lines, are objectionable on lines carrying energy for lighting. The manufacturer must design his equipment to give high power factor, and the user must distribute his single-phase load on the phases to avoid unnecessary unbalance and must take advantage of the economy of continuous operation. Meeting these conditions will bring satisfaction to producer and consumer and make true Mr. Crosby's prediction of an increase from 5 per cent to 75 per cent in the electrification of non-ferrous metal melting in the next ten years.

Obtaining True Costs Systematically and Accurately

THAT nearly all engineering problems are fundamentally economic ones is well recognized by most engineers; moreover, the public is coming more and more to the same viewpoint, especially in regard to public utility problems. In this issue an article, the second one of a series on economics of electrical distribution, points out the importance of systematic and accurate cost determination. Not only is it necessary to know the cost of the work when it is finished, but also it is essential that the cost records be in such shape that they can be used, as modified by present conditions, to serve as a basis for planning new work.

It is further brought out that first cost and annual cost are two very distinct things. The first, involving labor and material costs only, indicates the amount to be spent at the time of construction; the second, involving costs of labor and construction and also costs of lost energy and of operation, gives the means of determining the relative economy when comparing various ways of doing a certain piece of work. From this it is seen that low first cost may not result in the lowest annual costs and that therefore first cost is no indication of the economy of a project.

The evident conclusion is that engineering problems should be studied from their annual costs and that the work should be done in such a way that these will be a minimum. It is also evident that there is no economy where electric service is not satisfactory, so that good service must always be considered. Furthermore, when a limited amount of money is available for a piece of work, the minimum annual costs consistent with good service should still be the basis on which to decide what should be done, in order that these may be approached as nearly as possible within the limits of allowable expenditure. This point of view, which is the correct one in regard to engineering problems, makes it evident that proper determination of costs is fundamental to correct solution of problems.

Labor Saving in Handling the Fuel Supply

EVERY designing and operating engineer charged with the responsibilities of a large station aims to make its operation as nearly automatic as is humanly possible. One cannot altogether get rid of manual labor, but it is at least feasible to keep it far below the present average amount, with extremely good results in economy. In the current issue M. D. Engle gives details of the methods used in the big station of the Baltimore system at Westport, Md. This plant of approximately 140,000 kw. capacity is operated in connection with the hydro-electric plant at Holtwood, and between the two it has been possible to keep Baltimore permanently free from power shortage, even through the strenuous years of reconstruction that have just passed.

One of the very interesting features is the ingenious system of co-operation between this steam plant and the hydro-electric system, on which all possible burden is thrown. Carrying out this policy demands that the Holtwood station should carry the output until it is fully loaded and then call upon Westport for help, the latter station taking merely the necessary amount of load and keeping the plant at Holtwood steadily on the job.

The scheme actually used for carrying out this program is the not unusual one of frequency variation, adjusted in an extremely skillful and successful way. The Holtwood governors are set for a fraction of a period higher frequency than the governors at the steam station, and not until the hydraulic plant is fully loaded does the speed sag off enough to transfer the load to the steam station, kept exactly at 25 cycles. There are many details in the equipment here described which will repay study, and the whole plant is a capital example of judicious engineering in a system where water power and steam must co-operate to the utmost advantage in supplying a large and increasing load.



Charles Augustus Stone

Whose realized vision of the possibilities of public utility development through the associated combination of engineering, administrative and financial abilities marks him as a master builder of the electrical industry

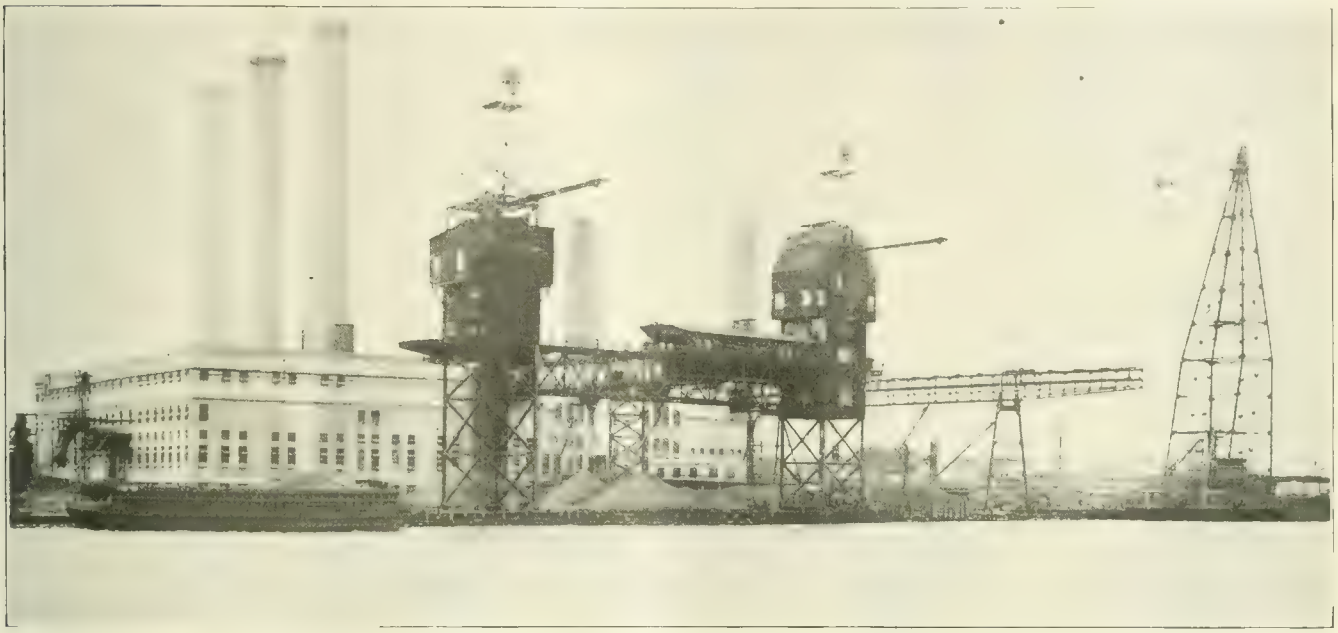
CO-FOUNDER of a great house whose name is known the world around for its achievements in engineering and finance, C. A. Stone stands in the front rank of American captains of industry whose influence upon the electrical field has covered nearly a generation of constructive accomplishment. With classmate Edwin S. Webster he was graduated from the Massachusetts Institute of Technology in 1888, and in 1889 the two formed at Boston, Mass., a partnership under the firm name of Stone & Webster, consulting engineers. The electrical industry was then in its infancy. Many new public utilities were unsuccessful, and during their reorganization the firm was consulted for analyses and remedies. So effectively did these young men do their work that in a short time they were [illegible] to manage and promote and the business grew until today the organization, with added partners, directs the affairs of public utilities with a capitalization of about one-third of a billion dollars and annual gross earnings of forty to fifty millions. Its managerial activities include properties in Canada, Cuba and Porto Rico as well as utilities widely distributed throughout the United States and construction jobs including hydro-electric plants, transmission systems, electric railways, central stations, notable buildings and industrial establishments in various parts of the world. From engineering to finance was a logical development for the organization, so that today it is as well known in banking circles as in technical fields. It is significant that throughout this period the desks of Mr. Stone and Mr. Webster have remained side by side and that Mr. Stone's removal to New York City in 1916 to become president of the American International Corporation did not separate him from active continuous interest in Stone & Webster, Inc., of which he is chairman of the board.

As president of the American International Corporation Mr. Stone is actively concerned with the development of the foreign commerce of the United States, the upbuilding of enterprises at home and abroad and the bringing together of foreign and American bankers, business men and engineers for the transaction of business and the development of mutually advantageous undertakings. He is a director in many leading corporations. As an associate once said, "He can dream dreams, but is always anchored to earth." Mr. Stone is a native of Newton, Mass., and will observe his fifty-fourth birthday tomorrow, Jan. 16.

New Station at Baltimore Has Unique Coal-Handling Method

How Coal, Received by Water, Is Handled at Westport Station Interesting Method of Load Division with Holtwood Hydro-Electric Plant Provision Against Generator Fires and Ceiling Condensation Among Other Features

By M. D. ENGLE
Consolidated Gas, Electric Light & Power Company of Baltimore



WATER-FRONT STATION OF THE CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY AT WESTPORT, MD. TWO COALING TOWERS, EACH CAPABLE OF HANDLING 300 TONS PER HOUR, ARE SHOWN IN THE FOREGROUND

TO MEET the ever-increasing industrial and domestic demand of the city of Baltimore for electrical energy, the Consolidated Gas, Electric Light & Power Company in 1905 started the building of a steam generating station at Westport, Md. Today, after fifteen years of almost continuous building, this station has an installed generating capacity of 120,000 kw. Coal for the plant, received principally by water, is handled with a minimum of labor and by the use of some unusual automatic devices. The coal is raised by unloading towers, passed through crushers and distributed by automatically controlled cable cars to hoppers, or by centrally controlled cableway bucket to storage. Of especial interest, also, is the operation of the plant in co-ordination with the hydro-electric plant at Holtwood, Pa., in order to make the best use of whatever water may be available there. Other features are the provision against turning on the water for quenching generator fires and prevention of condensation on the ceiling of the turbine room.

The station generator capacity consists of 14,500 kw. in engine-driven units and one 8,500-kw., one 17,000-kw. and four 20,000-kw. turbo-generator units. The installation of a fifth 20,000-kw. unit is to be completed about March 1, 1921, giving a total of 140,000 kw. It is of interest to note that owing to the foresight of the Consolidated Gas, Electric Light & Power Company management Baltimore is one of the very few cities in the eastern part of the United States where there is no shortage of power. No doubt this condition is largely responsible for the rapid industrial growth of the city in the past few years.

Coal for the station is received over the local coal piers, loaded on lighters owned by the company and towed to the plant by the company's tugs. In case of emergency coal may be received direct over the Western Maryland or Baltimore & Ohio Railroad. Fig. 1 on page 143 is a plan of the station and shows the coaling equipment layout.

The equipment provided for unloading coal received by water consists of two electrically operated, high-speed coaling towers, each of which is capable of unloading coal at the rate of 300 tons per hour when "topping" scows; a gantry crane, and a stiff-leg derrick. Under ordinary operating conditions all unloading is done by the two coaling towers. These towers take coal from lighters at the waterfront by means of 2-ton grab buckets and dump it into hoppers 100 ft. (30 m.) above, from which it flows by gravity to double-roll crushers, directly above other hoppers from which the cable-road cars are loaded. These loading hoppers beneath the crushers are equipped with air-operated gates which make it possible for the operator to load a 4-ton coal car in approximately four seconds.

The cable-road cars pass beneath the loading hoppers of the two towers, across an automatic track scale and

out across a steel bridge to boiler house No. 3. The stocking-out hoppers are beneath the incoming track on this bridge. The cars pass into the boiler house and over the coal bunkers, where they are automatically dumped. Bunkers of 320 cu.yd. (245 cu.m.) capacity are provided for single boilers and 538-cu.yd. (412-cu.m.) bunkers for two boilers facing each other. The cars pass on, engage the door-closing device and cross over the change-over and regripping device, which automatically causes them to release the incoming cable and grip the outgoing cable. These automatic features reduce the labor of operating the coal-handling equipment to a minimum.

A gantry crane is used for coaling boiler houses No. 1 and No. 2 either from lighters at the waterfront or from storage. The stiff-leg derrick shown in the

For handling the coal which must be carried in stock for a plant of this size, and for a plant whose load varies with the rainfall from 400,000 kw.-hr. to 1,400,000 kw.-hr. per day, an aërial cableway approximately 1,000 ft. long has been provided. The cableway has a stationary head tower 240 ft. (73 m.) high and a movable tail tower 85 ft. (26 m.) high. The operator is stationed in a crow's nest in the rear of one of the coaling towers and from his position has a full view of the whole storage lot. Coal unloaded for stock by the two coaling towers is dumped into one of the stocking-out hoppers beneath the bridge between the towers and boiler house No. 3. By means of chutes with flexible connections these hoppers place the coal within reach of the 3-ton grab of the cableway. This bucket then carries the coal to the three-acre storage lot.

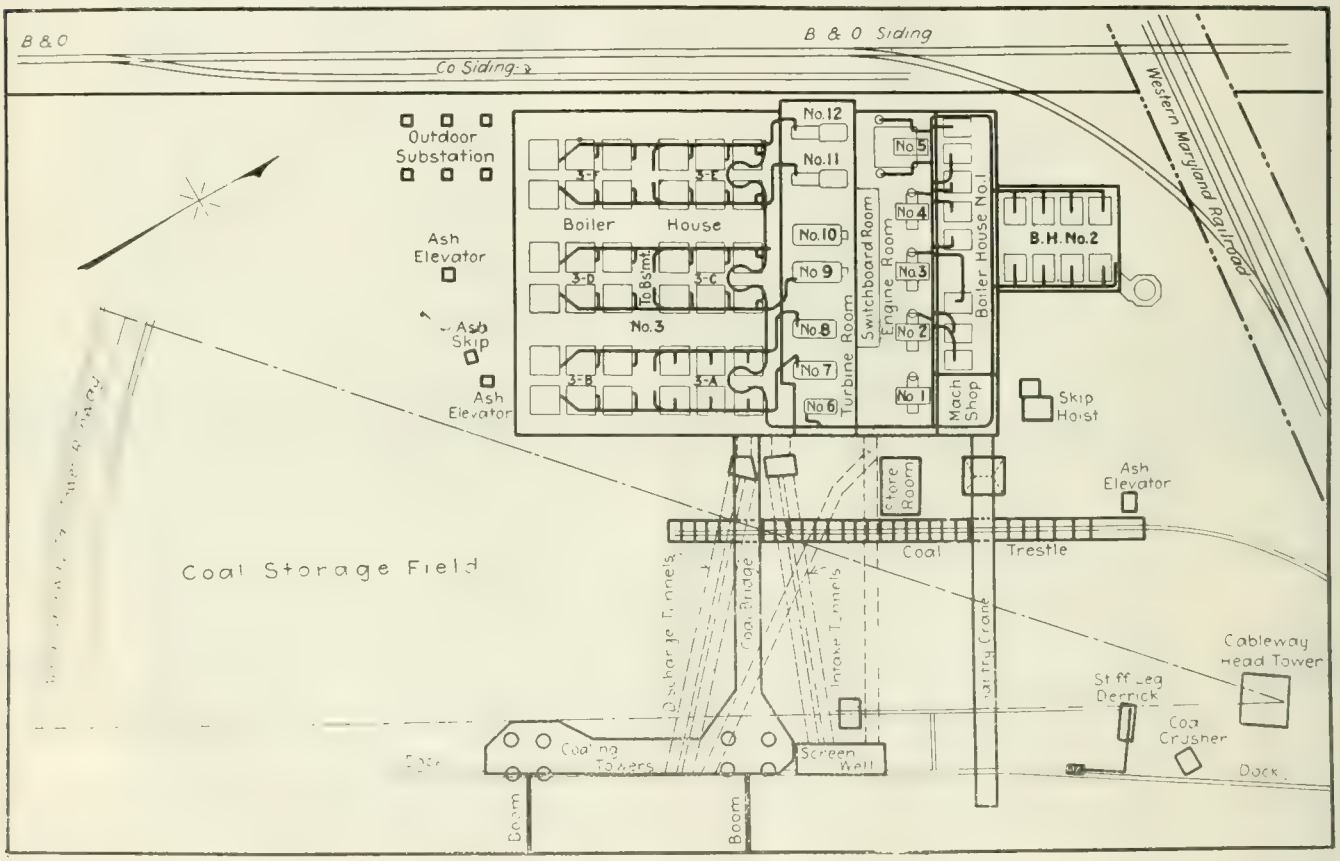


FIG. 1—LOCATION AND ARRANGEMENT OF THE STATION ON THE COMPANY'S GROUNDS
Sedimentation pond, filter house and clear-water basin (not shown) are west of the railroad tracks. The aërial cableway shown in the plan may also be seen in the photograph, page 141, although the tail tower and part of the cable are cut off.

exterior photograph is used in connection with a 5-ton electric coal car, a 3-ton trailer and a skip hoist for coaling the same boiler houses from lighters. It was installed for use during construction and is rarely used.

Boiler house No. 2 is not coaled directly by above-mentioned equipments, but takes coal from a bunker in boiler house No. 1, by means of a conveyor belt. A bucket elevator and a 4-ton electric coal car are provided for transferring coal either way between the equipments coaling boiler house No. 3 and boiler house No. 1.

For the purpose of unloading coal received by rail a trestle is provided. The gantry crane picks up the coal dumped from cars on this trestle and carries it to boiler house No. 1 or to storage. Coal is received on this trestle when it is impossible to get it by water. The trestle is also used in connection with a bucket elevator for loading ashes into cars which are to be sent out over the Western Maryland Railroad.

In reclaiming coal from storage the aërial cableway bucket picks up the coal and dumps it into a movable hopper on the upper deck of bridge between the coaling towers and boiler house No. 3. The coal then flows by gravity to the cars on the lower deck of the bridge and is carried to the boiler-house bunkers, being weighed in transit.

Coal for the stokers flows by gravity from the concrete bunkers through cylindrical steel chutes to the apron-type chutes which feed the stoker hopper. Until a uniform grade of coal can be procured the use of automatic coal scales on each boiler has been abandoned. They were originally installed for the purpose of checking the evaporation per pound of coal for each boiler. At the present time the quality of the coal in the different bunkers at one time varies so widely that the readings are useless.

The gases from each battery of three boilers are col-

lected by one breeching, and four such breechings discharge into the bottom of one stack. All stacks for boiler house No. 3 are of radial brick and are built on a steel structure 70 ft. (21.3 m.) high. Each stack rises 210 ft. (63.8 m.) above its steel foundation and is 20 ft. (6.1 m.) in inside diameter at the top. This type of stack construction gives the gases a clean sweep into the stack and gives additional floor space in the boiler room and in the basement. In fact, the boiler-feed pumps are installed on the boiler-room floor, and the turbine-driven service and heater pumps are in the basement directly beneath the stacks.

The boiler capacity of the station consists of fifty-two boilers in three boiler houses known as No. 1, No. 2 and No. 3. In boiler house No. 1 there are eight 650-hp. Babcock & Wilcox boilers. Six of these are fired by eight-retort Taylor stokers, and two are equipped with grates for hand firing. In boiler house No. 2 there are four 650-hp. Babcock & Wilcox boilers and four 750-hp. Edge Moor boilers. All are fired by eight-retort Taylor stokers. The main boiler capacity of the station is in boiler house No. 3 and consists of thirty-six 1,047-hp. Edge Moor boilers fired by eleven-retort Taylor stokers. Thirty of the stokers are seventeen-tuyère and six are twenty-two-tuyère. Twelve of the thirty-six stokers are equipped with steam dumps. The thirty-six boilers are arranged in batteries of three each on two single firing aisles and two double firing aisles running perpendicular to the turbine room. The general arrangement may be seen in Fig. 1. Fig. 2 shows a general section through boiler houses 3-A and B. The front header of the last twelve boilers installed is 10 ft. 6 in. (3.2 m.) above the boiler-room floor, giving a combustion chamber of 1.4 cu.ft. (0.038 cu.m.) per rated horsepower. All settings are covered with Armocote bituminous plastic cement to prevent air filtration. Each boiler is equipped with eight Vulcan soot-cleaner elements.

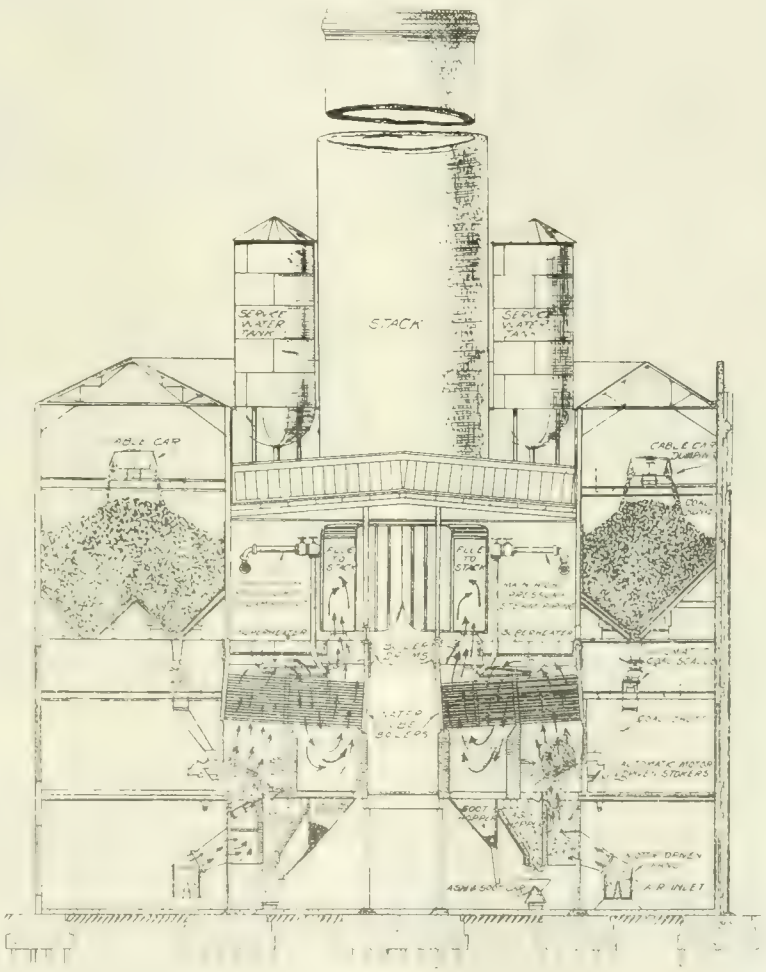


FIG. 2—TYPICAL SECTION THROUGH BOILER HOUSE

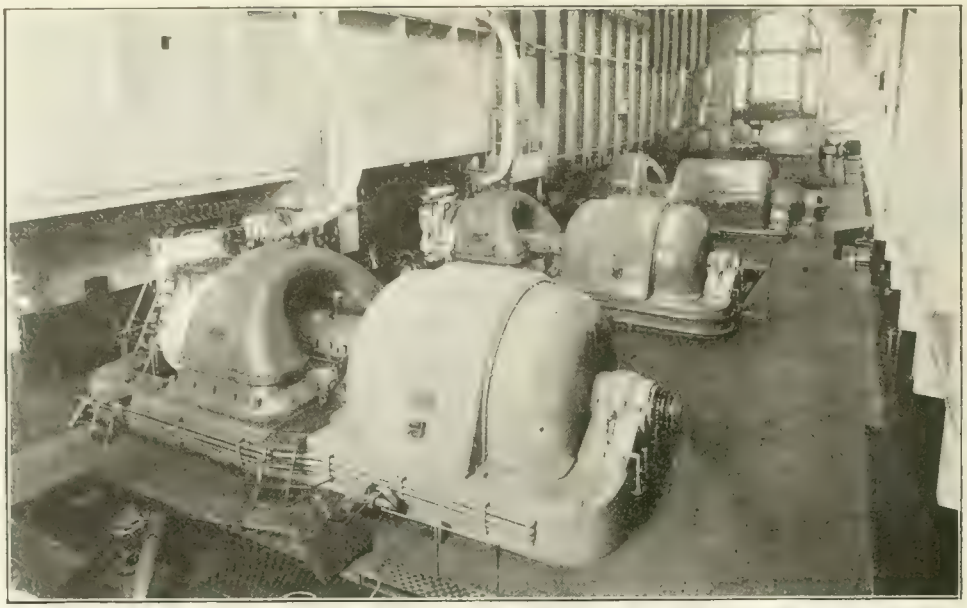
VOLUME OF MAKE-UP WATER IS REDUCED

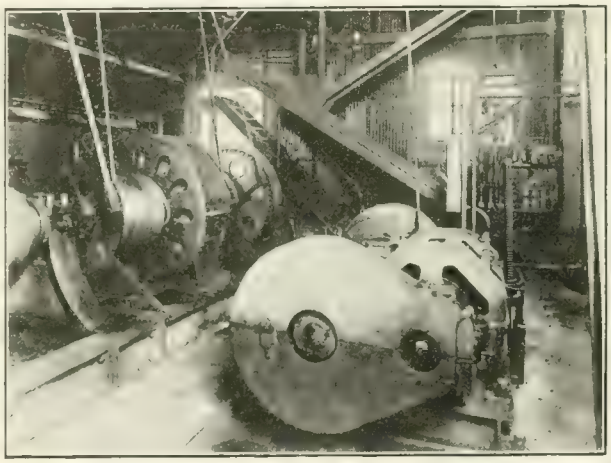
The feed water for the boilers is obtained from three sources—*i.e.*, from the condensate of the surface condensing machines, from the sump tanks in the turbine-room and boiler-house basement, mentioned before, and from the clear-water reservoir. The water from these sources is discharged into feed-water-heater surge tanks and from there is fed to open feed-water heaters. One tank has been installed in connection with each twelve boilers in boiler house No. 3, and all three tanks are connected by means of an equalizing line. Consequently a surge of condensate to any heater tank due to a surge of load on the machine from which it receives condensate water is distributed to all feed-water-heater surge tanks. Furthermore, all make-up water for boiler house No. 3 may be pumped into any one of the three tanks. The overflows from these heater tanks are discharged into the sump tank and pumped back when make-up water is needed. These provisions for conserving the overflow from the heater tanks and the injection water from the labyrinth packing condensers have reduced the demand for raw make-up water to a minimum. Two Cochrane 10,000-hp. feed-water heaters and a V-notch meter are installed in connection with the first twelve boilers in boiler house No. 3, and six 10,000-hp. Hoppes feed-water heaters are installed in connection with the last twenty-four boilers. Three 5,000-hp. Warren Webster feed-water heaters are installed for boilers in boiler houses No. 1 and No. 2. These heaters bring the feed water in contact with the exhaust steam obtained from the auxiliary turbines when necessary, and raise its temperature to 200 deg. or 210 deg. Fahr. (93 deg. to 99 deg. C.) depending upon the feed-water demand. The temperature of the water entering and leaving each battery of heaters is recorded by a Brown double-scale recording thermometer of the gas-bulb type. The water is then metered and piped to the suctions of the centrifugal boiler-feed pumps. The Cochrane V-notch meter measures and records the water from the Cochrane heaters, and Bailey orifice meters record the water delivered by the Hoppes and Warren Webster heaters.

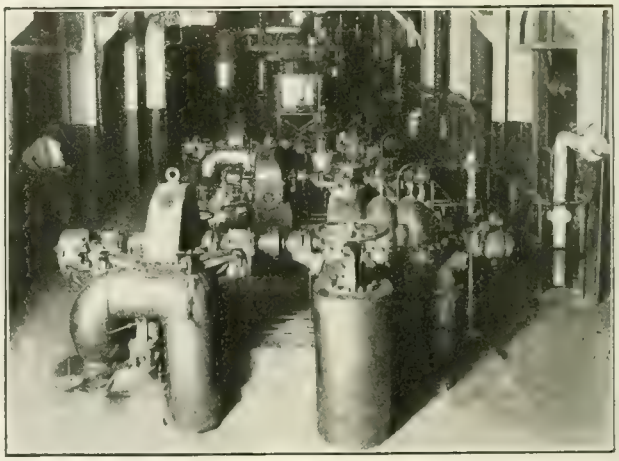
Steam is generated at from 190 lb. to 195 lb. (13.3 kg. to 13.7 kg. per sq.cm.) pressure and superheated by means of Foster superheaters 125 deg. to 150 deg. Fahr. (52 deg. to 66 deg. C.). Steam is received at the turbine throttles at from 7 lb. to 15 lb. (0.5 kg. to 1 kg.) below boiler pressure and at a total temperature of from 475 deg. to 510 deg. Fahr. (246 deg. to 266 deg. C.). The auxiliary turbines operate at an average back pressure of 1 lb. (0.07 kg.).

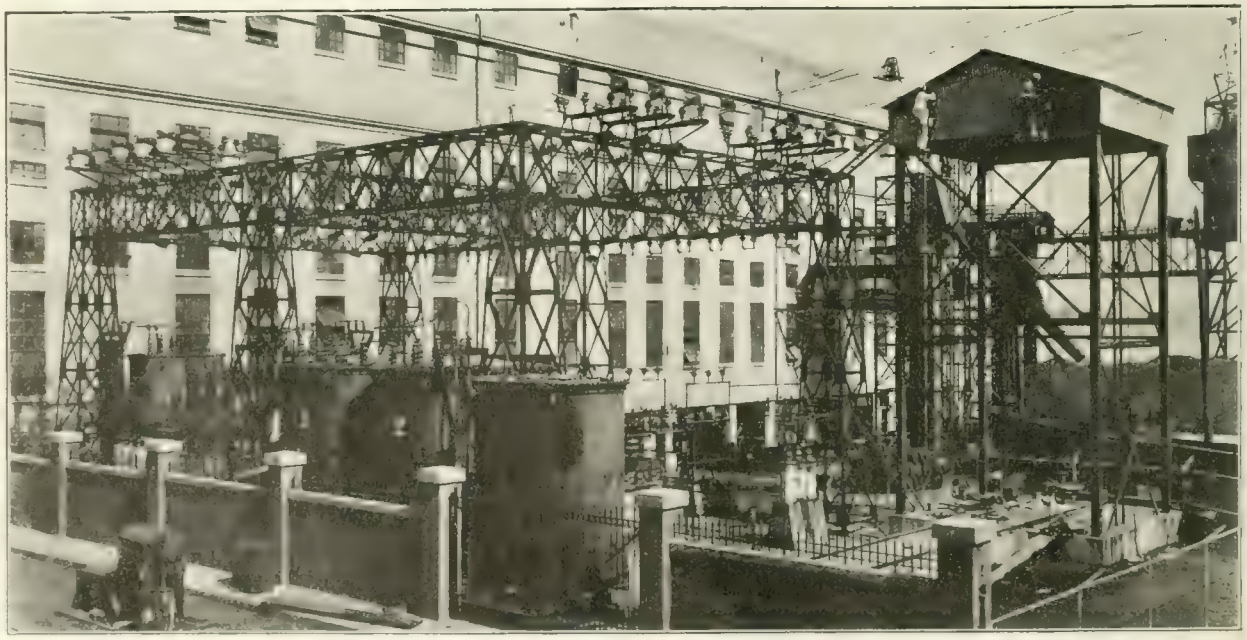
Twenty-four of the thirty-six boilers in boiler house No. 3 are equipped with General Electric steam-flow

Westport Station Helps Prevent Power Shortage in Baltimore









Above—Turbine room, showing one 15,000-kw. generator and five 20,000-kw. units. The flexible hose connection for fire extinction is shown at the base of units in the foreground. Left center—Main hoist and trolley machines for electrically operated coaling tower. Right center—Boiler-feed pumps—two 1,000-gal.-per-min. (3,780-l.) and one 500-gal.-per-min. (1,890-l.), 555-ft. (169-m.) head, turbine-driven pumps are installed for each twelve boilers in boiler house No. 3. Below—Outdoor substation containing 12,600-kva. auto-transformers for 26,000-volt station tie lines.

meters and Precision three-in-one draft gages. The last twelve boilers installed are equipped with Bailey boiler meters, which record steam flow, gas flow and flue-gas temperature and indicate pressure in the wind box and draft over the fuel bed. Different makes of CO_2 recorders and flue-gas recording pyrometers are being tried out at the present time in an endeavor to find satisfactory instruments to record the state of the fires in the furnaces, the tightness of the baffles and the cleanliness of the tubes at all times. A gage and instrument panel is provided in connection with each unit of twelve boilers and on it are the feed-water fluid meter, the recording thermometer, recording the temperature of water entering and leaving the feed-water heaters, and the indicating gages, indicating the pressure on the boiler-feed, service, ash sprinkling and air lines and indicating the water level in the feed-water-heater surge tank and the stand-by service tanks on the roof. The assembling of these gages and instruments on one panel for each twelve boilers enables the station superintendent, engineers and foremen to tell at a glance the condition of all lines.

MONTHLY BOILER-ROOM REPORT—WESTPORT STATION
August, 1920

1.	Total kilowatt-hours generated	18,539,300	
2.	Total water evaporated, lb	311,089,400	
3.	Total coal consumed, lb	37,037,324	8
4.	Station over-all water rate, No. 2 ÷ No. 1, lb	16	78
5.	Coal per kilowatt-hour, No. 3 ÷ No. 1, lb	1	997
6.	Actual evaporation, No. 2 ÷ No. 3, lb	8	399
7	Average steam pressure, lb	185	
8.	Average superheat, deg. Fahr	120	
9.	Average feed-water temperature, deg. Fahr	202	
10.	Factor evaporation	1	128
11	Equivalent evaporation, No. 6 × No. 10, lb	9	484
12.	Per cent moisture	3	43
13.	Per cent volatile	15	84
14.	Per cent fixed carbon	67	78
15.	Per cent ash	12	95
16	B t u. as fired	13,049	
17.	Average number boilers in service	17	
18.	Boiler horsepower-hours in service	6,682,080	
19	Boiler horsepower-hours banked	6,636,430	
20.	Average rating developed, per cent	155	
21.	Average daily load factor, per cent	49	04
22.	Boiler-room operating efficiency, No. 11 × 970.4 ÷ No. 16, per cent	70	68
23	Per cent combustible in ash (by analysis)	32	62

COAL WEIGHED TO BUNKERS

From scow, tons	13,596	11
From lot, tons	2,624	41
Per cent lot coal to total coal burned	16	18

July 31, 1920 (Midnight)

Bunker estimate, lb	10,380,160	
Scow coal unloaded to bunkers, lb	30,455,286	4
Lot coal unloaded to bunkers, lb	5,878,678	4
Total, lb	46,714,124	8

August 31, 1920 (Midnight)

Bunker estimate, lb	9,676,800	
Coal consumed, lb	37,037,324	8
Coal consumed, tons	16,534	52
Coal consumed according to scales, lb	32,809,100	
Per cent shortage to be added	12	88

Considerable trouble has been experienced at Westport with recording instruments owing to the fact that it is practically impossible to keep the clock movements properly regulated. This means, of course, that records are not in phase and that the sequence of events in cases of trouble cannot be accurately ascertained. Because of the fluctuations of the system frequency between 25 cycles and 25½ cycles for the reasons mentioned previously it is impossible to obtain uniform time by driving these recorders by synchronous clocks, such as the Warren synchronous clocks, operating on the station service. Therefore it has been necessary to install a small motor-generator set to supply this constant frequency and run constant-frequency service throughout the station. This constant-frequency generator is driven by means of a direct-current motor and is automatically regulated by a device on the master clock in the operating room, so that the meter clocks can never be more than one minute out of time with the master pendulum clock. It is proposed to change over most of the present spring-clock-driven meters to synchronous-clock drive in the near future.

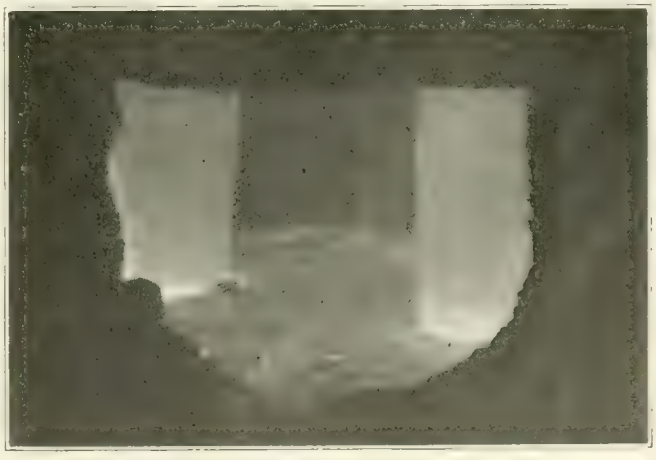
A careful check is kept upon the performance of the station and monthly reports are got out showing in detail the performance for the preceding month. The accompanying table shows a typical boiler-room report. The low load factor is accounted for by the fact that there were ten high-flow days during the month of August. On those days Westport took only peaks and such load as Holtwood was unable to carry.

Illuminated load indicator boards are installed in the firing aisles and in the turbine room. These boards contain a megawattmeter which indicates the load on the station at all times, a clock and a narrow-range pressure gage indicating the pressure on the boiler-room headers. The twelve unit numbers appear on the bottom of the board, and a light is turned on behind its number as a unit is got ready to go on the line. By watching the board the boiler-room engineer is able to follow closely the station load and hold down to a minimum the variation in pressure. The watch engineer by closely observing the megawattmeter can anticipate the call for additional generator capacity.

Electrical features of the station will be discussed in a later issue.

How Does the Inside of a Furnace Look in Operation?

AN UNUSUAL photograph taken by John Boyle of the Boston Edison Company laboratory shows the interior of a 2-ton Heroult furnace in operation with an electrical input of 650 kw. The view was taken at the plant of the Hub Electric Steel Casting Company, South Boston, Mass., with a Graflex camera.

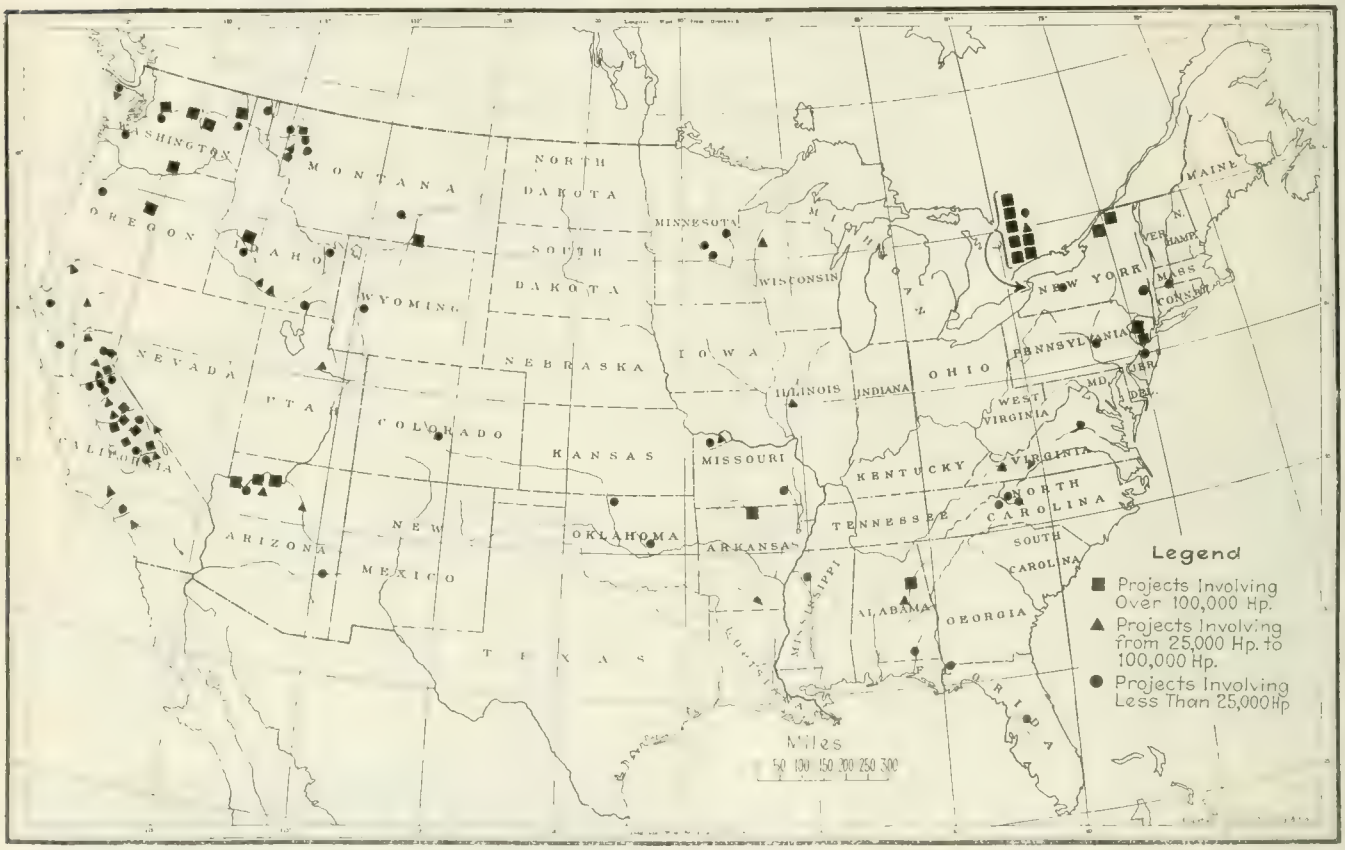


VIEW OF ELECTRIC FURNACE ARC THROUGH DOOR

The exposure was 0.001 second and a U. S. 32 stop was used. The temperature of the metal was about 3,500 deg. Fahr., and that of the carbons at the point of contact about 6,000 deg. Fahr. The lens was brought within about 4 ft. of the furnace door when the exposure was made. A film of molten slag $\frac{1}{16}$-in. thick is shown on the top of the charge. Although the arc is constantly traveling back and forth between the carbons, the view was obtained in the interim between two such passages.

Water-Power Applications Filed in 1920, 13,000,000 Hp.

Federal Power Commission Reports 143 Applications for Preliminary Permits at Close of 1920 Net Total Horsepower Exceeds Present Development by About 4,000,000 Hp. Mountain and Pacific States Lead All Other Sections



LOCATION AND SIZE OF HYDRO-ELECTRIC PROJECTS ON FILE WITH FEDERAL POWER COMMISSION JAN. 1, 1921

WATER-POWER applications on file with the Federal Power Commission on Dec. 30, 1920, numbered 137, totaling 15,073,731 hp., of which 2,172,600 hp. was in conflict, giving a net total of 12,901,131 hp. Six additional applications were filed prior to the close of the month, bringing the total applications on file at the end of the year to 143. The projects for which preliminary permits are requested are fairly well scattered throughout the country, the Mountain and Pacific section leading with 8,883,521 hp., or 69 per cent, and the applications from the Eastern portion of the country totaling 4,017,610 hp., or 31 per cent. The location and size of the various projects on file with the Federal Power Commission on Jan. 1 are indicated on the accompanying map.

Table I gives the distribution among various light and power companies and other applicants. The Southern California Edison Company, with 5,072,500 hp., is the only company with applications totaling more than 1,000,000 hp. The projects contemplated by industrial companies total only a little over 200,000 hp., or less than 2 per cent of the total.

In Table II is given a list of the applications filed with the commission from Nov. 20 to Dec. 30. A list of the applications on file prior to Nov. 20 appeared in the Jan. 1 issue of the ELECTRICAL WORLD.

TABLE I—APPLICANTS FOR FEDERAL POWER PERMITS FILED DURING 1920

	Horsepower
Alabama Power Co., Alabama	150,000
Big Horn Canyon Irrigation & Power Co., Montana	217,550
Coast Valleys Gas & Electric Co., California	400,000
Columbia Valley Power Co., Oregon	378,000
Dixie Power Co., Arkansas	100,000
Idaho Power Co., Idaho	91,000
St. Lawrence Transmission Co., New York	400,000
Louisville Power Corpn., New York	600,000
Lower Niagara River Power & Water Supply Co., New York	250,000
Niagara Falls Power Co., New York	400,000
Niagara Gorge Power Co., New York	300,000
Pit River Power Co., California	92,000
Rocky Mountain Power Co., Montana	272,000
San Joaquin Light & Power Corpn., California	195,000
Sound Power Co., Washington	106,000
Southern California Edison Co., California	5,072,500
Straits Power Co., Washington	95,000
Southern Sierras Power Co., California	106,230
Western States Gas & Electric Co., California	74,500
Wisconsin-Minnesota Light & Power Co., Wisconsin	75,000
Other light and power companies	270,078
Manufacturing companies	201,850
Mining companies	11,300
Irrigation companies	419,000
State and municipal	162,700
Individuals	4,134,023

TABLE II—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS HAVE BEEN FILED WITH THE FEDERAL POWER COMMISSION

Name of Company	Location of Project	Capacity Hp.
ALASKA		
Mount McKinley Gold Placers, Tanana, Alaska	Wonder Lake, McKinley Fork of Kantishna River	500
Frank J. Ballaine, 702 Haight Bldg., Seattle	Kenai River above Skilak Lake	10,000
William R. Rust, 1208 Fidelity Bldg., Tacoma	Cann Creek, Sitka Mining District	250
W. E. Epperson, 555 Colman Bldg., Seattle	Summit, Josephine and Mello Lakes, Prince of Wales Island	10,000
Kantishna Hydraulic Mining Co., Fairbanks, Alaska	McKinley Fork and Wonder Lake, Kantishna Mining District	500
City of Los Angeles, Dept. of Public Service, Los Angeles	Transmission Line in Inyo and Los Angeles Counties, Cal.	
M. D. Lechey, 620 Alaska Bldg., Seattle	Beaver Falls and Lake Mahoney	3,000
ARIZONA		
Southern California Edison Company, Edison Bldg., Los Angeles	Three power developments in Colorado Canyon, Colorado River	3,570,000
James B. Giraud, Care Parsons, Klapp, Brinckerhoff & Douglas, 84 Pine St., New York City	Colorado River near Diamond Creek	60,000
CALIFORNIA		
San Joaquin Light & Power Corpn., Fresno, Cal.	North Fork of Kings River, Fresno County	150,000
F. B. Pattee et al., care E. R. Solinsky, Call Bldg., San Francisco	North Fork of Stanislaus River	3,000
Southern California Edison Company, Edison Bldg., Los Angeles	Headwater of San Joaquin River	800,000
Southern California Edison Co., Edison Bldg., Los Angeles	South Fork of San Joaquin River	425,000
Southern Sierras Power Company, care W. L. Huber, First National Bank Bldg., San Francisco	Owens River	9,430
Southern California Edison Company, Edison Bldg., Los Angeles	San Joaquin River	150,000
City of Los Angeles, Dept. of Public Service	South Fork, Kings River	60,000
City of Los Angeles, Dept. of Public Service	Owens River Gorge	25,000
Southern Sierras Power Co., First National Bank Bldg., San Francisco	North Fork and South Fork of Whitewater River	60,000
Southern Sierras Power Co., First National Bank Bldg., San Francisco	Headwaters San Gabriel River	30,000
Goodwin M. Trent, 317 Sharon Bldg., San Francisco	East Fork Carson River	16,800
City of Los Angeles, Dept. of Public Service	South Fork of Kern River	27,500
M. I. Crocker et al., 350 Post St., San Francisco	North Fork Mokelumne River	38,400
COLORADO		
Grace S. Eyre, Buena Vista, Cal.	Chalk Creek, Chaffee County	700
IDAHO		
Mrs. N. P. Bean, care Cotton & Wilson, Post Bldg., Idaho Falls, Idaho	Warm River, Fremont County.	1,840
John R. Love, et al., care J. D. Fisher, Colorado Springs, Col.	Salmon River, Custer County	400
MONTANA		
Flathead Valley Electric Company, Old National Bank Bldg., Spokane, Wash.	Flathead River at Lake Outlet, Flathead County	650
Butte-Jardine Metals Mines Company, Butte, Mont.	Transmission Line	
J. B. Leignton, Miles City, Mont.	Yellowstone River at Buffalo Rapids	15,000
NEVADA		
Spanish Belt Silver Mining Co., 629 Nicholas Bldg., Toledo, Ohio	Transmission line	
NORTH CAROLINA		
Catawba Valley Light & Power Co., care H. L. Millner, Morganton, N. C.	Wilson Creek, Caldwell County.	2,500
OREGON		
Portland Railway, Light & Power Co., Portland	Oak Grove on Clackamas River.	22,000
UTAH		
Great Basin Power Co., Walker Bank Bldg., Salt Lake City	North Fork Duchesne River.	25,000
VIRGINIA		
W. H. H. Stineman et al., Gunther Bldg., Baltimore	Plummers Island, Potomac River, D. C., Va. and Md.	50,000
WASHINGTON		
City of Everett	Sultan River to Lake Chaplain	10,000
Lloyd E. Gandy, 803 Sherwood Bldg., Spokane	Spokane River at Fort George, H. Wright	10,000
WISCONSIN		
Wisconsin-Minnesota Light & Power Co., 1107 Grand Rapids Savings Bldg., Grand Rapids, Mich.	Forks of Chippewa River, Sawyer County	75,000
WYOMING		
Home Colony, Cody, Wyo.	Kitty Creek, Park County	10

The Projected Development at Priest Rapids

THE contemplated hydro-electric development at Priest Rapids on the Columbia River, in eastern Washington, made possible at last by the federal water-power law, will involve a dam more than 1½ miles in length—or longer than the Assouan Dam in Egypt, which is now the longest in the world. The dam will be 90 ft. high and create a lake 1½ miles wide and 9 miles long. This dam will be 14 miles below Beverly, where the Chicago, Milwaukee & St. Paul Railway crosses the Columbia. It has been ascertained by engineering investigations that 350,000 primary, all-the-year-round horsepower can be developed at this site and that an additional 300,000 secondary horsepower may be provided during the high-water period from April to October that may be utilized for pumping water to irrigate the bench lands of the Columbia Valley above and below the rapids.

"The question which mostly concerns my associates and myself," Henry J. Pierce, president of the Washington Irrigation & Development Company and chief promoter of the project, recently observed, as quoted in the *Puget Sound Electric Journal*, "is, 'Can uses be found for the 350,000 hp. that can be developed at Priest Rapids?' At present there is no market for power in that almost uninhabited region. Since the power bill passed I have talked with many of those whom I thought might use Priest Rapids power and have had considerable encouragement in the belief that industries may be established at the rapids which will utilize the power project together with natural resources that exist in this and adjoining states.

"It is the ambition of my associates and myself," Mr. Pierce continued, "to build at Priest Rapids in connection with the hydro-electric plant a manufacturing town, a Niagara Falls of the Northwest. It may be stated without exaggeration that probably $150,000,000 will be expended in the portion of the Columbia River Valley tributary to Priest Rapids during the next six years in the construction of the great hydro-electric plant, manufacturing industries and the town which will be built there. It is our hope that in this way that portion of the Columbia Valley will be developed and filled with an agricultural and industrial population."

Building 280,000-Kw. Plant in New York City

Generator Room Adjacent to River to Eliminate Suction Tunnels—Four Units of 35,000 Kw. Each to Be Installed at Outset

THE new Hell Gate station of The United Electric Light & Power Company, now under construction at 134th Street and the East River, borough of the Bronx, New York City, will be, when completed, one of the largest generating stations in the world, with a rated capacity of 280,000 kw. This station will be unique in many respects. The turbine room will be parallel to and adjacent to the river. With this arrangement it will be possible to eliminate the suction tunnel, the individual suction pipes for the condenser pumps being carried through the east foundation wall into the screen basins back of the bulkhead line. The boiler house will be next to the turbine room, between the electrical galleries and the turbine room, and will be separated from the electrical galleries by a narrow passage.

The initial installation of generating equipment will consist of two 35,000-kw., 25-cycle, three-phase, 11,400-volt turbo generators and two 35,000-kw., 60-cycle, three-phase, 13,200-volt turbo-generators. The steam end of the 25-cycle units will be of single-cylinder impulse type, while the 60-cycle units will have tandem compound reaction turbines.

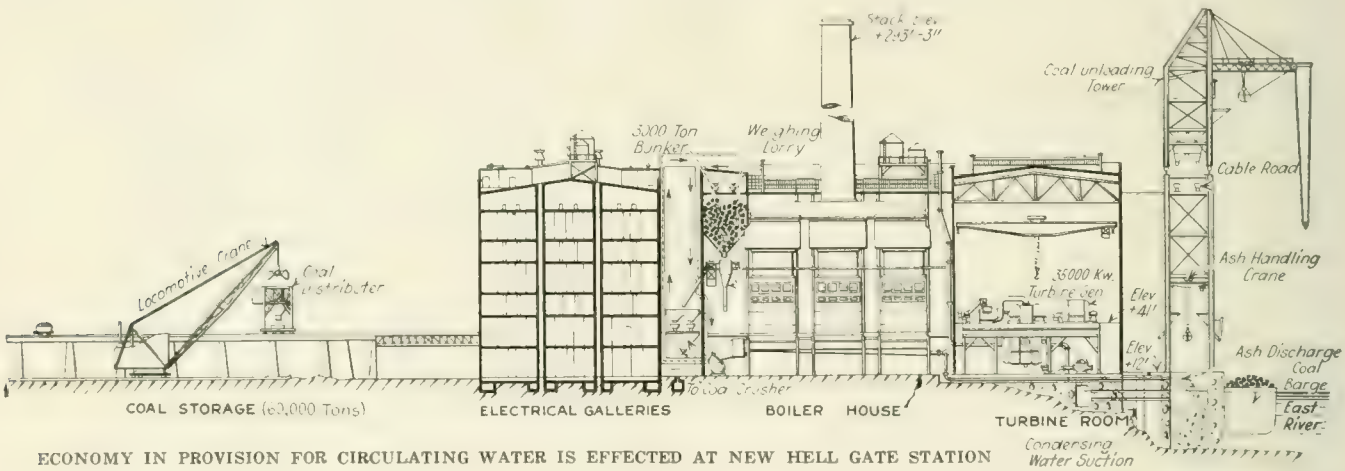
Coal will be unloaded from barges or oceangoing vessels by means of three traveling towers installed on a trestle adjoining the bulkhead. Each tower will have a capacity of 250 tons of coal per hour and will be equipped with coal crushers. A double cable road will be installed for transporting the coal to a 3,000-ton bunker at the west side of the boiler house. The coal for immediate use will be carried from this point to the boilers in weigh lorries. If a surplus of coal arrives, it will be transferred to a low-level cable road which will discharge into a 60,000-ton "storage" on the adjoining property.

The boiler house will accommodate twenty-four 1,890-hp. water-tube boilers. Twelve boiler units are to be installed with the first four turbines. Each boiler unit will be equipped with two fourteen-retort gravity underfeed stokers and clinker grinders. The ashes from the boilers will be removed from the building by a hydraulic flume.

The condensers for each unit will have 50,000 sq.ft. (4,600 sq.m.) of surface, made up of approximately 10,040 tubes, each 1 in. (2.54 cm.) in outside diameter and 19 ft. 3 in. (5.87 m.) long. The condensers for the 25-cycle units will be rigidly attached to the turbine exhaust and be supported on springs. The condensers for the 60-cycle units will be attached to the turbine exhaust by expansion joints and carried by straps from turbine foundation. The water boxes on each condenser will be split vertically so that one side can be cleaned without shutting down the unit.

The capacity of each of the two circulating pumps for each condenser will be 35,000 gallons per minute, or 70,000 gallons per minute total (132,500 l. or 265,000 l.). Each of the two hot-well pumps per unit will handle the condensate from the unit at full load. The condensers on the 25-cycle units will be equipped with steam-jet air pumps, while the other units will have centrifugal hydraulic air pumps. A reciprocating air pump will be connected to all condensers for test purposes.

Two 2,000-kw. turbo-alternators will be installed to supply one-half of the auxiliary power for the initial installation, the rest of the power being supplied from the main bus. Practically all the auxiliaries will be motor-driven, so arranged on the main and house buses that interruptions on either will not shut down a main unit.



ECONOMY IN PROVISION FOR CIRCULATING WATER IS EFFECTED AT NEW HELL GATE STATION

For handling heavy parts in the turbine room one 110-ton and one 90-ton electric traveling crane will be installed. The 90-ton crane will have a 50-ton auxiliary hoist on a separate carriage.

This preliminary information is offered through the kindness of Frank W. Smith, vice-president and general manager of The United Electric Light & Power Company. A more complete article concerning the features of the Hell Gate station will appear in a future issue of the ELECTRICAL WORLD when the construction work has reached a point to permit full discussion and illustration.

Recent Developments in Electrical Apparatus

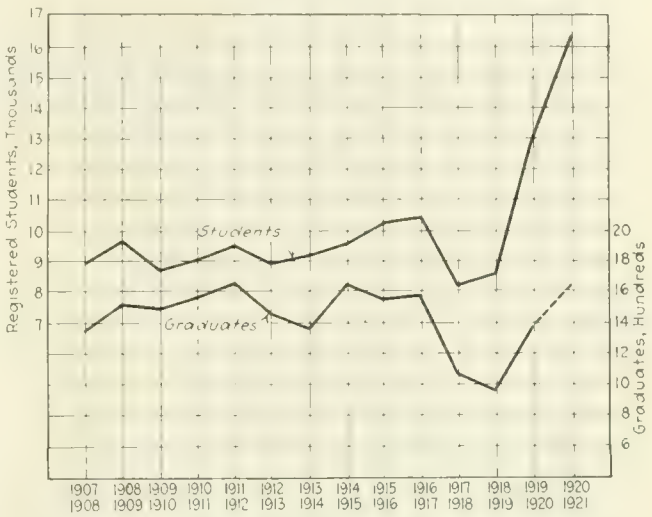
SOME of the important developments in electrical apparatus in 1920 were shown by pictures on page 18 of the Jan. 1 issue of the ELECTRICAL WORLD. Unfortunately credit to M. M. Samuels, Electrical Division, J. G. White Engineering Corporation, for assistance in securing these illustrations was omitted on that page. The developments shown were referred to by Mr. Samuels in his article entitled, "Rating and Reliability of Electrical Apparatus Increasing," page 23, same issue.

Electrical Engineering Students Increase

Survey Indicates a Total of 16,248 Enrolled in Present College Year, a Large Gain Over Last Year — Graduates in June Will Number More Than 1,600 — Salary Increases of Teachers Since 1915 Average About 35 per Cent

WARS play havoc with undergraduate enrollment in colleges. This is especially true with the technical colleges, because the highly scientific development of modern warfare calls for young men of superior education in technical matters. During the period in which America took part in the world war several of the smaller colleges closed their engineering courses entirely for lack of students, and the technical departments of all colleges and universities, except in those cases where special government training courses were conducted, were greatly depleted during the sessions of 1917-1918 and the first session of 1918-1919.

In an endeavor to ascertain the effect of the war on the student bodies of electrical engineering colleges, and also to bring the census of these colleges up to date, the ELECTRICAL WORLD has undertaken a survey covering the college years 1915-1916 to 1920-1921 inclusive. Satisfactory returns were received from about 72 per cent of the colleges and universities offering electrical engineering courses, including practically all of the larger schools. From the data received the total number of students and graduates has been estimated for each college year. To this tabulation have been added tabulations made by the ELECTRICAL WORLD prior to 1915.



FIFTEEN YEARS' TOTALS OF ELECTRICAL ENGINEERING STUDENTS AND GRADUATES

In order that a more comprehensive analysis may be made of the situation the electrical engineering colleges of the country have been divided into three arbitrary classes or groups, as follows:

Class I—Colleges whose electrical courses have the highest standing, whose teaching equipment is most complete, and whose degree is recognized as conferring a certain prestige on the graduate.

Class II—All other colleges whose electrical engineering courses require all of the student's time as distinct from those where the student may carry on some regular occupation at the same time.

Class III—Those colleges having an organized course in electrical engineering in which the instruction is quite elementary from a professional standpoint and as a rule is arranged for evening class work.

Table I gives the post-graduates, undergraduates and graduates of the electrical engineering colleges for the college years 1914-1915 to 1920-1921 inclusive. The number of graduates in 1921 has been based on the percentage of seniors graduated in previous years. The student bodies of the colleges as a whole were reduced by about 21.4 per cent in 1917-1918 as a result of the war, but showed a slight recovery during the year 1918-1919. This increase in 1918-1919 was not indicated in the Class III colleges, probably owing to the fact that the students in this class of colleges were not pursuing a regular electrical engineering course looking to a degree and were not, therefore, led to an immediate resumption of study upon their discharge from the army and navy. The increase in number of students during the past and present college year has, however, exceeded all records. The total increase of the present year over last is estimated at 3,383. The number of students at present pursuing an electrical engineering course is 16,248, which is almost exactly twice the enrollment during the college year 1917-1918.

TABLE I—POST-GRADUATES, UNDERGRADUATES AND GRADUATES OF ELECTRICAL ENGINEERING COLLEGES 1914 TO 1921

College Year	Freshmen	Sophomores	Juniors	Seniors	Post-Graduates	Total Students	Graduates	Total Graduates to End of Year
CLASS I COLLEGES								
1914–1915	1,140	819	714	627	98	3,398	667	10,212
1915–1916	1,144	902	722	576	133	3,477	535	10,747
1916–1917	1,050	829	723	587	136	3,325	569	11,316
1917–1918	828	653	568	389	90	2,528	389	11,705
1918–1919	1,047	827	718	257	59	2,908	295	12,000
1919–1920	1,460	1,152	1,003	455	104	4,174	463	12,463
1920–1921	1,887	1,490	1,295	518	119	5,309	*532	12,995
CLASS II COLLEGES								
1914–1915	1,846	1,200	881	689	89	4,705	679	8,020
1915–1916	1,871	1,297	926	703	68	4,865	683	8,703
1916–1917	1,920	1,332	953	696	67	4,968	697	9,400
1917–1918	1,505	1,042	746	433	42	3,768	483	9,883
1918–1919	1,644	1,140	814	388	38	4,024	426	10,309
1919–1920	2,225	1,550	1,113	712	70	5,670	636	10,945
1920–1921	2,863	1,985	1,420	928	92	7,288	*834	11,779
CLASS III COLLEGES								
1914–1915	581	360	283	240	2	1,466	284	2,918
1915–1916	703	405	442	327	12	1,889	314	3,232
1916–1917	748	517	470	327	12	2,074	302	3,534
1917–1918	654	452	409	327	12	1,854	183	3,717
1918–1919	644	443	404	118	4	1,613	238	3,955
1919–1920	1,182	816	742	272	9	3,021	262	4,217
1920–1921	1,454	1,004	912	272	9	3,651	*262	4,479
SUMMARY OF ALL COLLEGES								
1914–1915	3,567	2,379	1,878	1,556	189	9,569	1,630	21,150
1915–1916	3,718	2,604	2,090	1,606	213	10,231	1,532	22,147
1916–1917	3,718	2,678	2,146	1,610	215	10,367	1,568	24,250
1917–1918	2,987	2,147	1,723	1,149	144	8,150	1,055	25,305
1918–1919	3,335	2,410	1,936	763	101	8,545	959	26,264
1919–1920	4,867	3,518	2,858	1,439	183	12,865	1,361	27,605
1920–1921	6,204	4,479	3,627	1,718	220	16,248	*1,627	*29,253

*Estimate from previous years.

The total number of the electrical students who will be graduated in June, 1921, is estimated at 1,627. This is about 266 more graduates than last June, but is three less than the number of graduates in June, 1915, which was the high point in number of electrical graduates. A study of the three classes of colleges indicates that in June, 1921, about 33 per cent of the budding electrical engineers will graduate from Class I colleges, about 51 per cent from Class II colleges and about 16 per cent from Class III colleges.

A study has also been made of the distribution of the average electrical engineering graduation class by industries. Such a distribution, of course, depends a great deal upon the location of the college, a proximity to a large electrical manufacturing center tending to induce a large number of graduates to enter the manufacturing side of the industry. The data given in Table III are average figures for two classes of colleges. Sufficient data were not obtained from Class III schools to warrant inclusion in this table.

Table III also gives some interesting information on the percentage of students entering other lines of work than electrical engineering upon graduation or a year or so after graduation. These figures indicate that more than 20 per cent of the electrical engineering graduates eventually drift to other professions or lines of endeavor. This condition is not necessarily a reflection on the electrical engineering profession, but on the contrary is a testimony to the broadness of the electrical graduate and his fitness by education to succeed in other lines of human activity.

Some very pertinent facts on teachers' salaries are given in Table IV. Increase in college salaries has been discussed quite extensively during the past year in connection with the raising of endowment funds, and the figures shown in this table emphasize the low salaries that are paid to the average electrical experts in our colleges.

TABLE II—STUDENTS AND GRADUATES OF ELECTRICAL ENGINEERING COLLEGES, 1907 TO 1921

College Year	1907-1908	1908-1909	1909-1910	1910-1911	1911-1912	1912-1913	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1919-1920	1920-1921
Students	8,929	9,651	8,670	9,041	9,515	8,921	9,143	9,569	10,231	10,367	8,150	8,545	12,865	16,248
Graduates.	1,358	1,501	1,473	1,545	1,641	1,442	1,366	1,630	1,532	1,568	1,055	959	1,361	*1,627

*Estimated from previous years.

TABLE III—DISTRIBUTION OF THE AVERAGE ELECTRICAL ENGINEERING GRADUATION CLASS BY INDUSTRIES

Class of College	Distribution of Students Upon Graduation by Industries (Per Cent): Manufacturing	Central Station	Telephone and Telegraph	Teaching	Miscellaneous	Students Entering Other Lines of Work Than Electrical Engineering: Upon Graduation (Per Cent)	One Year After Graduation (Per Cent)
Class I.....	28 5	20 5	22 0	4 0	25 0	10 0	10.0
Class II...	39 0	23 0	20 0	3 0	15 0	17 5	8 5
Class III..	Insufficient data						

TABLE IV—COMPARISONS OF AVERAGE SALARIES OF TEACHERS IN ELECTRICAL ENGINEERING COLLEGES—1915 AND 1920

Class of College	Professors 1915-1916	Professors 1920-1921	Associate Professors 1915-1916	Associate Professors 1920-1921	Assistant Professors 1915-1916	Assistant Professors 1920-1921	Instructors 1915-1916	Instructors 1920-1921
Class I....	$3,340	$4,630	$2,550	$3,305	$1,861	$2,790	$1,279	$1,828
Class II...	2,574	3,410	1,900	2,740	1,590	2,310	1,240	1,645
Class III...	2,605	3,590	2,070	2,490	1,230	1,910	895	1,640

Long-Distance Radio Telephony Now Practicable

Conversation by Combined Radio and Wire Telephony —Trend Toward Electron Tubes and High-Frequency Alternators—Wire-Directed Radio

By J. H. DELLINGER
Chief Radio Research Section, Bureau of Standards

THE past year has witnessed steady progress and increasing public interest in radio telephony. Voice transmission by radio waves, for distances of a few hundred miles, has advanced from the experimental stage to established commercial practice. All difficulties in the extension of the commercial range to a few thousand miles in the immediate future have been surmounted. The quality of transmitted speech or music is as perfect as with ordinary wire telephony. There has been no single feat surpassing the experiment which startled the world in 1915, when radio telephony was carried on from Arlington over a distance of 5,000 miles (8,000 km.), but the possibilities then shown have been steadily brought into being.

On Aug. 21 last year the first message was sent out from the newly completed Lafayette radio station, near Bordeaux, France.* This message (telegraphic, not telephonic) was heard in all parts of the world. The station is the most powerful yet built, using 1,000 kw. and having eight 820-ft. (250-m.) towers. It was begun by the United States military forces and has been taken over by France.

A sharp distinction no longer exists between radio and ordinary wire telephony. The methods and the uses of the two have become partly merged, and each is used to supplement the other. Radio telephony is sometimes carried on with the aid of wires which guide the waves. More than that, a particular conversation may be carried on with part of the distance covered by ordinary wire telephony and part by radio waves without guiding wires. On Oct. 21 the American Telephone & Telegraph Company gave such a demonstration to the delegates to the International Communication Conference. The delegates listened to conversation both ways between a ship in the Atlantic Ocean and an island in the Pacific, the speech being caried by radio from the ship to shore, by ordinary wire transmission across the continent, and by radio from the California shore to the island.

Concerts and lectures are being sent broadcast by the radiophone. The Western Electric Company, the Bureau of Standards, many amateurs and others have sent out music at scheduled times. This music has been heard all over the Eastern States and even in Europe. An interesting feature is that the sound-wave trace on a phonograph record can easily be converted directly into radio waves, so that the music is heard at the distant receiving stations while there is no sound at the transmitting station.

*See ELECTRICAL WORLD, Aug. 28, 1920, page 445.

There has been far-reaching progress on all of the essential components of a radio system. These essentials are devices for producing, modulating and rectifying high-frequency electric power and means for moving the high-frequency power through space. The latter includes antennæ and guiding conductors. The purpose of using high frequencies is to obtain power in a form that can be radiated—radiation is the soul of the radio method.

For the generation of high-frequency power the trend is toward alternators and electron tubes. The former are used for high-power work, the latter for low power, and either for medium power. Alexanderson alternators of 200 kw. are in regular use, producing power at 25,000 cycles per second. The problem of speed control within one-tenth of 1 per cent has been solved. Generating sets using electron tubes are available in power up to 15 kw. The input power of such sets is usually alternating current, which is transformed and rectified to furnish the high direct voltage needed for the plate circuit of the electron tubes. Systems for smoothing out the ripples caused by the supply current have been developed.

How Electron Tubes Are Revolutionizing the Art

The influence of the electron tube on radio telephony has been compared to the influence of the gasoline engine on aviation. The tube performs all the essential functions of generating and modulating the high-frequency power (at the transmitting station) and rectifying the received power (at the receiving station). Besides all this it is used as an amplifier to facilitate each one of these processes. Thus the trend of use of the tube as a generator is the generation of small power of the frequency and character desired and then its amplification by powerful amplifier tubes. Again, the modulation of the high-frequency current according to the voice wave form is accomplished with the aid of an amplifying tube, so that there is no longer any use whatever for the special high-power microphones of the early days of radio telephony.

The electron tube has unfortunately not been extensively available to the public because of patent litigation. It has recently been reported that the principal companies producing tubes have reached a patent agreement. This will probably result in greatly increased use of small-power and medium-power radio-telephone equipment.

The development of antennæ is away from the ordinary elevated type, at least for special purposes. Where the elevated type is retained, as in high-power transmission, the tendency is to use a counterpoise instead of the ground, thus approaching a more nearly perfect condenser antenna. A noteworthy improvement in antenna efficiency has been obtained by multiple-tuned connections between the upper and lower conductor systems. The tendency to build very large antennæ has been arrested by the extraordinary advances in sensitiveness of receiving apparatus. Coil antennæ are much used in receiving because of their utility as direction finders and interference preventers.

Directive radio—sending the waves only in the direction desired—is being attained by the use of conductors to guide the waves. This not only gives a large measure of secrecy to radio messages but also greatly reduces the power required for a given distance. The method entails even less interference than ordinary low-frequency telephony; for instance, the guiding conductors can be power wires carrying very large low-frequency currents, or telephone wires which are carrying independent conversation by the ordinary means. In fact, any existing wires will serve as guides for the radio waves. This is the basis of multiplex telephony, by which five or more conversations are carried simultaneously on one pair of wires.

A number of systems have been devised and put into use for overcoming interference of one radio station with another. These devices make use of the directional properties of the waves, phase opposition, resonance and amplifiers. They are so successful that they even protect the receiving apparatus from the effect of the transmitting apparatus at the same station. This makes possible duplex or unrestricted two-way telephony.

Present Problems Requiring Solution

Atmospheric electrical disturbances, or "strays," cause noises in the receiving telephone. Progress is being made in their elimination, partly as a result of recognizing that they come largely from a particular direction. Special antennæ and circuits for balancing them out are being developed.

When frequencies over 1,000,000 are used for the carrier wave the received current fluctuates rapidly in intensity. This presents a problem for which no solution is in sight as yet, but the nature and causes of the effects are being studied.

It is desirable that a way be found to make secret such communication as must be carried on without wires. One method which holds promise causes the speech frquencies to modulate the carrier frequency at entirely different frequencies, which are converted back to the speech frequencies at the receiving station.

A simple and reliable calling signal is needed, so that it shall not be necessary for an operator to be continuously on duty listening. Methods have been devised for this, but have not yet been developed sufficiently to be employed in the usual radio station.

It is desirable to extend the number of conversations which can be carried on simultaneously in a given system by finding the maximum number of carrier frequencies that can be used without disturbing harmonics, beats and other interference.

Wire-Directed Radio Coming Into Use

In the use of radio waves guided by wires ideal duplexing is sought—that is, the use of the same source of power by both transmitting and receiving apparatus, with power consumed only during speech. The use of submarine cables to guide the waves is also a matter of which the possibilities need to be investigated.

Reliable telephony can be carried on by means of high-frequency carrier waves over as great distances as ordinary wire telephony. Commercial telephony across the Atlantic is said to be near at hand and is certainly not held back by technical limitations.

The carrier waves may either be radiated into space or guided along conductors. The latter method seems bound to become more common, since trolley wires, power wires or any other sort may be used to guide the waves. Thus a telephone becomes possible for every building into which electric light wires run. Furthermore, carrier-wave telephony may be linked with or connected to ordinary wire telephony. Thus it seems unquestionable that the radio method will more and more supplement the regular telephone system.

Assuring Continuous Production

Standards of Inspection Adopted in Several Large Plants in Connection with Successful Maintenance Work Based on Long Experience Under Industrial Conditions

ALTHOUGH the methods of inspection work which are warranted in given plants are exceedingly variable and thus difficult to set forth in terms of standards, several well-defined features have resulted from a study of existing methods in actual industrial practice. One of these may be set forth at the outset as a fundamental basis for what follows, namely, that whereas the frequency of inspection is subject to wide variations because of extreme differences in the duty cycles and in the general operating characteristics, both of the machinery driven and of the driving equipment itself, the rational basis of inspection work is to standardize it at such a point, both as regards frequency and extent, that it may be the means of continuity of service or, conversely, that it may prevent interruptions to service.

Therefore, although some apparatus by its very nature calls for inspection possibly as often as once an hour, while for other equipment the best interests of production are served by an inspection of once a week, those responsible for the successful operation of the electrical equipment should determine for themselves what standards are warranted on a basis of individual classes of apparatus throughout the plant. This aspect of the problem makes evident the importance of a rather careful interpretation of the following specific examples in terms of the requirements of any individual plant, whereas it is equally evident that concrete instances as set forth in the following paragraphs may contain suggestions which will prove helpful to those whose problems are similar to the ones cited.

Importance of Inspection Schedules

The basis for any well-organized and successfully conducted inspection work is the schedule which is used as a guide for the inspection staff, and no effective schedule can well be planned by an industrial factory electrical department without a proper appreciation of the importance of this subdivision of the upkeep work. To illustrate how the problem has been handled in one large plant, it is of interest to note that an inspection schedule has been so arranged that the night electrician draws out and replenishes the oil in the shop motors and makes certain generalized observations on each motor in the plant once every six months. To this general inspection there is added the more frequent inspection on the part of the electrical department foreman of all motors once each week, usually on a Monday, for oiling, and he is also made responsible for the external cleanliness of all motor equipment.

It is of particular importance to note the special care given in this plant to the making of a check by the electrical department of the bearings of every new motor received at the time of its purchase, as a means for ascertaining whether or not repair linings are in stock of a size adapted to the new motor. This systematic attention to the important renewal parts of new equipment makes it possible to order immediately any parts not available in stock and thus to insure an adequacy of renewal and repair parts for every motor in the plant. This plant takes the attitude that a stock of bearings to fit every motor in operation is one of the best guarantees of continuity of service that can be realized through its inspection department.

Interrelation of Inspection and Maintenance

It is clearly evident that successful maintenance is closely related to the inspection system. In fact, systematic inspection work may be classed as a fundamental starting point for any well-ordered maintenance department. While this correlation of inspection and maintenance work makes it difficult to draw a distinct line between the two divisions of the upkeep work, it is evident that a certain degree of inspection is essential for successful maintenance, and on this basis various industries have developed report charts for the repair work of the force assinged to electrical apparatus as an indication of the degree to which the inspection work is being carried out.

As an illustration of such report charts, one plant has found it desirable to utilize a daily repair form for electrical repair work, such as is shown herewith, the stipulation that each daily report is to be turned in at the superintendent's office at 8 a.m., Sundays excepted, and each given report is to cover twenty-four hours ending at 6 a.m. These reports, in addition to listing the apparatus, contain the items of time of shutdown and time of start just before and just after the repair work is completed, together with the causes of the trouble and the remedy for it.

Such reports on repair work furnish a fairly complete indication of the physical status of the electrical equipment in any given department, and it follows that if the foreman of any one section of the plant is especially careful in his inspection work, the repairs for that department will tend to be less than for other departments where the inspection work may not be conducted along such careful lines, the report charts thus furnishing an indication indirectly of the degree of care with which the inspection work is being followed up.

Another type of report form which is in use in one of the larger plants is that which is especially adapted to motor armatures, as shown on page 137. The purpose of such a report is largely that of indicating just which motors in any particular section are giving trouble, and this information is then further useful because it serves as a basis for a determination of which motors throughout the plant should be replaced either by motors of a more modern design or by types and sizes better suited to the work and to the surrounding conditions.

While it is obvious that careful repair work is of considerable importance to production in any plant, it is well to point to the conclusions which have been formed under actual conditions after years of experience. These include the wisdom of intrusting such repair work on motors and control apparatus to high-

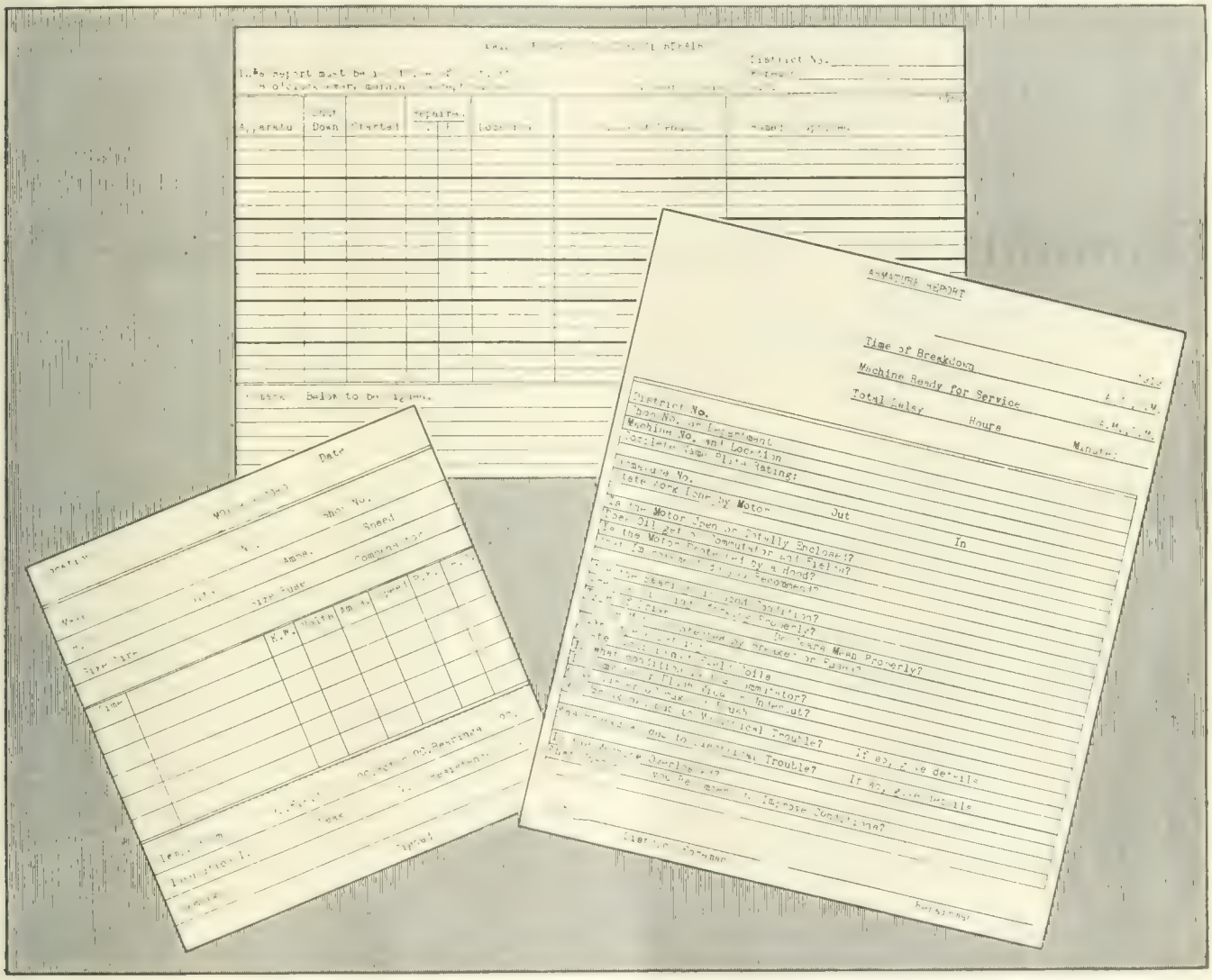
grade electricians and of seeing that the work is done not so much with the idea of keeping down the first cost of the repairs as in a way to comply with all insurance rules and so that by the excellence of the repair work the accompanying cost may be distributed over a relatively long period of successful operation.

In one notable example of a plant where a high standard has been maintained in the electrical repair work for years it is felt that when any equipment is installed the electrical department employees must be made to understand that any defect which appears later must be made good. The ideal is continually kept before the force that only by first-class workmanship on all motor and control repairs can the plant be assured continuity of operation. In one industrial organization it is looked upon as good practice to insist that all electrical work be done either by the plant electrical department itself or by outside electricians under the direct supervision of the works electrical department, to which the outside help is responsible.

With a high grade of maintenance work the needs for emergency and temporary repair work become correspondingly small. It has been found that in the progressive plant where effort is made to keep on hand spare parts for every individual motor in the factory there is little or no need of temporary makeshifts in case of serious breakdowns because of the immediate availability of the necessary reserve parts on which to base effective repairs. It is apparent that under such circumstances the emergency question is not nearly so serious as in plants where no systematic forethought is given to the factors intimately concerned with successful maintenance work.

However, to facilitate the repairs on unexpected breakdowns, one plant provides its electrical department with emergency kits. These consist merely of a box, a cover and a suitable handle with repair equipment which includes a lead hammer, a machinist's hammer, an ordinary wrench, a socket wrench, a fine file, emery cloth, waste and an oil can. The repair equipment in this particular instance is owned by the company and charged out to the electrical department.

Other equipment to facilitate repairs in this plant includes a Franklin hoist for convenience and speed in moving motors and several pairs of flexible auto cable, 6 ft. (1.8 m.) in length, at each end of which a 100-amp. bulldog clamp is attached. These cables are found useful where there is need for jumping a defective switch



SOME FORM OF RECORD SYSTEM IS ESSENTIAL TO PROPER INSPECTION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

Top.—Daily report form for electrical repair work for giving an indication of the physical condition of the motor and control equipment in any given department. Right—Armature report form for listing data on motors as an index to their adaptability to the apparatus driven. Left—Motor test record form for listing the data obtained with a portable test set.

or compensator and, in fact, for practically any kind of an emergency connection. The two legs of these cable lengths are red and black respectively for ready identification.

An accurate method of cost recording for factory maintenance work is looked upon as a fairly established part of the well-organized plant, because such records may serve as an index to the variations of the work from month to month and also as a basis of comparison with other plants where the nature of the operations and the motor and control equipment are similar. While the matter of systematic maintenance cost records for electrical repair work may be classed as of the same general order of importance as similar records for other branches of the factory maintenance work, various plants compile such records in different ways.

A typical scheme is therefore of interest as suggestive of a method which is available for such recording. Here repair jobs are charged on the employees' daily time cards, these cards also containing the department number and a key letter which indicates "repair" work. A small job of new work is charged in exactly the same way except that a different key letter is employed to indicate "new" work.

The stock required for repair work is kept in the electrical department storeroom, a card index file being employed as the means for keeping tab on the number and the cost of the various repair parts on hand. Upon the completion of a repair job the stock is charged off against the job directly on the card.

A special form of ticket is issued for a large job, and the repairman's time and the stock used are charged against an assigned number and are entered on the ticket, which is sent to the office upon the completion of the work, with the signature of the head of the department.

Economics of Electrical Distribution—II*

Accurate Determination of Cost of Construction and Cost of Energy Is Basis of Economical Design — Method of Keeping Detailed and Assembled Costs—What Annual Cost Must Include

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THE basis underlying the whole question of economic design is the accurate determination of costs; that is, costs of construction and cost of energy. If these are not correctly determined, any conclusions drawn from their use will have little value. Furthermore, it is generally inadvisable to accept for this purpose any cost data which have not been locally derived, as every power company has its own methods and standards of construction, its own labor costs, its own efficiencies of operation. These may differ widely. Hence, as a basis for any economic study, it is absolutely necessary to make as complete a determination of local costs as possible.

Evidently, when it is decided to establish a cost record on construction, material and labor, difficulties will be encountered in obtaining correct information regarding all details. Much valuable information will be found in appraisals and much can be obtained from the books by a skillful economist. However, in most cases it will take several years to establish a complete record and special studies will be necessary. This record, when obtained, is an easy thing to keep up to date and in convenient form for use. In the meantime certain makeshifts will be necessary. If a complete record of unit construction and operating costs is not obtainable, or when lack of time or of available records requires any item of cost to be estimated, the estimate should be based on known conditions so far as possible. Further than this, there should be determined by what percentage the final result will be affected by any reasonable variation in the assumed cost. For example, the cost of energy at any point may be assumed to be 1 cent per kilowatt-hour. If this is not an accurately determined figure, however, it would be well to determine how the result would be affected if the cost of energy were, say, ¾ cent or 1¼ cents per kilowatt-hour. Such a comparison will at least place the solution of the problem within definite limits.

It is a generally recognized fact that the computation of first cost is only a step in the investigation of the real cost of a project. Its economy in comparison with any alternative project can be determined only when the annual cost is investigated. The annual cost must include all annual charges against the investment itself and all operating costs, maintenance, repair and energy losses. Of course, annual costs cannot always be considered the determining factor, since on items involving large expenditure the possible difficulty of obtaining capital may have considerable weight. Usually, annual cost may be accepted as the criterion.

Unit Costs Will Be Found Valuable

Before annual costs on a piece of property such as a transmission line can be obtained it is necessary to determine its total value or first cost.

First Cost.—The determination of cost figures for general use is greatly facilitated if line construction, materials and methods are standardized. This allows a fairly accurate figure to be obtained for standard units as per pole or per a thousand feet or per mile for any type of construction. Otherwise smaller units must be depended upon, such as cross-arm, insulator, a hundred feet of wire, etc. In any case, it will be found exceedingly valuable to have as complete a record as possible of itemized costs, from the smallest part, such as a bolt, up to an average cost for a large assembled unit, such as a mile of line. This should include both material and labor costs with overhead expense, all shown separately. Provision should also be made for easy revision of costs as prices change. This revision

*For previous installment see ELECTRICAL WORLD of Jan. 8, page [illegible].
†Distribution engineer. ‡Distribution department.

should be frequently made when prices of labor and material are fluctuating to any extent, since a large part of economic study deals with possible new construction, which will be at present or future prices, or with old construction, which represents a value equal to new construction less a certain percentage deducted for age. Some types of problems require the consideration of the actual cost of the old construction at the time it was built, but these are not so general.

The determination of unit material and labor costs cannot be taken up in detail here. Some of the items which must be included in addition to current quotations on material or actual labor time in erecting will be suggested. To material price may be added such items as freight and handling, treating material for poles, tie wires on line, etc. To actual unit labor costs should be added a proportional amount for unoccupied time, rainy days, vacations, transportation, inspection, etc. Naturally these additional items vary for each unit and each company. It is usually possible to obtain a percentage which may be added to actual price to include such incidental material. Labor costs on any unit may usually be reduced to an equivalent formula of man-hours for various classes of labor, as foreman, lineman, groundmen, etc., for each unit, plus a percentage for incidental expenses as above. Such formulas facilitate revision of prices when necessary as the current wages may be substituted and the labor cost on the unit easily obtained.

Effect of Overhead Expense

Loading.—The item of overhead expense or loading is one which must be included in nearly all problems involving costs. There are various methods of applying this loading, but for the purpose under consideration the method of unit loading is probably the most satisfactory; *i.e.*, apportioning to each individual item its pro rata cost for different items of overhead expense, both on material and labor. It is evident, for example, that the item of breakage will be greater for insulators than for wire. The items which may legitimately be included in loading are as follows:

Waste—End trimmings of wire, cable cut back for splicing, incompetent labor, etc.
Loss and breakage—Theft, broken insulators, etc.
Tool expense—Tools used up, broken, stolen and repairs and depreciation on same.
Direct supervision—Engineering, heads of departments, general foremen, office expense, clerks, stenographers.
Injuries and damages—Doctor and hospital expenses, liability insurance, etc.
Purchasing expense—All expenses of purchasing department.
Stores and supplies expense—All expenses of stores department and handling.

As will be seen later, all problems do not require a detailed application of loading. Many problems, involving the comparison of relatively small amounts of construction, may be safely considered from the point of actual material and labor costs alone, considering overhead to be equal in both cases. The question of whether or not to apply loading must be determined by the conditions involved in the particular problem under consideration. In general, where good cost records are kept it will be just as easy and more accurate to include it in all problems.

The accompanying tables are given as an illustration of one method of keeping detailed and assembled costs on various parts of the construction. The formulas for labor costs are based on the daily wages of the various classes of labor, and the incidental charges mentioned are included by proper adjustment of the multiplier. Similar methods with the necessary variations can be applied to all parts and types of construction, including both the underground and overhead lines. With this system it is intended that the sheets be printed with blank columns. The figures can then be filled in and revised sheets easily made up at stated intervals to care for changes in price.

Annual Costs

The determination of annual costs as used in this work is naturally divided into two parts, that pertaining to the physical property itself, such as construction and maintenance costs, and that pertaining to the load carried, *i.e.*, cost of energy.

The items to be considered under the first heading—*i.e.*, annual costs on the physical property—will each be discussed briefly. They include interest, taxes, insurance, maintenance and repair, and depreciation.

Interest.—Whenever money is invested in a piece of property a legitimate rate of interest must be included as part of the earnings of that property unless it be

ONE METHOD OF KEEPING DETAILED AND ASSEMBLED COSTS* OF VARIOUS PARTS OF CONSTRUCTION

LABOR CHARGES

Stringing

No. 6 - 4-tel wire ... F + T + 30 + 4L per mile.
No. 0 - stranded wire ... F + T + 36 + 4L per mile.
Pole to anchor guy ... F + T + 6 + 2L each.
1 in. x 10 in. x 1 in. wood pin - ½ (1 3F + 1 3T + 6 + L ...

where
F = daily wage of foreman.
T = daily cost of operating truck.
= daily wage of a groundman.
L = daily wage of a lineman.

DETAILED COSTS

Date.

Poles — Height Ft.	Top Diameter, In.	Material	+ Loading (17 Per Cent)	Labor	+ Loading (12 Per Cent)	Total
30	6	$7 28	$8 52	$5.80	$7 05	$15 57
35	7	12 90	15 10	8 05	9.79	24 89
40	7	16 70	19.50	10 26	12.48	31 98
Cross-arms ...			+ 23 per cent		+ 18 per cent	
3½ in. x 4¼ in. x 92 in., six-pin		0.74				
Braces and bolts (See itemized list)		0.54	$1.63 (complete)	$1 04	$1 23	$2 85
3½ in. x 4¼ in. x 108 in., etc.						

ASSEMBLED COSTS

Total cost per 1,000 ft. of line, including labor, material and loading. Average span 125 ft. Does not include guying nor corners.

Secondary	Cross Arms (One per Pole)	Pins	Insulators	Wire	Wire Pins and Ins.	+ Cross Arms	+ 35-Ft. Poles 125-Ft Span	+ 40-Ft. Poles 125-Ft Span
3 No. 6	$22.80	$4.70	$1.37	$160 00	$166.07	$188 87	$387 99	$444 71
2 No. 6	22 80	3 14	91	106 80	110 85	133 65	332 77	389 49
2 No. 4	22 80	3 14	91	140 50	144 55	167 35	366 47	423 19
etc.								
Primary								
2 No. 2	22 80	3 14	3 36	186 15	192 65	215 45	414 57	471 29
2 No. 6	22 80	3 14	3 36	106 80	113 30	136 10	335 22	391 94
etc.								

*The above figures must not be taken as representing current prices. They are given as an example only.

run at a loss. Interest must be figured on the total investment involved, including all material, labor and overhead costs. The rate at which interest should be charged may vary with the problem under consideration. Fundamentally it should be the current rate of interest on sound investments or the rate at which the company could borrow money under ordinary conditions. Sometimes the average rate paid on total capitalization may be taken, but in case the dividend on capital stock is fairly large, part of it might be considered as a profit

in excess of a fair rate of interest. In some cases, due to poor financial conditions or to an emergency, a company might have to pay a higher rate for money even on bonds than the market rate. All such factors should be considered in determining the interest rate to be used.

Taxes.—Taxes are an ever-present charge on any property, and usually the definite percentage may be easily determined from the company's accounting records.

Insurance.—Insurance against loss by fire is the most common form, but on some classes of property insurance against theft, storm, etc., is also carried. In any problem the kind and amount of insurance chargeable to each class should be investigated. In many cases no "insurance" charge is necessary.

Maintenance and Repair.—Maintenance and repair will be different for each unit considered. No two transformers, for example, will require the same amount of attention during their life even though similarly located; breaks in a line can rarely be anticipated, etc. A large part of maintenance is occasioned by imperfection in material. Maintenance and repairs due to such causes on any individual piece of equipment cannot be foreseen. In such cases average figures only can be obtained from actual experience over a number of years. Other items of maintenance, such as inspection, testing, etc., can be quite definitely determined from payroll and time reports.

Depreciation.—No detailed discussion of depreciation can be here included. Strictly speaking, depreciation is the percentage by which a piece of property is reduced in value each year of its life (by value is not meant necessarily selling price). From an accounting point of view, a certain amount must be set aside each year to replace the property when worn out. Sometimes the usefulness of the property in service is considered as a measure of its value. All these different viewpoints give rise to different methods of figuring depreciation. For the purpose of this work, however, what is known as the straight-line method is probably the simplest and most satisfactory. This method considers a piece of property to have given service for the years of its life for a definite total cost which may be equally divided between the years. The cost is obtained from the total first cost of the property in place, including material, labor and overhead charges, less the salvage value at the end of its life, plus the labor cost necessary to salvage it. This cost is divided by the estimated number of years of life and the percentage of depreciation taken as the percentage of the total first cost thus obtained. Naturally this will vary with different classes of property. Some will have little if any salvage value—cross-arms, for example. A pole when rotted at the base, on the other hand, can be sawed off and used again either as a shorter pole or a stub. Bare copper wire will have practically no physical depreciation, the cost of springing and removing together with tie wires and other incidentals making up the depreciation.

The years of life to use for any unit may depend on other things than its own life. For a transmission line, for example, it is probable that no definite limit can be fixed at which the whole line must be replaced. Poles and cross-arms will be replaced from time to time when necessary as long as the line is in service. In such a case it is probably simplest to assume a definite life for the whole line, possibly the assumed life of a pole, and figure depreciation on all units, wire, insulators, etc., on that basis. Thus any class of property may have a different percentage of depreciation, depending on where it is used.

A simple example of a computation for depreciation follows, insulated wire being taken as the specific item:

Assume new wire at 30 cents, scrap copper at 20 cents per pound.

Cost of No. 0 wire per 1,000 ft. (420 lb. at 30 cents)	$126.00
Labor of stringing (assumed)	10.00
Labor of salvaging (including burning off insulation)	10.00
Total	$146.00
Salvage value of 319 lb. at 20 cents per pound	63.80
Net cost	$82.20

If the assumed life of insulation is fifteen years:
82.20 ÷ 15 = $5.47 per year.
5.47 ÷ 136.00 = 4 per cent per year.

The matter of obsolescence, which is sometimes considered as a separate figure, may for this work be considered as a part of depreciation. Where it is anticipated that materials will become obsolete and require replacement before they are worn out, on account of improvement in design, the assumed life and salvage value used in computing depreciation should be adjusted accordingly.

Many special problems arise in figuring annual cost. One which also includes the idea of obsolescence is encountered when the replacement of a serviceable line with one of larger capacity is being considered. The value remaining in the old line must be included in the computations, and the total investment represented in the new line must include, in addition to the cost to build it, the present value of the labor necessary to build the old line—*i.e.*, first cost for labor less depreciation for years of age and the labor cost necessary to dismantle the old line. Such problems will be discussed in more detail later.

The cost of energy will be discussed in the next installment of these articles.

The Nauen Wireless Station

SINCE it was first installed in 1906 as a modest 10-kw. experimental plant, says Dr. Alfred Gradenwitz in the London *Electrician*, the Nauen wireless station has gradually been extended by the erection of a 35-kw. and then of a 100-kw. sender. The latter is still in use, with the addition of two high-frequency generators of 150 kw. and 400 kw. respectively, so that Nauen may be said at present to comprise three self-contained radio stations, of which the smallest, a 100-kw. spark sender, in conjunction with the 150-kw. high-frequency generator, is set apart for the time signal and meteorological as well as the transcontinental service, whereas the 400-kw. high-frequency generator serves as sender for the overseas traffic with a range of 12,427 miles. There are two antenna systems, one for high and one for lower power, permitting simultaneous sending. Two of the masts are 858 ft. in height and two are 393 ft. All the masts rest on ball points which are insulated from the earth by porcelain blocks. The high-frequency machine used to generate transmitter energy is designed on the induction-coil principle, an 800-hp. rotor supplying single-phase alternate current that can be stepped up to 24,000 cycles by stationary transformers.

Readers' Views and Comments

Mr. Schwab Exemplifies the Beauty of Optimism

To the Editor of the ELECTRICAL WORLD:

SIR: An optimist has been defined as a man who doesn't give a continental what happens as long as it doesn't happen to him. This definition does not fit the optimism of Charles M. Schwab, whose enormous business interests surely make him stand to lose as much as any one by hard times and who, none the less, instead of scheming to get from under, announces his disagreement with "prophets of despair" and advises business men to keep right along, declaring that he can see nothing ahead except prosperity.

Mr. Schwab, however, bases his roseate forecast upon the wide adoption of a policy of thrift. The end of extravagant expenditure, the revision of the tax laws and adequate care for foreign trade will, in his opinion, place the United States on a stable commercial basis that will endure. His tripartite remedy for depression deserves the consideration of men everywhere who would fain see America, in Miltonic phrase, shake her invincible locks and press forward, unhesitating, in the paths of a noble and puissant industrialism.

Brooklyn, N. Y. FRANK W. CHASE.

Water Powers Which Are Beautiful and Useful

To the Editor of the ELECTRICAL WORLD:

SIR: Bearing the date line "Washington, D. C., Dec. 28," there appeared in the Salt Lake City *Tribune* of Dec. 29 an article commenting upon an editorial in the Dec. 18 issue of the ELECTRICAL WORLD in reference to the commercial use of waters within the boundaries of the national parks. This article reprinted a portion of your editorial, and this was clipped and read at the weekly luncheon of the Pocatello Chamber of Commerce held Dec. 29. The editorial was much and favorably discussed by those present, since it was the first of its kind to appear in an Eastern publication. The writer was authorized at this meeting to assure you of our appreciation of a periodical which, after a very careful consideration of facts, had laid before the people of the East the truth regarding the Falls River project in Yellowstone National Park. Many large publications, such as the *Saturday Evening Post* and others, have attempted to precipitate an East and West fight. With the exception of one, the *Literary Digest*, every large publication in the East has printed pictures and data not based upon facts, though in some instances emanating from prominent writers, in an endeavor to feed the fires of this fight, which they consider has begun.

We of the West have investigated very thoroughly the Falls River project and, with no feeling of antagonism, have presented the facts to the different Eastern magazines, requesting that they be fair not only to us but to the people at large and publish these facts. In every case the same reply was made, that they "were unalterably opposed to any scheme which would ruin the beauty of our national parks." We even went so far as to suggest to one magazine that we would pay the expenses of its editorial staff over the Falls River project in an attempt to get the facts of the case in its columns, but even in this we were refused. In every case they seemed to forget that, especially in the case of Idaho, the money of tourists on their way to the Yellowstone Park is part of the means by which we exist, and that to desecrate any portion of the park attracting tourists would destroy this means of existence.

W. GLENN FIELD,
Secretary Pocatello Chamber of Commerce.
Pocatello, Idaho.

Improving Power Factor by the Use of Induction Motors

To the Editor of the ELECTRICAL WORLD:

SIR: The article on "Improving Power-Factor Conditions with Induction Motors" in the Nov. 20 issue of the ELECTRICAL WORLD gives some interesting data, but the authors have drawn a few conclusions which are not wholly warranted. The main objection to the use of standard induction motors as synchronous motors is their inability to stay in step at overloads or even at full load in some cases. This is the result of the low value of magnetizing ampere-turns of the induction motor as compared with a synchronous motor of the same rating. The magnetizing ampere-turns of the induction motor may be 25 or 30 per cent of the full-load primary ampere-turns, while the magnetizing ampere-turns of a normally designed synchronous motor are about equal to or even greater than the full load ampere-turns of the armature. The ability of either machine to stay in synchronism when carrying load is dependent largely upon the ratio of the actual exciting ampere-turns of the field to the ampere-turns necessary to magnetize the machine at no load. If the maximum exciting current in the rotor winding of the converted induction motor is limited to the value of current which it has carried during normal induction-motor operation, its stability or pull-out torque as a synchronous machine will hardly be satisfactory.

The curves which Messrs. Warner and Knowlton have drawn (Fig. 3) show that at 23 amp. excitation, the normal rotor current, the greatest load that can be carried is between 5 kw. and 6 kw. At a field current of 33.5 amp. it appears that the full rated load of 10 hp. could have been carried at a power factor very close to unity. Industrial motors should be capable of carrying at least 50 per cent overload without pulling out of step, and the average synchronous motor designed for unity power factor is capable of even better performance than this. There may be cases where an induction motor can be used for synchronous operation, but as a general rule the performance would not be satisfactory.

One other point which should be borne in mind is that the voltage required for sending the exciting current through the rotor winding is usually very low. This, of course, depends upon the design of the particular machine in question. The authors have not given the exciting voltage required for their motor, but it was probably around 15 volts or 20 volts. This means relatively large rheostat losses when the available direct-current supply is 125 volts.

QUENTIN GRAHAM,
Power Engineering Department.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Cost of Arresters Compared with Cost of Transformer Burn-Outs

COSTS of repairing burned-out transformers and of maintaining lightning arresters installed one to each transformer under different densities of installation are shown in the accompanying table. The figures are for about 15,000 single-phase, 2,400-volt distribution

COST OF LIGHTNING ARRESTERS AND TRANSFORMER BURN-OUTS COMPARED

Number of arresters and transformers per square mile	75	150	300
Fixed charges and maintenance of arresters	$10,000	$20,2 0	$40,000
Transformer repairs	32,000	9,400	3,100
Total per year	$42,000	$29,650	$43,100

transformers of different sizes, aggregating some 200,000 kva. They are connected to the four-wire, 4,000-volt primary lines of the Commonwealth Edison Company. The arresters are installed on the transformer poles.

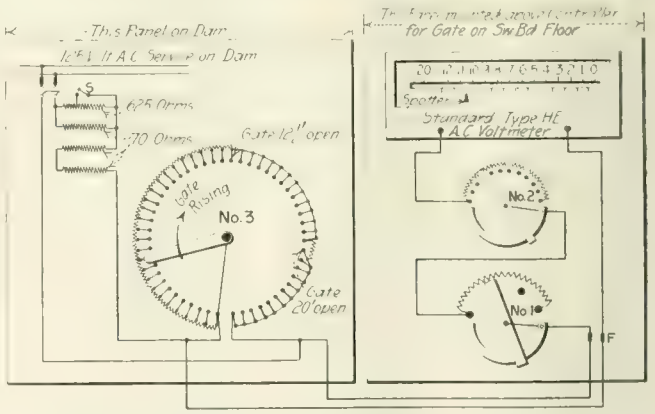
This information was given by Harry B. Gear of the foregoing company in a discussion of a paper by D. W. Roper of the same company, read before the American Institute of Electrical Engineers.

Gate-Opening Indicator Made in Station

A LONG-DISTANCE gate-opening indicator that has been in successful operation about six months was made from an old field rheostat and an alternating-current voltmeter in a hydro-electric plant of the Washington Water Power Company, Spokane. This indicator shows the switchboard operator the amount of opening in a waste gate on the spillway dam. This gate is used during the summer to maintain a constant level on a storage lake. Before the indicator was put in it was often necessary to run up and down a 150-ft. (45-m.) stairway to move the gate 6 in. (15 cm.) at a time. The gate is 25 ft. (7.6 m.) wide, has a maximum lift of over 25 ft. and is operated by a 250-volt direct-current motor having regenerative braking on lowering. The motor has two controllers, one on the dam and one in the power station near the switchboard, 400 ft. (122 m.) from the gate.

The rheostat shaft is connected to the gate gearing by a chain drive. Voltage is applied through an external resistor across the entire rheostat from the 115-volt alternating-current service on the dam. A switchboard-type 115-volt alternating-current voltmeter is mounted above the controller in the power house, and a pair of small leads run to the rheostat, shown as No. 3 in the sketch. One lead is connected to the end of the rheostat winding, and the other to the contact arm. With the gate shut the voltmeter is across all the resistance and reads full scale. Raising the gate cuts out some of the resistance tapped by the meter and lowers the needle. A scale reading in feet, and marked every half foot, is laid off from right to left, the zero being at the right. It was arranged to use the full voltmeter deflection for zero on the foot scale, as this is a more sensitive and accurate part of the voltmeter than the zero end, and the majority of gate operations come within the first 6 ft. (1.8 m.) of opening. The scale divisions are very nearly uniform. After 12½ ft. (3.75 m.) it was not considered necessary to provide indications except one point to show the gate wide open. Hence almost the entire voltmeter scale was used for the 12½-ft. range. By trial a proper amount of resistance was inserted in series with the rheostat to give full deflection on the meter, corresponding to zero gate opening. This was found to be 210 ohms. The original resistance in the field rheostat was removed, and twenty-five spools having 12 ft. (3.6 m.) each of No. 20 German-silver wire were inserted between the steps.

The alternating-current voltage on the bus is held steady by the Tirrill voltage regulator on the generators, but occasionally this voltage is changed a few per cent. In order to compensate for different bus voltages two small regulating rheostats were connected in series with the voltmeter leads, shown as rheostats 1 and 2 on the sketch. Before starting to raise the gate the operator brings the needle to zero by rheostat adjustment, then makes the required opening and brings the spotter to the needle. When it is next desired to change the gate opening the operator first brings the needle to the



THIS INDICATOR SHOWS ATTENDANT IN STATION POSITION OF GATE ON SPILLWAY

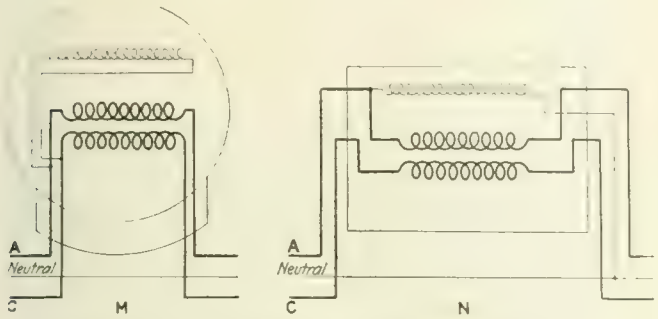
spotter if any change in voltage has moved it and then makes his gate opening and resets the spotter. If there is any doubt about the correctness of the spotter, a glance at the station log sheet will always show the present amount of gate opening. There is also a scale on the gate itself, graduated in feet and tenths, by which the indicator can be accurately checked.

Washington Water Power Co., Spokane, Wash. R. S. DANIELS.

Use of Polyphase Meter on Three-Wire Single-Phase Loads

ONLY in very unusual cases is it necessary to use a 110-volt polyphase watt-hour meter to measure a three-wire single-phase lighting load fed from the same switchboard which serves a power load. There may be occasions when unbalanced lighting loads make it desirable. Usually, however, the load is balanced, in which case the single-phase meter should be installed to avoid the relatively higher cost of the polyphase meter.

The greatest inaccuracy of registration occurs when all the load is on one side of a three-wire circuit.



SINGLE-PHASE METERS ON THREE-WIRE CIRCUIT

Take, for example, a meter wired as shown at *M*. Suppose the entire lighting load is on the *C* side. Let voltage from *A* to neutral be 110 volts, from *C* to neutral 105 volts, and from *A* to *C* 215 volts. If the current is *I*, the power used is $I \times 105$ watts. The registration, however, would be $I/2 \times 215$. Therefore the registration would be $[(I/2 \times 215) \div (I \times 105)] \times 100 = 102.4$ per cent of the actual power. With twice as much current in C side as in the other, this inaccuracy is reduced to 0.8 per cent instead of 2.4 per cent. Another reason for incorrect registration on unbalanced load is that the two current coils of the meter may be different. Specimens taken from two lots of fifty single-phase, three-wire watt-hour meters showed on test a difference between current coils as high as 4.8 per cent. These same meters when tested with current coils in series gave 100 per cent registration on two-wire load. However, most loads may be so divided that the errors of registration are not worth consideration and should not affect the meter choice. Even with older meters, as *N*, of which the potential tap is taken from the neutral of the circuit, the possible inaccuracy is only twice that of the foregoing meter *M*.

Although unbalanced load will not affect the accuracy of polyphase meters, prices of three-wire polyphase meters as compared with three-wire single-phase meters of corresponding current rating vary from more than double in smaller sizes to less than double for 50 amp. and above. Cost of testing a three-wire polyphase watt-hour meter is somewhat greater than for a three-wire single-phase watt-hour meter of corresponding size, unless the test is made between coils, when the cost would be only slightly more. Where space is limited the polyphase meter would take up more than the space ordinarily allotted for a lighting meter.

In connection with this subject the question arises whether or not large lighting loads should be connected on three-wire, three-phase, 110-volt circuits or on single-phase, three-wire, 110/220-volt circuits. From the metering standpoint the three-wire, single-phase distribution gives a substantial saving in first cost, space, installation and maintenance, if three-wire single-phase watt-hour meters are used. Also, for distribution at the same point to several consumers, both small and large, the three-wire, single-phase method appears more flexible, especially for small-motor service, say up to 3 hp., a balance on the three-phase feeder system being attempted by rotating the successive connections along the line. However, experience indicates that where one large consumer is served from individual transformers the three-phase, 110-volt distribution may give a better balance.

S. C. HENTON,
Superintendent of Meters.
Northern Ohio Traction & Light Company,
Akron, Ohio.

Wood-Pole Structure for Incoming and Outgoing Circuits

IN THE construction of small power plants and substations where the expense of steel towers is not warranted it is frequently advantageous to make use of a wood-pole structure for outgoing and incoming lines similar to the one shown in the accompanying photograph. This design is suitable when all the wires can be brought out in a horizontal plane through one side or end of the building. The poles should be placed about 3 ft. (0.9 m.) from the building with the crossarms overhanging the roof, provided that the building in not too high. If the building is too high for this arrangement, the poles must be placed farther away. Up to 6 ft. or 8 ft. (1.8 m. or 2.4 m.) no bracket will be required on the building, and the wires can be brought out direct from the porcelain tubes to the vertical wires on the structure.

All the circuits rise vertically to a point above the top arms, where they are dead-ended on suspension-type porcelain insulators suitable to the voltage used. The suspension-type insulators may be supported by 4-in. x 6-in. (10-cm. x 15-cm.) timbers or by two angles, 5 in. x 3½ in. x $\frac{5}{16}$ in. (12.5 cm. x 9.6 cm. x 0.8 cm.), bolted or riveted together and separated about $\frac{5}{8}$ in. (1.6 cm.) to permit the vertical wires to be moved either way in the direction of the poles for vertical alignment. The bottom angle-iron supports are placed about 18 in. (45 cm.) below the porcelain tubes so as to obtain a "weather droop." Instead of using a standard N. E. L. A. crossarm 8 ft. (2.4 m.) long, a special 4-in. x 6-in. x 10-ft. (10-cm. x 15-cm. x 3-m.) cross-arm is used so as to give plenty of clearance on both sides of the pole for working with the circuits energized.



THIS CONSTRUCTION FOR INCOMING LINES IS CHEAPER THAN STEEL TOWERS

In such a layout for incoming and outgoing feeders ample provision should be made for taking care of future additional circuits. There should be flexibility so that connections may be made from one circuit to any other and so that circuits may be paralleled.

Lykens, Pa. A. L. Johnson.

79 per Cent of Steam Prime Movers Are Turbines

PROBABLY the most interesting development in central station primary power equipment is the rapid growth in installation of steam turbines. The 1917 census of central electric light and power stations recently issued by the Bureau of the Census gives some very interesting data on this subject.

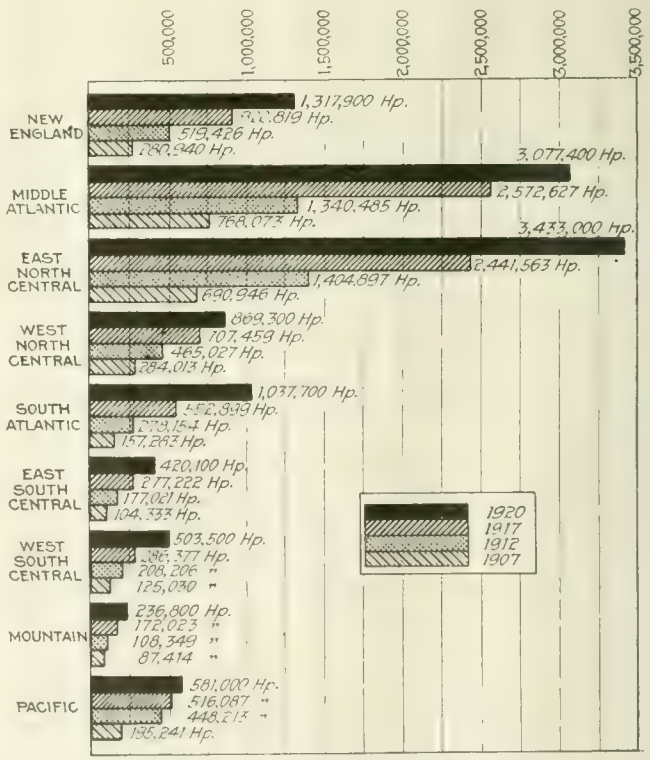
The total rating of all central-station steam-power equipment in 1917 was 8,449,076 hp., of which 1,701,677 hp. was credited to steam engines and 6,747,399 hp. to steam turbines. This is a very radical change from 1907, when the total rating of steam engines was 1,810,040 hp. and only 798,025 hp. was credited to steam turbines. According to statistics compiled by the Electrical World, the total installed steam power equipment in 1920 is 11,476,000 hp., of which 15.5 per cent or 1,781,100 hp. is credited to steam engines and 84.5 per cent or 9,695,500 hp. to steam turbines. These data indicate that since 1917 steam engines have increased by only 79,423 hp. while steam turbines increased 2,948,100 hp.

It appears that the movement away from the use of steam engines has in all cases been much more marked for commercial plants, irrespective of their size, than for municipal plants. This is probably due to the fact that municipalities have in many cases been rather conservative in their investment policy, and have continued to use equipment which a commercial company would have discarded, or have installed equipment which has been discarded and sold by commercial plants.

The Electrical World's statistics for 1920 indicate that New York leads in steam turbines with 1,335,000 hp., followed by Pennsylvania and Ohio with 1,062,100 hp. and 1,050,000 hp. respectively. Those states reporting the greatest steam engine rating in 1920 are Pennsylvania, Illinois and Ohio, all of which report more than 100,000 hp. The states of Pennsylvania, New York, Illinois, Ohio and Massachusetts reported in 1920 a total of 5,555,900 steam horsepower, equivalent to 48.5 per cent of the total rating of steam engines and turbines in the United States.

The diagram shows the total installed central-station steam equipment by sections of the country for 1907, 1912, 1917 and 1920. The East North Central section leads in this type of primary power equipment in 1920 with the Middle Atlantic States a close second.

Practically all the steam engines in both commercial and municipal stations are to be found in the lowest group, "500 hp. or under," and the average size of these machines is in both cases well under 200 hp. The decrease in the number of these small machines has been very marked for commercial plants, from 4,535 in 1907 to 3,253 in 1917, accompanied by decrease in horsepower rating from 781,673 to 593,538. On the other hand, municipal plants reported an increase in number in this small-sized group from 1,648 in 1907 to 1,947 in 1917, with a corresponding increase in horsepower rating from 236,893 to 313,419. In the group between 500 hp. and 2,000 hp. there was some decrease both in number and horsepower of engines reported by commercial stations. In the next group 2,000 hp. to 5,000 hp., while there was a slight decrease in number of units and rating subsequent to 1912, there was actually a considerable increase in both since 1907. The highest group over 5,000 hp. has witnessed very little change and municipal plants have had at no time any steam engines with a capacity as high as 2,000 hp. Perhaps the most interesting development in this connection has been the growth in horsepower capacity of steam turbines. In both classes of stations these turbines are found to be most numerous in the group between 500 and 2,000 hp.—598 or 40.2 per cent of the total, for commercial plants and 106 or 50.2 per cent of the total for municipal plants. The municipal plants also report the greater part of their steam turbine rating 40.9 per cent of the total in this group. Commercial stations, on the other hand, have shown a rapid increase in the number and the rating of turbines in the highest grouping, until in 1917 of the total horsepower 76.1 per cent was furnished by these larger units, which average 13,105 hp. per turbine, as opposed to an average of only 6,318 for steam engines in this group. In the lower group there was not a wide difference between the average size per unit in commercial and municipal plants. There was during the period from 1907 to 1917 a rapid increase in the size of steam



STEAM PRIME MOVER INSTALLATION IN THE CENTRAL STATIONS FOR THE YEARS 1907, 1912, 1917 AND 1920

turbines directly connected to generators, and now units of 40,000 to 60,000 hp. are not uncommon.

It is possible that the maximum size of steam turbines that will be used for practical purposes has been reached, but the Electrical World data for 1920 indicates a decided increase in total rating for the past three years. Steam engines as a source of motive power in central stations have evidently reached the high mark and will probably slowly decrease.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Semi-Inclosed Transformer Room Allows Free Air Circulation

TO PROVIDE ample air circulation for cooling, the transformer rooms of the Central Gear Company, Detroit, Mich., have one side open. The substation shown in the accompanying photograph contains three 250-kva. 4,600 440-volt power transformers and one



ONE SIDE OF THIS TRANSFORMER ROOM IS OPEN TO ALLOW AIR CIRCULATION

200-kva. lighting transformer. No openings are provided from the shop to the transformer rooms, which are entirely fireproof. They consist of brick walls with a concrete roof and floor. The side of the room shown in the illustration is entirely open to the weather, and unauthorized persons are kept out by an iron grill with removable sections, which allow the replacement of any transformers. The floor of the room is on a level with the loading platform extending along the entire side of the gear shop, so that any transformer may be rolled into a car and replaced with little time and effort.

Esselstyn, Murphy & Hanford, Detroit, Mich.

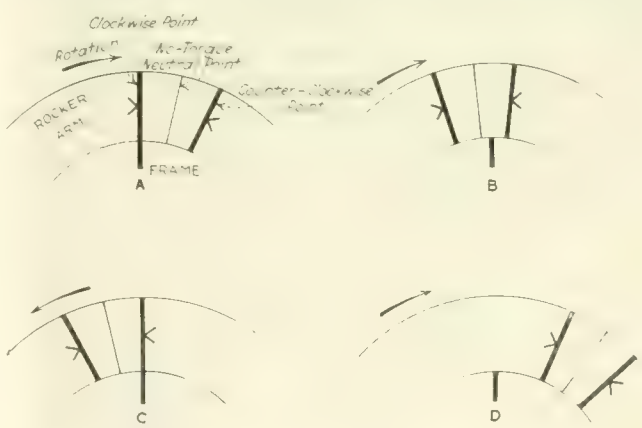
G. WAGSCHAL, Electrical Engineer.

Determining Rotation of a Repulsion-Induction Motor

IN REPAIRING an induction-repulsion motor it was necessary to determine the direction of rotation, the brush position and the correct connection for the compensating leads, besides replacing the slot sticks. This was a General Electric 2-hp., single-phase repulsion-induction motor, type RI. Both bearings were badly worn, which permitted the rotor to rub the stator core. The heat generated by this friction had charred the slot sticks but had not burned the wire insulation. Accordingly the slot sticks were removed from both cores, which were then heated and saturated with a thin baking paint. While the paint was soft new slot sticks were inserted. The cores were then baked to dry the paint. The windings received the standard high-potential ground test, which was successfully withstood.

The motor had been received disassembled; therefore the direction of rotation, brush position and compensating lead connections were unknown. The brush holder is usually marked at the factory for each direction of rotation. In this case, however, two sets of marks were on the frame. To determine the correct marking it was first necessary to find the no-torque point. This was done as follows: The compensating leads were disconnected and the motor was connected to a line having one-half normal motor voltage. The brushes were shifted until a point was found where the armature locked. When the brushes were shifted to each side of this point the direction of rotation of the armature changed. As the direction was opposite to the movement of the brushes, the wrong no-torque point, of which there are two, had been found. The brushes were therefore shifted through an angle of 90 electrical degrees to the true no-torque point. On a 1,750 r.p.m. motor (four-pole) this is an actual shift of 90 deg.

With this point known it was then necessary to determine the correct compensating-lead connection for a certain direction. The leads were connected in the most convenient manner for trial. With the brushes set for clockwise rotation as shown in sketch *A*, the rocker arm was shifted in the counter-clockwise direction, which caused the direction of rotation to change when the mark on the frame was half way between the no-torque point and the counter-clockwise mark, as shown in sketch *B*. This showed that the compensating leads were incorrect for clockwise rotation and correct for



SETTING OF INDUCTION-REPULSION MOTOR BRUSHES FOR DIFFERENT DIRECTIONS OF ROTATION

counter-clockwise direction. If the lead connection had been correct for clockwise rotation, the direction would not have reversed until well beyond the counter-clockwise mark. The motor was then stopped and the brushes were set for counter-clockwise rotation, as shown in sketch *C*.

When the compensating leads are correctly connected and the motor running, the brushes can be shifted considerably beyond the position of opposite direction of rotation.

Therefore, in order to give a final test, the brush holders were shifted in clockwise direction until the rotation reversed. This occurred at the point shown in D, well beyond the clockwise mark, which proved that the lead connection was correct for counter-clockwise direction.

A. HERVEY.

New York, N. Y.

Maximum Temperature Allowable for Insulation

THE values given in an accompanying table were recommended by the Electric Power Club at its meeting in November for adoption as the maximum temperatures to which electric insulating material should be subjected. Methods are given for correcting temperature as determined by thermometer and resistance measurements. Tests for heating should be made at the rated voltage, frequency and load for which the apparatus is rated under conditions equivalent to operating conditions. The first method consists in the determination of the temperature by mercury or alcohol thermometers, by resistance thermometers, or by thermocouples, applied to the hottest accessible parts of the completed device. The corrections as given in Table I should be added to the highest temperature observed, except when the instruments are applied directly to the surfaces of bare windings, when no correction is to be applied to determine the maximum hottest-spot temperature.

TABLE I—PERMISSIBLE TEMPERATURES FOR INSULATING MATERIALS*

The ambient temperature of reference for air shall be 40 deg. C.

Class of Material†	Maximum Allowable Hottest-Spot Temp., Deg. C.	Hottest-Spot Correction	
		Thermometer Method	Resistance Method
A	130	Add 20 deg. C. plus 1 deg. C. for each 0.1 in. in thickness of winding.	Add 1 deg. C. for each 0.1 in. in thickness of winding.
B	150		
C	No limits		

*The limiting observable temperature rise for bare enameled air-insulated coils is 90 deg. C. This applies also to coils where a fiber sleeve or collar is used to insulate coil from frame or core.

†Class A—Cotton, silk, paper and similar materials when so treated or impregnated as to increase the thermal limit or when permanently immersed in oil; also enameled wire. For cotton, silk, paper and similar materials when neither treated, impregnated nor immersed in oil the highest temperatures shall be 35 deg. below the limits for class A. Class B—Mica, asbestos and other materials capable of resisting high temperature in which any class A material or binder is used for structural purposes only, and may be destroyed without impairing the insulation or mechanical qualities of the insulation. Class C—Fireproof and refractory materials, such as pure mica, porcelain quartz, etc.

TABLE II—RISE OF RESISTANCE OF COPPER WITH INCREASED TEMPERATURE

Temperature of the Winding at Which the Initial Resistance Is Measured, Deg. C.	Increase in Resistance of Copper per Deg. C. per Ohm of Initial Resistance, Ohms
0	0.00427
5	0.00418
10	0.00409
15	0.00401
20	0.00393
25	0.00385
30	0.00378
35	0.00371
40	0.00364

The resistance method consists in the measurement of the temperature of windings by their increase in resistance. In the application of this method thermometer measurements should also be made whenever practicable without disassembling the device, in order to increase the probability of revealing the highest observable temperature. Whichever measurement yields the higher temperature after adding the proper correction factor, that temperature should be taken as the highest observable temperature, and a hottest-spot correction as given in Table I is to be added thereto to give the maximum hottest-spot temperature. This method should be used for shunt coils and elsewhere when possible. Table II is to be used for the temperature coefficient of copper.

The third method employs thermocouples or resistance temperature detectors, placed as nearly as possible at the estimated hottest spot. A liberal number should be employed, and all reasonable efforts should be made to place them where the highest temperatures are likely to occur. No correction is added.

Intensities and Types of Lighting for Shoe Factories

BOTH general and local illumination are necessary in manufacturing shoes according to the particular processes. In the accompanying table are illumination intensities that have been found satisfactory. The intensities vary from about 3 foot-candles for rougher work to 20 or 30 foot-candles for stitching. In general the processes in the shoe factory can be grouped into three divisions: (a) Work similar to that of the ordinary industrial plants, involving no machines with overhanging parts and having demands for low, medium or high intensity, depending on the degree of fineness of the work. The standard type of general illumination meets these conditions. (b) Work on machines with overhanging parts which are so grouped as to demand particular directions of light at the working points. Most of this work is relatively minute and demands a high intensity. The localized general system applies here. (c) Certain classes of work, such as stitching on dark material, require an unusually high intensity which in many cases could not be economically provided by overhead units. This requires a combination of local and general lighting.

A. L. Powell and J. H. Kurlander gave this information at a recent meeting of the Illuminating Engineering Society.

LIGHTING INTENSITIES AND SYSTEMS REQUIRED IN SHOE FACTORIES

Intensities in Foot-Candles

FACTORY MAKING LEATHER SHOES

Type of Lighting: General		Localized General		Local and General	
Leather storage	3	Drinking	6	Perforating	10
Cutting	10	Last racks	3	Stitching	20
Skiving and splitting	6 8	Lasting	3	Button holing	10
Staying	6	Pulling over	8	Eyeletting	10
Sole laying	6	Trimming	8		
Leveling	6	Welting	8		
Nailing	8	Rough rounding	8		
Treeing	12	Sole stitching	8		
Heel scouring	6	Channeling	8		
Burnishing	6	Heel breasting	8		
Spraying	6	Edge trimming	8		
Bench work	4 8	Edge setting	8		
Box making	4				

FACTORY MAKING RUBBER SHOES

Washing	3	Calendering	6	Sole rolling	10
Milling	6				
Compounding	4				
Cutting	10				
Making	12				

Motor Drive for Oil-Well Drilling Becoming Standardized

A NUMBER of oil-well drilling equipments using electric power have recently been installed in California which show that it is possible to standardize apparatus for this class of work. The outfits are designed to handle all of the necessary operations of drilling by either the standard cable tool or the rotary process, the standardized equipment consisting of a 75-hp. variable-speed induction motor, a main controller and resistor for providing ten possible speed variations between half and full-load speed, an auxiliary controller and resistor for dividing each of the ten speeds furnished by the main controller into eight additional speeds, an oil circuit breaker for protection against undervoltage or overload and a speed-reducing countershaft provided with the proper size of pulley to give the correct drilling speed. In the installation of this equipment for use with standard cable tools no change is necessary in the construction of the rig except in the size and arrangement of the engine house, the speed-reducing countershaft occupying the usual engine block, the motor being installed on an additional engine block situated on the band-wheel side of the countershaft.

The motor itself consists of a variable-speed slip-ring type with polar-wound rotor. The main and auxiliary resistors and their governing controllers are connected in series with each other and with the motor rotor, this scheme permitting each of the steps on the main controller to be subdivided into small increments, the total possible speeds being a product of the control points on the two controllers, thus providing great flexibility. The controllers are provided with rope wheels and are operated independently by telegraph cords from the head post. It is recommended that all of the control and protective apparatus be mounted on a separate engine block as a complete unit in itself in order to facilitate its removal to a new location upon the completion of a well.

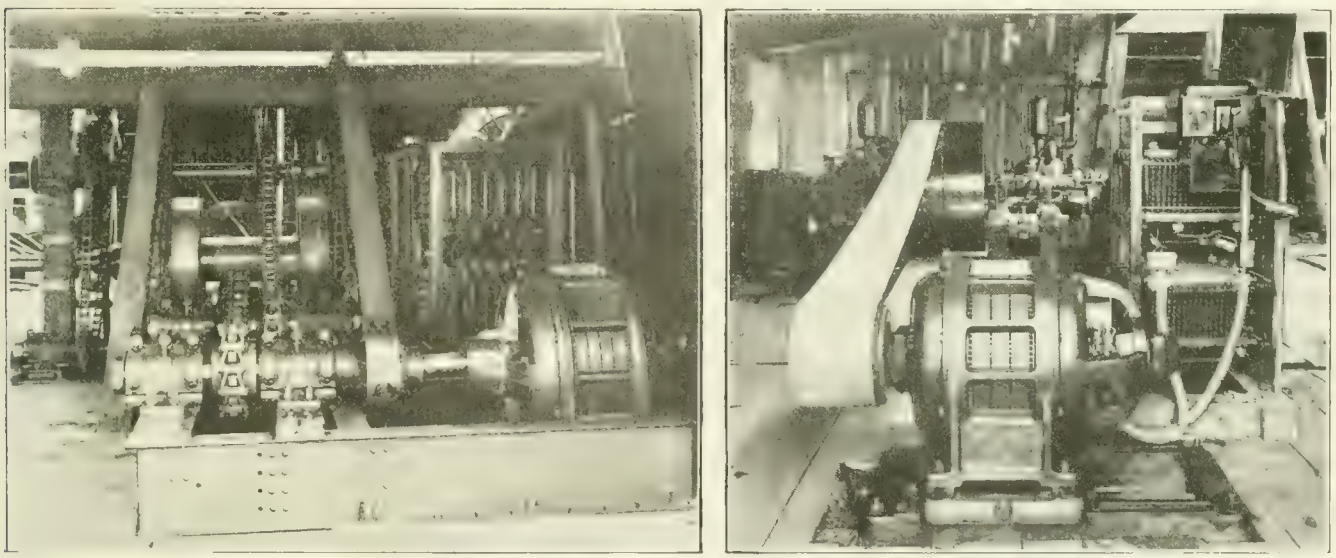
In standard-cable tool drilling the matter of utmost importance to the operator is that the tools shall have a free drop in order to strike the most cutting blow. In order to accomplish this the motor must slow down perceptibly on the lifting stroke and speed up on the falling stroke. This result is very satisfactorily obtained by so proportioning the countershaft pulleys that some of the main resistance is always left in the rotor circuit when operating at the correct drilling speed, and by the very fine speed adjustment obtainable through the introduction of the auxiliary resistance to make the beam accord with the natural period of vibration of the drilling line. The auxiliary resistance is designed only for the purpose of obtaining micrometer adjustments when actually drilling on the beam and must be shorted out during all other operations, such as pulling the tools, bailing, fishing, etc. This is for the reason that the power required for actual drilling on the beam is only a small percentage of the normal rating of the motor, and if left in circuit during operations requiring either the normal or overload capacity of the motor, it would be subjected to such severe overloads as to cause great danger of its burning out.

This micrometer speed adjustment is necessary because the beam has a critical speed at which the tools will strike the most effective blow. Too slow a stroke means too little work accomplished for the time consumed, while too fast a stroke merely takes the stretch out of the wire line without permitting the tools to strike a cutting blow.

In territory where a caving formation is encountered, making necessary the use of a circulating or slush pump, or in cases where the operator prefers to obviate the necessity of frequent bailing by handling the cuttings with a mud pump, belt-driven mud hogs are installed as a separate unit and are driven by a single variable-speed motor of from 35 hp. to 50 hp., the capacity of the motor depending on the nature of the formation encountered and whether or not it is to be used for cementing.

Electrical Equipment Same for Rotary Drilling

For drilling by the rotary method the same electrical equipment is required, but with a slightly different set-up. Experience has demonstrated that if the oper-



MOTOR DRIVE FOR OIL-WELL DRILLING HAS REACHED THE POINT OF STANDARDIZED EQUIPMENT

On the left is shown a 100-hp. oil-well drilling equipment operating shaft-drive rotary for the La Merced Oil Company, Montebello Field, Los Angeles County, Cal. On the right is shown the duplicate motor-driven mud pumps for the same installation.

ator will proportion the sprockets so that the rotary table cannot exceed a speed of 80 r.p.m., which compares favorably with that ordinarily used with steam drive, a 75-hp. standard-cable tool-drilling motor will satisfactorily handle the work. However, the tendency has been to make use of the tremendous overload capacity of electric drive, with a resultant speeding up of the rotary table to about 100 r.p.m. and a consequent increase in hoisting speed. Working on the basis of a high safety factor, most of the operators have standardized on 100-hp. slow-speed motors for driving the draw works and rotary table, the slight difference in initial cost being more than offset by the assurance that they have ample power to meet whatever conditions they may encounter.

In standard-cable tool drilling, even under conditions of frequent reversals, the fact that both the countershaft and the band wheel are belt-driven, and preferably through long belt centers, provides a cushion for the motor bearings against severe shock occasioned by such reversals. Therefore a standard two-bearing motor is satisfactory for this application. On a rotary rig, however, reversals, which are much more sudden and frequent, occur while the motor is operating at higher speed and delivering greater horsepower. Furthermore, when the bit strikes a boulder or other formation which it can neither penetrate nor dislodge, and starts putting a twist in the drill stem, an instant reversal is necessary to save the drill stem from being twisted off. Because of this severe duty imposed belt drive on a rotary rig is not satisfactory and chain and sprockets are employed both for the drive from the motor to speed-reducing countershaft and for that from this countershaft to the draw-works spindle. These chains, being positive-drive, provide no cushion from severe shock, and it is therefore necessary to use either a three-bearing motor or some modification of it in order to protect the motor bearings.

The ideal drive from the motor to the speed-reducing countershaft seems to be through the medium of a high-speed silent chain operating on short chain centers, but to insure satisfactory operation some means of maintaining perfect alignment of the two shafts must be provided. From the countershaft to the draw-works spindle standard rotary chain is employed.

The latest development in electric rotary set-up is that of the La Merced Oil Company operating in the Montebello Field at Los Angeles and is shown in the illustration. On this particular rig No. 1,240 rotary chain was used for both drives, but should the operator later decide to use silent chain no change would be necessary except substitution of the proper sprockets and chain. Duplicate mud pumps are used on this rig to provide a greater factor of safety, the mud-pump motor being provided with a speical base to permit of movement along its shaft in order to shift the belt from one pump to the other as shutdowns for valve renewals and repacking may require. In this installation, as in all rotary rigs, a 50-hp. variable-speed motor drives the pumps.

On the basis of present prices a standard cable-tool equipment, including the motor, controllers, oil circuit breaker, countershaft and countershaft pulleys, can be installed complete, ready to run, but exclusive of all belts, buildings or foundations, for approximately $3,200. If a circulating pump is to be used, necessitating the installation of a 50-hp. variable-speed motor, this figure will be increased to approximately $5,100. Since all rotary rigs require the circulating-pump motor the latter figure will cover a 75-hp. rotary installation. If a 100-hp. motor is used on the draw works and rotary table the installation, complete with mud-pump motor, will approximate $5,400. These figures are for the electrical equipment only.

W. G. Lane,
General Electric Company, Engineer.
Los Angeles, Cal.

Pump Motor Mounted Above Floor to Prevent Burn-Outs

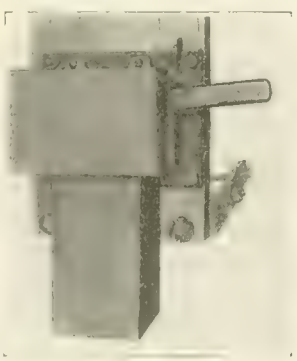
By mounting the motor of a vertical pump on a stand several feet above the floor of the basement of a large factory burn-outs which had occurred when the motor was mounted just below the floor were stopped. Originally the motor was installed below the floor level on a steel plate resting on the walls of a concrete sump. An automatic switch and float were installed under the floor plate and wire connections were carried through conduit up to the line. Unfortunately, every few days a lot of castings would be piled on the floor plate so that the apparatus became inaccessible. It was noticed every time the floor plate was removed that there was much moisture on the motor, although it was above water level. After two motor burn-outs within one month, apparently due to the excessive moisture, it was decided to install the motor above the floor.

Consequently, a very strong stand was built over the pit, upon which the motor and switch were placed, the pump remaining below and having its shaft lengthened with a 1-in. (25-mm.) round rod held by a coupling. This shaft is 4 ft. (1.2 m.) long, and to prevent its vibrating sideways when running at 1,200 r.p.m. a specially made vertical bearing with packing and an oil cup was placed midway on the shaft. The rod from the float below was extended with a brass rod to the switch box above. The whole outfit was painted with black asphaltum, a drop light was placed overhead, and the motor has been running ever since, giving no trouble.

East Berlin, Conn. H. S. Rich.

Oil-Insulated Signal Switch for Mines

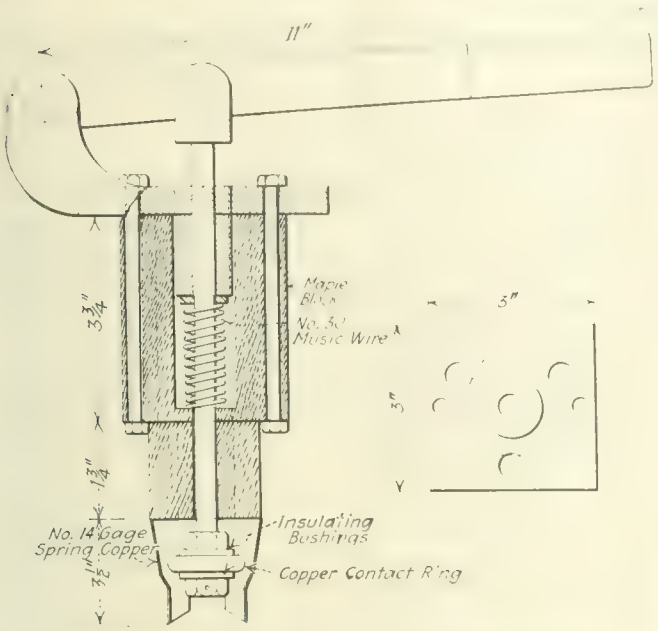
A rugged signal switch which operates submerged in oil has been developed by the Copper Range Company of Plainsdale, Mich., for use in its copper mines. Besides the feature that practically all working parts of the switch are covered with oil, other advantages are that it is very strongly constructed and all bearing surfaces are either iron-to-brass or brass-to-brass, so that corrosion caused by dampness will not make the operation sluggish. The body of the switch is made of a block of maple wood through which a plunger carrying a copper contact ring projects. This ring makes contact with three No. 14 gage copper springs, fastened on the block and projecting below its lower end. Normally the spring is kept out of contact by a music-wire spring which is rather stiff and requires considerable force to push it down. The leads from the



SWITCH IS TOTALLY INCLOSED IN CAST IRON

copper contact pass up through holes in the maple block, where they terminate in small copper lugs to which the incoming wires are connected. A small cast-iron tank filled with oil incloses the lower part of the switch.

The upper part is covered with a cast-iron box through which the cast-iron handle projects. This box



OIL-INSULATED SWITCH USED FOR MINE SIGNALING

keeps all drippings of moisture off the top of the switch. A latch, *A*, on this cover serves to hold the handle down when it is desired to ring the buzzer continuously. This entire switch is mounted on a creosoted board attached to pipes in the side of the shaft.

A more comprehensive description of the signal system on which this switch is installed and of other such systems was printed in the ELECTRICAL WORLD for Aug. 21, 1920, page 372.

Desirable Qualities in Welding Electrodes

MILD-STEEL electrodes with a combined slag and flux covering give the best results in electric welding. The mild-steel electrode contains from 0.1 per cent to 0.25 per cent carbon and 0.4 per cent to 0.6 per cent manganese for general welding, with as little sulphur and phosphorus as is possible and silicon to the ordinary extent—in fact, an excess of silicon acts as a cleansing agent.

Vanadium is left in some electrodes to flux out impurities. Copper in a small amount tends to reduce corrosion by a sort of brazing action between layers of the weld where corrosion might start.

The flux-coated electrode has chemicals which pass into the arc together with the steel to free the resultant welded metal mainly of oxide and pass off as gas, whereas the slag-coated electrode furnishes a covering over the molten metal and in some cases an envelope around it, preventing the air from combining with it. The flux-covered electrode fails in the case of a long arc because more impurities are absorbed by the molten metal than the flux can take care of in the short time available, whereas the envelope-covered metal fails where impurities are present in the electrode or parent metal as shielding from the air will not remove them.

A combination of a covering and a flux is therefore necessary for a first-class electrode, which, when properly applied, will result in a weld free from oxides, nitrides or cyanides and as ductile as the best annealed steel casting. The ingredients used in the most desirable coverings are, first, an inorganic substance, generally a silicate; a fluxing reagent, such as aluminum, titanion, boron and magnesium, together with an inert substance, generally a calcium compound, to bring the slag to the surface quickly.

Chemical analysis of electrode material is necessary but not all that is essential. The electrode must be of such structure and even density that it will pass smoothly through the arc without sputtering. The only way to tell this is to try it.

Much progress is being made with special steels which deposit welded metal at nearly the content of the parent metal. As the arc removes some of the impurities in greater proportion than others the difference has to be made up in the electrode. So far, high carbon, high manganese, chrome, nickel and vanadium steel alloys have been successfully welded.

In applying envelope-coated electrodes there is danger of slag inclusion, and in the case of completely covered electrodes, even where the slag is not included in the weld, it remains as a covering and must be removed before the application of the succeeding layer. This covering in some electrodes can be removed with a heavy wire brush, in fact brushing is highly desirable with any method of welding in successive layers. Slag inclusion depends upon the expertness of the operator, but the chances are lessened by an electrode covered on one side only, welding with the bare side advancing.

Welding is inherently a casting process, the castings being made in small quantities, each deposition annealing the previous layer. If the weld is carefully made of successive thin layers ending with a heavy deposition at a high heat, which last deposition is removed in machining, the weld will partake almost of the qualities of rolled plates.

C. J. HOLSLAG.
Electric Arc Cutting & Welding Company,
Newark, N. J.

Determining Approximate Load on Induction Motor from Speed

IT IS often desirable to know the load on a squirrel-cage type of induction motor without going to the trouble of connecting instruments in the circuit. Where only approximate results are desired the speed of such a machine will give a fairly close figure on the load.

The synchronous and full-load speeds are usually given on the nameplate of the motor, and since the slip of a squirrel-cage machine increases almost uniformly with the increase in load within the limits of its rating, any fraction of the total slip from no load to full load will represent that fraction of the full-load rating.

Several speed readings will generally obviate the error that might be introduced by variations in the frequency of the system supplying the current. Any marked deviation in the applied voltage from the rated voltage would also affect the slip.

This method would, of course, not be applicable to motors with continually varying loads nor to heavily overloaded motors, though in the latter case it would give an indication that the motor was overloaded.

San Juancito, Honduras, C. A. FREDERICK KRUG.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Central-Station Merchandising Policy

THE following outline of a merchandising policy from a central-station standpoint is abstracted from a paper read by A. S. Nichols at the recent convention of Stone & Webster, commercial managers at Boston, Mass. It embodies the experience of Mr. Nichols in establishing electrical shops in the Middle West.

Though great strides have been made in the development of the industry, the estimate has been made that there are fourteen million unwired homes in the United States and that only 40 per cent of the industrial power has been electrified. The market for the product of the central station is almost unlimited and the saturation point of the average central station is almost indiscernible. It has been estimated that the combined sales of all the department stores in the country before the prohibition amendment did not equal the annual expenditure of two billion dollars for intoxicating drink. The proportion of this released purchasing power which electric or gas service will attract will rest upon the degree of intelligent understanding of the principles of merchandising applied to the sale of the product.

The industry as a whole has failed to apply the principles of modern business to the sale and distribution of appliances so as to popularize the use of its product and build the load where it is most needed. There are some who contend that the central station should confine its effort to the direct sale of energy and leave the sale and distribution of appliances in the hands of electrical contractors. Those who adhere to this theory justify it on the grounds that it permits better relations with the contractor and that his efforts and consequent pay roll devoted to the indirect sale of the product of the central station are not reflected in its operating expenses. This argument is tenable in theory, but unfortunately the electrical contractor in the average town has not the capital or the initiative to merchandise appliances to the best advantage. He lacks the facilities of the central station for education in the use of appliances and for distribution to the market. His advertising is frequently poor and cohesion of effort in this direction is rarely exhibited between this allied industry and the central station. The service of the central station is concerned with the quality of appliance connected to its line, and a proper conception of its duty to the public requires that the people be kept informed of improvement in the art and of the usage of the many labor-saving devices which they eagerly demand.

Merchandising of electrical appliances involves three functions—buying, displaying and selling. The function of buying concerns supplying existing demands of customers and accommodating latent desires which the education of prospective customers makes active. The patrons in the main will be women, and judgment of what or what not to buy must be based upon the practical application of the articles considered to domestic use, the relative prosperity of the community, the general attitude toward the use of labor-saving devices and the character of appliances already on the line.

A display window possesses important advertising or sales value in ratio with the degree of intelligent consideration given to it. Its tangible value may be readily recognized from the estimate placed upon it by the leading merchants of the country as reported in a recent magazine. Charles Stevens & Company of Chicago place a value upon their windows of $150,000 a year; R. H. Macy & Company, New York, $100,000 a year; Filene's, Boston, $106 a day; Saks & Company, New York, $50,000 a year; Famous & Barr, St. Louis, $10 to $25 a day, according to location.

Since a large volume of the sales will be made to women, it is good policy to equip the store with attractive and comfortable chairs, furnish a flat-top writing table in a convenient corner and develop the reception-room idea. Let the table stand upon a rug, place near it one or two chairs, a tabourette and a fern and keep a supply of blank bank checks on the table for the convenience of customers. Train a young woman to fill the position of saleswoman competently. She will intuitively discover the desires of your women patrons much better than a man will. When a customer purchases an appliance thank her or him for the patronage. Whenever possible escort a customer to the door. Make a record of the sale so that in a few days some one can call the patron on the telephone and inquire if the appliance is working satisfactorily. It pays to do so. One may arrange the most attractive shop and destroy its purpose by failing to appreciate that courtesy is a dominating factor in the policy of a successful business venture.

Puget Sound Company Insures Wide Distribution of Note Issue

MORE than three thousand new holders of its securities have been acquired by the Puget Sound Power & Light Company by the sale during two campaigns of $2,000,000 five-year 8 per cent notes. Approximately a thousand of the purchasers of the notes are employees working in the Seattle or other Puget Sound divisions of the company, which extend from the Canadian boundary to Olympia. The sale of its second million dollars of 5-year 8 per cent notes was completed in fourteen working days.

Sales were handled almost entirely by the sales departments of the company and its various subsidiaries. A very small portion of the issue was allotted to the banks. During the sale an advertising campaign was conducted in all of the daily papers and in most of the larger country weekly publications.

One offer made by the company which attracted many subscribers was the announcement that notes in limited amounts could be purchased by paying 10 per cent with

the order and the balance in nine monthly payments, the company retaining the notes until the final payment; interest at 6 per cent to be allowed on installments paid. The amount paid may be withdrawn at any time before final payment is made, in which case 4 per cent interest will be allowed.

What Hydro-Electric Development Means to Industry

IN THE West, where industrial progress is dependent upon the development of hydro-electric energy, every effort is being made to demonstrate to the public the direct results of such development. Public morale and financial support are being gained by repeated demonstrations. An effective appeal to the layman has been formulated by J. M. Morris, Westinghouse Electric & Manufacturing Company, Los Angeles.

The basis of the appeal is four charts which have been prepared from actual data on present conditions by the Southern California Edison Company. These data are representative of other Western power companies and show that each additional kilowatt of electrical energy developed means the building of one new home, the irrigation of four more acres and the employment of one more person in industry.

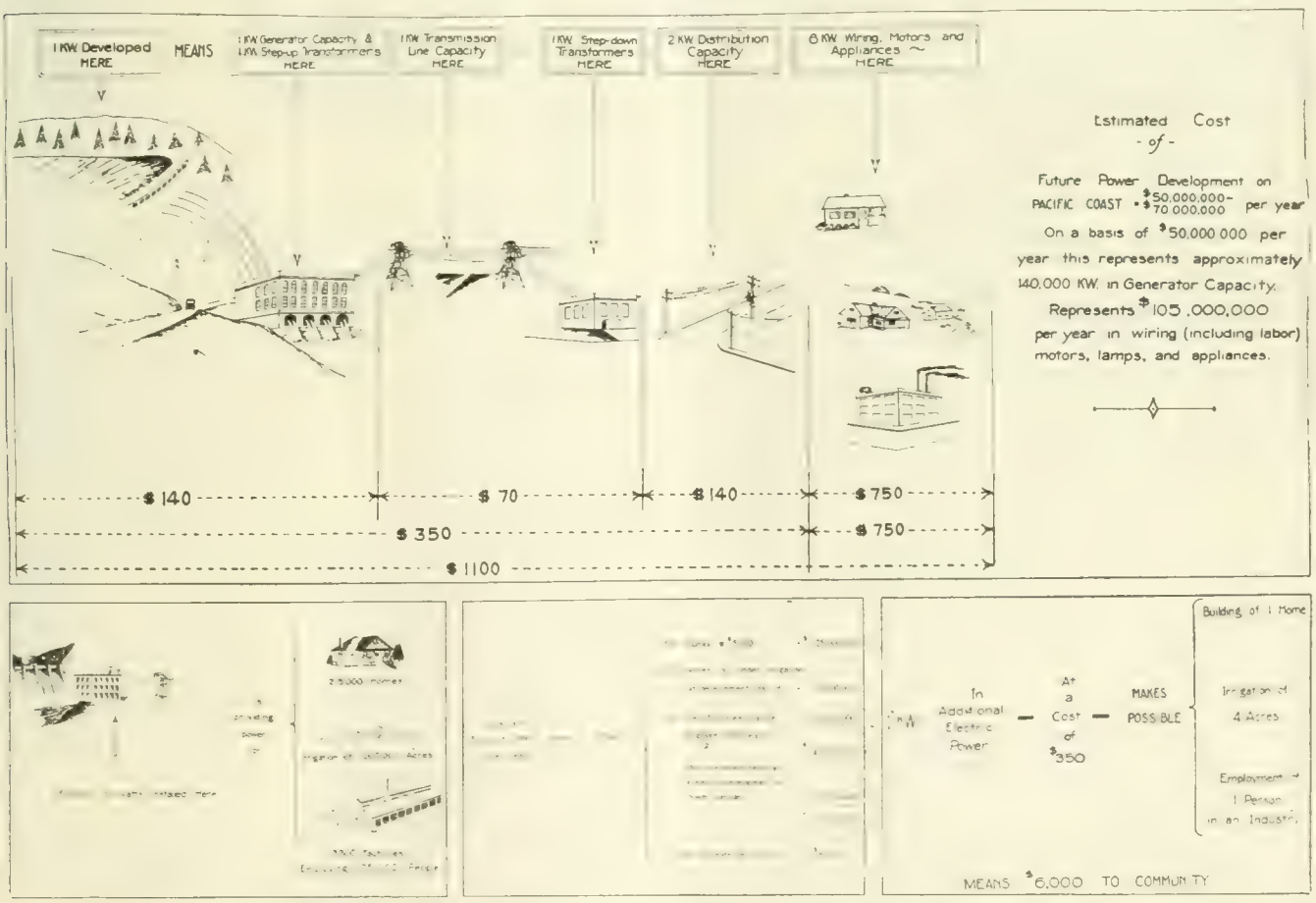
One of the charts shows the comparatively large sum of money that must be spent in utilizing the energy as compared with the cost of generation, transmission and distribution. This is shown as indicative of the huge sums that will be spent annually in the electrical industry in the West.

Utilities Should Scrutinize Terms of Insurance Policies

CONTENDING that fire insurance matters do not receive the attention from utility men that they deserve, J. G. Reese of the Consolidated Gas, Electric Light & Power Company of Baltimore in a paper, "Fire Insurance from the Public Utility Viewpoint," calls attention to several conditions and clauses written into most insurance policies which can be easily misunderstood.

"Although ordinarily," says Mr. Reese, "the insurance companies deal in good faith with the assured, nevertheless there are certain conditions in the policy the violation of any one of which may invalidate the entire policy. As examples, if more than one policy covers the property, and notice of this fact is not given to all the insuring companies, or if a manufacturing establishment operates later than 10 p.m. without permission having been obtained, or if the fact of a mortgage is not set forth on the policy, the policy may be declared invalid by the insurance company, and the company would not be required to pay any loss unless it was willing to waive the violations of the prohibitions. It is necessary to study closely the policy clauses and local conditions in order to provide for proper indorsements granting necessary privileges.

"Probably one of the least understood conditions of insurance is the co-insurance clause. Practically every fire insurance policy covering property of the gas or electric utility contains a small clause tucked in among the various other clauses on the form attached to the policy, known as the co-insurance clause. Though short,



GRAPHIC PRESENTATION OF DATA SHOWING RESULTS OF HYDRO-ELECTRIC DEVELOPMENT

it has a powerful effect in the settlement of a loss as to whether the insurance company makes full restitution for damage by fire or only a proportionate amount. The wording of this clause is as follows:

"'This company shall not be liable for a greater proportion of any loss or damage to property described herein than the sum hereby insured bears to 80 per cent of the actual cash value of said property at the time such loss shall happen.'

"It is a very inoffensive looking little clause, but it has caused many a one to find, when it came to adjust a loss, that although considerable premium had been paid, not much protection had been acquired. The percentage of value used in the illustration is 80, as that is the usual percentage, though oftentimes 90 or 100 per cent may be agreed upon.

"This clause requires that the insured carry insurance to the value of at least 80 per cent or other specified percentage of the actual cash value of the property at the time the loss occurs. There are two questions involved—first, the required percentage carried; second, the sound or actual cash value.

"The best way to illustrate this clause is by two examples. Taking for granted that the sound or actual cash value of a property is $20,000, then if a loss occurs, adjustment would be made on the following basis:

100 per cent value of property	$20,000
80 per cent value, amount of insurance carried as required by the clause	16,000
Damage by fire	8,000
Insurance company pays full amount of loss	8,000

"Another example, using the same basis of cash value:

100 per cent value	$20,000
80 per cent value, amount required by the clause	16,000
Insurance carried, half of required amount	8,000
Damage by fire	8,000
Insurance company pays half loss	4,000
Insured loses one-half, equivalent to one-half the amount carried by himself	4,000

"These two examples illustrate the operation of this clause. In the first example the full amount of insurance as required by the clause is carried and the full amount of any loss up to the face value of the policy may be collected. However, the second example illustrates the danger of under-insurance, or non-compliance with one of the articles of the contract. The insured feels that only a portion of the building will burn, and not having sufficient knowledge of the operation of the co-insurance clause, and desiring to save on premiums, insures for only one-half the amount required. If a loss occurs, and fires sometimes break out most unexpectedly, money is lost in two ways—first, because premium was paid on insurance which cannot be collected, and second, because part of the loss has to be borne by the insured.

"The part of the clause explained above shows how it operates, provided that the actual cash value is determined. This actual cash value or sound value is another section of the clause that is frequently misunderstood. The actual cash value is not the original cost of the property nor its market value today. It is the replacement value new of the identical property destroyed, less proper amount for depreciation. Owing to the greatly increased costs of materials today, it may be readily seen how the replacement value new today, less depreciation, will probably exceed the original cost of the property. Therefore, in figuring how much insurance should be carried in order to comply with the co-insurance clause, the original cost should not be used, but the actual cash value. Otherwise at the time of a loss the adjustment would be figured to the disadvantage of the insured, who probably in good faith had believed the requirements of the clause were fulfilled. It follows, then, that in order to avoid contribution in case of loss, insurance should be maintained at all times at adequate values."

New York Company Conducts School for Meter Readers

WITH a view to increasing the efficiency of its meter readers and at the same time improving the service to customers, the United Electric Light & Power Company of New York conducts a short school course of instruction for meter indexers. The schedule of the course requires six days to complete and covers the essential features of the work of the employee. In addition, questions of public relations are discussed and the company's policy is outlined. The schedule follows:

First day: First half, register—its principles and operation; second half, instructions in reading.

Second day: First half, practice reading; second half, method of gaining access.

Third day: First half, principles of electricity; second half, principles of meters.

Fourth day: First half, principles of meters, talks on the company; second half, talks on the company, practice reading.

Fifth day: First half, practice reading; second half, difficult locations, misplaced and missing pointers.

Sixth day: Examination.

As a constant reminder of the instruction he has received, the accompanying "Notice to Indexers" is placed inside of the employee's index book for ready reference should the occasion arise.

NOTICE TO INDEXERS — *BE CAREFUL BE ACCURATE BE COURTEOUS*

Write neatly and distinctly, so that indexes may be easily read
Index every meter—skips are not evidence of good work and should be kept down to the lowest number possible
Keep down the number of skips and enter on skip sheets

SPECIAL INSTRUCTIONS TO INDEXERS

Locations of Meter Abbreviations

A	Area	E	Engine Room
Apt	Apartment	H	Hall and designation as in HB
B	Basement	HUS	" under stairs
HB	" of Hall	M	Motor Room
C	Cellar	ST	Store
C st	" of Store	TH	Transformer House
S M	Seal missing or cut	WC	Toilet

Check Locations When Reading

The Following Abbreviations to be Used

O K	Noted reading index verified	C	In country
C F	Cannot find or locate	V	Vacant
D R	Does not register	M	Moved
D I S	Meter disconnected	N T	New tenant
N I	Not in use	(Give name, also new address of old tenant on memo)	

NOTES

All indexers should carefully read and familiarize themselves with the contents of "Rules and Regulations for Meter Readers," a copy of which is given them.
Your figures in this book under a meter number indicate that you saw the meter and read the index. False reports of indexing call for peremptory dismissal.
Copying reports of a previous indexer—too many errors—too many skips—means an inefficient man and will call for dismissal
Before coming in make another call on skips
Don't guess at an index.
Don't stand on toilets, wash basins, etc., in order to read a meter—also, don't hold on to water pipes or tanks.
Report all abnormal conditions which may come to your attention.
If a meter has been changed and the old meter is still in the book, write the new number under the old one and the reading in consecutive space under current date.
Indexers should politely refuse to give information relative to rates, amount of bill, etc., requesting the consumer to communicate with the Company's office for such information. Should the consumer confine his request to the index reading of the meter, this information may be given.
Don't fail to make out your skip sheet and number of meters read.
Remember that the consumer is presumed to be right in the absence of evidence to the contrary, and complaints must be accepted and investigated on this basis.

The UNITED ELECTRIC LIGHT and POWER CO.

130 East 15th Street, New York *Branches:* 89th St. & Broadway 146th St. & Broadway

CONDENSED RULES AND REGULATIONS FOR METER READERS

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Development in Radio Generators for the Army and Navy.—F. I. HISS.—The writer gives some details of the development of the wind-driven generator designed for airplanes during the war and still in process of development at the time of the armistice. It is said that every machine has a steady voltage up to 12,000 r.p.m. and that commutation was perfect up to 8,000 r.p.m. Overspeed tests for one minute up to 14,000 r.p.m. were given to each machine. These qualities were obtained in part as follows: (1) Armature diameter was reduced to 2½ in. (6.4 cm.) over all; (2) a very large shaft was used having a ¾-in. (1.9 cm.) diameter inside the core; (3) armature punchings were given the rather heavy press fit on the shaft of 0.004 in. (0.102 mm.). A 1,500-volt dynamotor for operating the wireless telegraph on navy seaplanes is also described.—*Journal A. I. E. E.*, December, 1920.

Lamps and Lighting

High Cost of Poor Lighting.—R. E. SIMPSON.—The author shows that in plants of 1,000 employees where the lighting bill may be $375 per month the total bill may easily be increased one-third on account of the average accident rate due to improper or defective lighting. By similar illustrations of this nature the author points out the desirability of improvement in factory illumination.—*Transactions Illuminating Engineering Society*, Nov. 20, 1920.

Generation, Transmission and Distribution

Power Costs During the Years 1914 to 1919.—HUBERT E. COLLINS.—A comprehensive summary of the records of fourteen representative plants giving unit generating costs for the years under consideration. The plants discussed are in Connecticut, Massachusetts, New York, New Jersey and Pennsylvania. An interesting table giving the variation in costs of the principal items which went to make up the total generating costs during the years 1914 to 1918 is included as follows:

	Average Cost per Kilowatt-Hour				
	1914	1915	1916	1917	1918
Wages	$0 00159	$0 00147	$0 00147	$0 00168	$0 00198
Water	0 000131	0 000168	0 00013	0 000157	0 000189
Fuel	0 00313	0 0035	0 00358	0 0045	0 00443
Department on building	0 00127	0 00123	0 00098	0 [illegible]	0 001
Department on machinery	0 00338	0 00325	0 0026	0 00267	0 00267
Total cost	$0 009501	$0 009618	$0 00876	$0 009987	$0 010269

The author also gives the central-station charges for energy in these plants.—*Sibley Journal*, October, 1920.

Water Power of the Feather River and the Caribou Development of the Great Western Power Company.—J. H. ANDERTON.—Four principal sources of water power in California are as follows: Pit River, 310,000 kw.; Feather River, 486,000 kw.; Kings River, 205,000 kw., and San Joaquin River (Big Creek), 710,000 kw., making a total of 1,711,000 kw. The Feather River is discussed in particular, and some description is given of the Caribou development of the Great Western Power Company, the final capacity of which will be 120,000 kw. with six units, the initial capacity being 40,000 kw. The construction under way includes approximately 22,500 ft. (6,860 m.) of tunnel, 2,200 ft. (670 m.) of pipe line, a dam in Butt Valley, a power house and other work. Details of the power-plant equipment are given and the following tabulation concerning the 185-mile (300-km.) transmission line to Oakland is included:

	No Condenser	With Condenser
Load received, approximately	0	0
Generator volts	133,750	165,000
Receiver volts	150,000	150,000
Generator, kva	18,800	2,100
Generator, power factor—lead	2.04	40 1
Voltage drop in per cent of generator	—10 2	9 09
Condenser, kva., lag	.....	21,700
Load received, kw	54,000	54,000
Generator volts	220,800	165,000
Receiver volts	150,000	150,000
Generator, kva	75,400	60,850
Generator power factor, lag, per cent	83 5	100
Efficiency of transmission, per cent	85.6	88.7
Voltage variation generator end, per cent	65	0
Regulation receiver end with loss of load and condensers, per cent	62.2	21.2
Regulation line and transformers, with loss of load and condensers, per cent	81.9	19.3
Maximum voltage receiver end	243,300	182,000
Condenser, lead, kva		47,000
Minimum insulation, volts	250,000	190,000

The initial operation will be at 110,000 volts, which will ultimately be raised to 165,000.—*Stone & Webster, Journal*, October, 1920.

A Super-Power Plant for Utilization of Peat.—F. BARTEL.—The author has worked out detailed plans for a 120,000-kw. steam-electric power station for the utilization of peat taken directly from the peat bog. The plant is calculated for a total production of 400,000,000 kw.-hr. a year, and the peat consumption is estimated at 920,000 tons a year. The special equipment necessary for transporting and storing the fuel is dealt with in great detail, and the general lay-out of the projected plant is shown on maps and tracings.—*Elektrotechnische Zeitschrift*, Nov. 4, 11, 25, 1920.

Traction

Chicago Electrification and Elevation on Chicago, Milwaukee & St. Paul Railway.—Plans are in process of construction for the operation of passenger traffic over an elevated railway and freight traffic below it in the vicinity of Chicago. The plans provide for the passenger traffic to be handled by a third-rail system and freight traffic by trolley. This work is being carried out on the Evanston division of the system.—*Engineering News-Record*, Dec. 23, 1920.

Installations, Systems and Appliances

Protective-Relay Applications and Testing Practice.—H. P. SLEEPER.—The author says that current relays with selective time setting should be used on radial systems, whereas with ring and parallel-feeder systems

directional relays are especially applicable. Various connections necessary for machinery protection are also taken up.—*Electrical Review*, Dec. 4, 1920.

Electrically Driven Tin-Plate Mills.—W. E. TAYLOR.—A comparison between the Welsh and American methods.—London *Electrician*, Nov. 19, 1920.

Electrophysics and Magnetism

Current Flow Around a Submerged Insulated Wire.—O. OLDENBERG.—According to a recent invention a unipolar submarine cable carrying an alternating current and which is at its far end put in electric connection with the surrounding water is utilized for guiding ships through narrow passages during fog. The author studies analytically the field of flow in the water around such a cable. The problem leads to differential equations similar to those appearing in the theory of skin effect in round conductors. The solutions express themselves in terms of Bessel functions of complex arguments. In passing from the surface of the wire outward one will find not only a varying current density but also a rotation of the phase angle. The phenemenon thus has the characteristics of a tranversal wave motion. At 25 cycles the "wave length" is 448 m. and the waves are very strongly damped. Approximate expressions are given for the resistance, inductance and capacity of the cable as functions of the frequency. The author extends his analysis also to the case of an iron-sheathed cable.—*Archiv für Elektrotechnik*, Nov. 8, 1920.

On the Effective Capacity and Resistance of a Condenser for High-Frequency Currents.—By careful experiments on the free oscillations of a Lecher system, as the capacity of the end condensers is changed by increasing the elastic coupling, it is found that the capacity of an air condenser is independent of the frequency of oscillation. Rayleigh's equation for the effective stiffness (elastance) of a circuit due to the mutual elastic reactions between two circuits each containing inductance, capacity and resistance is verified. Use is made of his equation for effective resistance to determine the mutual resistance of two reacting circuits.—*Physical Review*, December, 1920.

Units, Measurements and Instruments

Statical Methods of Calculating the Potential Relationships and Fault Resistances of Direct-Current Networks.—G. W. STUBBINS.—The author points out the similarity between problems in statics and the design of cable networks. The same methods apply to testing for fault resistance in direct-current networks, which depends upon potential relationships under the varied conditions.—London *Electrician*, Nov. 19, 1920.

Multiple-Unit Shunts for the Measurement of Very Heavy Currents.—M. B. FIELD.—The difficulty of bringing 50,000 amp. to the conductor blocks which support the high-resistance strips of the shunts in common use and making adequate contact there, together with the uncertainty of the distribution of current through the mass and inability to test the unit at anything approaching full load, render such a high-current shunt impracticable. It is the author's opinion that 6,000 amp. is about the practicable limit of carrying capacity of a single unit. Beyond this limit the objections enumerated render such construction incompatible with good engineering. — *Journal Institution of Electrical Engineers* (British), August, 1920.

Some Applications of the Photoelectric Cell to Practical Photometry.—W. E. STORY, JR.—From the experiments carried on it is concluded that the photoelectric cell offers advantages in commercial photometering: (1) Freedom from the personal judgment of the operator; (2) sensitiveness over a considerable range of applied voltage; (3) possibility of controlling accurately large quantities of energy through the operation of relays; (4) automatic registering of changes of illumination. Its limitations are said to be: (1) A gradual change of sensitivity with time; (2) a color sensitivity differing to marked degree from that of the eye; (3) the difficulties of insulation met with in dealing with certain very small currents.—Paper presented before the Illuminating Engineering Society, Oct. 18, 1920.

Electrochemistry and Batteries

Methods Used in Modern Electric Vehicle Service Station.—Details regarding the most important methods of charging storage batteries, the charging apparatus, with other information regarding the conduct of the electric vehicle service station.—*Electrical Review*, Dec. 25, 1920.

Telegraphy, Telephony and Signals

Report of the Chief Signal Officer United States Army.—Report to the Secretary of War for 1920 includes a discussion of organization, engineering and research, commercial service, procurement division for the purchase of equipment, etc.—June 30, 1920.

Contribution to the Theory of Magnetic Frequency Changers.—J. ZENNECK.—Using iron core one-to-one transformers with or without supplementary direct-current excitation, the well-known magnetic frequency doublers and triplers can be arranged. The theory of these is developed, assuming a cubic relation between flux and field intensity. The emf. in the secondary, the effect of supplementary direct-current excitation, the primary current and phase and the secondary current for the unloaded doubler are derived. The results are extended to the loaded doubler, the efficiency and operating characteristics of which are calculated. The modification of the derived formulas due to iron hysteresis is obtained. The theory is clearly illustrated by a number of calculated curves, of which the primary current-voltage curves show an interesting combination of stable (rising) and unstable (falling) portions. The resulting desirable methods of practical operation are fully considered. The theory is to be further developed to cover phenomena dependent on iron saturation above the knee point of the magnetization curve.—*Proceedings Institute of Radio Engineers*, December, 1920.

Miscellaneous

Standard Testing Laboratory in Germany.—The German society of electrical engineers (Verein deutscher Elektrotechniker, or V. D. E.), according to an announcement by Secretary-General Dettmar, made at an "electrical week" in Hanover, Sept. 24-30, has established a semi-official laboratory for testing electrical material and appliances. The aim of the laboratory is to keep out of the German market such articles as do not fulfill the requirements of the V. D. E. standardization rules. When a new product or a new line of apparatus or machinery has been tested and found up to the mark, the manufacturer gets a certificate permitting him to mark his product with a special sign copyrighted by the V. D. E.—*Elektrotechnik und Maschinenbau*, Oct. 31, 1920, and *Elektrotechnische Zeitschrift*, Oct. 21, 1920.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALTERNATORS, FLUX HARMONICS ON SHORT-CIRCUIT.

It was shown by the writer in an A. I. E. E. paper on "Sustained Short-Circuit Phenomena and Flux Distribution of Salient-Pole Alternators" that, starting with a commercially smooth field-flux wave, consisting, say, of +100 per cent first harmonic, +10 per cent third and +5 per cent fifth, and an armature flux wave having corresponding harmonics of —95 per cent, +10 per cent and +5 per cent, the resultant flux distribution will be extremely distorted. The third and fifth harmonics apparently are the most important ones and are several hundred per cent of the fundamental. The writer has investigated also non-salient-pole alternators, and he hopes to publish the results soon. It would be well for others to check the conclusions of the paper referred to for salient, and particularly for non-salient, machines. The results of such an investigation will have great bearing on the A. I. E. E. standardization rules for efficiency tests, for cyclic heat-run tests, short-load tests, etc.—*N. S. Diamant, Lockport, N. Y.*

BRIDGE, HIGH-FREQUENCY.

A high-frequency bridge has been developed for measurement of inductances, capacities and resistances at high frequencies, and especially at radio frequencies up to 1,000,000 cycles. The results obtained are such as to justify the old voltammeter method when reasonable precision is desired. A vacuum-tube oscillator is used as a generator, and for frequencies above 8,000 the indicator is a vacuum-tube detector, the output of which may be fed into a two-step amplifier. With this bridge it is possible to measure inductances or capacities at high frequencies to an accuracy of within one-fourth of 1 per cent of the true value.—*Research Laboratories of the American Telephone & Telegraph Company and the Western Electric Co., New York City.*

BRONZE, BEHAVIOR OF, EXPOSED TO CORROSION UNDER TENSILE STRESS.

Specimens of wrought-manganese-bronze rods were exposed in special steel test frames to corrosion in water and moist air while at the same time under tensile stress with the object of determining the maximum safe stresses for this material under these conditions. None of the test bars fractured within this period under stresses below the proportional limit, and four of the bars withstood corrosion during this period under stresses which produced slight yielding and permanent set when first applied. Fracture did not occur under stresses less than 35,000 lb. per square inch (2,450 kg. per sq.cm.). One specimen with a proportional limit of 35,000 lb. per square inch fractured under a tensile stress of approximately 40,000 lb. per square inch (28,000 kg. per sq.cm.).—*P. D. Merica and R. W. Woodward, Washington, D. C.*

COAL, ILLINOIS, COKING OF.

As a result of extensive tests made on a new coke-oven process, under the supervision of a large staff of Government engineers and chemists at St. Paul, Minn., it is clearly demonstrated that some of the Illinois coals can be coked in the Koppers-type oven without radical change in operating methods for the production of coke which can be successfully used in a blast furnace. However, it appears that the temperature at which Illinois coal should be handled for the production of the best coke is somewhat lower than the best operating temperatures for Eastern coals, and, moreover, the speed of coking of the Illinois coal is somewhat less. The yield of gas and by-products from Illinois coal of the kind tested is excellent both in quantity and quality.—*Bureau of Standards and Bureau of Mines, Washington, D. C.*

CONDUCTIVITY RECORDER.

Many chemical processes can be followed and automatically controlled by means of an electrolytic recorder or controller. A precision instrument of this type has been developed that can be conveniently operated from a commercial alternating-current circuit. The device has proved satisfactory both for industrial applications and for research work where a record covering a considerable period of time is desired.—*Leeds & Northrup Company, Philadelphia.*

GLASS FOR SPECIAL USES.

Among the developments of special glasses are the following: A heat-absorbing and light-absorbing glass for welding goggles; an ultra-violet absorbing glass for spectacles; a glass opaque to visible but transparent to ultra-violet rays which is used in some industries, especially for the sorting of fluorescent zinc ore. Research is continuing along the lines of the properties of various heat resisting [illegible] to measure the stress in the glass just at the breaking point.—*H. P. Gage, Corning, N. Y.*

INSULATOR STUDIES RESUMED.

Following the announcement that Prof. H. J. Ryan of Leland Stanford University, who has conducted insulator studies for several years, has resumed this work after an absence of about a year, the executive committee of the N. E. L. A. voted that the subcommittee on insulator maintenance be instructed to pursue insulator studies with the understanding that the work necessarily must be carried on by its successor next year.

MAGNETIC LOSSES AT HIGH FREQUENCY.

A study of radio apparatus design has yielded the fact that the generally established principles of the alternating current power technique could be applied to the radio technique almost without change. The magnetic properties of iron which had been reduced to an exact science by Steinmetz thirty years ago had to be studied again at radio frequencies, but it was found the Steinmetz laws of hysteresis, eddy currents and skin effect were as accurate at 200,000 cycles per second as at 25 cycles.—*E. F. W. Alexanderson, Schenectady, N. Y.*

PIEZO-ELECTRIC EFFECT.

The piezo-electric effects are very feeble, but have interesting possibilities when amplified by vacuum tubes. It was found that Rochelle salt crystals could be made sensitive when properly grown and treated and mounted in suitable housings. Such crystals are efficient detectors of sound waves, converting them into electrical waves. The effect is reversible, for they are good emitters of tones when corresponding electrical oscillations are imposed upon them.—*Western Electric Company, New York City.*

Suggestions for Research

CLOCKS, ELECTRIC CONTROL OF, BY POWER LINES.

It is suggested that some method be developed by which a control circuit for electric clocks may be superimposed upon a city power system and thus bring the advantage of perfect time control to all residences and power consumers without the necessity of added electric lines. The principle of multiplex telegraph lines, of carrier frequency or of synchronous-motor clocks operated at regulated station frequency might be applied. —*Editorial Suggestion.*

CUTOUTS, PRIMARY FOR LINE TRANSFORMERS.

It is suggested that the development of primary cutouts for line transformers has not kept pace with the development of the transformers themselves. Several of the larger companies install the larger sizes of overhead-line transformers and all sizes of subway types of transformers in manholes without any primary cutout. This difficulty, which is one of long standing, should be eliminated.—*A. I. E. E. Protective Devices Committee.*

FUSES, RENEWABLE, BETTER CONTACT IN.

In some well-known types of renewable fuses the threaded disk which fastens the end of the fusible link is liable to work itself loose, owing to mechanical vibrations, thus making the electrical contact less positive. Moreover, after an explosion the contact surfaces become covered with a little deposit, and after repeated blowing of the fuse the surface may finally make a poor contact. The user can hardly be expected to clean the surface carefully, and for this reason improvements in the construction are desired, keeping in view the two foregoing points.—*Editorial Suggestion.*

FOURIER SERIES, AVERAGE VALUE.

Many electrical problems may be conveniently solved by expanding the variable quantity into a Fourier series of sine and cosine terms. The problem of finding the *effective* or the mean square value of a function represented by a Fourier series is quite simple, and the solution may be found in almost any advanced treatise on alternating currents. The problem of finding the plain arithemtical average is much more difficult and does not seem to be treated in the general form in standard works. The difficulty lies in the fact that the average value depends upon the relative phases of the higher harmonics and involves the proper limits of integration difficult to determine, while the effective value depends only upon the amplitudes of the harmonics, and the limits θ and 2π are always correct. There are problems that involve the average and not the effective value of the variable quantity, and for this reason a general solution with instructions for numerical applications is desired.—*Editorial Suggestion.*

INSTRUMENTS, MEASURING, ALTERNATING-CURRENT FOR PLANT TESTING.

Special instruments are needed for plant acceptance tests which will do for alternating-current power what the deflection potentiometer does for direct current and voltage.—*H. B. Brooks, Bureau of Standards, Washington, D. C.*

OSCILLATING CIRCUIT, THEORY OF.

In the Research Section of April 20, 1918 (ELECTRICAL WORLD, Vol. 71, page 16), a suggestion was made by Louis Cohen regarding the desirability of developing a mathematical theory of an oscillating circuit taking into account the variable resistance of the spark gap. We are pleased to state that at least a beginning in the mathematical treatment of this important problem has been made (see an article by J. Bethenod in the *Revue Générale de l'Electricité;* April 6, 1918, Vol. III, page 499). He solves the problem of both an uncoupled and a coupled oscillating circuit with the simplest assumption of a constant counter-*emf.* across the spark gap, this *emf.* being different for the positive and the negative impulses. The next step would be to assume this counter-*emf.* e to be some simple function of the current i; for example, $e = a + b/i$. Some information bearing upon this subject will also be found in an article by A Blondel and F. Carbenay on "Systèmes Osccilants à l'Amortissement Discontinue," in the *Lumiere Electrique of Nov.* 27, 1915, page 193.—*Editor's note.*

SWITCH, POTENTIAL, FOR ROTATING STANDARD TEST METER.

The committee still reports the lack of a satisfactory potential switch for controlling rotating standard test meters. This switch is an essential part of the testing equipment used by nearly all the companies. The switch should be rugged, simple in construction and of a reasonable cost.—*N. E. L. A. Committee on Meters.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Proposed Texas Utility Act Includes Municipal Plant Regulation

THE committee responsible for drafting a public utilities act for the State of Texas expects to complete its work and submit the bill to the Legislature by Feb. 1. At a meeting of the committee held this week in Austin, Tex., it was decided that municipally owned plants would be placed in the same category as other public utilities so that municipalities would also be required to obtain a certificate of necessity from the commission before a plant is constructed. Representatives of public utilities are objecting to the provision for the appointment of receivers on five days' notice when a utility disobeys an order of the commission. An appeal may be taken from an order of the commission first to the district court and then to the appellate court. W. B. Head and Mr. Pincks of the Texas Power & Light Company are the central-station representatives on the committee.

Illinois to Have New Commission Pending Legislative Action

ABOLITION of the Public Utilities Commission was recommended in Governor Small's inaugural address on Monday. The Governor said: "I pledged the people of Illinois that I would do all in my power to secure the repeal of the state public utilities act, thereby abolishing the state Public Utilities Commission, and that I would recommend the enactment in its stead of a law giving to all cities in Illinois the right of home rule in the regulation and control of their public utilities. I therefore urge the General Assembly to repeal this law."

The message, however, recognized the problems presented where two or more communities are served by the same utility and indicated that some governmental agency was necessary to handle these problems, asserting that such an agency must be prohibited from impairing any contracts between public utilities and corporate authorities unless mutually agreed to and approved by referendum vote of the people affected. The General Assembly is urged by the new Governor to enact legislation permitting Chicago and the neighboring districts, or any other contiguous territory in the state, to establish transportation districts and provide for public ownership and operation of local transportation systems.

That Governor Small will not follow the course of letting the commission die by leaving the commissionerships vacant is indicated by the appointment of Cicero J. Lindley of Greenville, a member of the old Railroad and Warehouse Commission during the Tanner administration, to fill one of the four vacancies caused by the resignations of the entire commission on Monday. This is further borne out by a statement made Wednesday that there would be no change in the present policy of the commission until after April 1 at the earliest and that a new commission would be appointed next week.

Springfield (Ill.) Company to Suspend Because of Franchise Refusal

SERVICE will be discontinued to electric and heating customers on March 10, it was announced by the Springfield Gas & Electric Company of Springfield, Ill., on Monday. This is the outcome of several years' controversy with the city of Springfield, and the date set marks the expiration of the franchises.

Efforts have been under way continuously for several years to reach an agreement on which renewal of the franchises could be made, but have been unsuccessful. During this time offers of sale of the property to the city either for cash or part cash, the remainder to be paid over a twenty-year period, have been made, including a provision for arbitration as to price, with no success. The city has declared that the company will not be permitted to operate after the expiration of its franchises.

Springfield has a municipal plant that has been in competition with the Springfield Gas & Electric Company. On Tuesday the City Council announced that it had decided to buy the properties to forestall shutting off of service.

Employees to Be Represented in Commonwealth Edison Management

PLANS for the representation of employees in the management of the Commonwealth Edison Company were announced a few days ago by Samuel Insull, president of the company. The Public Service Company of Northern Illinois, another Insull property, has had in operation for about six months a joint council plan which is satisfactory. A working draft of the plan has been prepared and will be submitted to the employees shortly. Representatives of the employees and of the management will then meet to consider the question of recommending a constitution for an employee representation plan.

One of the features of the plan is the establishment of an industrial relations department with a manager charged with administering a comprehensible personnel and employment policy. This department will be headed by Homer E. Niesz, formerly assistant to the vice-president in charge of contract, operating, construction and electrical departments. There is also created in the department the position of "dean of women" for promoting "the well-being and the representation of women employees."

The new plan was announced to the employees on Jan. 7 by President Insull in the following letter:

Employee representation plans have been developed in

connection with modern management of industry. Many large organizations, both those operating in a single city like our own company and those operating at scattered points, have such plans working to the mutual benefit of the management and the employees. While few utilities have such plans, the experience of the Public Service Company of Northern Illinois and its employees with a joint council plan is satisfactory.

The object of an employee representation plan is to insure mutual understanding, fairness and harmony between the employees and the management. Such a plan sets up a definite channel for recommendations and appeals by the employees on all matters affecting the particular interests of any employee or group of employees and the mutual interests of the management and the employees.

Under the best of these plans there is provision for elected representatives of the employees, who take up matters with the departmental officials or submit them to departmental joint councils made up of elected employee representatives and appointed representatives of the management having equal voting power. Provision is also made in these plans whereby the employee representatives on a departmental joint council can appeal to higher officers of the company and to higher joint councils, also made up equally of management representatives and employee representatives. Finally, provision is made that if a matter comes up through this channel to the president of the company and he is unable to reach an agreement with the employees' elected representatives, there shall be arbitration.

Another general feature of such plans is the establishment of an industrial relations department headed by a manager of industrial relations charged with administering a comprehensive personnel and employment policy. Among his duties are acting as an impartial intermediary between the employees and the management, promoting the interests of the employees and assisting in the operation of the employee representation plan.

For some time the company has been working on this subject, with the assistance of industrial engineers and personnel advisers of the Bureau of Commercial Economics, Inc., of Chicago. Special study has been made of practical experience under many of the plans in operation by some three hundred companies in the United States. The question of adapting such a plan to our organization and of introducing it in our service has been carefully considered, and a working draft of an employee representation plan has been prepared which we believe would be suited to our organization and would promote the best interests of the employees, the supervisory force, and stockholders and the public.

We now wish to secure the advice of the employees and of the supervisory force on the subject of employee representation and on this working draft of a plan, and for this purpose it is proposed to hold in the near future a convention to which the employees of all classifications will elect delegates to meet with representatives of the management to consider the question of recommending a constitution for a plan of employee representation. The convention will be called and presided over by Homer E. Niesz, who has been appointed manager of industrial relations. Mr. Niesz will vacate his former position and will devote his entire time to the work of the industrial relations department, including the impartial direction of the introduction of an employees' representation plan.

Merger of Small Pennsylvania Utilities

APPROVAL has been given by the Pennsylvania Public Service Corporation to the merger of the M. E. Kraybill Light, Heat & Power Company, Carroll Township Electric Company, Monroe Township Electric Company, Upper Allen Township Electric Company, South Middleton Township Electric Company and South Mountain Electric Company into a new corporation, the Cumberland Valley Light & Power Company. Officers of the new company, which will have headquarters at Harrisburg, Pa., are Farley Gannett, president, and Samuel W. Fleming, secretary.

New Power Again Available for Jackson Industries

THE addition of nearly 1,800 new customer stockholders during the last nine months and the rapid progress made with plant improvements and new construction have made it possible for the Consumers' Power Company to lift the ban on all new power business which was put into effect in Jackson, Mich., last March. A limited supply of new power will now be available whenever general conditions demand the full resumption of industrial activities in the district.

Public Utilities Bureau for Wisconsin

THE Wisconsin electric, gas, telephone and other public utilities have established the Wisconsin Public Utilities Bureau at Milwaukee under the charge of Frantz Herwig, a former Milwaukee newspaper man. "We propose to deal with human interest as well as economic facts," said Mr. Herwig. "The utilities seek nothing else through our bureau except fair play and just treatment, so as to enable them to supply the public with the very best gas, electric or telephone service, and desire so to conduct their industries as to enable them to pay their employees more than a mere living wage and to provide the men who have invested their money in the industry with a reasonable return on the investment. Therefore our bureau means to tell the people the truth and then be content to let the people judge the merits of the utilities case, for after all it is the public that suffers or prospers as the utility suffers or prospers."

Hydro-Electric Symposium in Philadelphia Next Week

A SYMPOSIUM on hydro-electric power and distribution will be held at the Manufacturers' Club of Philadelphia during the afternoon and evening of Jan. 21 under the auspices of the Engineers' Club of Philadelphia and the Philadelphia Section of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. The program of the meeting includes the following papers:

"The Modern Hydraulic Turbine" (illustrated), by Frank H. Rogers, hydraulic engineer I. P. Morris Department, William Cramp & Sons Ship & Engine Building Company.

"The Application of a New Method of Water Measurement in the Efficiency Tests of the 37,500-Hp. Turbines of the Niagara Falls Power Company" (illustrated), by Norman R. Gibson, hydraulic engineer Niagara Falls (N. Y.) Power Company.

"Surges in Conduits and Other Hydraulic Problems" (illustrated), by Raymond D. Johnson, consulting engineer, New York City.

"The Present Trend of Hydraulic Turbine Development" (illustrated), by Lewis F. Moody, consulting engineer I. P. Morris Department, William Cramp & Sons Ship & Engine Building Company.

"Niagara Falls Power Development and Its Products in Philadelphia" (illustrated), by John L. Harper, vice-president and chief engineer Niagara Falls Power Company. Colored moving pictures, covering power-house equipment at Niagara, scenic views of Upper Rapids, the Cataracts, Goat Island, etc., construction views of the new 100,000-hp. extension and the erection of the world's largest hydro-electric units.

"Electrical Features of Hydro-Electric Power" (illustrated), by David B. Rushmore, chief engineer power and mining department General Electric Company, Schenectady, N. Y.

Detroit Edison Issues $5,532,600 of Ten-Year 8 per Cent Bonds

AN ISSUE of $5,532,600 in ten-year 8 per cent convertible debenture gold bonds, due Jan. 10, 1931, has been made by the Detroit Edison Company at par. A substantial amount of these bonds has already been subscribed for by the stockholders of the company. The bonds are convertible between Jan. 10, 1923, and July 10, 1930, at the option of the holders, into paid-up shares of the capital stock of the company at par.

Senator Calder Introduces Bill to Regulate Coal Industry

SENATOR CALDER of New York, chairman of the United States Senate's committee on reconstruction, which has just concluded an investigation into the bituminous-coal situation, on Wednesday of this week introduced a bill which seeks to regulate the coal industry of the United States and declares the ownership, production, sale and distribution of coal throughout the country to be "charged with public interest and use." By the terms of this bill coal operators and others engaged in the coal business must give to the government at stated intervals complete reports as to their business activities. It gives to the President of the United States in any period of emergency the right to fix maximum prices, to direct production and distribution and, if need be, to engage in the sale of coal to the people.

In commenting upon his bill Senator Calder accused the coal operators of engaging in biased and self-serving methods of publicity and of concealing the facts of the coal situation from the public. Profiteering, he asserted, had been proved and admitted, but a controversy exists as to its extent and its promoters and beneficiaries. The bill aims to make such practices impossible. It does not set up any new governmental machinery, but utilizes the experienced agencies in existence, chiefly the Federal Trade Commission, the Interstate Commerce Commission and the Geological Survey.

Wide Ownership of Industries Will End Labor Unrest, Says Doherty

MAKE the people part owners by their investment in the preferred stocks or bonds of those industries which furnish occupation to the workers and differences between capital and labor, bolshevism and unrest will cease automatically, Henry L. Doherty declared in an address entitled "Benjamin Franklin and Modern Ideas of Thrift" before the New York Electrical Society on Jan. 12.

"When the worker becomes an owner of a security of a corporation," Mr. Doherty said, "he at once becomes a capitalist with the capitalist's viewpoint. The whole trouble with capital has been that it has considered itself the aristocrat of the business world; it is snobbish and has turned a cold shoulder to the small investor. I should like to see everything in the nature of class distinction wiped out, and one of my ambitions is that Henry L. Doherty & Company be known as a democratic investment house.

"There never was a time when money could be invested with as great security and at such high interest rates as at present. Among the electric utilities there are first-mortgage securities which can be purchased at a price representing only 17½ per cent of the reproduction value of the property covered. However, I am not advocating exclusively the purchase of utility securities; in fact, I am recommending to our own employees a diversity of investment.

"I do not believe any company should advise its employees to confine their investments entirely to the industry in which they are employed. It is too great a risk, for should that company meet reverses the man not only loses his money and probably his employment but his confidence is destroyed.

"Make the American people thrifty, get them interested in corporation securities, make them partners in capital, and our troubles are nearly over," concluded Mr. Doherty.

N. E. L. A. Commercial Committee Men See Benefits in High Freight Rates

ALMOST every phase of central-station commercial work was covered in the discussions of the wiring committee and the various committees of the Commercial Section of the National Electric Light Association at their meetings in Chicago this week. As it is planned to hold the national convention earlier than usual, probably in May, all committee chairmen and others were urged to get their reports into headquarters as close to March 1 as possible.

The Lighting Sales Bureau has the industrial lighting exhibits well under way and plans to feature better home lighting at the convention.

Members of the Power Sales Bureau reported that the increased freight rates are of benefit to the central-station industry as a whole because they tend to localize manufacturing industry and thereby to spread industrial development over the entire country instead of concentrating where power is exceptionally cheap. An outside agency is conducting a survey for the Electric Vehicle Bureau to determine the present status and commercial possibilities of this means of transportation. The "Electrical Salesman's Handbook" has been changed from a free to a self-supporting basis, and during this transition period the committee in charge is trying the experiment of publishing a few sections to find out the extent of the demand.

Tests which will determine the durability, efficiency, etc., of various household appliances are being standardized by the wiring committee, which, however, does not attempt to recommend the use of any particular appliance.

Water-Power Hearing Not to Be Postponed on Mere Request

A NUMBER of the applications pending before the Federal Power Commission have passed the advertising period, but in no instance is the case ready for submission to the commission. The commission ruled at its meeting on Jan. 10 that hearings on applications will not be postponed on the mere request of objecting persons. In each case such a request must be fortified by a good reason.

A public hearing on the Great Falls project on the Potomac River, near Washington, D. C., will be held in the office of the Secretary of the Interior on Jan. 20 before the commission.

Ohio Commercial, Technical and Meter Men Meet Next Week

COMMERCIAL, technical and meter committees of the Ohio Electric Light Association have meetings scheduled for next week. The group of meetings commences at Cincinnati on Wednesday, when the new-business co-operations committee will discuss a paper by C. C. Henderson describing some of the industrial electric heating installations in Toledo. The transmission and distribution committee meets the next day in Columbus to take up the subjects of "Economical Voltage for Distribution from High-Tension Transmission Lines" and "Surge and Lightning Arresters and the Bennet Arresters." This meeting will be held at the Ohio State University, the electrical department of which will be inspected. The third meeting will be under the auspices of the meter committee and will be held at the Hotel Statler, Cleveland, on Friday. The papers to be presented will deal with rate engineering as it affects metering and the development of new types of meters.

Fire Hazard of Oil Transformers to Be Discussed by Western Inspector

THE fire hazard involved in the use of oil-insulated transformers will be discussed at the Detroit meeting of the Western Association of Electrical Inspectors, Jan. 25 to 27. Location and construction of vaults along safety lines without excessive costs, ventilation and drainage and the installation of protective equipment will be considered. Central-station men are expected to take part in the discussion. The National Electrical Code grounding rules are to be talked over, and the electric fixture and motion-picture-theater hazards are on the program for full discussion.

Growing Interest in Industrial Lighting Exhibit

INTEREST in the industrial lighting exhibit program which is being promoted by the lighting department of the N. E. L. A. is steadily growing, and favorable progress is reported as having been made. There are now permanent exhibits at Baltimore, Chicago, Cincinnati, Kansas City, New York and San Francisco, and plans are under way for demonstrations in Boston, Los Angeles, Jersey City, Portland, Seattle, Pittsburgh, Buffalo, New Orleans, Rochester and Indianapolis. The Buffalo show is to start by the week of Feb. 13 so as to be under way during the convention there of lighting-fixture men.

At the meeting of the Lighting Sales Bureau in Chicago on Monday a recommendation from Clarence Law, chairman of the educational exhibits committee of the lighting department, to the effect that there be included in the program a residential lighting exhibit was favorably received.

The industrial lighting exhibit has got well under way in New York, where a comprehensive plan has been worked out. It is the intention of those in charge of the exhibit to establish a definite time one day each week when a demonstration will be made for all interested. Moreover, all conventions to the city will be invited to see the exhibit and make the demonstration one of the convention sessions.

In addition plans are being made for demonstrations before each of the following groups: Central-station employees, contractors' associations, jobbers' associations, lamp manufacturers' representatives, reflector manufacturers' representatives, State Labor Bureau (division of factory lighting inspection), educational institutions (including Columbia University, New York University, Stevens Institute and the College of the City of New York), organizations representing industries, the Chamber of Commerce, the Merchants' Association, the Fifth Avenue Association, city underwriters' inspectors, state inspectors, inspectors of the Department of Water Supply, Gas and Electricity, public utility representatives and building management associations.

H. W. Blake Celebrates Thirty Years as "Electric Railway Journal" Editor

IN APPRECIATION of his thirty years of editorial service with the *Electric Railway Journal* and its predecessor, the *Street Railway Journal*, a dinner was tendered to Henry W. Blake, senior editor of the paper, on Jan. 6 by his associates in the McGraw-Hill Company.

After graduation in 1886 as a civil engineer from Yale Mr. Blake took a course in electrical engineering in the Massachusetts Institute of Technology, then



H. W. BLAKE, WHO HAS JUST ROUNDED OUT THIRTY YEARS AS EDITOR OF "ELECTRIC RAILWAY JOURNAL," AT HIS WORK

became connected with the Sprague Electric Railway & Motor Company, handling advertising and publicity work. When he joined the *Street Railway Journal* staff in 1891 the argument between cable and electric advocates was at its height, not to mention such minor antagonists as the compressed-air car, the storage-battery car, the combustion engine, etc. Heavy electrification of any sort, such as the Baltimore tunnel work, was still four years away. In short, he entered this work during a period of unparalleled activity of invention, promotion, financing and construction in the street-railway field. In 1894 he became editor-in-chief, with results to the paper that speak for themselves. For, as one of his long-time associates put it: "Mr. Blake has indelibly written his very life into the columns of the *Electric Railway Journal*, which stands as a monument to his thirty years' endeavor."

As an editor Henry W. Blake is pre-eminent for his sense of fairness, for his well-nigh universal knowledge of the field and for what editors among themselves call "balance"—the just apportionment and interpretation of news values. He has always enjoyed the confidence and whole-hearted co-operation of the publisher in the upbuilding of the *Journal*.

To Discuss Rural Service Problems at Indiana Meeting

THE forty-first annual meeting of the Indiana Engineering Society will be held at the Claypool Hotel, Indianapolis, Jan. 27 and 28. The first evening will be devoted to a joint meeting with the A. I. E. E., A. S. M. E. and Indianapolis Scientech Club with the following program: "Operating Characteristics of Small Steam-Driven Pumps," by L. V. Ludy, Lafayette; "Some Problems in Supplying Electric Power Service to Rural Communities," by D. D. Ewing, Lafayette; "Lightning Protection for Rural Transmission Lines," by D. L. Curtner, Lafayette, and "The New 600,000-Volt Testing Laboratory at Purdue University," by C. F. Harding, Lafayette.

Preliminary Draft of Remaining Water-Power Regulations Completed

THE preliminary draft of the remaining water-power regulations has been completed by O. C. Merrill, executive secretary of the Federal Power Commission. These regulations will form the basis of discussion at a public hearing which probably will take place early in February. At that time an opportunity will be given to all interests concerned to discuss the regulations and to suggest changes.

Power-Factor Correction Has Been Shown to Pay

A CAREFUL study of motor application in an industry with a view toward power-factor correction will usually produce rather startling results, P. T. Vanderwaart, electrical engineer of the New Jersey Zinc Company, asserted, in his paper on "Power-Factor Correction and Its Relation to Plant Operation," read before the Philadelphia Section, Association Iron and Steel Electrical Engineers, on Jan. 8.

In plant No. 1, a case cited by Mr. Vanderwaart, the horsepower in motors released by such a study was 2,640, while the cost of new motors and reapplication of old ones was $1,400. Substation capacity to the value of $600 was also released. The power factor of the maximum demand was raised from 76.5 per cent to 82.1 per cent through this study. The saving in energy is not so important, as the weighted average efficiency was only raised from 87.7 per cent to 88.3 per cent. A study of plant No. 2 produced even better results, the value of motor horsepower released being $3,400 and the cost of making changes $1,800. Substation capacity released was valued at $700. Mr. Vanderwaart showed how it was possible to make such surveys of a plant through the use of record systems and a liberal use of instruments. The application and economies of other power-factor correction methods were also brought out.

In the discussion which followed, James Allen, Counties Gas & Electric Company, said that industrial men could well afford to make a study of this kind as the question of rates, including power-factor clauses, would soon make it worth while. Mr. Vanderwaart was of the opinion, however, that the power-factor clauses were not severe enough to make it profitable to study the question from that standpoint alone and suggested that the base power-factor requirement should be made higher in most cases.

C. W. Pilse, consulting engineer, Philadelphia, pointed out that the spot-welding load is one which should have careful study because of the transformer light-load characteristics.

E. S. Jeffries, president of the national association, stated that the body had been asked by the American Engineering Standards Committee to act as sponsor for a standardized set of crane specifications. These specifications have been prepared by a committee and will be submitted to the various sections of the association for suggestions.

No Change in Control of Niagara, Lockport & Ontario Power

A REPORT to the effect that a substantial block of stock of the Niagara, Lockport & Ontario Power Company which carries the controlling interest has been sold to a group of bankers representing the General Electric Company, the Aluminum Company of America and the Schoellkopf interests of Niagara Falls is stated by Fred D. Corey, president of the power company, in a telegram to the ELECTRICAL WORLD, to be untrue. Mr. Corey says that none of the above companies acquired any stock of the power company. The reports further stated that the stock was purchased from the Albright interests, which are credited with controlling the company for many years. Mr. Corey said in his dispatch that the Albright interests have not retired and that the management of the company is and will continue to be the same as heretofore.

The Niagara, Lockport & Ontario Power Company is engaged in transmitting power to industrial plants, utilities and transportation companies in western New York, including Syracuse, Rochester, Medina, Batavia and other towns and villages. The company absorbed the Salmon River Power Company, with a 31,680-kva. capacity, three years ago and leases from the Northern New York Power Company its 12,000-kva. plant on the Oswego River. It operates at Lyons a 37,500-kva. steam plant and a smaller one of 1,500 kw. capacity at Auburn. In addition, the company purchases 60,000 hp. from the Ontario Power Company.

Favorable Report Expected on Water-Power Bill Personnel Amendment

THE select committee on water power of the House of Representatives is expected to report favorably to the House the Esch amendment to the water-power act, which will enable the Federal Power Commission to employ its own personnel. Of even greater importance is the fact that the amendment will make it possible for the commission to receive the increased appropriations which are necessary if delays are to be prevented in the development of new water-power projects. In his statement to the committee as to the necessity for prompt enactment of the Esch amendment, Oscar C. Merrill, executive secretary of the commission, said:

"One of our jobs at the present time is that of valuing $150,000,000 worth of property. If the national interest is to be protected, men who command high salaries must be engaged. The Interstate Commerce Commission pays salaries from $6,500 to $10,000 for positions of similar character. We cannot hope to get competent men for less. On valuation work alone we already have pending applications involving 738,000 hp. Among these are the hydro-electric developments on the American side of Niagara Falls.

"If we had all the assistance we could properly use and if we were not delayed by requests for hearings, it should not take longer than two or three weeks to act upon licenses in the Washington office after the advertisements have been completed and the field reports submitted. We would not be justified in employing a personnel enabling us to have a hundred or more field examinations made simultaneously. It would take at least a year to handle the applications already before the commission with the personnel which we have requested. Under present conditions, our efforts must be directed primarily toward completing the regulations and preparing forms for applications, for permits and for licenses. While we are having field examinations made as rapidly as possible, they must depend entirely upon such field personnel as the departments have available for assignment to this work over and above their own demands upon the same personnel. For example, we have sent to the district engineer of the Forest Service in San Francisco thirty-five applications for examination and report. If he can complete them inside of a year, he is doing well."

Mr. Merrill's statement was interspersed with many questions and observations by members of the committee. Representative Raker of California and Representative Taylor of Colorado were insistent that government expenses must be curtailed and apparently are out of sympathy with any increase in the federal appropriation for the Federal Power Commission. Chairman Esch declared: "This is a poor place to economize. The commission was only organized recently and has a large field of work before it. It has not acquired its trained personnel and cannot build up an efficient organization without this legislation."

New York to Defend State's Rights in Water-Power Hearing

THE Attorney-General of the State of New York has been directed by Governor Miller to test the legality of the federal water-power act relative to jurisdiction over boundary streams. The state's position will be given at the hearing later this month at Washington on granting licenses for power development on the Niagara and St. Lawrence Rivers.

Governor Miller maintains that the authority invested in the Federal Power Commission infringes state rights. This action is expected to have a distinct bearing on the recent attempts to outline a state water-power policy.

To Celebrate Franklin's Birthday Next Week as Thrift Week

NEXT week, the 215th anniversary of the birth of Benjamin Franklin, will be celebrated throughout the country as Thrift Week. This campaign, which is being promoted by the industrial department of the Y. M. C. A. international committee, has an economic program based on the following ten-point financial creed: (1) Work and earn; (2) make a budget; (3) record expenditures; (4) have a bank account; (5) carry life insurance; (6) own your own home; (7) make a will; (8) invest in reliable securities; (9) pay your bills promptly; (10) share with others.

To the electric light and power utilities Thrift Week opens up an opportunity to co-operate in the movement by pushing the sale locally of electric utility securities.

New York Electrical League Elects Officers

AT ITS annual meeting the New York Electrical League on Jan. 12 held an election of officers and talked over business of the coming year. James R. Pollock was re-elected president, while James H. McGraw was elected first vice-president, James H. Betts second vice-president, J. Wynne Jones secretary, and L. L. Strauss treasurer. Directors elected for two years were Walter Neumuller, F. H. Leggett, Harry M. Walter and L. L. Strauss. James H. Betts was appointed chairman of the advisory committee and A. L. Bush chairman of the membership committee.

General Electric's Merchandising Conference Started

A MERCHANDISING conference—sales, service and advertising—with its distributers, dealers and representatives, was started in Newark, N. J., last Monday by the General Electric Company and its associated companies—the Edison Lamp Works, Duplex Lighting Works, Ivanhoe-Regent Works, Sprague Electric Works, Edison Electric Appliance Company, Electric Vacuum Cleaner Company, Hurley Machine Company and the Trumbull Electric Works. While it provides a method of presenting to General Electric distributing jobbers



MODEL WORKING INDUSTRIAL EXHIBIT

and retailers first-hand data pertaining to the products manufactured by these companies, the conference has at the same time the fundamental principle of boosting the sale and use of electrical supplies and wiring materials with a view to overcoming the impression in some circles that the electrical industry is in for a period of dull business.

The plan embraces a trip covering the entire United States, and meetings are scheduled through the first week in May. Specialists from the companies named will cover the various lines represented by means of talks, demonstrations and slides and for properties will use an industrial lighting display, a miniature show window and a revolving stage, 14 ft. x 12 ft. and 12 ft. high, for display of the wiring and lighting of machine-tool work, rooms, etc. By dividing the exhibit into an upper and lower part it has been made possible to show the applications under different schemes of lighting.

A three-day conference has just closed in New York City.

Maryland Electricians Must Give Thousand-Dollar Bond

IN ACCORD with new regulations as adopted by the Maryland State Board of Electrical Examiners and Supervisors, effective Jan. 1, all master electricians in the state who install electrical work of any kind must give a bond for $1,000. This is to insure absolute responsibility for defective wiring. Under the new provision, any person who discovers within a year after the completion of an installation that such wiring was defective can appeal to the board for damages. Frank Stark is president of the board, G. W. Wilkinson treasurer and A. B. James secretary. Other members are Robert E. Cooney and G. E. Painter.

New Head of California Commission for Even Justice to All

ON JAN. 1 Chester H. Rowell, for many years editor of the Fresno (Cal.) *Republican*, took up his duties as president of the California State Railroad Commission, succeeding E. O. Edgerton. In his acceptance of the appointment Mr. Rowell said: "In accepting the appointment as Railroad Commissioner tendered by Governor Stephens I do so with no illusions as to its responsibilities and difficulties. It makes a considerable and unexpected change in my personal plans, but I hope that there will be opportunity for usefulness enough to justify it. If we so restrict the utilities that their securities cannot command private capital, there will be no choice but to provide that capital out of the public taxes. On the other hand, if we permit these public monopolies by overcharges, inefficiency, extravagance or fictitious capitalization to exploit the people, the demand for premature public ownership will become irresistible. The only safety is in even-handed justice. This, I am confident, is the policy of my colleagues on the commission, and it will be mine. The time has come in the public regulation of public utilities when even justice both to the utilities and to the public is vital. To give the utilities either too much or too little would be to precipitate public ownership before its time."

Interest in the Sheldon Memorial Foundation Growing

INTEREST and activity are growing in the Sheldon Memorial Foundation. The aim is to establish a fund of $100,000, the annual income of which is to go toward the founding of a chair in electrical engineering at the Brooklyn Polytechnic Institute, where Dr. Sheldon spent the thirty years preceding his death in organizing and enlarging the department of electrical engineering.

The movement for a memorial foundation was authorized and started at the Sheldon memorial exercises held last November in the United Engineering Societies Building, under the direction of a committee of which T. C. Martin was chosen chairman.

An active campaign was started by these representatives in December to secure pledges and funds. Pledges from members of the professional societies, and from the Polytechnic trustees, alumni, students and friends, have already been received and amount to approximately $25,000. Of this upward of $6,000 has so far been paid in.

The treasurer of the fund, Charles E. Potts, is one of Dr. Sheldon's former students and a trustee of the Polytechnic Institute. He is receiving pledges and contributions daily at his office at 81 Franklin Street, New York City.

Possibility of Repeal of New York Franchise Tax Law

A STUDY is being made by New York State legislators of the special franchise tax on public utility companies within the state. This tax nets the state about $14,000,000. Litigation, however, is being encountered continually, and other costs incidental to the collection of this tax are believed to be so high as to offset the revenue derived. There appear, therefore, to be possibilities that a report will be presented to the State Legislature recommending the repeal of this tax.

The principal yield comes from traction companies and water, light, heat, power and electric companies, which contribute about $10,000,000 a year.

J. E. Aldred Lectures at Johns Hopkins Begin Next Week

NINE lectures—three each in civil, electrical and mechanical engineering—are to be given in 1921 in the department of engineering of Johns Hopkins University as a course founded by J. E. Aldred for "furthering and improving undergraduate instruction in the methods and problems of the practice of engineering." These lectures, which presuppose an elementary rather than an extensive knowledge of underlying theory, will be held on Wednesdays at 4.15 p.m. in the civil engineering building of the university and will be open to the public. The three electrical lectures will be as follows: Jan. 19, "Electricity Supply Systems in Large Cities," by Philip Torchio, chief electrical engineer New York Edison Company; Feb. 9, "Radio Telephony, Its Principles and Use," by John V. L. Hogan, manager International Radio Telegraph Company; March 2, "Recent Advances in Long-Distance Telephony," by Dr. F. B. Jewett, chief engineer Western Electric Company. Azell Ames, engineer Kerite Insulated Wire & Cable Company, will lecture on "Railroad Signaling" on Jan. 26.

Another French Super-Radio Station

THE cornerstone has just been laid for a super radio station at Sainte-Assise, France, which is termed "the most powerful radio station in the world." Engineering details are still lacking, but it is said that this station will communicate with all parts of the world. Although the report states that two instruments will send 24,000 words hourly, or 200 words per minute for one instrument, this is considered by representative radio engineers in this country to be possible only under the most favorable conditions. Receiving and deciphering speed is also reported to be 200 words per minute per instrument. The antennas will be supported on sixteen towers 820 ft. (250 m.) high.

The station is being built for the Compagnie Générale de Télégraphie sans Fil (General Wireless Telegraph Company), the capital investment being 70 per cent French and 30 per cent English. The company has a working agreement with the Radio Corporation of America.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Kansas City Planning Electrical Show.—Kansas City, Mo., will hold an electrical show at Convention Hall, April 18 to 21, 1921, inclusive. The show will be held under the management of the Electrical Trades Exposition Company. Sam Furst is the manager of the exposition company and will direct the electrical show.

Oklahoma Railroad Electrified.—The Northeast Oklahoma Railroad, running from Miami to Century, in that state, via Cardin, Picher and other points, with a total length of 15 miles, has, according to a report from Miami, completed reconstruction and is now operating its line entirely with electric equipment, steam and gasoline motive power having been discarded.

Hydro-Electricity on Small Scale Helps Neighboring Farmers.—In the vicinity of Weyers Cave, Va., says the *Manufacturers' Record*, a 500-hp. hydro-electric plant has been completed on the Shenandoah River, where a 20-ft. head of water is available without dam construction. A feature of this plant is that the farmers of the neighborhood will be in a position to take full advantage of the conveniences which electric power provides.

Southern California Increases Capital.—To obtain funds with which to finance hydro-electric power developments on the San Joaquin and Kern Rivers and to make additions to its transmission and distribution systems, the Southern California Edison Company has applied to the Railroad Commission of California for authority to make a bond issue of $10,000,000 and to issue 100,000 shares of common capital stock, par value $100. In connection with the stock application the company sets up the claim that the cost of its operative properties, as of Oct. 31, 1920, is $102,394,923.80.

British Electricity Commissioners' Activities.—Thirteen electricity districts have up to the present been provisionally determined by the Electricity Commission appointed a year or so ago by the British government. The last of these, known as the South Wales district, is one of the largest yet outlined, its extreme dimensions being 70 miles by 100 miles and there being included within its boundaries one distribution company with a connected load of 48,000 hp., as well as three large municipal undertakings. According to the London *Engineer*, however, local jealousies have worked up to the present to prevent the consummation of centralized control in any of the districts set up.

Five-Year Technical Courses Favored.—Dean Mitchell of the faculty of applied science and engineering, University of Toronto, Canada, has gone on record in favor of increasing the length of technical courses to five years, maintaining that present-day demands for specialized instruction cause constantly increasing difficulty in providing the requisite instruction within a four-year period.

Nipigon Hydro-Electric Plant in Service.—The city of Port Arthur, Ontario, at the head of Lake Superior, is now supplied with power from the Nipigon development of the Hydro-Electric Power Commission of Ontario, which has recently been placed in service. This plant, which is at Cameron's Falls, has a present rating of 25,000 hp. and an ultimate rating of 75,000 hp. Power is generated at 12,000 volts and stepped up 110,000 volts for transmission. The plant has been two years in building.

Distribution Wire Embedded in Branch of Tree.—The section of 110-volt distribution wire which is shown here was not deliberately strung through the center of a tree limb. Its odd position was the result first of the wire rubbing against the limb and then of the limb growing around the wire. The limb appears to have a growth of approximately nine years, and it is estimated the wire has passed through the



center of it for at least seven years. This unusual condition was found by the trouble gang of the British Columbia Electric Railway Company when inspecting distribution lines recently in Vancouver, B. C. A citizen had pruned the trees on the boulevard in front of his house and had cut the limb above and below the wire and left the portion shown here suspended in the air. When the trouble gang found it they cut the wire on each side of the limb and turned the severed part into the office embedded in the wood.

"Accident Prevention Week" in Baltimore.—From Nov. 4 to Nov. 10 last the Consolidated Gas, Electric Light & Power Company of Baltimore observed an "accident prevention week," and the latest issue of the house organ of the company announces that during that week there was not one accident of a serious nature to an employee and only eight trifling accidents. No personal injury of any kind was sustained by any member of the public for which the company could be held responsible, and only two slight injuries to the property of citizens were recorded, these being caused by vehicle collisions.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New York Electrical Society.—At the regular meeting of this society held on Wednesday last, Jan. 12, Past-President Henry L. Doherty gave a talk on "Benjamin Franklin and Modern Ideas of Thrift."

Engineering Society of Akron, Ohio.—The Electrical Section of this society is scheduled to meet on Wednesday evening, Jan. 26, when E. H. McFarland, turbine expert of the American Gas & Electric Company, New York, will describe the Windsor (W. Va.) power plant.

February Meetings of A. I. and S. E. E.—Meetings of the various sections of the Association of Iron and Steel Electrical Engineers are scheduled for next month as follows: Philadelphia Section, Saturday, Feb. 5, "Review of Cost of Rolling Steel in Various Mills," by G. E. Stoltz, engineer in charge of steel-mill division, general engineering department Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Cleveland, Monday, Feb. 14, "Scientific Combustion Control for Boiler Furnaces," by M. G. Benjamin, Benjamin Engineering Company, Cleveland. Pittsburgh, Saturday, Feb. 19, "Reliability of Steam and Electrical Applications in the Iron and Steel Industry," by B. G. Fernald, consulting engineer, New York City. Chicago, Saturday, Feb. 19, "Steel Making," by John Sullivan, Wisconsin Steel Company, South Chicago, Ill. Birmingham, Saturday, Feb. 19, "Electrical Features of the Chickasaw Shipbuilding Plant," by H. T. White, chief electrician Chickasaw Shipbuilding Company, Mobile, Ala.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Chicago Section, Jan. 15; Pittsburgh Section, Jan. 15; Birmingham Section, Jan. 27; Philadelphia Section, Feb. 5; Cleveland Section, Feb. 14.

Iowa Engineering Society — Des Moines, Jan. 18-20.

Wisconsin State Association of Electrical Contractors and Dealers — Milwaukee, Jan. 19 and 20.

American Society of Civil Engineers—New York, Jan. 19.

American Washing Machine Association—Chicago, Jan. 19 and 20.

American Institute of Electrical Engineers—Pittsfield Section, Jan. 20; Chicago Section, Jan. 24.

Western Association of Electrical Inspectors—Detroit, Jan. 25-27. (For program see issue of Jan. 1, page 58.)

Association of Municipal Electrical Utilities of Ontario—Toronto, Jan. 27 and 28.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section) — New York, Jan. 28.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see issue of Jan. 8, page 111.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Iron Wire Not Necessarily Proof of Imprudent Construction.—A line loss of 10 per cent due to the use of a transmission line of iron wire does not, in the opinion of the Missouri Public Service Commission, necessarily show imprudent construction where the line was erected during the war period when copper wire was virtually unobtainable.

Reduced Rates to City.—It is within the jurisdiction of the Missouri Public Service Commission, a recent decision of that body holds, to fix rates for a municipality at a lower level than rates charged to private consumers in a case where the municipality is without sufficient financial resources to meet its proportion of the necessary increase in rates.

Minimum Bill as a Demand Charge.—An electric company may not, according to a decision of the Board of Railroad Commissioners of North Dakota, apply and authorize a minimum charge as a maximum-demand charge where the motors served have never been tested as to their service requirements but the company has endeavored arbitrarily to apply the minimum-service charge as a constant maximum-demand charge.

What Constitutes Reasonable Extensions.—Passing on the question of what constitutes a reasonable demand for the extension of electric service as obligated by acceptance of a franchise, the Missouri Public Service Commission has found that the construction of an extension to cost $396 at the sole expense of the utility to serve a consumer with anticipated bills of $1.50 is not reasonable. An expenditure of $259 by the utility in making a 1,000-ft. extension is deemed reasonable upon condition that the consumer served shall construct the portion thereof upon private premises (375 ft.) and guarantee for five years a monthly use of service costing $2.50.

Disputed Bill for Past Services Not Sufficient Reason for Refusal to Serve.—Upon the deposit by consumer of an amount estimated to represent the maximum amount of service that would be required for any one month an electric company was ordered by the North Dakota Board of Railroad Commissioners to reinstall service for a customer who had been disconnected from the company's system for refusing to pay a disputed bill for past services. The commission found that it had no jurisdiction to pass upon the correctness of the bill, which was in the amount of $60 for accumulated minimum service charges for a 10-hp. motor for six months during which no electricity had been used. The rate of $1 per horsepower per month, the commission declared, however, to be a reasonable minimum charge.

Charges for Service Connections.—Complaints against new rules and regulations for service connections adopted by the Public Service Electric Company of New Jersey were made to the Board of Public Utility Commissioners, which declared them unjust and unreasonable. The commission held the reasonable charge to be the cost to the company of the connections, and that the company should continue its former policy of making no charge whatever under certain conditions. "Long and expensive constructions for the benefit of individuals whose use of the facilities would be insufficient to pay interest on the capital expenditure and provide for depreciation are quite different from the connection of premises located alongside the distributing system," the commission said. "The rule previously in force providing for a charge for service connections beyond a distance which would include the great majority of those desiring service does not seem unreasonable. On the other hand, the propriety of the new rule requiring the payment of a fixed sum by all those connected and within the former free limit is open to serious question." The commission recommended a refund of charges already paid, but did not make an order to that effect because of lack of jurisdiction over reparation.

Defense of the Service Charge.—The New York Public Service Commission, Second District, recently made these observations on the service charge: "The service charge as the term is herein used is a uniform charge to all consumers. The service charge is not new, although it has not as yet come into general use. It is sometimes called a readiness-to-serve charge and sometimes a consumer's charge. Its real nature does not seem to be generally understood by consumers, and unless it is understood it appears to them to be a mere arbitrary imposition in addition to the regular price also paid for what they consider the service supplied. It differs from the familiar minimum charge in that it is imposed on every consumer." The minimum charge, the commission continues, "was intended to serve the same purpose as the service charge, but only did so to a limited extent and in a very crude manner. Its advent was greeted by an enormous storm of disapproval on the part of consumers. Its injustice was vehemently asserted, and because of its partial and discriminating effect the attack was not without foundation. It had sufficient reason behind it to enable it to resist the attack. It is now all but universal where the service charge is not applied, and it is an interesting fact that those who now resist the service charge are strenuous advocates of the minimum charge—some of them probably merely because they are accustomed to it, others for reasons worked out as applied to their own bills by means of a lead pencil and a pad of paper."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Powers of Indiana Public Service Commission.—Under the statute fixing the powers of the Public Service Commission, the Supreme Court of Indiana found, in Public Service Commission vs. Girton, the commission may fix and in a proper case increase the rates charged by any public utility on its petition for relief, so far as the Legislature has constitutional power to grant such authority. A contract of sale of telephone lines by individuals to a corporation providing that the charges to subscribers should not be increased except by consent of the sellers did not deprive the commission of authority to increase the telephone company's rates. (128 N. E. 690.)*

Estimating Overcharges Due to Defective Meter.—In a suit brought by the Board of Commissioners of Owen County, Ind., against the Spencer Light, Heat & Power Company to recover alleged overcharges due to a defective meter in the County Court House, the Appellate Court of Indiana refused to overrule the verdict found for the plaintiff by the lower court. Evidence that an electric meter registered more energy than was consumed and that the difference in charges for the same amount of service before and after the meter was replaced would, if deducted from the charges during the time the meter was in use, exceed the amount awarded by the jury was, the court held, sufficient to support the verdict. (128 N. E. 700.)

Orders for Spot Fuel Cannot Be Filled While Contract Deliveries Are Not Made. — The United States Supreme Court has refused to review the case of Producers' Coke Company vs. McKeefrey Iron Company, in which the coke company sought in the Pennsylvania federal courts to upset a verdict for $60,000 damages brought against it because of its failure to supply the iron company with coke according to contract terms during the shortage of cars. The coke company took refuge in a clause in the contract stating that in case of a car shortage shipments should be divided from time to time in fair proportion on all orders, but the iron company contended that the coke company had, while failing to fill its contract obligations, disposed of large quantities of coke for immediate delivery at enormous prices. The trial courts held that spot customers of this nature were not entitled to share with contract customers.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

F. A. Leach, Jr., who has recently been elected to a vice-presidency of the Pacific Gas & Electric Company, San Francisco, will have charge of the commercial activities, the publicity work



F. A. LEACH, JR.

and the district organizations of the company. Mr. Leach is a native of California, where he was born in 1871 and where he attended the public schools. For several years he was engaged in newspaper work in Oakland, and in 1898 he was employed by the Oakland Gas, Light & Heat Company, rising through the position of auditor to become manager in 1904, when that company was absorbed into the California Gas & Electric Corporation. When the latter company became part of the present Pacific Gas & Electric Company Mr. Leach was continued as district manager, and he held that position until his recent promotion.

Henry I. Harriman, president of the New England Power Company, Boston, has been elected vice-chairman of the Massachusetts Commission on Foreign and Domestic Commerce.

William McNeil, formerly assistant general manager of the Western Power Company, Vancouver, B. C., has been promoted to the position of general manager, succeeding R. F. Hayward.

J. A. Todd, formerly superintendent of electric distribution of the Consolidated Light & Power Company, Kewanee, Ill., has been promoted to the position of general superintendent of the company.

W. H. Corddy, heretofore a member of the engineering staff of Gannett, Seelye & Fleming, consulting engineers at Harrisburg, Pa., has been appointed manager of the Memphis (Tenn.) office of that firm.

Charles B. Hart, superintendent of the light and power department of the Indiana Service Corporation of Fort Wayne, Ind., has resigned to engage in another line of business with his brother, Oliver J. Hart, in Chicago. Mr. Hart has been with the company first in a clerical capacity and later in the sales department as superintendent since 1902.

E. B. Neiswanger, chief engineer of the Texas Power & Light Company, Dallas, Tex., has resigned to become president of the American Fuel Corporation. Mr. Neiswanger will have active charge of the new company's work in developing the lignite fields in Freestone County, Tex. He leaves the Texas Power & Light Company after eight years of service.

Chester H. Rowell has been appointed to the California State Railroad Commission to succeed Chairman E. O. Edgerton. Simultaneously Governor Stephens announced the reappointment of Commissioner Harry B. Loveland, the oldest member of the commission in point of service, to another term of six years. Both of these terms began Jan. 1. Mr. Rowell is a graduate of the University of Michigan and served in the United States House of Rep-



C. H. ROWELL

resentatives from 1899 to 1901. In 1898 Mr. Rowell became editor of the Fresno (Cal.) *Republican*, which position he held until the latter part of 1920, when he became a member of the United States Shipping Board.

A. H. Markwart has recently been appointed to the position of director of engineering of the Pacific Gas & Electric Company of San Francisco, where he will have general charge of all the company's engineering work. Mr. Markwart was born in Illinois in 1880, and after graduation from the University of California in 1903 he spent a short time with the Pacific Construction Company as civil engineer. From 1904 to 1906 he was assistant civil engineer for the California Gas & Electric Company (now the Pacific Gas & Electric Company). Following this he was chief engineer and manager of the Syndicate Water Company, Oakland,



A. H. MARKWART

Cal., and later vice-president and manager Richmond (Cal.) Water Company. From 1907 to 1912 he was a member of the civil engineering firm of Galloway & Markwart, who practiced extensively in hydro-electric plant engineering and irrigation projects. From 1912 to 1915 Mr. Markwart was chief of construction of the Panama-Pacific International Exposition, after which, from 1915 to 1917, he resumed his former connection with the firm of Galloway & Markwart. During the war period he entered into shipbuilding work and was general manager of the Clyde company on behalf of the United States.

Alfred Swan, well-known inventor of incandescent electric lamp devices, was a guest of honor on the occasion of his eighty-fifth birthday, Dec. 30, at a banquet given by his friends and associates connected with the Edison Lamp Works of the General Electric Company, Harrison, N. J.

G. S. Pritchard has joined the sales force of the line materials division of W. N. Matthews & Brother, Inc. Mr. Pritchard was connected with the Western Electric Company for eleven years, the first six years having been spent at the Hawthorne factory. For five years he has been with the Chicago office of the Western Electric as line construction specialist and sales specialist on street-lighting equipment.

Edward S. Jenison has been appointed acting general sales manager of the Goulds Manufacturing Company, Seneca, N. Y., succeeding W. E. Dickey, who has resigned. For the last five years Mr. Jenison has been manager of the company's Philadelphia office.

C. W. Yerger has been appointed New England district sales manager of the Cutler-Hammer Manufacturing Company at Boston, Mass. Mr. Yerger has been in the employ of the company for about thirteen years, in both factory and sales work, and recently was on the staff of the Igranic Company, Ltd., of England.

P. S. Klees, formerly sales manager and vice-president of the Franklin Electric Manufacturing Company and more recently with the Pierce Fuse Company of Buffalo, N. Y., has been appointed district manager for the Tubular Woven Fabric Company in its New York territory, which comprises the States of New York, New Jersey, Delaware, Maryland and Virginia as well as the District of Columbia and the western half of Pennsylvania. Mr. Klees' headquarters will be at 52 Vanderbilt Avenue, New York, the new office of the company in that city.



P. S. KLEES

Charles W. Leber has resigned as sales manager of the American Radio & Research Corporation, with which he has been connected since 1917, first as representative for war radio sales and later in charge of the sales and advertising departments in New York City. The lines handled by Mr. Leber included government radio apparatus, amateur radio apparatus and small fractional-horsepower motors. During 1916 and 1917 he was industrial power representative of the central division, Public Service Corporation of New Jersey. From 1912 to 1915 Mr. Leber was with the Marconi Wireless Telegraph Company, serving during 1912 as government representative and designing engineer and later being appointed cost and sales manager. Mr. Leber is a graduate of Purdue, class of 1908. His home address is Rahway, N. J.

Dr. Charles Walcott, the vice-chairman of the National Research Council, will succeed the late Dr. Bumstead, at least temporarily, as the active chairman of the council.

M. S. Bassett, who for some fifteen years has been connected with the engineering and sales department of James Leffel & Company, Springfield, Ohio, has been appointed manager of its new sales and engineering office, established at Minneapolis, Minn.

R. F. Eissler has been appointed assistant to the vice-president of the Chicago Pneumatic Tool Company, with headquarters in the company's new office building at 6 East Forty-fourth Street, New York. W. C. Straub, formerly district manager of the New Orleans branch, has been appointed district manager of the Pittsburgh branch to succeed Mr. Eissler, and Ross Wyeth, formerly attached to the Pittsburgh branch, district manager of the New Orleans branch to succeed Mr. Straub.

E. H. Boss, superintendent of the American Public Service Company in Texas, has joined the sales staff of the line-materials division of W. N. Matthews & Bro., Inc., St. Louis, Mo. From 1890 to 1899 Mr. Boss was connected with the Bell Telephone Company of Canada. He was manager of the Niagara Falls (Canada) plant at the time he joined the Niagara, St. Catharines & Toronto Railway Company in 1899. In 1900 he entered the employ of the Hudson Valley Railway Company, Glens Falls, N. Y., receiving charge of construction and maintenance of transmission, lighting, railway, telephone, telegraph and signal systems. In 1903 he joined the Connecticut Railway & Lighting Company in charge of construction and maintenance of transmission. Later he joined the New York, New Haven & Hartford organization and in 1914 accepted the position of superintendent of the American Public Service Company in Texas and Oklahoma, in charge of its construction, transmission and distribution systems. Mr. Boss will cover the territory formerly covered by Warren H. Heim, who has resigned.

B. E. Sunny, for twelve years president of the Chicago Telephone Company, has been elected head of the Illinois Bell Telephone Company, which is a combination of the Chicago Telephone Company and the Central Union Telephone Companies.

Frederick P. Vose, who was presented with a silver dining service at the recent meeting of the Electrical Credit Association, Central Division, in Chicago, in recognition of twenty-five years of service to that association, was one of its organizers. Mr. Vose was born in Chicago May 4, 1870, and was graduated in law from Northwestern University in 1893. In connection with his law practice he became interested in electrical credit work, and he has served without remuneration as secretary-treasurer of both the National Credit Association and its Chicago branch for a quarter of a century. Mr. Vose is well known among the electrical and civic associations in the Middle West for his able addresses on business and methods of handling business. His address on "Telephone Courtesy" has become a handbook for many employers who wish to promote politeness.



F. P. VOSE

Obituary

Loomis Dee Thompson, commercial agent of the Galveston (Tex.) Electric Company, died recently at his home in Galveston. Mr. Thompson joined the staff of the company in October, 1897. In January, 1913, he was appointed commercial agent.

Robert A. McCarty, a scientist and inventor who was associated with Thomas A. Edison in the early days, died in New York City Dec. 29. Mr. McCarty was a member of the Edison Pioneers. He helped Mr. Edison install the first electric light system in New York City. He was born in Guelph, Canada, seventy-four years ago.

Henry A. Bumstead, chairman of the National Research Council, died suddenly a week or two ago while traveling from Chicago to Washington. He had been in attendance at scientific meetings in Chicago and had taken an active part. The services rendered by Dr. Bumstead during the war were notable. As an attaché of the American Embassy at London he was in immediate charge of the exchange of confidential scientific data with the Allies. In his twenty-seven years' work at Yale Dr. Bumstead influenced the thought of thousands of students at that university, where he had charge of one of the finest laboratories in the world.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Hopeful Sign Seen in Re-employment in General Industry

THIS week has brought the most encouraging signs in general business of any week since the slump began last fall. Factories are opening again, some after many weeks of shutdown. This is occurring most markedly in Detroit and in New England.

The factories reopening include large automobile plants, textile mills in Fall River, Lowell, Lawrence and Salem, Mass.; Manchester, N. H.; Biddeford, Me., and many places in the South; Pennsylvania silk mills, tinplate mills, schedule material factories and many others.

Besides, a number of important factories have announced during the past week that they are re-employing large numbers of men because of increased business. The International Harvester Company is one of these, and the Chain Belt Company is another.

The re-employment of large numbers of men means, in addition to the increased production and sale of goods, a greater stability of industry and greater freedom from industrial unrest.

A number of bankers in public statements this week have stated that the bottom has been reached and that there are more favorable indications already. The above facts would indicate the truth of these assertions.

All of this, of course, has its natural effect on the electrical industry, which depends so largely on general industry for its business.

High-Tension Porcelain Insulator Deliveries Still Long

DELIVERIES of porcelain high-tension insulators, though improving, are still long, despite the fact that comparatively few new orders are coming in just now. Manufacturers have enough old business on the books, however, to carry them well along through the first half of the year. It is this circumstance, coupled with production difficulties, that has caused new orders to stand scant chance of being filled promptly. One of the difficulties mentioned has been the short supply of natural gas upon which some manufacturers depend for firing their insulators. Another has been raw material, though recently the latter has almost ceased to be a factor affecting production adversely. Production, as a matter of fact, in several cases is increasing and the capacity of some plants is also being enlarged to care for the larger volume of business that is expected to break during the year.

Although manufacturers are warning their customers to enter the market now if they expect to make new power extensions during 1921, the prospect of long insulator deliveries does not seem to have hastened buying. In fact, demand from home and abroad has been dropping off and is light at present. Good prospects for insulator buying are said to exist in Italy, Switzerland, Japan and Scandinavia. Just when the large need for insulators that is known to exist in this country and abroad will result in orders being placed, however, is a question. Prevailing exchange rates, on the one hand, and tightness of money, on the other, have a deterrent effect on buying. Expectations of lower prices may also be a consideration, though producers offer little hope of prices changing for some time. Wages remain unchanged at insulator plants, it is stated, and no employees have been laid off, so far as can be learned. The raw material, being mostly a complete product of nature, is not subject to great fluctuation, and costs are no lower there.

Deliveries, generally speaking, probably average three to four months, though extremes of two to six months, and even seven occasionally, are quoted, depending upon the size and type of insulator and the manufacturer. In some cases suspension insulators are worse off than pin types as regards supply, and in others better. Surplus stocks in the high-tension field, of course, do not exist anywhere.

Electrical Exports in November Reach $10,488,628

A STILL higher record was hung up for electrical exports for the year 1920 when the month of November turned in $10,488,628. This amount is second only to the high figure of the last two years—$10,990,817, reached in June 1919. Total exports for the first eleven months of 1920 amount to $88,806,257, only $300,000 less than the total for the entire year of 1919. At this rate it would not be surprising to see December turn in a figure which would bring the past year's total to just under one hundred million dollars.

	November		Eleven Months Ended November	
	1919	1920	1919	1920
Batteries	$406,722	$615,402	$5,521,121	$5,983,773
Carbons	61,971	130,447	1,290,819	1,354,038
Dynamos and generators	617,981	824,515	5,216,860	6,450,392
Fans	68,298	122,132	1,388,512	1,108,334
Heating and cooking apparatus	117,772	151,001	1,469,182	1,594,579
Insulated wire and cable	535,746	1,003,898	8,292,994	6,877,232
Interior wiring supplies	174,640	326,772	2,074,051	2,943,939
Arc lamps	1,904	4,900	16,303	23,824
Carbon-filament lamps	41,501	7,094	185,919	94,920
Metal-filament lamps	253,963	476,042	4,363,009	3,587,062
Magnetos, spark plugs, etc	237,604	304,479	2,802,013	3,287,234
Meters and measuring instruments	156,655	221,058	2,663,352	2,344,234
Motors	1,003,864	1,406,149	9,857,437	11,560,811
Rheostats and controllers	40,655	100,295	478,924	1,326,150
Switches and accessories	229,941	396,927	3,348,752	3,870,366
Telegraph apparatus	37,147	106,008	789,120	612,193
Telephones	373,610	477,492	3,453,175	3,354,919
Transformers	157,381	341,345	3,489,982	4,107,101
All others	2,186,829	3,472,672	25,697,682	28,325,156
Total	$6,704,184	$10,488,628	$82,399,207	$88,806,257

November showed individual yearly records in metal-filament lamps, insulated wire and cable, motors, rheostats and telephone materials. When compared with November, 1919, exports for that month in 1920 increased 50 per cent.

Figures in the attached table were compiled by the Bureau of Foreign and Domestic Commerce.

St. Louis Collections Averaging Sixty to Seventy Days

CREDIT and collection conditions in that portion of the Southwest represented by St. Louis show signs of continuing to be tight for some time after the beginning of 1921. Growers in the cotton and rice sections of the South and Southwest are holding their crops or losing a great deal of money and the banks are moving very conservatively. Business in those sections is finding very little money to work on, and collections there are difficult. St. Louis houses report that discount customers have become thirty-day customers, thirty-day customers are asking for sixty days, and sixty-day customers are asking extensions to ninety and 120 days. An average of between sixty and seventy days is being maintained. No serious trouble in

collections has been met with yet, but the number of notes being offered, while still small in percentage, is growing steadily.

Railroads and utilities have become much slower, while industrials are not showing a very great degree of promptness. These accounts are still considered very good and are among those most favored. Credit men are proceeding very carefully both on new accounts and on increasing old credits. The consensus of opinion is, however, that the electrical industry in this section is on a satisfactorily sound basis and can weather the period of deflation successfully.

Armored Conductor Market Easier

WITH large supplies of flexible armored conductor on the market certain manufacturers at the close of the year made a reduction in price of around $15 per 1,000 for two-wire No. 14. Steel-strip prices of independent mills late in December came down to Corporation levels, and on that one item alone the decline effected amounts to around 20 per cent. Jobbers' prices were reported off two weeks ago under an exceedingly light demand.

Grain Prices Affect Purchases in Agricultural Territory

THE following letter to a representative Middle-West motor dealer from a farmer of Iowa is an interesting commentary on the feeling and condition in the agricultural sections of the country, particularly in the Middle Western sections, where the agricultural industry overtops everything else. The viewpoint is interesting because it has a direct effect on the utilities of the agricultural regions. The recently expressed opinion of a New Orleans banker is interesting in this connection. He thinks that the cotton, cane and rice producers of Louisiana are not so hard hit by the decline in prices as they think. It is not so much what they expected to get out of their crops as compared with what they got as it is what they are able to buy at today's prices compared with what they bought last year at the prices secured then for their products. The readjustments of the coming months may change the agricultural viewpoint materially. The letter states:

"A few days ago we received a quotation from you on electric motors in reply to our inquiry. We note that you quote us on a second-hand motor at $500 f.o.b. Chicago. We consider this out of line.

"At present prices of corn here in the country we would have to give 1,050 bushels of corn to pay for this second-hand motor. In August, 1919, you quoted us on a second-hand General Electric motor of the same size and equipment for $450 f.o.b. Chicago which was sold before we could get our order. At that time 257 bushels of corn would have paid for a better motor than now we could get for 1,050 bushels of corn. I guess we will have to get along with the old tractor until the prices of motors and corn get nearer together again."

New Selling Plan for Miniature Mazda Lamp

PRIOR to Jan. 1, 1921, miniature "Mazda" lamps were sold through agents to whom the lamps were consigned by the manufacturer under agency appointments covering agents' annual sales. The appointments were based on the list value and ranged from $1,000 to $3,500 for "form MA" agents, who were usually retail dealers, and from $3,500 and up for the wholesale distributers or jobbers. In both cases the basic rate of compensation was increased for increased volume of sales.

Under the old form of agency appointment, as under the new, the agent was authorized by the manufacturer to distribute lamps to the small dealer and in turn to the consumer.

A dealer whose purchases reached $500, list value, within the period of one year received an allowance of 10 per cent on the net value of his purchases, which purchases were made on the basis of either 25 per cent from list on one unit-package quantity of ten lamps or 40 per cent from list on ten or more unit-package quantities of 100 lamps or more. Under the new arrangement, which became effective on Jan. 1, 1921, agency appointments will be given only to wholesale distributers of merchandise and supplies, with a fixed basic compensation for services rendered to the manufacturer along the lines of increasing the number of retail outlets in order to give better service to the consumer.

For the retail distributer a discount schedule has become effective and is as follows:

Less than unit-package quantity, net list.

One unit-package quantity (ten lamps of same "Mazda" number and specification, 30 per cent from list.

Standard-package quantity (100 lamps of same "Mazda" number and specification), 33⅓ per cent from list.

In addition to the above discounts to purchasers of $500 net value of miniature "Mazda" lamps of one brand, either directly from a single manufacturer or through one agent, 10 per cent additional discount will be allowed on the net value of such purchases when such purchases have reached $500 net value within the period of one year or less.

A purchaser's contract may be given to cover lamps actually installed by the purchaser in lighting apparatus, devices or equipment owned, controlled or used by the purchaser, such as a manufacturer of automobiles, automobile lighting equipment, electrical toys, Christmas-tree lamps, flashlights, etc.

The Metal Market Situation

THE suggestion made in these columns last week that a price as low as 12.50 cents per pound delivered for copper was low enough to offer electrical manufacturers a propitious market seems thus far to have been borne out. Since that time a decidedly firmer tone has developed to the copper market, and it is now virtually impossible to buy copper from any holder at 12.50 cents delivered. The 12.75-cent delivered price to which some producers were shading last week has been withdrawn, and 13 cents delivered for prompt shipment is generally asked by producers and 13.25 cents for first-quarter delivery. Little copper is offered in the outside market, and that at prices fully as high as producers.

Despite the firmer tone of quotations, large consumers are placing no more orders than has been the case. Speculators are taking an active interest in buying, however, especially in future positions, but are finding it difficult to place orders. Export buying is reported as being a little better. At a meeting of the leading copper producers last week it is understood that steps were taken toward reducing the enormous surplus stocks of copper above ground by curtailing production, and it is expected that some of the previous cut-throat competition may now be eliminated.

Tin has also developed a much firmer tone, a sharp advance being recorded the past week. Buying interest of consumers is light, however. Demand in the scrap-metals market remains light, but more confidence is expressed that low price levels have now been reached.

NEW YORK METAL MARKET PRICES

	Jan. 4, 1921	Jan. 10, 1921
Copper	£ s d	£ s d
London, standard spot	72 0 0	74 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13 50	13 75
Electrolytic	13 00	13.00-13 25
Casting	12 37½	12 75
Wire base	16.25	16.25
Lead, trust price	4.75	4 75
Antimony	5 20	5 15
Nickel, ingot	43 00	43 00
Sheet zinc, f.o.b. smelter	11 50	11 50
Zinc, spot	6 10	6 00
Tin	36 00	38 75-39 00
Aluminum, 98 to 99 per cent	28.30	28 30

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 50-11.00	10.00-10.75
Brass, heavy	6 00 6 50	6 00 6 50
Brass, light	4 00 4 50	4 00 4 50
Lead, heavy	3 50 3 75	3 50 3 75
Zinc, old scrap	3 00 3 25	3 00- 3 25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

LITTLE change is shown in the general run of business. Maintenance and rewiring work are keeping a certain volume of supply materials continually on the move, but little is reported in new construction, although there is quite a volume of building coming into the electrical stage, especially in New York.

The trade is buying only as business in hand warrants, with little ordering for the future. Deliveries can be had in quick order on virtually all kinds of wiring supplies, the smaller sizes of pipe and porcelain taking a little longer than other materials. High-voltage insulators are ruling long so that summer needs must be anticipated now. The open winter is allowing more outdoor work than usual and is easy on line maintenance.

No marked improvement is seen in the collection situation, but from the standpoint of the banks in various territories the outlook for better conditions in the financial world in the spring is bright.

NEW YORK

The existing quietness of week-to-week trade in the electrical industry presents no change over conditions that have prevailed during the past several weeks. Prices are still on the down grade, and buying on the part of retailers and right on up the line is of the most cautious kind.

In some quarters it is stated that industrial plants are ordering unexpected quantities of electrical material as the period of slack business is being taken advantage of to make repairs. Contractor-dealers are not in the market very heavily, however, and on the whole lamps are about the only item whose sales hold up strongly.

Manufacturers' reductions on conduit have been announced within the last fortnight, and new heating-appliance schedules of several manufacturers dated Jan. 15 show considerable reductions on hollow ware, heaters, flatirons, etc. A few cancellations on appliances were received by jobbers from department stores and other large buyers after the Christmas trade, but this phase of trade has not been widespread because of the small total of outstanding orders for goods. Collections remain unchanged and are very unsatisfactory.

Conduit.—Manufacturers' price reductions amounting to an increase of three points in the Pittsburgh basing discount went into effect within the last week. Jobbers' prices have not yet reflected the drop. Demand remains light with a good supply of all sizes available.

Flexible Armored Conductor.—The bottom seems to have dropped out of this market as the price is whatever can be obtained, with almost no buying. Jobbers quote $65 to $70 per 1,000 ft. for No. 14 two-wire, but quantities have been sold lower than this where stocks are too large.

Rubber-Covered Wire.—The market remains stagnant with large stocks and very light demand. On No. 14 in 10,000-ft. quantities jobbers nominally quote from $8.50 to $9.50 per 1,000 ft.

Heating Appliances.—Several manufacturers have issued new price schedules effective Jan. 15. Reductions by Landers, Frary & Clark were announced last week. Manning Bowman & Company have announced reductions in list prices, of which the following are representative: 6-lb. iron, $8.50 to $8; toaster, $10 to $9.25; percolators, $24.50 to $22.50, or about 10 to 15 per cent on the whole line of hollow ware; heating pads, $12 to $11. The Simplex Electric Heating Company has announced list price changes as follows: Sunbowl heater, $12.50 to $12; 6-lb. iron, $8 to $7.75; heating pads, $12 to $11; toasters and soldering irons, no change; ranges, $15 reduction each.

Lamps.—Sales hold up remarkably well, and jobbers are well pleased with the volume of their lamp business. General stocks are good, and so are shipments, though some complaint is heard of the supply of 40-watt B, type C and round-bulb lamps.

Heaters.—Jobbers report that owing to the continued mild weather sales have been disappointing. A fairly even demand is reported from the retail trade, however. Jobbers' stocks are large, and price cuts have been resorted to in order to move supplies.

Lead-Covered Wire.—A comparatively small stock is carried and demand is light. In 1,000-ft. quantities No. 14 duplex is quoted at from $45 to $55 per 1,000 ft.

Vacuum Cleaners.—Prices have held steady, although sales are reported as being light. Stocks in jobbers' hands are plenty large enough—too large in some instances.

Washing Machines.—Demand has slowed down until very few are being sold at present. Prices have undergone no change, but the number of machines in stock is carefully held down.

CHICAGO

A real turn for the better in the electrical trade seems to have arrived, denoted not so much by renewed flow of orders as by an increase in the number of inquiries being received by manufacturers and jobbers alike. The retail stores are finding post-holiday business better than they looked for at this time. The heaviest portion of the new inquiries, however, is coming from municipalities and public service corporations, most of them being in connection with maintenance work, although some extensions are being seriously considered.

Prices are holding firm on all sides, a minimum of price cutting being indulged in on scattered items by smaller concerns. If this condition exists for a sufficiently long time to convince the trade and the public that present prices are stable a definite increase in business should result.

Copper Wire.—This is the one item in which price uncertainty is found. Business is good so far as sales are concerned, but it is possible to get quotations on different price bases from different jobbers. This condition will probably obtain until the recent price fluctuation of raw copper is ended.

Weatherproof Wire.—Prices are more nearly uniform on this line. A leading jobber quotes $23.50 per 100 lb. on No. 8 triple-braid, this being on a 22-cent base. Orders are numerous and supply steady so that a very satisfactory business is resulting.

Line Hardware.—New lists on line hardware are being issued this week carrying a reduction in price. Hot galvanized crossarm braces, 1½ in. x ¼ in. x 24 in., are $155.03 per 1,000 in lots of 500, and in larger quantities $137.80. Crossarm bolts, ⅝ in. x 10 in., are, in similar quantities, $13.71 and $12.19 per 100. Prompt deliveries are being made on most items and demand is only fair.

Poles.—In spite of radical decreases in all other wood products the price of poles remains unchanged, with no indication of a break seen. Inquiries have increased in volume materially in the past week and a reasonable amount of new business at current prices is expected.

Insulators.—This is the one item, in both porcelain and glass, which manufacturers are unable to supply in sufficient quantities to fill demand. All plants are reported as working full time and deliveries are still many weeks behind. Prices, as a natural result, are firm.

Rigid Conduit.—A little more activity in inquiries for this class of material is noted, but not much is doing in the way of actual orders placed. Present quotations in 5,000-lb. lots are: For ½-in., $78.71 per 1,000 ft., and for ¾-in., $104.19.

Metallic Flexible Conduit.—This item is also quiet as regards sales, but the volume of inquiries points to improved business in the near future. Prices are reported as unchanged, the ½-in. size being quoted, in original coils, at $9.50 per 100 ft. and ⅜-in. at $6.75 per 100 ft.

BOSTON

Little change in the volume of trade occurred in the past week, but a tendency for small orders to increase in size was remarked. Buying is largely from hand to mouth, but some repeat orders are coming in and most electrical manufacturing plants are running at least on part time. Collections are still slow and unsatisfactory. Building is handicapped by labor troubles, notwithstanding mild weather which would ordinarily enable construction to be pushed in many lines. Building and engineering contracts for New England for the week ended Jan. 4 totaled $2,125,300, against $4,401,000 a year ago. Prices showed further weakness last week, notably in rubber-covered wire, knobs, tubes, lamp cord and storage batteries. Industrial plants continue to resume operations, and the American Woolen Company announced that all its mills, employing about 50,000 persons, would be at work by Jan. 19 on the basis of a general 22½ per cent wage reduction. Jobbers' stocks vary a good deal in make-up, but no present shortages of any moment are known to exist. Very active sales efforts are being made now in both wholesale and retail fields. A moderate improvement in retail trade as a whole is reported.

Wire.—Rubber-covered wire is softer in price, No. 14 being quoted around $8.50 to $9 per 1,000 ft., according to quantity. Weatherproof and bare bases are steady at 20 and 17½ cents respectively.

Knobs and Tubes.—"Nail-it" knobs weakened Jan. 7 from $32 to $27 per 1,000 in barrel lots, and 3-in. tube eased off slightly from $11.50 to $11.35 per 1,000. Plenty of this material is now in hand for current needs.

Pole-Line Hardware.—Stocks appear equal to present demands, and only moderate orders are being booked. The mild weather is expected to lead to earlier consideration of central-station needs this year.

Sockets.—Prices are remarkably steady. The size of the standard package of pull sockets with ½-in. caps has been increased from 250 to 500 units, putting all classes on the same packing basis.

Motors.—Deliveries are improving, and some houses can make prompt shipments where small numbers are desired. Activity in the designing and production of new and advanced equipment is arousing much interest in competitive circles.

Rigid Conduit.—Deliveries are much better than hitherto, and prices are fairly steady. In lots of 50,000 lb. and less-than-carload amounts 1-in. black pipe is quoted about $153 per 1,000 ft., and 1-in. galvanized at $163,20.

Lamp Cord.—Cotton-covered cord dropped from a 22-cent to an 18-cent base within the week.

Dry Cells.—Prices are steady with a good renewal business noted. The No. 6 cell quotes at $37.35 per 100 in barrel lots with the ignition type $38.35.

ATLANTA

The electrical jobbing business this week is in a state of stagnation, activities being confined to inventories and general housecleaning. Retailers have not begun to restock, and central stations and municipalities are awaiting annual statements and new appropriations before placing orders for their anticipated needs, though of course some orders are filtering through for materials that are required for immediate use. Survey of the retail electrical trade discloses the fact that practically all firms enjoyed a very satisfactory holiday business, and their stocks as a result are at a low ebb. One of the largest retailers reports the best holiday business in its history—approximately 40 per cent in excess of last year. The composite of opinions of leaders in all lines of business activities throughout the section indicates that they believe the pendulum has swung its limit and activities in general will be on the increase within the next few weeks. They look for a resumption of business on the new level of prices, and, in view of the fact that the condition of the country is basically sound, they can see no further depression ahead. Reports indicate that buyers are beginning to come into the market for spring and summer stocks, and textile mills that have been shut down are recommencing operations.

The successful financing of the Federal Foreign Finance Corporation and the action of Congress in reviving the War Finance Board have already had a good psychological effect. Non-employment has never become acute in this section. Some delay in building activities will be experienced as a result of the union heads calling a general strike of the building trades in protest against the new scale of wages as set by the master builders. Despite this, building permits are being taken out in volume considerably in excess of the past two months.

Non-Metallic Flexible Conduit.—The predicted break in prices has materialized, the last quotation for ½-in. variety being on the basis of $21 per 1,000 ft. Heavy stocks are reported and material is not moving satisfactorily.

Rigid Conduit.—Despite the lowering of steel prices and unfilled steel orders no further reductions are reported in the conduit line. Sufficient building is under way to hold up the demand in this territory and stocks of the popular sizes continue somewhat spotty. Buying is limited, however, to current needs.

Electric Fixtures.—Jobbers report a continued brisk movement in the fixture line caused by the completion of construction undertaken in the early fall. The slump will be felt keenly in the next sixty to ninety days, as building operations fell to a low ebb in the last two months of 1920.

Farm-Lighting Plants.—Little or no activity is reported, low prices for agricultural products having effectually stopped sales of plants, though a resumption is expected in the late spring as farmers' holdings become liquidated.

Panelboards.—More activity than has been present for several months past is reported, commercial buildings and apartment houses nearing completion having caused brisk demands for all popular sizes. Prices, however, remain steady and shipments are reported satisfactory.

Interphones.—These are moving quite satisfactorily. Local stocks are reported in good shape and shipments fairly prompt. No price changes are noted.

ST. LOUIS

Extreme quietness has marked the first week of the year for manufacturers, jobbers and dealers. This condition was not an unexpected one, and if the whole of January continues very quiet present predictions will be no more than justified. As a whole, however, electrical circles here are not pessimistic about the future. A great deal of construction, both residence and industrial, is vitally needed here in the near future. With a little aid from the building material manufacturers in the way of price deflation, much of this building should get under way in the spring. In any event confidence is being expressed on all sides that the present month will witness the passing of the worst part of the depression and that the market will recover gradually in February and March.

Data on inventories are still complete but it is generally supposed that they will be heavy in such items as wire, knobs, tubes, cleats, sockets, fuses, etc., and that hollow ware, several porcelain items, rigid conduit and a few other articles will be either a trifle short or about in normal supply.

Non-Metallic Flexible Conduit.—A considerable price decrease is noted here, quotations having dropped about 40 per cent. Jobbers' stocks have been large for some time, but even this concession has failed to bring forth enough demand to cut stocks down. Representative quotations are $30 per 1,000 ft. for the ½-in. size and $27.50 for the ⅜-in.

Schedule Material.—There is plenty on hand, with very little chance of getting rid of much of it until building starts in earnest. Prices are holding firmly.

Transformers.—Manufacturers continue to report back

orders on their books and say that there was a very satisfactory amount of new business during December. Delivery on distribution transformers is being promised in six to eight weeks and on power types in three to four months.

Conduit Fittings.—Sales are rather light. Supplies are normal, though a few jobbers report slight overstocks. There has been no price change of any consequence, though an earnest buyer could probably obtain concessions on large orders

Tape.—Sales of tape, both rubber and black friction tape, have slowed up considerably. Stocks are good. Prices have dropped slightly, from 42 to 45 cents per pound being the average.

Wire.—Several instances of sales of No. 14 rubber-covered wire, at prices ranging from $8.52 to $9.50 per 1,000 ft., have been noted in the last week. It is felt that wire of all sorts has reached the lowest price it will go to, and demand has bettered slightly on this account. Jobbers' supplies are still very large and immediate shipment may be had on almost any quantity of rubber-covered, weatherproof, bare-copper or magnet wire.

Rigid Conduit.—Stocks of the smaller sizes have again become spotty, although larger sizes in general are good. Demand is not strong enough to make these shortages seriously felt, and the interchange agreement among St. Louis jobbers operates so that no orders go unfilled. Prices have not changed.

Motors.—Stocks are improving although there is still some difficulty in getting sizes around 15 hp.

SAN FRANCISCO

The latest reports show that California is now leading the United States in the production of oil. Collections are reported fair. There is a general tendency on the part of various jobbers and manufacturers of household appliances to abandon particular credit agencies for their own plans, which are based upon bank acceptances of lumped lease forms. To the considerable power projects of the state must be added that of the Red River Lumber Company, whose new Feather River plant not only cares for the lumber town of Westwood but also for the neighboring city of Susanville and will probably be the means of sale of a great many long-needed appliances and home conveniences.

The total construction figures for the entire year 1920 are as follows: San Diego, $5,671,798; Oakland, $9,489,906; Los Angeles, $59,920,559; San Francisco, $26,729,992. The total figures for the entire year 1919 were as follows: San Diego, $2,938,651; Oakland, $7,134,672; Los Angeles, $28,553,669; San Francisco, $15,163,242. In general these figures show a 100 per cent increase in 1920, and it is expected that 1921 will run even higher than 1920 in spite of a smaller number of large buildings.

A period of hand-to-mouth buying has set in and will probably continue for several weeks. This is partly caused by rumors of price recessions and partly by rather large stocks carried over into the new year.

Radiators.—The recent cold snap and the price advance of 10 per cent makes the radiators that were carried over a good investment.

Wireless Material.—Because of its geographical location the Pacific Coast is well supplied with radio plants, making good business for each new manufacturer and causing the establishment of several Pacific Coast factories. These factories report that their Eastern customers have practically ceased buying because of a general spirit of retrenchment among their own buyers. The field of sale is limited and educational plans are slow to materialize.

Fans.—Jobbers' salesmen are now canvassing their trade for summer contracts. The new forms are based upon the quantities of previous years, but the new prices are about 12 per cent higher than last year's.

Schedule Material.—The growing popularity of the tumbler-type switch is reflected in its inclusion with push switches to make the 500-lot quantity price.

Illuminating Line.—Commercial installations are being checked and redesigned, and the resulting business together with the big sales of pole-line material makes a good backbone for the present electrical business.

SEATTLE—PORTLAND

Generally speaking, the new year finds jobbers and dealers in the Puget Sound section carrying a good deal heavier stocks than during the same period last year. Specifically, nearly every concern has good supplies, and in many cases firms are overstocked, particularly with hollow ware. Eastern factories have almost caught up with back orders and deliveries are prompt. Buying is unusually sluggish. Rumors of imminent price recessions all along the line are abroad, but reductions are not materializing to any noticeable extent. Certain grades and types of wire are fluctuating, but changes are not affecting trade. Since the holidays some retailers have cut prices a little on hollow-ware merchandise, principally heaters and percolators. No improvement is shown in collections; they are tight and extremely hard to make. The few calls for credit are being scrutinized minutely. The municipal light department of Tacoma recently completed arrangements to buy $30,000 worth of ranges and $25,000 worth of meters. The Washington Water Power Company, Spokane, has awarded contract for construction work in the Spokane River in connection with their new power plant.

The labor situation in Seattle and Puget Sound district shows no improvement; in fact, the unemployment situation is becoming more serious daily. To augment further the condition, heavy wage reductions have been put into effect. The Master Builders' Association in Seattle, whose membership handles practically all building construction, states that the readjustment of wages will be made within two or three weeks and it is expected this will noticeably increase the volume of new construction. In lumber circles there is a well-defined streak of optimism based upon the belief that credit will ease and that the unsatisfied demand for housing and other construction will soon assert itself. The Shipping Board has announced an indefinite postponement of the proposed sale of surplus shipbuilding material on the Pacific Coast; bids had been called for Jan. 14.

The general feeling in the Portland section among jobbers and manufacturers is that the first two or three months of 1921 will be very quiet, but that business will pick up in the spring. To offset the expected slump in January and February it is quite generally felt that a number of price reductions will come.

SALT LAKE CITY—DENVER

The price situation is still puzzling to jobbers and dealers. They have little intimation of what the immediate future will bring; consequently they are cautious in placing orders for electrical merchandise. If reductions come without due warning they do not propose to be caught with an overload of lines bought on a high market. A cheerful tone prevails in banking circles. Officials competent to express an opinion declare that business is now well over the most difficult period. No less than $12,000,000 in rediscounts held by a Federal Reserve bank of the Rocky Mountain region was recently taken up by debtor banks. "That this liquidation could take place despite the unusual and severe commodity price declines, which have arisen during the crop-moving period, is indication in itself of the fundamentally healthy condition of the district," said the manager. The tax period and the end of the year settlements have been accomplished in the district without dislocation, and one of the most hopeful indications is the fact that the banks now can tell just where they stand. They are on solid ground now for the first time in months, and on this basis the banks and their customers can make their definite plans for the future.

Cheerfulness throughout the district is on the increase. With the banks sure of their ground and in sound condition, business is certain to reflect the renewed confidence and to feel the reassurance of the new and better status of affairs.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution
Together with Trade Personals and Notes on Foreign Trade,
Jobbers' News and New Trade Literature

Underwriters' Demerit Schedule Plan Being Extended

Following the success of the plan conceived by the Underwriters' Laboratories, Inc., of apportioning a schedule of demerits for failures in tests of rubber-covered wire the laboratories have employed the plan for flexible cord, fixture wire, rigid conduit, cartridge inclosed fuses and snap switches. It is announced that in the near future the demerit schedule plan will be applied to still other products.

The idea since the plan's incorporation in 1911 is to arrest automatically the labeling of any make of wire, etc., which is showing unsatisfactory performance for any appreciable percentage of the product for any considerable length of time through excess demerits charged. In some cases the appearance of any demerits has caused manufacturers to seek to determine and rectify the conditions responsible in the factory processes.

New Company Takes Over Automatic Light

The Holt Farm Light Company has been incorporated in the State of Ohio for $1,000,000 and will locate in Toledo, taking over the Automatic Light Company of Ludington, Mich., manufacturer of the Holt 110-volt farm-lighting plant.

The plant at Ludington will be continued for such time as will enable the company to get a site in Toledo. Arrangements, however, will be made at once in Toledo for at least 50,000 sq.ft. of floor space in which to assemble the unit, the various component parts being manufactured at Ludington until it is possible to make the complete unit in this city.

The company elected the following officers: L. W. Holt of the Automatic Light Company, president; S. H. Humphries of Detroit, vice-president, and H. K. Greenman of the Automatic Light Company, secretary and treasurer. Mr. Humphries is one of the best known production men in the automotive industry, he having been manufacturing manager of the United States Motor Company, the Hupp Motor Car Company and the Chalmers Motor Car Company. During the war he was in charge of production for the Wright Martin Aircraft Corporation at New Brunswick, N. J.

L. W. Holt, president of the company, has been president of the Ludington plant. He was formerly a motor-car man, having been connected with the merchandising of such cars as the Chevrolet, Haynes and Matthewson. In association with Mr. Greenman, who at one time was a distributer for this farm-lighting plant at Minneapolis, the business was purchased from Scott J. Matthews of Port Clinton. The plant at Ludington was formerly known as the Also plant, but later the name was changed to the Holt power plant.

Philadelphia Jobbing House Celebrates Twenty-Fifth Anniversary

At the annual "family party" a few days ago the employees of J. F. Buchanan & Company, Philadelphia electrical supply jobbers, presented to John F. Buchanan and Gilbert S. Smith, who manage the company's business, suitable gifts marking the twenty-fifth anniversary of the organization's birth.

At the same time there was a distribution of bonuses based on time of service. For two years' service, 1 per cent on the year's salary was paid; for four years, 2 per cent; six years, 3 per cent; eight years, 4 per cent, and ten years or more, 5 per cent. Out of 115 employees fifty received bonus checks.

Mr. Buchanan announced that the company was working out a plan whereby it would not be necessary to reduce wages. By increased efficiency the employees, it is expected, will be able to maintain the present wage scale.

Washing Machine Association Meets Next Week

The program of the fifth annual convention of the American Washing Machine Manufacturers' Association at the Sherman Hotel, Chicago, on Jan. 19-20, will depend very largely upon the members present. Outside of the reports of old officers and the election of new ones it is planned to devote practically all the available time to discussions of methods of distribution, which are said to be the paramount problem of the industry today. In order that methods may be discussed in detail those who distribute through jobbers and those who sell direct to dealers may be divided into separate groups. The annual banquet will be held during the evening of the first day.

Associated Jobbers to Meet in March and May

Of the spring meetings of the Electrical Supply Jobbers' Association already announced those of the Atlantic Division and of the Central Division will be held on March 15, the latter division in Chicago. The general meeting is scheduled for May 25, 26 and 27 at Hot Springs, Va. The executive committee will sit in Cleveland March 16 and 17 and at Hot Springs May 23 and 24.

Independent Lamp and Wire Plants Sold to G. E.

Company Had Lost in Coolidge Patent Suit to G. E. and Was Not a Licensed Lamp Manufacturer

The lamp and wire plants of the Independent Lamp & Wire Company have been sold to and are now being operated by the General Electric Company. Dr. A. J. Liebman, vice-president and general manager of the Independent company, is now in the General Electric employ. The Independent company has ceased manufacturing and, it is stated, will most likely go out of business.

The Independent Lamp & Wire Company was engaged in manufacturing incandescent lamps at Weehawken, N. J. and insulated and enameled wire at York, Pa. Its lamp output in 1920 was around 9,000,000 lamps. One-third of the Independent stock was owned by the General Motors Company, which took about 10 per cent of its lamp output.

For a number of years the Independent Lamp & Wire Company and the General Electric Company were engaged in litigation over the Coolidge patent for drawn-tungsten wire. When the other independent lamp manufacturers were offered licenses by the General Electric Company under the Just and Hanaman patent, the Independent Lamp & Wire Company did not take one out, but continued to manufacture unlicensed lamps. The Coolidge patent suit was decided six months ago in the United States District Court in favor of the General Electric Company against the Independent Lamp & Wire Company.

Square D Announces Constructive Advertising Policy

A new advertising policy discarding the negative appeal concerning the danger of electricity and substituting therefor a constructive appeal for the safety switch has been announced by the Square D Company. For its former advertising the company was severely criticised because of the emphasis it placed on electrical hazards.

This appeal, however, A. MacLachlan, secretary and director of sales of the company, has stated to the ELEC-

TRICAL WORLD, was understood from the start to be only temporary. "We had to shock the public," said Mr. MacLachlan, "into a realization of the dangers of the open knife switch, a device admitted even by the industry to be dangerous. We had to accomplish in a few months what the whole industry would by less dramatic methods have taken ten years to do. An appeal other than that of fear would have suggested to factory owners and managers that the open knife switch was dangerous, but the suggestion would either have been forgotten or action on it put off. But the negative appeal drove the fact deep into their consciousness, and while our campaign may have caused some timorous people to believe that the unusual cases portrayed in our advertising were commonplace wherever electricity was used, it cannot be denied that it saved hundreds of lives.

"In the new campaign, instead of building our appeal on tragic, dramatic accidents—even though founded on fact—we will by analogy entirely removed from the electrical industry show how Square D switches prevent the accidents that are bound to happen as long as open knife switches are permitted to make electricity dangerous. The pictorial display in our advertising will be dramatic—just as dramatic as it was last year. But it will in no way have any connection with the use of electricity. Rather, its purpose will be to convey instantly to the reader that Square D switches are a safeguard, and in this manner to promote the use of electricity rather than retard it."

New Officers of N. Y. Electrical Credit Association

William R. Conklin, American Copper Products Corporation, was elected president; F. A. Booth, Westinghouse Electric & Manufacturing Company, was elected vice-president, and Albert F. Thacher, Alpha Electric Company, was elected treasurer of the New York Electrical Credit Association for the fiscal year ending Nov. 30, 1921, at the meeting of the new board of directors of the association on Dec. 22. W. J. Kreger was appointed secretary, with offices at 47 West Thirty-fourth Street.

Hubbell to Resume Production

After a shutdown since Dec. 24, Harvey Hubbell, Inc., expects to resume operations at its plant in Bridgeport, Conn., on Jan. 17. Although production will be carried out on a full-time basis it will probably be on a somewhat reduced output.

Benjamin Prize Distribution Covers Many States

In the awarding of prizes last year in the annual contest held by the Benjamin Electric Manufacturing Company, Chicago, for the best window display or sales experience story of its dealers and distributers, in connection with the No. 92 two-way plug, a good geographical distribution results. New York State scored twice, while New Mexico, Florida, Ohio, Iowa, Illinois and Wisconsin scored one each. The material turned in was double that of 1919.

International G. E. Moves Headquarters

The headquarters force of the International General Electric Company, Inc., which has been housed in the main office building of the General Electric Company, has just moved into its new office building erected on what was formerly the Westinghouse property on River Road, Schenectady, N. Y. This change places under one roof about 400 persons in the following departments: Executive, European, the Americas, Far East, merchandising, service and accounting. The building is six stories high with a basement under half of it. The exterior is tapestry brick with limestone trim. The total floor space is approximately 70,000 sq.ft., each floor being about 60 ft. x 220 ft.

The Southern Testing Laboratories, American Trust Building, Birmingham, Ala., recently incorporated with a capital stock of $25,000, is planning to establish a commercial laboratory.

Vinton Smith, who has been connected for several years with the San Francisco office staff of the Standard Underground Cable Company, has been appointed assistant Pacific Coast manager, reporting to Richard G. Harris.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., announces the opening of a St. Louis office in the Railway Exchange Building, in charge of Harold Phillips, formerly of the engineering department of Chicago and later office manager of the Chicago office. This new office is a branch of the Chicago district office. The increasing amount of business done in the St. Louis territory is given as a reason for this expansion.

The Yale & Towne Manufacturing Company, Stamford, Conn., has recently taken over the industrial electric truck division of the C. W. Hunt Company, West New Brighton, Staten Island, New York. Arrangements have been completed by the Yale & Towne Manufacturing Company for increasing the manufacturing facilities of its chain block and hoist works at Stamford.

The Ideal Electric & Manufacturing Company, Mansfield, Ohio, is completing an extension, 160 ft. x 430 ft., and is also preparing plans for another addition 100 ft. x 430 ft.

The Allen-Bradley Company, 284 Greenfield Avenue, Milwaukee, Wis., has increased its authorized capitalization from $186,000 to $250,000 to provide for expansion to its business. The company makes control devices.

C. D. Gilpin has removed his office from Philadelphia to 523 Equitable Building, Baltimore, Md., to facilitate handling the Maryland and Virginia territory. Mr. Gilpin is manager for the Baker R & L Company in this district, including the southeastern part of Pennsylvania with the exception of a little territory around Philadelphia.

The Pawling & Harnischfeger Company, Milwaukee, Wis., has increased its authorized capital stock from $1,000,000 to $3,000,000. This new issue is to cover an extensive plant development. The company manufactures electrically driven traveling cranes.

The Whiting Foundry Equipment Company, Harvey, Ill., announces that it has changed its name to Whiting Corporation and has increased its authorized capital stock from $700,000 to $3,000,000. The Whiting Corporation remains under the same management and will continue the manufacture of cranes, foundry equipment and railway specialties as heretofore.

The James T. Hessel Company, New Haven, Conn., has been appointed distributer for "Universal" electrical appliances, manufactured by Landers, Frary & Clark, New Britain, Conn., and has been appointed distributer for the State of Connecticut for the "National" renewable fuse. This recently established organization, with headquarters at 19 Prout Street, New Haven, has just enlarged its warehouse to accommodate a complete stock of pole-line hardware, crossarms, etc.

The Electric Storage Battery Company, Philadelphia, incorporated with a capital of $30,000,000 in that state, has received permission from the Secretary of State of Missouri to issue $114,000 worth of capital stock in Missouri. H. B. Marshall, Federal Reserve Bank Building, St. Louis, is the principal Missouri agent for the company.

The Worthington Pump & Machinery Company, 115 Broadway, New York City, is taking bids for the construction of an addition, 50 ft. x 75 ft., to its plant at St. Bernard, Ohio.

The Edison Lamp Works of the General Electric Company, Harrison, N. J. is planning to erect a four-story addition, 80 ft x 200 ft., on South Street.

The Robertson-Cataract Electric Company, 151 West Mohawk Street, Buffalo, N. Y., has filed notice of increase in capital stock from $1,500,000 to $3,000,000.

The Gold Seal Battery Company, Green Bay, Wis., recently incorporated, has started work on the erection of a manufacturing building, 40 ft. x 150 ft., at James and McDonald Streets, which will soon be ready for occupancy. The present plans provide for an initial capacity of 100 batteries per day.

The Crown Electric Company, 164 North Gay Street, Baltimore, Md., through George W. Wilkinson, head of the company, is reported to have acquired property at 419-25 High Street, on which it will erect a new building. The company manufactures electrical specialties.

The Southern Ice Machine Company, Charlotte, N. C., recently organized with a capital stock of $125,000, plans to equip an existing building for the manufacture of ice-making machinery. The company proposes to construct a new

plant at a later date. F. A. Owens is president and manager.

The Engineering Equipment Company, Ltd., 263 St. James Place, Montreal, Canada, Canadian dealer for the Baker R & L Company, Cleveland, Ohio, announces through its president, Norman M. Campbell, the establishment of its new headquarters.

The Northern Engineering Works, Detroit, Mich., has established a new office at 990 Union Arcade Building, Pittsburgh, in charge of J. B. Laird, who has heretofore represented the company in western New York and northern Pennsylvania. Mr. Baird will cover the entire East and Ohio Valley and for the present will also look after the Buffalo district. The company manufactures cranes and hoists.

Westinghouse Changes. — George Baily, formerly assistant to manager of the Industrial section, supply department, of the Westinghouse Electric & Manufacturing Company, has been put in charge of the Merchandising section of the supply department, succeeding M. C. Morrow, who takes charge of the merchandising bureau. J. A. Clark has been appointed manager of the merchandising section of the industrial department.

The Harlan Electric & Machine Company, Harlan, Ky., has changed its name to the Cumberland Machine Works.

H. M. Byllesby & Company, 208 South La Salle Street, Chicago, investment bankers, engineers and managers, are distributing a new booklet describing the scope and services of the organization.

The Pawling & Harnischfeger Company, Milwaukee, Wis., manufacturer of electric cranes and hoists, machine tools, excavating machinery, etc., announces the annual general meeting and business sessions of its district managers and sales engineers at the plant from Jan. 25 to 27.

The Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City, announces the appointment of J. F. Huvane as Eastern manager of compressor and engine sales, with headquarters at 6 East Forty-fourth Street, New York City, and G. C. Van den Boom as Western manager of compressor and engine sales, with headquarters at 300 North Michigan Boulevard, Chicago. The company also announces the resignation of H. L. Dean, formerly manager of the compressor and engine sales.

Foreign Trade Notes

PROPOSAL TO LINK UP ELECTRIC GENERATING STATIONS IN ENGLAND. —The powers granted under the electricity (supply) act of 1919 will, it is hoped, according to the London *Electrician*, insure that all future developments shall be considered as part of a general scheme and that the elimination of non-standard frequencies will make it possible for stations to be linked up profitably, thus saving considerable capital expenditure and stand-by plant by insuring that only the most economical plant shall be kept on load.

DEMAND FOR ELECTRICAL SUPPLIES IN SOUTH AFRICA.—Extensions and improvements are contemplated to a number of electrical projects in South Africa, among which are the construction of a large electric power station at Durban by the government and the purchase of cables for the electric lighting and traction department of Johannesburg, to cost about £40,000. Other local authorities are also contemplating extensions to electric supply systems.

URGENT DEMAND FOR ELECTRICAL EQUIPMENT IN NEW ZEALAND.—According to the *World Salesman* there is an urgent demand for machinery and equipment for electric power plants, electric cars and accessories in New Zealand.

ELECTRIFICATION OF BRAZILIAN RAILWAYS.—The bill to equip for electrical operation the Central Railway of Brazil, the lines of which are conveniently accessible to water power for the generation of electricity, has been passed by the Chamber of Deputies. This bill authorizes the government to spend not more than 15,000 contos (about $11,000,000) for the purpose of transforming them from steam to electrical traction, in whole or in sections, as is found most feasible. The bill also authorizes the government to contract with a private enterprise to furnish the necessary power for not more than fifteen years. The State Legislature of Sergipe has authorized a loan of 15,000 contos (about $2,800,000) to be used to equip urban traction lines for electrical operation and other improvements.

GERMAN ELECTRICAL EQUIPMENT IN CHILE.—The local branch of a German house in Santiago, Chile, it is reported, has received 72 tons of electrical equipment from Germany. Other recent orders from firms in Germany are four cranes to be used in Valparaiso harbor and five 1-ton [illegible] for the brewing industry in Chile.

ELECTRICAL GOODS IN SOUTH AFRICA. — The Standard Bank of South Africa, Ltd., reports that supplies of electrical goods from the continent of Europe are coming into the Union of South Africa at prices below those of English or American manufacture.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An engineer in Italy (No. 34,203) desires to purchase electrically driven knitting machines for factories manufacturing cotton and woolen knitted goods.

A commercial agent from Australia (No. 34,213) is in the United States and desires to secure an agency for the sale of electrical goods, etc.

New Apparatus and Publications

TESTING EQUIPMENT. — The Delta-Star Electric Company, 2433-2453 Fulton Street, Chicago, is distributing a leaflet describing its 10,000-lb testing equipment for mechanically testing insulators, bus supports and switches which will be subject to heavy mechanical stress.

OUTLET BOXES. — Renim Specialty Company, 100 K Street, Boston (27), Mass., has issued under date of Jan. 1, 1921, catalog No. B1 on its outlet boxes for use with flexible armored conductor and nonmetallic flexible conduit.

MARINE SETS.—Bulletin No. 42,300A, entitled "Steam Engine-Driven Generating Sets for Marine Installations," is being circulated by the General Electric Company.

SAFETY DISCONNECTING HANGERS. —The Thompson Electric Company, 226 St. Clair Avenue, N. E., Cleveland, Ohio, has issued catalog B-19, in which it describes and illustrates the new underslung feature of its safety disconnecting hanger.

CONDULETS.—The Crouse-Hinds Company, Syracuse, N. Y., has issued Bulletin 1000R, effective Nov. 26, covering its new line of conduit fixture joints and extensions.

STATION CONTROL EQUIPMENT.—The General Electric Company has published bulletin No. 47,730, entitled "Automatic Station Control Equipment," in which is presented a list of technical articles which have appeared in leading magazines on the subject of automatic station control equipment within the last eight years.

RECORDERS.—The Foxboro Company, Inc., Foxboro, Mass., is distributing bulletin No. 114, covering its Foxboro-Heath CO$_2$ recorder.

TELEPHONE EQUIPMENT.—The Tele Call Company, 5604 Cedar Avenue, S. E., Cleveland, Ohio, has sent out a booklet describing its "Tele-Call" equipment for use in connection with telephone switchboards.

New Incorporations

THE EFFICIENT ELECTRIC PROTECTION COMPANY, Newark, N. J., has been chartered with a capital stock of $50,000 to manufacture electrical products. The incorporators are Frank Silken, M. and Harry Dvorken, 86 Jefferson Street, Newark.

QUINCY & SCHROEDER, INC., New York City, has been incorporated by J. R. Courtney, R. B. Quincy and E. C. Schroeder, 62 East Thirty-fourth Street. The company is capitalized at $55,000 and proposes to manufacture electric motors and similar products.

F. H. ALLEN & COMPANY, INC., Newark, N. J., has been incorporated with a capital stock of $125,000 to manufacture electrical appliances. The incorporators are John W. Beck, James H. Ward, Jr., and Franklin H. Allen, 26 Lawrence Street, Newark, N. J.

THE TITAN MINIATURE LAMP COMPANY, 281 Glenwood Avenue, Bloomfield, N. J., has been organized to manufacture electric lamps. F. M. Merrick, 182 Bay Avenue, Glen Ridge, N. J., is interested in the company.

THE BROAD MANUFACTURING & SUPPLY COMPANY, Philadelphia, Pa., has been organized to manufacture steam, water and electrical equipment. Frank A. Moorshead, Commonwealth Building, Philadelphia, is representative for the company. Application has been made for a State charter.

THE NEW FAMOUS CHANDELIER COMPANY, Philadelphia, Pa., has applied for a State charter for the purpose of manufacturing electric and gas lighting fixtures and attachments. David Brussell and Myer Genstein are among the organizers. A. S. Ashbridge, Jr., 1319 North American Building, Philadelphia, is representative for the company.

THE WISCONSIN ELECTRIC WELDER COMPANY, Milwaukee, Wis., has been incorporated with a capital stock of $150,000 to manufacture electric welding and cutting apparatus and to operate a commercial welding shop. The incorporators are G. F. Runge, E. H. Mills and Walter L. Poppe, 431 Cass Street, Milwaukee.

THE LYTHAN ELECTRIC LAMP COMPANY, Jersey City, N. J., has been incorporated with a capital stock of $150,000 to manufacture electrical appliances by William J. Tompkins, John W. Aymar, Jr., and Waldemar F. Timme.

THE NOR-DAN ELECTRICAL SUPPLY CORPORATION, New York City, has been incorporated by N. C. Degnon, L. C. Naughton and D. F. MacDonald, 161 East Ninety-third Street, New York City. The company is capitalized at $100,000 and proposes to manufacture storage batteries.

THE AUTOMATIC TELEPHONE EQUIPMENT COMPANY, New Brunswick, N. J., has been incorporated with a capital stock of $100,000 by Oscar S. Bowel, Providence, R. I.; Percy S. Hayden, New York City, and Harold R. Fick, New Brunswick.

THE MEADOW CREEK POWER COMPANY has been incorporated with a capital stock of $100,000 to operate in Fayette and Greenbrier counties, W. Va. The incorporators are George S. Couch, Thomas B. Jackson and V. L. Black, all of Charleston, W. Va.

THE WEYERS CAVE LIGHT & POWER COMPANY, Weyers Cave, Va., has been incorporated with a capital stock of $100,000 to construct and operate an electric power plant on the Shenandoah River.

THE LEXINGTON (KY.) STORAGE BATTERY MANUFACTURING COMPANY has been chartered with a capital stock of $25,000 by H. Greenbaum, M. B. Davis and L. B. Speyer.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 21, 1920)

1,363,157. ELECTRICALLY WELDED TUBE AND METHOD OF MAKING THE SAME; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 3, 1920. Inner and outer tube electrically united.

1,363,158. ELECTRICALLY WELDED TUBE AND METHOD OF MAKING THE SAME; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 3, 1920. Inner and outer tube electrically united.

1,363,159. ELECTRICALLY WELDED TUBE; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 3, 1920. Inner and outer tube welded together.

1,363,160. METHOD OF INCLOSING TUBES WITHIN TUBES; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 3, 1920. By electrical weld.

1,363,161. METHOD OF UNITING METAL PLATES; Thomas E. Murray, Brooklyn, N. Y. App. filed Aug. 1, 1920. Electrically welded.

1,363,162. FILAMENT FOR INCANDESCENT ELECTRIC LAMPS; Ralph E. Myers and Roy D. Hall, East Orange, N. J. App. filed May 14, 1915. Durable and resistant.

1,363,167. ELECTRICAL GENERATOR WITH COUNTER-COMPOUNDING; Robert Peugeot, Valentigney, France. App. filed Dec. 12, 1913. Work at constant voltage.

1,363,186. ELECTROLYTIC METHOD, APPARATUS AND PRODUCT; Matthew M. Merritt, South Middleton, Mass. App. filed April 15, 1919. For depositing metal.

1,363,206. ELECTRIC HEATER; Henry Kruesheld, New Washington, Ohio. App. filed June 25, 1920. For toasting.

(Issued Dec. 28, 1920)

1,363,219. TRUNKING SYSTEM; Henry M. Bascom, New York, N. Y. App. filed Oct. 21, 1918.

1,363,220. SIGNALING DEVICE; Henry M. Bascom, New York, N. Y. App. filed Oct. 24, 1918. Telephone.

1,363,224. SHOT-FIRING ATTACHMENT FOR ELECTRIC BATTERIES; Ezekiel E. Birch, Crafton, Pa. App. filed Nov. 13, 1918. For blasting.

1,363,227. ELECTRIC STOVE; Fred C. Boyd, New Haven, Conn. App. filed Aug. 2, 1920. For utilizing heat below coil.

1,363,228. ELECTROLYTIC CELL; Frank H. Buck and Philip McRae, Wilmington, Del. App. filed July 17, 1920. For generation of chlorine and sodium hydroxide.

1,363,236. STARTING AND GENERATING SYSTEM; Thomas R. Du Bois, Niagara Falls, N. Y. App. filed May 18, 1916. Automobile.

1,363,237. STARTING AND LIGHTING SYSTEM; Thomas R. Du Bois, Orange, N. J. App. filed Sept. 20, 1917. For automobiles.

1,363,268. TELEPHONE SYSTEM; Winfred T. Dowell, East Orange, N. J. App. filed March 29, 1918. Automatic.

1,363,299. MOTOR CONTROLLER; Charles W. Yerger, Milwaukee, Wis. App. filed June 23, 1919. Drum type.

1,363,303. REVERSIBLE ENGINE-STARTING SYSTEM; Thomas Zimmerman and Thomas R. Bois, Niagara Falls, N. Y. App. filed May 24, 1916. Marine service.

1,363,319. RECEIVER FOR WIRELESS TELEGRAPHY; John L. Hogan, Jr., New York, N. Y. App. filed July 14, 1916. Operating on heterodyne principle.

1,363,334. TELEPHONE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed July 27, 1916. Semi-automatic.

1,363,337. SECTION INSULATOR; William C. McIlvain, Russellton, Pa. App. filed March 9, 1920. Trolley.

1,363,350. ELECTRIC TERMINAL CLAMP; Adolph C. Recker, Oakville, Conn. App. filed Aug. 26, 1919. For electric batteries, spark plugs, etc.

1,363,[illegible]. [illegible] CALL ENDS, Jacob C. Sander, Lynn, Mass. App. filed May 10, 1920. Electric weld.

1,363,356. METHOD OF BUTT-WELDING TUBING; Jacob C. Sander, Lynn, Mass. App. filed May 21, 1920. Prevents formation of burr.

1,363,364. SELECTOR SWITCH; Frank M. Slough, Rochester, N. Y. App. filed Nov. [illegible], 1917. Telephone.

1,363,365. AUTOMATIC SELECTOR SWITCH; Frank M. Slough, Rochester, N. Y. App. filed Nov. 5, 1917. Telephone.

1,363,382. PROCESS OF PRODUCING METALLIC ALLOYS; John P. Arend, Dommeldingen, Luxemburg. App. filed March 21, 1918. Free from oxygen.

1,363,394. ELECTRICAL APPARATUS; David Conlan, Jr., Brooklyn, N. Y. App. filed Jan. 5, 1920. Extension plug.

1,363,472. ELECTRIC WATER HEATER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Jan. 25, 1919. Attached to pipe system.

1,363,473. ELECTRICALLY HEATED TOOL; Frank Kuhn, Lawrence H. Thomas and Jules G. Spiess, Detroit, Mich. App. filed May 27, 1920. Soldering iron.

1,363,474. ELECTRICALLY HEATED TOOL; Frank Kuhn, Lawrence H. Thomas and Jules G. Spiess, Detroit, Mich. App. filed May 27, 1920. Soldering iron.

1,363,491. ELECTRICAL TESTING INSTRUMENT; Edward C. Bartsch, Chicago, Ill. App. filed May 19, 1919. For automobiles.

1,363,630. DYNAMO-ELECTRIC MACHINE; Charles E. Wilson, Wilkins Township, Allegheny County, Pa. App. filed Nov. 16, 1917. For automobiles.

1,363,633. ELECTRICAL SYSTEM; Thomas C. Wurts, Pittsburgh, Pa. App. filed May 7, 1917. Indicates changes in rotation of driving wheels relative to rotation of guiding wheels of locomotives.

1,363,635. CONTROL SYSTEM; Edgar M. Bouton, Wilkinsburg, Pa. App. filed March 31, 1920. For mine fans.

1,363,636. ARC-WELDING ELECTRODE; Porter H. Brace, Pittsburgh, Pa. App. filed May 12, 1919. Slag core.

1,363,638. APPARATUS FOR THE CONTROL OF DYNAMO-ELECTRIC MACHINES; Wilfred Brooke, Altrincham, England. App. filed May 18, 1918. Automatic acceleration.

1,363,644. BRUSH HOLDER; John V. Dobson, Wilkinsburg, Pa. App. filed Nov. 19, 1917. Bears on sides of ring.

1,363,645. STORAGE BATTERY; William S. Gould, New York, N. Y. App. filed Feb. 17, 1920. Means for supporting separators.

1,363,646. STORAGE BATTERY; William S. Gould, New York, N. Y. App. filed July 23, 1920. Means for supporting plates and separators.

1,363,647. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed May 3, 1916. Regenerative control.

1,363,648. STORAGE BATTERY; Albert S. Hubbard, New York, N. Y. App. filed Dec. 6, 1917. Ventilating plug.

1,363,649. STORAGE BATTERY; Albert S. Hubbard, New York, N. Y. App. filed July 26, 1918. Plate supports.

1,363,650. STORAGE BATTERY; Albert S. Hubbard, New York, N. Y. App. filed Dec. 6, 1917. Plate supports.

1,363,666. ELECTRICAL SYSTEM; Joseph N. Mahoney, Wilkinsburg, Pa. App. filed Aug. 30, 1916. For automatically connecting feeder circuits together.

1,363,671. BATTERY; Maurice E. Pipkin, Nacogdoches, Tex. App. filed May 15, 1918. Plate supports.

1,363,673. INSULATOR; William Schaake, Pittsburgh, Pa. App. filed April 5, 1917. Minimum amount of metal and cement.

1,363,681. MOTOR-CONTROL SYSTEM; George E. Slocum, Cleveland, Ohio. App. filed Jan. 26, 1917. Automatically controlling field strength.

1,363,683. BATTERY; Almond H. Snyder, Lancaster, N. Y. App. filed Feb. 28, 1918. Means for supporting plates.

1,363,684. STORAGE BATTERY; Almond H. Snyder, Lancaster, N. Y. App. filed April 20, 1920. Means for supporting plates and separators.

1,363,685. STORAGE BATTERY; Almond H. Snyder, Lancaster, N. Y. App. filed July 13, 1920. Means for supporting plates and separators.

1,363,686. STORAGE BATTERY; Almond H. Snyder, Lancaster, N. Y. App. filed Feb. 17, 1920. Means for supporting free ends of plates.

1,363,688. MEANS FOR BALANCING HIGH-SPEED COMMUTATOR CYLINDERS; Charles W. Starker, Pittsburgh, Pa. App. filed Feb. 8, 1918. Weights added to periphery.

1,363,698. PORTABLE [illegible] George W. Wacker, Rutherford, N. J. App. filed Feb. 14, 1918. Flashlamp.

1,363,707. SYSTEM [illegible] POWER FOR LIGHTING PURPOSES FROM LOW-FREQUENCY [illegible] R. Beard, Benton, England. App. filed April 15, 1920. For [illegible] cycle [illegible]

1,363,721. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; John S. Dean, Edgewood Park, Pa. App. filed Nov. 3, 1917. Insulator for supporting pin.

1,363,722. BRUSH HOLDER; John S. Dean, Edgewood Park, Pa. App. filed Nov. 16, 1917. Replaceable parts.

1,363,729. BATTERY ELEMENT; Charles F. Haunz, Lancaster, N. Y. App. filed Aug. 2, 1919. Grid.

1,363,742. IGNITION APPARATUS; Charles T. Mason, Sumter, S. C. App. filed April 6, 1920. Magneto.

1,363,754. STORAGE-BATTERY SEPARATOR; Gustav H. Rabenalt, Lancaster, N. Y. App. filed March 30, 1918. Impervious to minute particles of material.

1,363,757. SYSTEM OF CONTROL; Carl P. Taylor, Norfolk, Va. App. filed Feb. 24, 1916. Regenerative.

1,363,758. BRUSH STRUCTURE; Henry H. Wait, Chicago, Ill. App. filed Aug. 22, 1917. Holder.

1,363,796. ANSWER-BACK MECHANISM; Richard C. Leake, Rochester, N. Y. App. filed March 25, 1915. Railway signal.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WHITING, ME.—At a special town meeting the sum of $14,000 was raised for completing the electric light plant at this place.

WORCESTER, MASS.—The American Steel & Wire Company, Grove Park, contemplates the erection of a 30,000-kw. central power station to replace several power houses in Worcester.

NEW LONDON, CONN.—The Connecticut Power Company has entered into agreement with the city officials to extend the ornamental street-lighting system through Main and Bank Streets, at a cost of about $25,000.

Middle Atlantic States

ALBANY, N. Y.—Commissioner of Public Works W. Greenlach has submitted to Mayor Watt an annual report which includes a recommendation that the filtration plant be electrified.

MOUNTAINDALE, N. Y.—The Mountaindale Electric Light & Power Company, recently incorporated with a capital stock of $10,000, plans to operate an electric light and power plant. F. J. Garden, S. Wingard and others are the incorporators.

UNION SPRINGS, N. Y.—Joint petitions have been filed with the Public Service Commission, Second District, by the Ledyard Lighting Company, Aurora, N. L. Zabriskie, also operating an electric lighting plant at that place, and the Union Springs Light & Power Company, Union Springs, under which the Ledyard company asks permission to issue securities, lease the Zabriskie plant and erect a transmission line from Union Springs to Aurora.

LAKEHURST, N. J.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 19 for ducts and manholes for a signal system and an electric distribution system for light and power with a series street-lighting system with underground ducts, cables, etc. (Specification 4348.)

PLAINFIELD, N. J.—The Common Council plans to install electrical equipment in the proposed garbage incinerating plant to be erected. A. N. Vars, City Hall, is engineer.

TRENTON, N. J. The McKinley Memorial Hospital, Brunswick Avenue, contemplates the erection of an addition and the installation of electrical equipment, at a cost of about $100,000. N. A. K Bugbee, 206 East Hanover Street, is chairman of the committee in charge.

ALTOONA, PA. Bids will be received until about March 1 by W. N. Decker, secretary of the Altoona School District, for the construction of a two-story power house on Sixth Avenue to cost about $200,000. Plans include the installation of equipment and erection of underground conduits. Wood, Huise, Yates & Company, Inc., Woolworth Building, New York City, are architects.

CATASAUQUA, PA. The electrification of the water plant is under consideration. According to a report submitted by R. G. Dougherty, chairman of the water and fire committee, the cost of such improvement is estimated at $11,357.

COLEBROOK, PA.—It has been reported that the power house at the local plant of the Bethlehem Steel Company, Sixteenth and Cumberland Streets, has been damaged by fire.

PHILADELPHIA, PA.—The Bureau of Health, City Hall, is arranging for the erection of a power plant at the Byberry Hospital for the Insane. Dr. C. L. Furbush is director.

READING, PA.—The Reading Hospital, Front and Spring Streets, has plans under way for an operating addition and power house to cost about $350,000. F. H. Muhlenberg, Flanders Building, Philadelphia, is architect.

CHARLESTON, W. VA.—The Meadow Creek Power Company, recently incorporated with a capital of $100,000, plans to operate an electric light and power system in Fayette and Greenbrier Counties. V. L. Black is one of the incorporators.

PRINCETON, W. VA.—The Princeton Power Company has been organized with a capital of $10,000 and will operate the electric railway between Princeton and Graham. Improvements and extensions are planned. H. S. Hardy is president.

North Central States

LANSING, MICH.—The Michigan Soldiers' Home will ask the state budget committee to provide $185,000 for the construction of a power and heating plant. The secretary of the home is in charge.

BAY VILLAGE, OHIO.—The Northern Light & Power Company has applied to the Public Utilities Commission at Columbus for authority to issue 1,000 shares of common stock at $75 a share and 3,550 shares of preferred stock at $100, the proceeds to be used for the construction of a power plant and to furnish energy to Dover, Avon and Avon Lake.

POWHATAN, OHIO.—The American Gas & Electric Company, 30 Church Street, New York City, is considering the construction of a new electric generating station in this vicinity.

SPRINGFIELD, OHIO.—The Masonic Home, National Pike West, contemplates the erection of a power plant in the spring in connection with a proposed hospital to cost about $700,000.

MAYSVILLE, KY.—The United States Engineer's Office, First District, Room 405, Post Office Building, Cincinnati, Ohio, is having plans prepared for a 28-ft. x 57-ft. power house at the Ohio River Dam No. 33.

COLUMBIA CITY, IND.—The Board of Public Works is having plans prepared for the erection of a power plant to cost about $40,000. C. Brossman, 1503 Merchants' Bank Building, Indianapolis, is engineer.

CLINTONVILLE, WIS.—The city officials will receive bids soon for waterworks improvements, including the installation of a 500-g.p.m. motor-driven pump with automatic control, one 650-gal. and one 300-gal. pump. L. P. Pelishek, Clintonville, is engineer.

JANESVILLE, WIS.—Plans are being prepared for the installation of an ornamental street-lighting system, including cables and about 200 light standards, to cost about $15,000. C. V. Kerch, City Hall, is engineer.

MILWAUKEE, WIS.—According to W. W. Rumsey, engineer of the bureau of illumination, $350,000 will be required to complete the street-lighting system. During the last year 3,250 concrete posts were set, and it is estimated that half that amount will be installed in 1921.

KEEWATIN, MINN.—Improvements will be made to the light and water plant, including an addition to the boiler house for a switchboard, three 37½-kva. transformers with outdoor substation, a 200-g.p.m. deep-well pump and an electrically driven vacuum pump. The cost is estimated at $13,300. A. Bodah is superintendent of the light and water department, and W. H. Gallagher, 619 Woodland Avenue, Duluth, is engineer.

MITCHELL, S. D.—The city officials plan to replace the cluster lights with a new street-lighting system.

MOBRIDGE, S. D.—The State Hydro-Electric Commission, Pierre, has selected a site near Mobridge for the construction of dams and a power house to generate electricity to supply cities, etc. The cost is estimated at about $15,000,000 and a bond issue for financing the project is contemplated.

MONTEZUMA, KAN.—It is planned to erect a transmission line from the Dodge City light plant to Montezuma and along the Elkhart Railway. The Ruckel Engineering Company, Hutchinson, is engineer.

NEWTON, KAN.—An election will be held April 5 for the purpose of submitting to the voters a proposition to issue $200,000 for the erection of a municipal light plant.



LAST OF THE SPOKANE RIVER POWER SITES WITHIN THE CITY LIMITS, WHERE THE WASHINGTON WATER POWER COMPANY WILL PROCEED AT ONCE WITH A 14,000-HP. DEVELOPMENT

Southern States

BENSON, N. C.—The town officials, through their treasurer, the Farmers' Commercial Bank, plan to sell $30,000 in bonds for an electric light system.

OCALA, FLA.—The city officials contemplate the installation of an ornamental street-lighting system on Main Street.

SAVANNAH, GA.—The Savannah Electric Company contemplates an expenditure of $250,000 on light and street-railway system improvements.

RUSSELLVILLE, ARK.—The Arkansas Light & Power Company, Pine Bluff, is experimenting with pulverized coal as fuel, and if this proves successful the company plans to erect a 40,000-kw.-hr. to 50,000-kw.-hr. electric plant at Russellville and a hydro-electric plant on the Ouachita River. H. C. Couch, Pine Bluff, is president.

GUYMON, OKLA.—A proposition to issue $63,000 in bonds will be submitted to the voters for the purpose of purchasing and enlarging the local light plant. Ruckel Engineering Company, Hutchinson, Kan., is engineer.

HUGOTON, OKLA.—An election will be held on April 5 for the purpose of submitting to the voters a proposition to issue bonds to the amount of $100,999 for the construction of an electric light and water plant.

OKLAHOMA, OKLA.—M. Jayne and C. P. Nieder, associate architects, Empress Theater Building, have prepared plans for the erection of a state memorial hospital to include a power plant. The cost is estimated at $2,000,000.

BONHAM, TEX.—The Texas & Pacific Railway plans to install a 75-ft. electrically driven turntable at Bonham.

CLEBURNE, TEX.—The Chambers of Commerce of Cleburne and Waco are considering the construction of an interurban electric line to fill the gap between Cleburne and Hillsboro, or a line from Dallas to Cleburne and from there to Hillsboro.

FORT WORTH, TEX.—It is understood that $60,000 is available for improvements to the lighting system at this place.

MATADOR, TEX.—The city officials contemplate the installation of an electric light and ice plant.

PECOS, TEX.—The Pecos Power & Light Company has been incorporated with a capital stock of $30,000 and plans to operate a local electric light and power plant and system. J. W. Crowdus and M. E. Heiderkorn are the incorporators.

SAN ANTONIO, TEX.—The San Antonio Public Service Company contemplates the installation of new equipment and boilers in the power plant on Conception Road and in the substation on Tenth Street, to cost between $250,000 and $300,000. W. B. Tuttle is vice-president.

WAXAHACHIE, TEX.—The city officials contemplate the installation of an ornamental lighting system in Getzendaner Memorial Park.

Pacific and Mountain States

OLYMPIA, WASH. A. G. West and F. W. Lewis have applied to the county commissioners for a franchise to erect, maintain and operate an electric light and power line beyond Tumwater and to embrace the Brigham Park District and South Union.

GLENDALE, CAL.—The city officials are receiving bids for the installation of an electrically operated pumping station, including a centrifugal pump and a 60-hp. motor. H. B. Lynch, 1007 Van Nuys Building, Los Angeles, is engineer.

HOLLYWOOD, CAL.—Petitions are being circulated for a bond election to be held soon for a new street-lighting system. According to H. T. Wright, secretary of the Board of Trade, the cost is estimated at $1,500,000.

LOS ANGELES, CAL.—The board of directors of the Chamber of Commerce has proposed the issuing of $100,000,000 in bonds to carry out within the next ten years a series of developments along the Owens River valley and other available power sites.

MONTEBELLO, CAL.—The Chamber of Commerce is considering the installation of a street-lighting system.

SAN MATEO, CAL.—Attorney Kirkbride is preparing a resolution providing for the installation of an electrolier system at this place.

FOUNTAIN GREEN, UTAH.—The Big Springs Electric Company has had plans prepared for the erection of a new power house for increased service in the spring. Plans include the installation of a generator and waterwheel and the extension of lines to Wales, Nephi and Levan. E. R. Anderson is engineer.

PAYSON, UTAH.—The town officials plan to create a special lighting improvement district for the installation of a modern street-lighting system.

COLORADO SPRINGS, COL.—An ornamental street-lighting system will be installed on Ruxton and Manitou Avenues.

Canada

WINNIPEG, MAN.—H. C. Thompson, city treasurer, has sold bonds for $600,000 to provide for municipal light and power improvements.

TILLSONBURG, ONT.—The Canadian Cereal & Flour Company, Ltd., George Street, Stratford, contemplates the erection of an electrically operated flour and cereal mill, to cost about $100,000.

WINDSOR, ONT.—The Ontario Hydro-Electric Power Commission, 31 Chatham Street West, is having plans prepared for extension to the electric street-car lines from Ouellette Avenue to Walker Road, a distance of 10 miles. Electric energy will be supplied by the Hydro-electric system. The cost is estimated at $1,000,000.

Electrical World

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Thrift Campaigns and Self-Interest

ELECTRICAL men naturally like to think of Franklin as a great electrician and to link him indissolubly with their industry. But while Franklin was a scientist, he was more; and it is particularly to another accomplishment of his that men everywhere are referring this week. "Save, young man, and become respectable; it is the quickest and surest way," epitomizes Franklin's philosophy. Of thrift he was the great exponent, and by thrift is not meant hoarding but wise expenditure; for thrift connotes neither niggardliness nor miserliness. Thrift means success and advance in the acquisition of property, increase of worldly goods, prosperity. Surely none can gainsay the wisdom of preaching thrift at this or any other time, individually and nationally, and allying it with self-interest. Self-interest prompts the practice of thrift and the investment of the savings. Particularly attractive for this purpose are the bonds and stocks of strong electric light and power companies whose properties are managed by men of technical skill and broad business experience and whose securities are issued under the supervision of public service commissions. If those connected with the electrical industry will put their savings in it and induce others to do likewise, the electric light and power companies of the country will thereby be enabled to prosper and progress and to expand commensurately with the growth of the communities they serve. Thus the community gains, the industry gains, the individual investor gains, and all those connected with or serving the electrical industry profit accordingly. This is thrift in its highest sense.

Enlarged Activities of the N. E. L. A.

WE HAVE watched with considerable interest and admiration the new spirit animating the National Electric Light Association and the widening influence of that great body in industrial and civic affairs. This development has not escaped the attention of the other branches of the industry, and they not only recognize the value of the work being done and its purport, but are anxious and willing to co-operate in the program to the end that the campaign of good will which has begun so auspiciously shall be carried through successfully and triumphantly. Seldom have the individual electric light and power companies taken such an active interest in association affairs, and never has the association meant so much to them. During the coal crisis the association was not found wanting, and in dealing with the National Association of Railway and Utility Commissioners, the Investment Bankers' Association, the Federal Power Commission, the United States Chamber of Commerce and other vital organizations the part played by the National Electric Light Association has been helpful and effective. Co-operation with the other national associations in the electrical industry has also been wholesome and generous. Coming on top of the reorganization of the association, these activities have meant enormous work on the part of the staff at headquarters, but under the guidance and inspiration of so energetic and enthusiastic a worker as Executive Manager M. H. Aylesworth the added burdens have been borne with pleasure. On him more than any one else the greater part of the work has fallen, and to his vision and foresight much of the success which has already been accomplished is due. A great deal is expected of the good-will campaign now under way, and with the hearty co-operation of manufacturers and of other branches of the industry, as well as every individual in the utility field, the outcome is sure to exceed expectations.

Self-Interest of Industrial Plants in Utility Financing

DURING the past few years of high prices, long deliveries and comparatively low electric rates central-station service has helped power customers make the large profits which have diverted capital from utility companies to industrial channels. Central stations have been unable to make proper betterments or adequate additions to their plants during this period, and although the majority of power customers have accepted curtailments of electric service very philosophically, nevertheless they are prone to forget that electric rates do not even cover interest charges in all cases and never provide for needed improvements and a surplus. Even some large customers have failed entirely to understand why central stations are unable to supply all power requirements all of the time. Consequently plans are being made by these customers to build new isolated plants or rehabilitate old ones when equipment prices have dropped to what may be considered a new normal level. The time is opportune, therefore, to convince all large customers that there is a real partnership basis on which they can obtain adequate central-station service. The money invested by the utilities during pre-war times created the generating and distributing systems which enabled the industries to produce large quantities of very profitable merchandise. Now that utilities want money to rehabilitate their properties and to build up their reserve capacities to a pre-war basis, the logical investors in their securities are the customers who have profited most by the service and have a local self-interest in the utility as an institution contributing an essential service to the progress of the community. When this truth comes to be fully grasped by the industries dependent on electrical energy for their prosperity an era of co-operation should begin that will solve many financial problems.

Electric Trucks, Like Other Vehicles, Need Care

THE electric road truck has suffered in the past from the notion that no skill or knowledge of its nature and needs is required on the part of the operator. Statements to this effect from supposedly authoritative sources have appeared from time to time. It is, therefore, encouraging to note that recognition of the fact that the truck is a mechanical and electrical device that needs as intelligent care as any other similar device is on the increase, and that manufacturers and central stations interested are taking decided steps to educate owners and operators in the proper care and operation of their vehicles. The recognition of electric vehicle operation among the mechanical branches taught in the public schools of Chicago is another hopeful sign. The electric road truck can no more perform its task successfully without intelligent handling than can the gas-engine vehicle.

Foundation for Rural Rates Should Be Built

A FORM of rural rate that will include all items of cost of service is an important contribution to the rural service discussion. The article by Prof. J. O. Kammerman elsewhere in this issue is important because it reaches further toward the fundamentals than most of the discussions that have so far appeared. There will undoubtedly be much disagreement in many quarters with the numerical values assigned to the various factors in this article, but it should be remembered that these numerical values represent variables to which a large amount of study must be given before it will be possible to assign values confidently for even a single locality, much less for an entire section or the whole country. The important feature around which discussion should center is the principles underlying the problem. If their soundness can be thoroughly established, the assigning of correct values for any situation becomes largely a matter of detail study of the special case with rather limited chances of serious error. If the underlying principles of the scheme are wrong, no amount of concentration on detail study will produce anything except serious trouble. The whole purpose of the article is to formulate a method that will consider all factors of cost and produce a return to cover the fixed and variable charges. When this method has been established, the exact numerical values assigned to each factor and the profit on the business will be a relatively simple study. A further fact to which the article clearly points is that uniform rates to cover all extensions even in the territory of a single utility cannot be worked out because of the variation in number of customers per mile and the variable cost of lines and equipment per customer.

No Place for Vindictiveness in Industry

EVER since the complications of modern civilization began labor and capital have been engaged in a give-and-take combat of mutual exploitation. Labor has generally been the weaker, and its gains over any stated period have been gradual and small. Two years ago it came into what its leaders and champions no doubt honestly deemed "its own." Everybody knows the result. Capital, driven to the wall, paid wages that steadily grew to previously undreamt-of proportions for an output that steadily diminished; commodity prices soared higher and higher; the merry profiteer profiteered, and in the end labor gained far less than it had thought to do. Now the fortunes of battle have changed, the tide of non-employment is rising, and anxiety once more has taken possession of the wage earners. Human nature suggests to industrial employers that their inning has come round again and that the chance is here to avenge the hold-ups of the last two years and put labor in its place once more. Such an idea was bound to arise. None the less, if the indissoluble partnership of capital and labor is ever to be anything but a mutually destructive duel, a more mistaken policy could not be conceived. Vindictiveness is a two-edged sword. It has no place in the industrial world. It would play directly into the hands of communism and propagate belief in "direct action" of the Russian brand. Rather is this a time to rise above the primitive impulses—a time for breadth of view, for liberality of judgment, for generosity of terms. It is a time to rebuild, and to build for the future, along the lines of organized co-operation, of profit sharing, of employee representation or of individual rewards, as may be best in each particular case. In the long run it will prove as much to the benefit of capital as of labor if when these chaotic years shall at last be over and mankind shall settle down to industrious routine once more there shall prove to have been not a temporary and deceptive but a permanent and absolute advance in the earnings of every useful trade honestly followed.

Effective Interconnection Requires Team Play

IN THESE days of team play among public utilities the subject of interconnection rises to large importance, not only here and there and casually, but as a policy to be followed whenever feasible. The little discussion by A. T. Throop elsewhere in this number of some practical phases of interconnection from the psychological rather than the physical standpoint will prove instructive reading. Granted that a group of adjacent utilities want to take advantage of the large possibilities of interconnection, the terms and arrangements of such interconnection are easy enough to work out in general, but the details sometimes involve complication. Broadly speaking, there are two classes of interconnection—full pooling of resources for the benefit of the systems as a whole and exchange of power on some equitable basis as between one system and another. Exchange of power involves no special trouble except settling the price, for it is easy to draw a suitable contract and make proper arrangements for metering. If the proposed arrangement provides benefits for both parties, as it generally does, the matter almost settles itself. It is in plans for full interconnection that working difficulties are more often found.

Mr. Throop lays stress on the absolute necessity of a frank and open spirit of fair play between all the companies concerned. If interconnection is skillfully carried out, it can be of large commercial benefit to everybody concerned, but to win out to this successful result means fairly and squarely playing with the cards upon the table, with a frank spirit of give and take, willingness to make concessions and a spirit of genuine and whole-souled co-operation. It is the necessity of such a close working agreement that often proves the chief

motive for an actual merger, a motive far stronger than any furnished by a common purchasing system or a unified scheme of financing. It is the unified spirit of co-operation and management day by day and hour by hour that makes for genuine success in interconnection.

Reducing Labor Costs Electrically

EQUIPMENT that offers a quick return on the initial investment through the reduction of labor costs is becoming increasingly attractive to industries of many kinds. A brief article by J. S. Tuthill gives some extremely useful information regarding the extent to which electrical methods have supplanted human labor in the mere matter of handling and conveying material. Our old friend the industrial electric truck is steadily at work replacing the hand truck, and a little detailed investigation in one factory showed that a single truck is doing more work in an eight-hour shift than twenty-five men. In another shop four trucks and one tractor displaced twenty-five men with hand trucks, eight horses and their drivers and the services of a switch engine for two hours per day. And so the story goes on. Where the truck does not come into play the conveyor gets busy, and in one instance cited by Mr. Tuthill an overhead trolley conveyor system paid for itself in less than six months. Where the conveyor is not conveniently applicable the electric crane with an electromagnet can usefully take a hand in the game, loading a 50-ton car in half an hour. One or two men with adequate conveying machinery can displace a score working by old-fashioned methods, thereby releasing just so much available labor for those tasks to which electrical equipment has not yet been adapted.

Water Supply for Steam-Plant Purposes Needs Study

WATER as a vital factor in the operation of a large modern steam plant is too little appreciated. Intensive studies of available supplies for hydro-electric use have been made in a few cases, but as a whole insufficient attention has been devoted to the matter from the viewpoint of the large steam plant of the future. A very important note was struck in the recent water congress called in Kansas by Governor Allen to consider new water-resource laws when the discussion developed the fact that, though there are some hydro-electric power possibilities in the state that should not be overlooked, the industrial development of Kansas—already, it is said, overshadowing the agricultural development in value of products—is dependent on the future supply of power from steam plants. As a result, the subject of water supply for such plants will have a place in the work of the proposed water commission, along with irrigation, domestic water supply and food control.

The discussion at Topeka, in the water congress and also in a meeting of the Kansas Engineering Society, brought out the fact that the problem is more than a Kansas affair. Studies of the past three or four years in the Eastern States have indicated that there are relatively few sites away from tidewater or the great lakes at which unlimited water supplies are available. When convenience of transportation, proximity to fuel supplies and locations convenient to the power market are added to the problem, the available sites narrow down to an extent that startles even the men who have the most intimate knowledge of the situation. Prior claims on water because of long use and riparian rights add more complications. With this situation developing in the sections where rainfall and therefore water supply are presumed to be ample, it can be easily seen that the industrial developments in the Middle Western and Western States, where water supply is less plentiful, will bring increasingly embarrassing problems unless the study of the water-supply situation over the entire country also includes consideration of the steam-plant problem.

One regrettable feature of the Kansas meeting was the slight representation of the central-station industry in the discussions. This is a problem that the central station cannot afford to ignore. Fortunately it is not too late for Kansas central-station men to take part in such discussions in their own state in the future and for central-station men everywhere to bring this problem into discussion in other states and before appropriate national committees.

Dirty Lamps as a Source of Fire Hazards

IT IS, of course, a familiar fact that inflammable material in contact with the bulb of an incandescent lamp may reach the temperature of ignition. The bulb temperature itself, with the lamp free and clear of everything, does not generally rise to the danger point even in case of large lamps, but the shutting in of the outward flow of heat from the filament may carry the temperature dangerously high in a very short time. This fact is so commonly understood that the incandescent lamp, far less dangerous than any other usual illuminant, involves no real fire risk under ordinary circumstances. Cases arise, however, when inflammable material in the form of dust coats the lamp bulb and can be brought to the ignition point. It also may happen that a lamp bulb breaks and exposes gas-laden or dust-laden air momentarily to the high temperature of the filament. Very little has been known concerning the actual magnitude of risks thus incurred, and we are extremely glad to present a paper elsewhere in this issue by Messrs. Dows, Fox and Blackwell giving an experimental study along this line.

The practical moral to be drawn from these data is that wherever organic dust is likely to be widespread, as it is in flour mills and similar situations, the same precautions should be taken with installing and maintaining incandescent lamps that would be required in the presence of any highly inflammable or explosive material. The bulb itself should in such cases be inclosed in an outer globe somewhat as it is in marine practice, a globe practically dust-tight and big enough to present a radiating surface sufficient to keep down the possible temperature even should the surface become coated with dust. Ordinary common sense in the cleaning of fixtures of this type would free them from dust inside and out and remove any possible source of danger either from direct heating or from the breaking of the bulb. The same precautions should be taken with dust-laden air of the kind here considered that one would take with gases and vapors known to be explosive. There is occasion not for blaming the incandescent lamp, but rather for putting dusty air in the class of unusual hazards where it belongs.



Arthur Williams

Champion of progressive thought and public policy pioneer who has been unusually successful in his efforts to develop the human side of industry

OF ALL the classes of utilities none holds a higher or more secure place in the public esteem than those engaged in supplying electric light and power service. Nor is this a matter of chance or luck; it is, rather, the result of honest effort to give the best possible service. That this work has been done well is largely so because of the early guidance of a small number of clear-thinking electric light and power executives, among whom was Arthur Williams, now general commercial manager of the New York Edison Company. Mr. Williams was one of the first to have the broader vision of public policy. When the National Electric Light Association fifteen years ago, under William H. Blood's administration, first decided to appoint a public policy committee Mr. Williams, who has always championed progressive thought, was chosen to head it.

Although an engineer, his efforts have been directed largely to the development of the human side of industry in contrast with the mechanical. In the solution of personnel problems he is a pioneer whose fame has traveled so far outside his own industry that he was chosen first president of the National Association of Corporation Schools. Good employee relationship engendered by directed education, pensions, annuities, savings and loan funds, social activities and a mutually friendly spirit are the lines along which he has worked and which have brought his success. While Mr. Williams is essentially a practical psychologist, he never could have accomplished his purpose in this direction had it not been for his sympathetic understanding of and love for his fellows.

Mr. Williams was born in Norfolk, Va., Aug. 14, 1868, and when sixteen years old entered the electrical industry with a firm of electrical contractors in New York City. A few weeks later he was employed in the old Pearl Street Edison station. By hard work and close application he advanced through the electrical engineering side of the industry, and when a public contact man who was an engineer was needed he was appointed to the position of general inspector in 1890 and three years later became general agent in addition. Ever since that time Mr. Williams has directed the commercial growth of the New York Edison Company.

It would be hard to find another man in the electrical industry, or in any other industry for that matter, who has been engaged in so many activities outside his own company. It was in his office that the old Electric Vehicle Association, of which he later was president, was formed. He has been prominently identified with safety work as president of the Safety Institute of America. He is a past-president of the N. E. L. A. and the Association of Edison Illuminating Companies and many others of more local interest. During the war he was Federal Food Administrator for New York City.

Rural Service Rates Must Cover All Costs

Factors Entering Into the Cost of Service—Differences from Urban Business —Transformer Losses Have Run as High as 75 per Cent of Consumption— Cost-Plus-Profit Rate System Applied—Comparison with Isolated Plant

By J. O. KAMMERMAN
Professor of Electrical Engineering South Dakota State School of Mines, Rapid City, S. D.

THE rural dwellers of this country have long realized the advantages enjoyed by the people in cities who are supplied with electric light and power, but not until recent years has serious attention been paid to the possibility of supplying electric service to rural customers. During the last three or four years farmers in all parts of the country have enjoyed unprecedented prosperity, and with this has come an active demand for the modern conveniences enjoyed by the residents of cities. One of the foremost demands is for electric light and power on the farm. As a result the following two methods of supplying power to the farmer have been developed along commercial lines:

1. By means of small transformer substations located along existing high-tension transmission lines.

2. By means of isolated generating stations, usually consisting of a small direct-current generator, a gas, kerosene or gasoline engine and a storage battery.

From the discussion which is to follow it will be evident that the second method is usually not worth consideration where there is a transmission line in the vicinity to be served. Where power is available from a central station, there are two distinct methods of financing the project:

1. The central station contracts to furnish power to the rural consumer in much the same way as in cities.

2. Groups of farmers organize to purchase power at wholesale rates from the central station and to resell it among themselves.

It is not the purpose of this paper to advise the adoption of either of these plans. Local conditions of service and public sentiment must be considered in every installation. A digest of the cost of service, or rather an adequate rate for service, will be discussed. Several state organizations which have control of public utilities have made a study of rates for electric service to rural communities. These investigations have led to various conclusions, and from an analysis of these a method of determining a rate will be arrived at.

Nature of Rural Service

Many central stations that have undertaken to supply power to rural residents have made a financial failure of their extensions owing principally to failure to consider duly the different diversity factors met in rural work. Some stations have lost rural customers by making an excessive charge for their service and power. There is an inherent difference between the rural and the urban customers, and due account of this must be taken before rural extensions can be put on a paying basis. In cities power and light customers may average four or five to the block, while in the country they may average four or less to the mile. This difference is the chief difficulty that has been encountered in making rural extensions a sound financial project.

The watt-hour meter on a rural line is supposed to register all the power delivered to the line, which includes the transformer core losses, but, as the power factor of the line is very low (below 50 per cent), there is some doubt as to whether or not the meter records the losses. A conception of what this loss to the power company means can be gained from a study of Table I.

TABLE I—CORE LOSSES OF STANDARD DISTRIBUTION TRANSFORMERS

Transformer Size, Kva	Loss in Kilowatt-hours per Year — 2,300 { 115 volts 230 volts	6,900 { 115 volts 230 volts	13,800 { 115 volts 230 volts
1 0	166	...	...
1 5	...	236	...
2 0	210	...	...
2 5	...	...	403
3 0	280	315	...
5 0	350	438	596
7 5	473	604	...
10 0	560	762	928
15 0	770	1,000	1,400
15 0	1,150	1,500	2,100

This table was compiled from a table of core losses on a list of standard commercial distributing transformers built by one of the leading electrical manufacturers in this country. When a utility is selling power to an organized group of farmers and the master meter fails to record the core losses, some other method of charging for them must be used. From some actual observations made, the annual transformer core losses of a rural extension have been found to be as much as 75 per cent of the total power consumption.

Service Cost Factors

In order to obtain some basis for comparing the various methods of distributing the power costs among the rural customers, a list of factors has been compiled in which an attempt is made to determine a return to the utility from the rural extension that will just compensate for the fixed and variable charges, as follows:

1. Six per cent of total construction costs to cover interest on the investment.

2. Two per cent of total construction costs to pay for the "risk" of constructing the line.

3. One and one-half per cent of total construction costs to pay the taxes.

4. Five per cent of total construction costs for maintenance.

5. Four per cent of total construction costs to cover depreciation of the extension.

6. A charge for the total transformer core losses for the year at the utility's switchboard rate.

7. A charge for the total power consumed for the year at the utility's switchboard rate.

Item No. 1 in this list is the usual charge made in fixing a selling price of any commodity, but should the extension be owned by the customers this item must be omitted by the utility in fixing the rate. Item No. 2 is now recognized by most rate-controlling bodies as

an allowable and just charge which is intended to reimburse the utility for the hazard encountered in constructing the line. When one considers that a customer may or may not connect to the line, or that he may connect for a time and then discontinue the use of this service, this charge is not unreasonable. It is as justifiable as a premium on a fire insurance policy.

Item No. 3 will vary according to the location. One and one-half per cent is given here as an average covering a number of cases in various states. In no instance was a wide departure from this average found.

In item No. 4, 5 per cent is obtained by taking the usual 2½ per cent maintenance and operating charge on city lines and adding 2½ per cent for the increased cost of reading meters and making repairs on rural lines.

The depreciation of a line depends upon the quality of material put into the line and the workmanship. A rate of 4 per cent was taken in item No. 5 for depreciation because usually a life of about sixteen years is assumed for rural extensions.

In items Nos. 6 and 7 the core losses and power costs are charged at the utility's switchboard rate because this rate is assumed to be ample to cover the operating expenses within the power house.

This gives a method for handling the rural extension business. When the utility owns the line, transformers and meters the customers are charged a fixed sum of 18½ per cent of the cost of construction, plus the energy charge for core loss and power delivered to the consumer, plus a reasonable profit. This might be termed a "cost-plus-profit" system.

In the use of this system the following advantages and disadvantages are encountered:

1. The rural customer is assured an adequate supply of power at all times.
2. Utilities are now forced to pay a high rate of interest on money borrowed for extension purposes.
3. If those connected to the line cease to use the service, the power company is at a large loss.
4. An adequate return for energy delivered is assured the utility.
5. The monthly bills to the customers will be large.

Looking at the proposition from the consumer's standpoint the first of these paragraphs indicates what is most desired. From the utilities standpoint, the adequate return mentioned in the fourth paragraph is most desired. The other paragraphs concern disadvantages, but not insurmountable obstacles. No system can be devised which will satisfy in all respects the wants of the utility and of every consumer. The vital points tending to create harmony between the buyer and seller are those numbered 1 and 4. These advantages are gained by using the "cost-plus-profit" system. Local conditions will best determine how to overcome the disadvantages; many methods might be advocated here, but that is not the scope of this paper. The system is simple and can be understood by both the utility operators and the consumer.

Application of Method

Table II gives data on eleven extensions which have been operating for periods of more than a year. It is an example of the application of the "cost-plus-profit" system. The column of "per cent return on investment" shows clearly that a uniform rate cannot be made to rural customers. The column of "cost per kilowatt-hour" shows a wide variation caused by the number of customers per mile and the amount of power consumed annually. Some objection might be raised to the high rate in most of the cases. However, if the rate is compared with that arising from the use of an isolated-plant system, the plan of financing the extension and of fixing the rate which is advocated will be found to stand the comparison well.

The cost of extensions, where figured per mile, will vary to some extent. The "cost of extensions" as used in this article includes poles, wire, insulators, transformers, cross-arms and accessories necessary for proper installation, meters, labor and engineering. It does not include the cost of the service wire from transmission line to house or any labor for the installation of the service wire. The voltage used on the extension will depend in part on the length of the line and the amount of power delivered. The cost of a 2,200-volt line per mile should not be compared with the cost per mile of a 13,200-volt line. Since rural extensions will vary anywhere from a mile to 10 miles or more, it seems rather impossible to arrive at a figure which might represent the cost of construction per mile and could also be used for estimating any new extension, unless the proposed extension was to be similar to the extension already operating. In that case the cost of the new extension could be estimated from the known cost of the operating extension with a fair degree of accuracy.

It is evident that the number of customers per mile will affect the cost of an extension when the transformers are considered a part of the extension.

Isolated-Plant Costs

In order to determine the cost of power when furnished by rural farm-lighting sets, the data on a 1.5-kw. plant appearing on the next page was secured from several manufacturers to arrive at cost of battery, cost of gasoline engine and generator (complete with necessary switches and meters) and fuel and oil consumption of engine. An average was struck from the several replies, and this was used to determine the cost of power. In calculating the fixed charges, 6 per cent was taken for

TABLE II—DATA ON ELEVEN RURAL EXTENSION TRANSMISSION LINES THAT HAVE BEEN OPERATED FOR MORE THAN A YEAR*

Case No.	Cost of Extension	No. of Customers	Kw.-hr. Purchased per Year	Length of Lines (Miles)	Transformer Core Loss per Year, Kw.-hr	Utility Switchboard Rate†	Fixed Charges 18½ per Cent	Cost of Core Loss	Power Cost	Total Annual Income	Per Cent of Return on Investment	Cost per Kw.-hr. (No Profit Added)
1	$1,858	9	3,782	2.0	1,566	$0.027	$344	$23.50	$56 70	$424 20	22.8	$0 112
2	920	8	1,671	1.0	1,230	0 06	170	73 70	100 00	343 70	37.3	0.205
3	665	5	1,197	1 1	1,050	0 06	123	63 00	71 80	257 80	38.8	0 215
4	500	2	1,279	0 9	700	0 06	92	42 00	76.70	211 20	42 2	0 165
5	1,414	39	7,420	12 0	2,481	0.008	2,115	19 80	59 40	2,194.20	19 3	0 209
6	1,550	7	1,650	1.5	656	0 008	287	5 24	13 20	305 44	19 7	0 185
7	2,246	8	1,720	2 0	1,260	0 008	416	10 10	13 80	439.90	19 6	0 255
8	1,450	17	4,439	3 0	1,105	0 008	268	8 80	35 50	312 23	21 5	0 070
9	1,265	9	2,520	1.2	1,616	0 008	234	12 90	20 20	267 10	12.1	0.106
10	1,562	6	1,769	2 0	1,400	0 03	289	42 00	53 07	384 87	24 6	0.217

* It is assumed that the cost of extension represents the cost to the utility only. Customers' investment in service lines is not included, nor has any use of existing transmission lines been compensated for. The cost figures cannot therefore be used as measures to determine the cost of lines and equipment in other cases. Rates are based on a commercial basis. Rates per kilowatt-hour represent utility cost only. Profit must be added.

† Switchboard rate is assumed to represent the cost of power delivered to the switchboard.

Cost of battery	$155 00
Cost of engine and generator	445 00
Total cost	$600 00
Interest on investment	$36 00
Depreciation on battery	38 75
Depreciation on engine and generator	44 50
Fixed annual charge per year	$119 25
Fuel and oil cost per kilowatt-hour	0 0625
Assuming 500 kw.-hr. are used per year	
Fixed annual charge per year	$119 25
Fuel cost (500 kw.-hr.)	31 25
	$150 50
Cost per kilowatt-hour	0 301

If only 300 kw.-hr. was used per year, the cost per kilowatt-hour would rise to $0.46.

interest on investment, the life of the battery was assumed to be four years, and the life of the engine and generator was assumed to be ten years. The price of fuel was taken at 27.8 cents per gallon. The average results were as shown in the accompanying table.

As the isolated plant in most instances is in the hands of one not experienced, the cost of repairs or maintenance has been omitted, because this could vary from a few dollars per year to the cost of the plant.

No one system could be devised that would work equally well in all parts of this country as rates of interest and types of construction, which will necessarily cause the maintenance charges to vary, are different in different localities. These factors do not vary so erratically that they cannot be fixed within the boundaries of any one state, and it would be an easy matter for any state rate-regulating body to fix fair percentages for all of the items mentioned under the "cost-plus-profit" system.

Lighting for Dusty Places

Lamps in Grain Elevators and Similar Places Should Be Protected Against Breakage and Heavy Dust Accumulation—Good Safety Factor Possible If Lamps Are Properly Applied

By CHESTER L. DOWS,* E. B. FOX,† W. P. BLACKWELL‡

BECAUSE its bulb temperature is higher than that of the vacuum lamp, the gas-filled lamp has always been looked upon with more or less suspicion as a fire hazard from the time it first made its appearance in the latter part of 1913. Recently research has been undertaken to determine the hazard when lamps are used in the dust-laden atmosphere common to grain elevators, flour mills and the like, where disastrous explosions take place so frequently as to form a serious menace.

The results of these tests show that all the vacuum lamps up to and including 100 watts, and possibly the lower-wattage gas-filled lamps, may be used with safety in certain establishments where the dust has a high ignition temperature so far as danger from fire caused by dust collection on the bulb is concerned. However, no lamp should be allowed to become thickly coated with dust, first because of the danger of fire, and second because of the great loss in illuminating value. In some cases lamps actually become buried in the grain, and the hazard under such conditions is extremely great.

Fires Attributed to Two Causes

It must always be remembered that a fire may be started with any incandescent electric lamp, vacuum or gas-filled, or, for that matter, with any device that could be used for illumination, if it is operated continuously when so surrounded that the heat must accumulate. Under these conditions—the continuous accumulation of heat energy—the temperature of the surrounding material will steadily rise until it reaches a temperature at which the energy is dissipated as rapidly as it is supplied, and if this final limiting temperature is sufficiently high, a fire may be expected as a natural result if combustible materials are present.

The possibility of fires or explosions from incandescent lamps in dusty atmospheres, such as are usually found in the handling of grain, starch, flour, oatmeal, chocolate, sugar, etc., may be classified under two heads: (1) Fires directly caused by ignition of dust collecting on lamp bulbs; (2) explosions caused by accidental breakage of incandescent lamps in an atmosphere which has the proper proportions of dust and air to make it explosive.

Practically all of the carbonaceous dusts found in the milling and allied industries will smoke and give off an odor if they are allowed to collect on the bulb of a gas-filled lamp. This was at first considered as indicative of danger because smoke was generally interpreted as representing a fire. Experiment shows, however, that there is a substantial margin between the smoking and ignition temperature. This margin may be safe or unsafe, depending on the ignition temperature and character of the dusts and the temperature of the heated body on which the dust collects. It is very much less in some cases than in others.

It will be observed that with only two exceptions the margin between smoking and ignition temperature increases with increase of ignition temperature. That is, the smoking temperature, while varying slightly, is roughly of the same magnitude for all dusts tested. The extreme limits are found to be 284 deg. Fahr. (140 deg. C.) and 331 deg. Fahr. (166 deg. C.), without much regard to the type of dust and ignition temperatures. These smoking temperatures are about the same as the operating temperatures of the lower-wattage gas-filled lamp bulbs (75 watts and 100 watts), but are 100 to 150 Fahr. deg. (56 to 83 C. deg.) higher than the bulb temperatures[1] of vacuum lamps of corresponding wattage. This accounts for the fact that dusts smoke readily on gas-filled lamps and do not on vacuum lamps.[2]

The ignition temperatures of the first four unusually

*National Lamp Works, General Electric Company.
†Edison Lamp Works, General Electric Company.
‡Westinghouse Lamp Company.

[1]Differences in temperature are expressed as Fahr. deg. and C. deg.

[2]The bulb temperatures of vacuum lamps larger than 100 watts approach more nearly those of the lower-wattage gas-filled lamps.

chaffy dusts and cocoa, it will be noted, are all above 500 deg. Fahr. (260 deg. C.), and there is a margin of from 182 to 245 Fahr. deg. (101 to 136 C. deg.) between their smoking and ignition temperatures. The remaining four dust samples will not ignite until temperatures of 883 deg. to 934 deg. Fahr. (473 deg. to 501 deg. C.) are reached, making the margin between smoking and ignition around 574 to 623 Fahr. deg. (319 to 346 C. deg.) for these samples. Extra chaffy dusts,

TABLE I.—MARGIN OF TEMPERATURE BETWEEN THE SMOKING AND IGNITION POINT OF DUSTS

Name of Dust	Smoking Temperature, Deg F	Smoking Temperature, Deg C	Melting Temperature, Deg F	Melting Temperature, Deg C	Ignition Temperature, Deg F	Ignition Temperature, Deg C	Difference Between Smoking and Ignition Temperatures, F Deg	Difference Between Smoking and Ignition Temperatures, C. Deg
Sample No. 2	288	142			511	266	223	124
Sample No. 1	331	166			513	267	182	101
Sample No. 4	295	146			532	278	237	132
Sample No. 3	298	148			536	280	238	132
Cocoa	313	156			558	292	245	136
Graham flour	309	154	552	289	883	473	574	319
Cornstarch	284	140	545	285	891	477	607	337
White-wheat flour	315	157	507	264	919	493	604	336
Cornmeal	311	155	527	275	934	501	623	346

No. 1, durum wheat dust. No. 2, approximate percentage: oats, 22; durum, 20; winter wheat, 40; hard winter wheat, 10; miscellaneous, 10. No. 3, approximate percentage: oats, 60; winter wheat, 35; rye, 5. No. 4, approximate percentage: winter wheat, 40; barley, 35; oats, 25.

* Considered the point at which the dust becomes sticky or congeals

therefore, collecting on vacuum bulbs must be raised over 300 Fahr. deg. (167 C. deg.) before taking fire; on the 75-watt and 100-watt gas-filled lamps over 250 Fahr. deg. (139 C. deg.), and on higher-wattage gas-filled lamps over 150 Fahr. deg. (83 C. deg.). In an especially constructed chamber in which a continuous dust cloud could be maintained it has been possible to start a fire on the larger gas-filled lamps with each of the first four samples listed above. No fires were obtained with 75-watt and 100-watt gas-filled lamps and none with vacuum lamps up to and including 100 watts.

If the remaining dusts are grouped together, their temperatures must be raised over 700 Fahr. deg. (389 C. deg.) on vacuum lamps, over 600 Fahr. deg. (333 C. deg.) on the 75-watt and 100-watt gas-filled lamps, and over 500 Fahr. deg. (278 C. deg.) on the higher-wattage gas-filled lamps, before taking fire. No fires were started with any of these dusts on any of these lamps. Cornstarch in particular apparently melts into a crust and refuses to burn. Starch, graham flour, wheat flour and cornmeal all have a tendency to melt or congeal and form a crust which is difficult, if not almost impossible, to ignite except on a hot plate.

It is difficult to set definite workable limits between bulb temperature and ignition temperature which represent a safe difference, because if any dust is allowed to collect thickly enough and remain long enough a fire is almost sure to follow. As ordinarily used, however, all vacuum lamps operating around 150 deg. Fahr. (66 deg. C.) bulb temperature, and other units in this range of temperature, may be considered safe. The use of 75-watt and 100-watt gas-filled lamps with free ventilation would hardly be expected to cause a fire, but with drier dusts, larger wattages, or other changes in conditions the margin of safety might be so reduced as to cause a fire.

BREAKAGE OF BULBS OFFERS GREATEST POSSIBILITY OF DANGER

The second classification of fire possibility—that due to the breakage of bulbs in explosive atmosphere—is by far the more important of the two considerations. It has been previously shown that nearly all dusts having a high carbon content and being finely divided may be exploded by an open flame when such dusts are combined with air in the right proportion. This fact has been proved by co-operative tests between the United States Bureau of Agriculture and the United States Bureau of Mines. Their tests further showed that the electric arc or static electricity would produce an explosion. These facts have all been verified, and in addition it has been shown that explosions under the same conditions may be obtained when an incandescent lamp is broken or demolished in a dust cloud. Vacuum and gas-filled lamps will give the same results; the only exceptions noted so far have been with very low-wattage vacuum tungsten and carbon lamps. These lamps, however, are not excluded on this account, because much depends on the character of the dust cloud and the manner in which the lamps are broken. If the cloud has the proper proportions of dust and air, it is exploded when coming in contact with any lighted source such as a match, candle, lantern or other flame.

The breaking of incandescent lamp bulbs except by accident or careless usage is rare indeed. There are, however, certain practices in use in elevators which in view of the risk involved must be considered exceedingly dangerous. One of these is the lowering of an unprotected lamp bulb into an elevator bin to determine the amount of grain or feed it contains. The mechanical breaking of the bulb, or a short-circuit in the socket or wire, or the flash from a loose connection may easily be sufficient to produce a disastrous explosion under the right conditions. This and other similar practices should be prohibited.

There are on the market many types of so-called marine or vapor-proof fixtures which are designed for use in locations where explosive gases are prevalent or where the fixtures are subjected to moisture. Tests have been conducted on a few types of these fixtures to ascertain whether the temperature of the inclosing globe is sufficiently low to prevent the ignition of dust when gas-filled lamps are used. The tests conducted up to the present time indicate that globes having straight sides, which tend to prevent the accumulation of dust, may, if of sufficient diameter, be used with gas-filled

TABLE II—OPERATING TEMPERATURE OF BARE LAMPS *

Type of Lamp	Maximum Bulb Temperature, Deg. F.	Maximum Bulb Temperature, Deg. C.	Temperature Opposite Filament, Deg. F.	Temperature Opposite Filament, Deg. C.
Vacuum Lamps:				
50-watt	153	67	153	67
100-watt	152	67	152	67
150-watt	157	69	156	69
Gas-filled Lamps:				
75-watt	245	118	180	82
100-watt	259	126	178	81
150-watt	338	170	222	106
200-watt	327	164	222	106
300-watt	294	146	229	109

* Values are averages of several tests

lamps and yet maintain a temperature below the smoking temperatures given in Table I.

All incandescent lamps should be protected against breakage wherever there is danger of an explosive dust cloud. Good vapor-proof fixtures are a long step in the right direction, and their effectiveness can be increased by the use of a suitable wire guard or other protecting device. The point to be remembered is that it should not be possible for the filament of the lamp to become exposed to the dusty atmosphere under any conceivable condition.

Effective Oil-Switch Overhauling

Monthly Schedule of Maintenance and Repair Followed by Complete Dismantling and Realignment Yearly Methods Used in Caring for a Typical Switch in a Large Pennsylvania Power Plant to Insure Maximum Operating Efficiency

By F. I. MORGAN
Pennsylvania Water & Power Company, Holtwood, Pa.

IN ORDER to maintain oil switches in a condition of maximum operating efficiency it is necessary to have a definite program for the care of such equipment. Careful periodic inspection and repair and a complete overhauling occasionally will be found well worth while from an operating standpoint. The Pennsylvania Water & Power Company has developed certain practices in handling this work, and although the method considered is for one type of switch the principles involved are applicable to other designs.

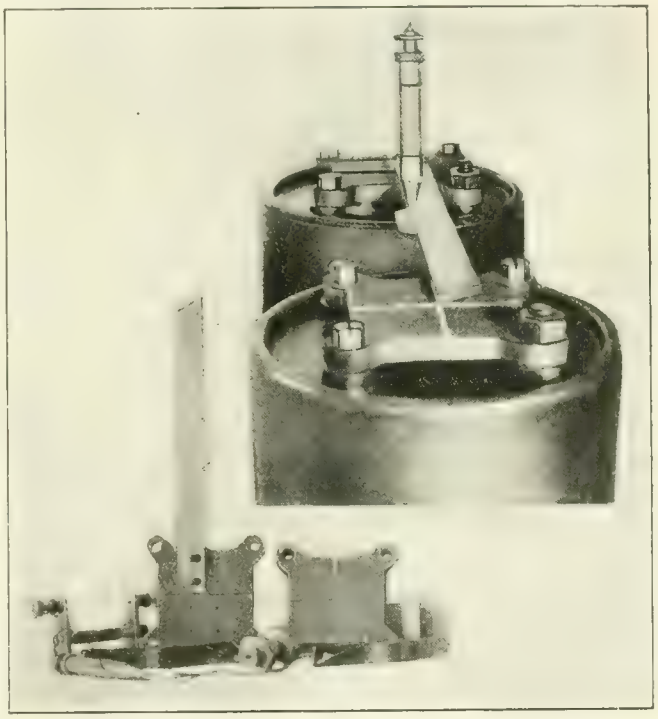
The oil circuit breakers in the Holtwood plant of the Pennsylvania Water & Power Company are General Electric type F, form H-3, rated at 300, 500, 800 and 2,000 amp. at 15,000 volts. All switches are inspected, cleaned and oiled monthly by the operating men. Any defects noted during these inspections, such as loose connections, slipping of clutches, unbalanced stroke, loose nuts, missing cotter pins, etc., are reported and promptly remedied by the maintenance department. Each switch is scheduled for a complete overhauling annually, and at this time pots are completely dismantled and cleaned, secondary contacts are dressed or replaced, and alignment of pots and mechanism is checked. The mechanisms are also taken down and all parts receive a thorough cleaning.

It frequently happens that when these switches are opened, as a result of relay action, considerable oil is spilled and the tips are burned off the contact rods. At the first opportunity after such an occurrence the contact rods are replaced by spares and fresh oil is substituted for the carbonized oil. In no case has it been necessary to remove the pots after such an operation because of damage to the secondary contacts. The oil level has been found to be from 3 in. to 4 in. (7.5 cm. to 10 cm.) low after particularly severe disturbances, but the average is from 1 in. to 2 in. (2.5 cm. to 5 cm.).

One of the safety rules of this company requires that no work shall be done on an oil switch until the mechanism has first been placed in the "open neutral" position. The wiring of the mechanism, as shown in the accompanying diagram, is so modified that this is very easily accomplished by removing the cartridge fuse, which prevents operation of the motor but allows the trip coil to be energized, and then short-circuiting the "opening" and "closing" wires.

ANNUAL OVERHAULING METHODS

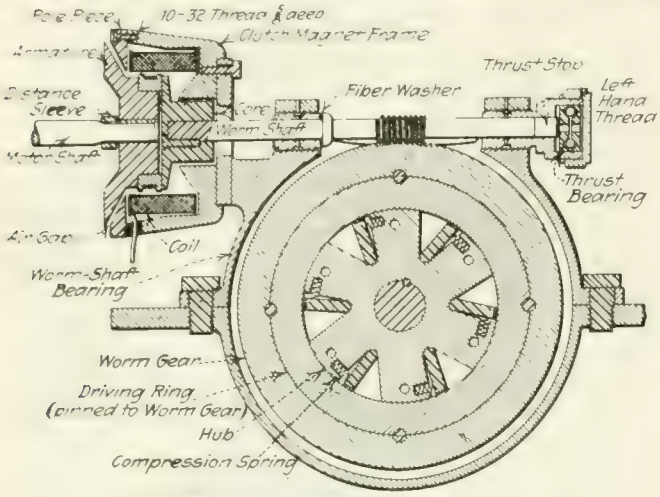
After removing crossheads, contact rods, etc., the oil is pumped out of all six pots. This is done by means of a hand pump, of the gear type, mounted on a small portable work table. Two tanks, each having a capacity sufficient to care for the oil from one switch—one for clean oil, the other for carbonized oil—are mounted on this table and connected by piping to the pump. Connection between the pots and pump is established by means of two lengths of oil-resisting hose, one for fresh oil and the other for carbonized oil. The suction hose is fitted with a length of ⅜-in. (9.5-mm.) pipe, which can be pushed through the secondary contact, thus permitting all oil to be pumped out. It was found necessary to equip the pump with a screen box, as without it small globules of brass which had been melted from the ends of the contact rods were drawn into the pump, making it inoperative. The work table is also fitted with a drawer for tools and a compartment for cleaning rags. After removal of oil the side bars are taken off, the clamp holding pots loosened and pots taken out. A set of spare pots is then installed, clamps are tightened and side bars replaced.



SPECIAL TOOLS ARE HELPFUL IN ALIGNING SWITCH POTS

In the beginning, when checking alignment or setting up a new switch, the back pot only is placed in each cell. This pot is first carefully leveled, the most successful method of doing this having been found to be by means of a 12-in. (30.5-cm.) level held against the front and side of the pot. Care must be taken to have the level in intimate contact with the pot throughout its entire length. It has been noticed that the machined contact surfaces on the cap are not suitable places for leveling as they become somewhat distorted when screwed into position. A form of level having a longitudinal groove in the center of its face is best for leveling purposes. Pots which are not plumb are made so by placing thin shims under the edges of the clamps which hold the lower porcelain bushing.

The pot is next centered and placed in correct position by the aid of an iron plate fastened to the cap by screws which enter the holes provided for the machine screws holding the top insulating bushing clamps. This device is made from ½-in. (12.5-mm.) boiler plate and has two center lines machined in its upper surface at right angles to each other and which cross at the exact center. A special rule made from tool steel is fastened to this plate and so mounted as to be easily removable. This rule is exactly 12 in. from tip to tip and is slightly wider midway between the ends. Two lines, at right angles to each other, are marked on its surface at the middle.



CAREFUL ATTENTION SHOULD BE GIVEN TO THE CLUTCH MECHANISM

This iron plate with the rule in position is then fastened to the top of the pot, and the pot is moved until the edge of the rule, which coincides with the line passing through the center of the pot, is approximately parallel to the cell walls and the center mark in the middle of the rule coincides with the point of the plumb bob suspended from the mechanism arm. If the cells have been properly constructed no difficulty will be experienced in doing this. In order to obtain accurate results this plumb bob should not clear the steel rule by more than $\frac{1}{32}$ in. (0.8 mm.). After the pot has been properly set the clamping nut on the under side of the porcelain bushing should be tightened securely.

Next the steel rule is removed and the front pot placed in position and leveled. An iron plate similar to the one secured to the rear pot is placed on the cap of the front pot. It is very important that both pots be of the same height, and this is checked by means of the level. The center lines of the iron plates on the tops of both pots must coincide with the edge of the steel rule, which is replaced after the front pot is in position. This will insure the parallel arrangement of the contact surfaces on the tops of the two pots. As shown in the illustration, a mercury plumb bob suspended from a device mounted in the arm of the mechanism is used in aligning the pots. By means of this device the plumb line is centered with respect to the arm and the hole in the arm. A means of easily raising or lowering the plumb bob is provided by the roller on which the excess line is wound and which can be locked by a thumb-nut.

After the pots are correctly aligned the proper amount of oil is pumped into each and the crossheads and wooden insulating rods are replaced. The oil level is gaged by means of a wooden T-gage illuminated by a flashlamp. Crossheads are then checked to see that they are not bent or distorted in any way. The tips of the contact rods should be exactly 12 in. apart, and they should be parallel. Care must be taken before making this check to see that the rods are straight. If it is found that the crosshead is bent or distorted the fault is quickly located by so supporting the apparatus that the machined surface, against which the lower wooden-rod clamp is bolted, is level (checked with a small level) and then dropping a plumb line alongside the contact rods in succession.

ADJUSTMENT OF THE CONTACT RODS

The contact rods are so adjusted that the distance from the tip to the under side of the crosshead is 28 in. (71 cm.). In the old form of crosshead where the contact rods screw into position this is accomplished by means of a gage clamped to the rod by a setscrew. The rod is screwed up until the top of the gage is in contact with the under side of the crosshead. The gages, which are made of 1-in. wrought-iron pipe with slots cut in one side to allow their being removed from the rod, are placed in position after inserting the rod in a hole in the top of the workbench. The distance from the top of the table to the shelf on which the tip of the rod rests is 26 in. (66 cm.), and the gage, being 2 in. long, makes the distance from the tip of the rod to the upper end of the gage 28 in. (71 cm.), which is the proper length of that portion of the rod below the crosshead. For the 2,000-amp. switches the length of the rod below the crosshead should be $28\frac{3}{4}$ in. (73 cm.). The type of wrench used in handling brass pipe, with slight modifications, is used to screw the contact rods into position. With the later form of crosshead it is unnecesary to use gages on the contact rods since the sleeve can be correctly set before placing the rod in the crosshead.

The crossheads are so adjusted that the laminated contact brushes are held firmly against the contact surfaces of the cap. The solid brass piece on the under side of the laminations is made to clear these surfaces by approximately $\frac{1}{32}$ in. The contact surfaces are lubricated with a slight amount of vaseline to prevent cutting. It is sometimes found that the end of the lower insulating rod clamp is not true with respect to the rod, which results in throwing the crosshead and contact rods out of plumb. This is corrected by machining the end of the clamp.

The crossheads on the 300-amp. switches are set by gage, as shown in the illustration. These crossheads cannot be properly adjusted by measuring between the top of the porcelain insulator and the under side of the crosshead since these insulators often vary in height above the cap.

OVERHAULING THE SWITCH MECHANISM

Before dismantling mechanism the tension of the springs is relieved by inserting a pin in the hole in the worm shaft and turning it backward the necessary degree. In case the springs are under too much tension the strain on the worm shaft is relieved by means of the ratchet wrench.

The ratchet can probably be considered as the most important part of the mechanism. It is completely disassembled and thoroughly cleaned. Several cases of failure of the mechanism to operate properly because of slipping of the ratchet have occurred, and this was

found to be due to the fact that the grooves in the pawls had become packed with particles of steel cut from the interior of the driving ring. This indicates the importance of periodic inspections.

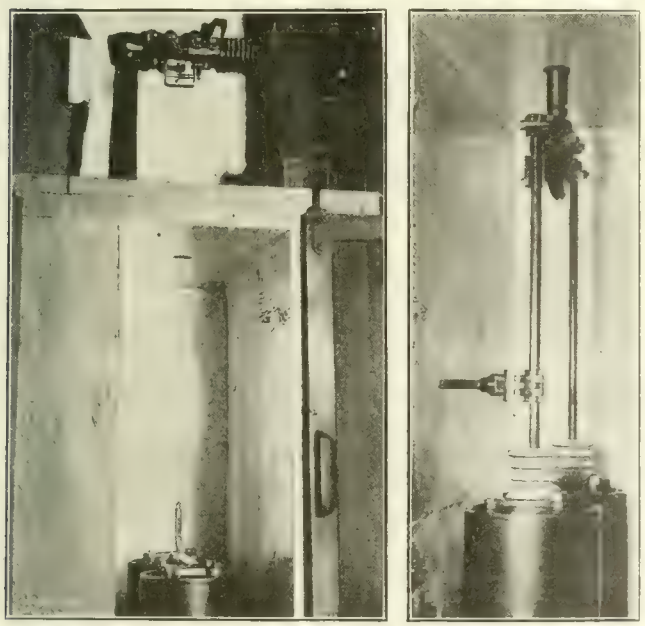
Test Made to Determine Efficacy of Various Lubricants

A special test to determine the efficacy of various lubricants for the ratchet was made on one of these switches, and as a result an engine oil was adopted for this purpose. Careful micrometer measurements of the internal diameter of the steel driving ring were made, and it was found that this diameter had increased, owing to wear, from two to three thousandths of an inch after 2,200 operations of the switch.

The ball thrust bearing on the worm shaft is taken apart and cleaned, afterward being lubricated with vaseline. The cap on this bearing must be screwed up tight, because if this be not done it may work partly off (as actually occurred in one instance) and allow the clutch armature to lock against the clutch coil frame, preventing normal operation of the switch.

Careful attention is given to the friction clutch since it is sure to give trouble if it is not correctly adjusted. Some of the causes of slipping of these clutches are: (1) Friction ring loose or incorrectly proportioned; (2) misalignment of motor and worm shafts; (3) the face of the worm-shaft core may not be true; (4) a loose worm-shaft bushing will sometimes result in clutch trouble; (5) air gap may be too great (maximum $\frac{5}{16}$ in., minimum $\frac{1}{32}$ in.); (6) defective clutch coil; (7) bent motor or worm shaft.

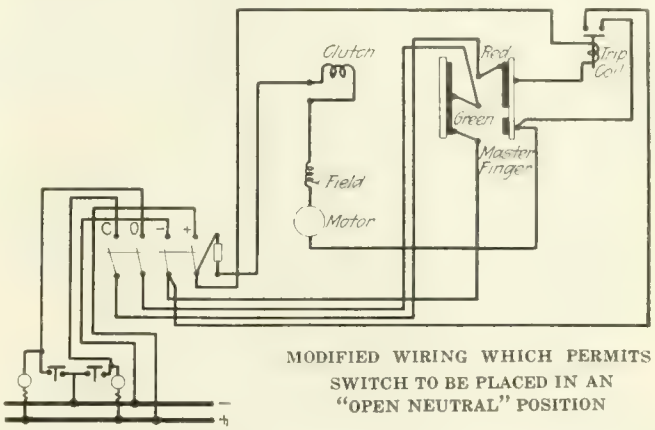
Wooden friction rings are bought in the rough, and



EXTREME CARE IS NECESSARY IN THE PROPER ALIGNMENT OF SWITCH POTS

before turning to a driving fit they are thoroughly dried out. After the armature has been fitted with the new ring it is placed on a mandrel and swung between the centers of a lathe. A groove for the banding wire is then cut in the outer surface of the ring, after which it is tightly banded with several turns of No. 17 B. W. G. steel wire. This banding wire is wound over narrow pieces of sheet brass spaced at intervals of 120 deg. around the circumference of the ring. After the banding wire is in place the ends of these brass strips are turned over the band and soldered. A minimum section of the band is heated, as otherwise the wire will stretch, rendering the band useless.

The face of the friction ring is turned true *after* the banding is done, since this process is very apt to distort the ring to some extent. The face of the ring is turned off until slightly less than $\frac{1}{32}$ in. of the wood projects beyond the iron. This dimension is important because



MODIFIED WIRING WHICH PERMITS SWITCH TO BE PLACED IN AN "OPEN NEUTRAL" POSITION

slipping will result if the friction ring projects too far beyond the iron.

A sliding fit must be maintained between the clutch armature and the motor shaft, and this must be remembered when changing these armatures.

The following lengths of clutch air gap have been adopted: Minimum, $\frac{1}{32}$ in. (0.8 mm.), maximum $\frac{5}{16}$ in. 0.48 mm.). If the air gap is made less than $\frac{1}{32}$ in. there is danger that the clutch armature will lock against the clutch-coil housing if the friction ring becomes badly worn. Care must be taken when adjusting the air gap to avoid forcing the worm-shaft core against the end of the motor shaft.

Probably the most convenient means of checking the alignment of the motor and worm shafts is by the use of a dial test indicator having a pointer and dial graduated in thousandths of an inch. Care must be exercised in using this gage since play in the front worm-shaft bushing is liable to result in false indications. Before making this check it is of course necessary to remove the clutch coil housing and the worm-shaft core. The same method is used in checking the worm-shaft core.

Oil often leaks around the plugs in the motor bearings, and this is remedied by removing the plugs and treating them with thickened shellac before replacing. All contact surfaces of the cam-operated fingers are cleaned and bearing surfaces lubricated with vaseline. The screws passing through the insulating sleeves in these fingers are tried to insure their being tight. Grounds on the control circuit have been caused by these screws working out of place.

The toggle in the older types of mechanisms requires especial attention. Any defect at this point may result in "pumping" of the mechanism. All toggle links are cleaned and pins lubricated with vaseline. One case of "pumping" was remedied by filing the brass piece immediately above the trip-coil plunger, thus allowing the toggle to be thrown slightly farther "over center" and making it less sensitive. However, this filing must be done with caution. Dirt in these parts will introduce friction, making the action stiff, preventing the toggle from returning to its proper position, and

"pumping" will result. Broken or weakened toggle springs also cause this trouble. Binding of the trip coil plunger will sometimes prevent the toggle from returning to its proper position. Of course, the later types of mechanism, equipped with the "positive toggle latch," are entirely free from this defect.

Before dismantling the "double reduction" type of mechanism the gear and pinion are marked, since if they are incorrectly meshed the dog on the crankshaft gear will strike the keyway extension on the pinion, thus violently arresting the movement of the switch. During the course of overhauling all anchor bolts holding the mechanism are securely tightened. Finally, the torsion springs are adjusted so that the opening and closing strokes are made in approximately the same length of time. Before making any adjustment to these springs the roller stop which holds the crankshaft dog is carefully blocked. Due precautions must be taken to insure the rods being thrown one inch into contact by the springs on the closing stroke.

Banking versus Oil Burner Losses

BY F. H. DANIELS
Sanford Riley Stoker Company

IN COMPARING the operating costs of coal-burning and oil-burning plants the banking losses of the coal plant should be balanced against the steam required by the oil burners. Where the load factor is high the loss is in favor of coal burners, and with low load factor oil burners have the advantage. For instance, in the case of a stoker the coal consumption on a banked fire is approximately 30,000 B.t.u. per square foot of grate surface. With 14,000 B.t.u. coal this would amount to 2.15 lb. per square foot of grate surface per hour. If we consider a 500-hp. boiler with a grate surface of about 80 sq.ft., the coal used per hour would amount to 172 lb., equal to 2,400,000 B.t.u. per hour.

The additional steam required to operate the oil burners amounts to approximately 4 per cent of the boiler output. Consider this same 500-hp. boiler fired with oil and operating at 200 per cent of rating. The steam required by the oil burners would amount to about 40 boiler horsepower. This would mean an input to the boiler of 1,800,000 B.t.u. per hour for operating the burners. If the boilers were banked 43 per cent of the time and were operating at 200 per cent of rating for 57 per cent of the time, the loss during a day's run from the steam required for oil burners would be equal to the loss brought about by banked coal fires under the same condition of load.

Remodeling Stokers and Furnaces Adds to Capacity

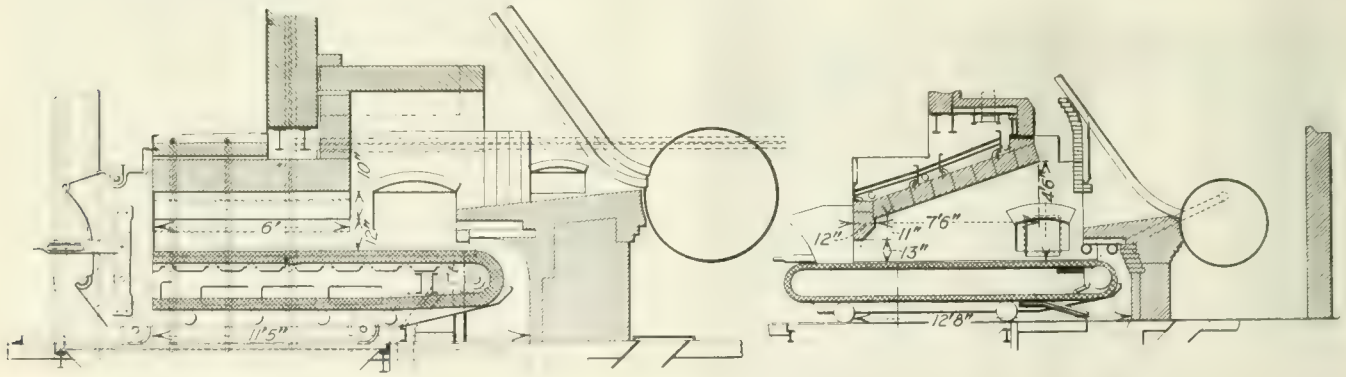
Boiler Ratings Raised 39 per Cent by Enlarging Grate Areas and Improving Arch Design—Practical Method at Minimum Cost

BY T. A. MARSH
Chief Engineer Greene Engineering Company

BOILER, furnace and stoker design of ten to fifteen years ago was based on ability to obtain 125 to 175 per cent rating. Present-day practice is to operate normally at from 150 to 200 per cent rating and to swing peaks beyond this rating as may be demanded. Many stations installed several years ago are remodeling their furnaces and enlarging their stokers in order to obtain ratings consistent with modern practice. A typical instance of this procedure has occurred at the Muncie (Ind.) plant of the Indiana General Service Company.

The original installation of boiler-room equipment at this plant consisted of the following units: Two class "S" No. 25 Stirling boilers, 500 hp., served by two 9.5-ft. x 10-ft. (2.9-m. x 3-m.) Green chain grates, and four Edge Moor boilers, 500 hp., also served by 9.5-ft. x 10-ft. Green chain grates. Draft is provided by a concrete chimney 14.5 ft. (4.5 m.) in diameter and 250 ft. (76 m.) high, capable of providing a draft to the furnace of the most remote boiler of 5 in. (1.27 cm.).

Situated as Muncie is, close to the coal fields of Indiana, such coals as Indiana Nos. 3, 4, 5 and 6 veins are the natural fuel. The station as originally designed was capable of handling the load for a number of years, but as the plant load increased steam requirements went up and higher ratings were required from the boilers.



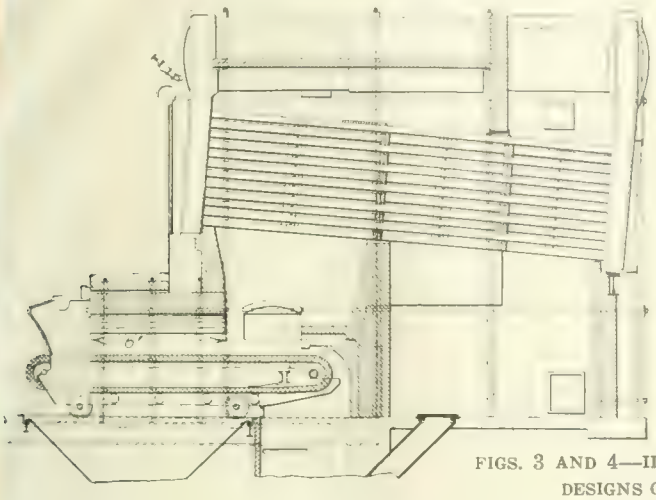
FIGS. 1 AND 2—IGNITION ARCH AND FURNACE DESIGN IMPROVEMENT POSSIBLE IN RECONSTRUCTION WORK

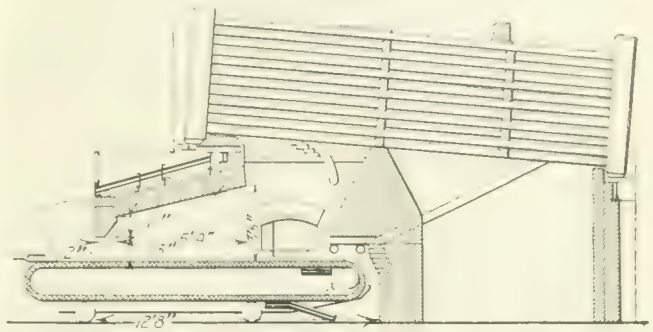
Typical test performances of the original installation are given below:

Type of Stoker	Green Chain Grate	Green Chain Grate	Green Chain Grate
Draft over fire, in.	0.58	0.39	0.43
Kind of fuel...	Hocking slack	Indiana screenings	Indiana screenings
B.t.u. per lb.	11,585	10,908	11,656
Coal burned per hour per square foot grate surface, lb.	32.2	31.4	33.6
Per cent rating	144	123	144
Net combined efficiency of boiler and furnace, per cent	75.7	70.6	73.8

The combined efficiency of boilers and stokers was high and resulted in excellent station performance, and the rating 144 per cent was consistent with the practice

at the time when the installation was made. As the station load grew additional boilers and stokers were added to meet the increased steam demands until the entire available boiler-room space was filled. Then came a consideration of how to obtain increased capacity from the existing boilers. To do this, two broad methods were open: (a) To burn more coal; (b) to burn higher grade fuel. Freight rates and costs at the mine prohibited the burning of higher grade fuel, therefore the problem became one of burning greater quantities of Indiana coal.





FIGS. 3 AND 4—ILLUSTRATION OF WHAT CAN BE ACCOMPLISHED IN IMPROVING DESIGNS OF SETTINGS. (3) OLD AND (4) NEW BOILER SETTINGS

In order to burn more coal two methods were open: (a) Increasing the rate of combustion per square foot; (b) increasing the grate area.

On account of the low fusing temperature of the ash of Indiana coal and the high percentage of ash, higher rates of combustion, such as might be obtained with forced draft, were considered an undesirable operating feature as abnormal clinker trouble would be encountered. Burning more coal would also cause increased furnace maintenance costs, and the ultimate benefits were doubtful. It was therefore decided to increase the coal burning ability by increasing the grate surface. Fortunately the furnace space of the Edge Moor and Stirling boilers was considerably greater than the stoker width, and it was readily possible to increase the width of the stokers, and in fact an advantage to do so, as the heat distribution under the first bank of tubes could be thereby improved. Figs. 1 and 2 show the changes in the Stirling boilers, while Figs. 3 and 4 are for Edge Moor boilers.

Installation	Type of Boiler	Rated Hp.	Grate Size, Ft.	Grate Area, Sq. Ft.	Grate Ratio Surface to Heating Surface	Per Cent Increase in Grate Surface	Hp Developed	Per Cent Increase in Capacity	Diameter of Furnace
Original	Sterling	500	9.5x10	90.3	1 to 55.5	....	720	..	Fig. 4
Revised	Stirling	500	10.5x11	133.2	1 to 35.2	47.5	1,000	39	Fig. 3
Original	Edge Moor	500	9.5x10	90.3	1 to 55.5	....	720	..	Fig. 1
Revised	Edge Moor	500	12x11	128.0	1 to 35.2	41.8	1,000	30	Fig. 2

The location of bridge walls permitted also the increasing of the stoker length, so it was decided to increase the grate surface the maximum amount possible by both widening and lengthening the stokers.

The accompanying tabulation indicates the relative dimensions, proportions and results obtainable from the original and the enlarged stokers.

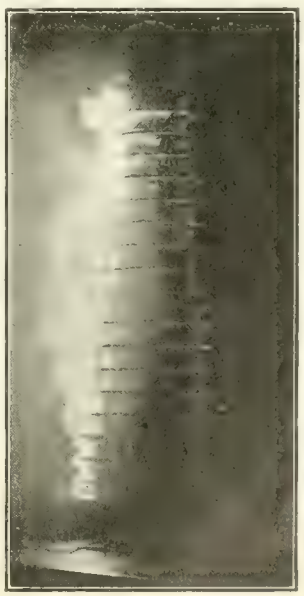
Evaporative tests have not been made on the units on which the grate surface has been increased, but from flow-meter and Venturi meter readings it is evident that the boilers operate at 200 per cent capacity in daily operation, which is a more important consideration than test performances. The Indiana General Service Company was so well satisfied with the performance of the first units on which the grate size was increased and the furnaces improved that it quickly proceeded in a similar manner with the other units in the station.

This is a typical case of a station designed twelve or fifteen years ago, and operated at boiler ratings of from 125 to 150 per cent, being reconstructed to obtain ratings of 200 per cent and over. Usually the easiest and cheapest method of doing this is by increasing the grate surface and modernizing the furnace.

With chain grates it is possible to improve the arch design so that much higher rates of combustion can be obtained and so that the ignition is never weak and is never the limiting factor as regards capacity.

Many stations, both of the public utilities and of the industrial plants, have made similar changes in grate size and in furnace design and have realized increased capacity similar to that obtained by the Indiana General Service Company.

With present costs of new equipment the cheapest way to obtain increased capacity is by means of making furnace improvements if such are possible. In this case by the small expenditure for the necessary repair parts to increase the stoker size an additional capacity of 1,500 hp. was obtained at about 20 per cent of the cost of installing additional boiler capacity.



Fireworks on a 250,000-Volt Insulator

THE beautiful electrical display here shown took place when a wet arc-over at 485,000 volts was developed on a General Electric 250,000-volt porcelain bushing. This is the type of bushings that is to be used on the 220,000-volt Southern California Edison system.

Starting Synchronous Motors Under Load

Investigation of the Variation of Pull-in Torque to Determine Procedure in Starting by Induction-Motor Action

BY E. E. GEORGE
A. L. Drum & Company, Chicago, Ill.

IMPORTANT considerations in starting synchronous motors by induction-motor action to avoid excessive currents and mechanical strains were brought out by the writer in a previous article.* It was shown that the behavior of the field ammeter is an important guide in operating procedure and that this operation might even be effected by a relay scheme depending upon field current.

It is evident from the preceding discussion that the effect of direct-current excitation is to produce a vibration of the rotor. A sufficient amount of excitation makes the frequency of the impressed force and the natural frequency of the rotor resonant, and this state of resonance results in a violent change in velocity, which, if the frequencies are synchronized properly, results in the rotor attaining synchronous speed smoothly and almost instantly. That is, the rotor "hunts" up to synchronous speed when the field is thrown on.

INFLUENCE OF DESIGN ON PULL-IN TORQUE

The preceding article gives sufficient information to the engineer in charge of installation, operation and maintenance to enable him to utilize the inherent starting qualities of any synchronous motor to the best advantage. In some cases he will be able to start twice the loads previously attempted. However, nothing has been advanced so far that would aid the designer in improving the starting qualities of synchronous motors. The designer has control over certain factors that affect the pull-in torque. Chief among these factors are field current, line current, moment of inertia of rotor and load, and slip before excitation (at highest induction speed under given load). The load torque may be negligible as compared to its inertia, as pointed out by Steinmetz, because the time taken by the rotor from excitation to practically complete pull-in is very short under favorable conditions—less than the initial slip cycle. The following equation represents (with the limitations discussed later) the relation which must be attained for the rotor to pull into synchronism under the most favorable conditions of switching:

$$\omega_1 - \omega_s = 2\sqrt{\frac{1650 \times P_p^2 \times K_m \times E_g \times I_d}{746 \quad \text{mass} \quad r^2 \quad Z_g}}$$

This can be reduced to:

Initial slip =

$$\text{constant} \times \sqrt{\frac{\text{line current} \times \text{field current}}{\text{moment of inertia of rotor and load}}}$$

The above equality can be obtained by decreasing the slip (increasing the induction-motor characteristics), or by increasing the natural frequency of the rotor (which is a function of the elasticity of the magnetic circuit and the moment of inertia of the mechanical construction), or by both methods.

*ELECTRICAL WORLD, April 10, 1920.

Decreasing the initial slip is usually permissible, but it slows up the latter part of the pull-in very appreciably, as may be seen from the two equations following:

$$\omega_1 - \omega_m = \frac{(\omega_0 - \omega_s)}{\cosh\left[\frac{(\omega_0 - \omega_s)}{2} t\right]}$$

$$\frac{(\omega_0 - \omega_s)}{2} t = \log_e \tan\left(\frac{\rho_m}{4} + \frac{\pi}{8}\right)$$

The Amortisseur Winding Which Prevents a Rotor from Hunting at Synchronism May Prevent It from Pulling Into Step Quickly.—In connection with the equalization of initial slip and natural frequency the characteristics of the amortisseur winding must be carefully considered by the designer.

BASIS OF PRECEDING DISCUSSION

The derivation, explanation and limitations of the preceding equations are given below, not in detail, except where necessary to make limitations clear. The purpose of the mathematical work is to find some explicit relation between time, velocity and rotor angle in the period between excitation and synchronism. The magnetic and mechanical forces involved give a second degree differential equation of angle with respect to time. All the preceding discussion is based on the results of the integration of this equation. The key to the method of integration was the result of reconciling Blondel's statement of the forces involved with the dynamical laws of vibration, with Routh's investigation of the stability of steady motion, and with some observations of the writer that indicated that pull-in was a "hunting" or vibratory phenomenon.

Notation:

ρ_m is the angle, in electrical radians by which the axis of the direct-current field of the rotor lags behind the axis of the same-signed rotating field of the stator.

ρ_s is the value of ρ_m after the machine has reached synchronism and settled down to its final phase position.

ρ_e is the value of ρ_m when excitation is impressed.

E_m is the induced or the motor emf. in effective volts to neutral for phase 1, and taken in such a direction as to be a counter-emf. under normal operating conditions (motor torque).

E_g is the supply or generator emf.

e_m is the instantaneous value of E_m.

e_g is the instantaneous value of E_g.

I_a is the alternating current, in effective amperes, induced in the motor-field circuit.

I_d is the direct current impressed on the motor field circuit.

I_m is the current in phase 1, in effective amperes, due to E_m acting on Z_m.

I_g is the current in phase 1, in effective amperes, due to E_g acting on Z_g.

i_m is the instantaneous value of I_m.

i_g is the instantaneous value of I_g.

$r^2 \times$ mass is the equivalent moment of inertia ($= r^2 \times$ weight $\div 32.2$) of the rotor and load (r in feet, weight in pounds).

t is the time in seconds, after $\rho_m = \rho_e$.

T_1 is the torque in watt-seconds due to phase 1.

T_m is the torque due to all phases.

ω_m is the velocity, in electrical radians per second of the rotor.

ω_g is the velocity of the stator rotating magnetic field.

ω_c is the value of ω_m when excitation is impressed.

U_g is the impedance of the system per phase to neutral at ω_g, including motor, generator and line.

Z_m is the impedance at ω_m.

ϕ_g is the power-factor angle for Z_g in radians.

ϕ_m is the power-factor angle for Z_m.

θ_e is the angle, referred to $\omega_g t$, in electrical radians, by which e_m lags behind e_g when excitation is impressed.

θ_s is the value of θ_e when $\phi_m = \phi_s$.

P_p is the number of pairs of poles on the motor.

β = integral of $(\omega_m dt)$.

A is a measure of the natural rate of vibration of the rotor for given magnetic and mechanical constants.

$$A = 2\sqrt{\frac{1650\ P_p^2\ k_m\ E_d\ I_d}{746\ \text{mass}\ r^2 Z_d}}.$$

D is a measure of the forced rate of vibration of the rotor for given values of slip, angle and A.

$$D = \sqrt{(\omega_g - \omega_c)^2 + \frac{A^2}{2}} \sin \frac{A^2}{2}.$$

Since $D = A = \omega_g - \omega_c$ at "critical" pull-in, D and A are angular electrical velocities, and if divided by 2π would represent electrical cycles per second.

k_m is the ratio of E_m to $I_d\ \omega_m$. It will be taken as constant during integration.

Physical Basis of Motor Torque

The chief torque on the rotor of a normally operating synchronous motor is due to the reaction between the current in the stator windings and the magnetic field due to the rotor windings, or vice versa. While under some conditions all electrical motors have a torque due to longitudinal tension of the lines of force in the air gap the greatest torque is that due to current-carrying conductors on one element being in a magnetic field due to current-carrying conductors on another element, with freedom of motion between the elements. In analyzing synchronous motor torque, the common explanation, involving attraction between the magnetic poles of the rotor and stator, must be laid aside. Torque should be evaluated from the power equation. Torque equals power divided by angular space velocity. The instantaneous value of power equals the product of the voltage and the current at that instant, provided that the voltage is a measure of the magnetic field acting on the conductors carrying the current. When the current is in phase with the voltage, the product is positive, denoting generator action or decelerating torque.

Construction of Torque Equation

The part of the rotor-field flux due to the induced current I_a in the rotor causes an induction-motor torque, to which the ordinary induction-motor equations for one phase of a phase-wound rotor are applicable. The part of the rotor field flux due to the direct-current excitation I_d causes the induction of a voltage E_m in the primary. This voltage E_m causes a current I_m in the primary, in addition to the current I_g due to E_g. As we have seen that the torque on the rotor is due to the stator current and the rotor field, and that E_m is a measure of that field, we may write, following Blondel:

$$T_1 = -P_p\ (e_m\ i_m + e_m\ i_g) \div \omega_m.$$

The minus sign is used because we will consider accelerating or motor torque as positive, contrary to the usage in the power equation. ω_m, which is an electrical velocity, must be divided by P_p to get a space velocity.

Taking the zero value of e_g in phase 1 as the zero of time:

$$e_g = \sqrt{2}\ E_g \sin(\omega_g t).$$

$$i_g = [\sqrt{2}\ E_g \sin(\omega_g t - \phi_g)] \div Z_g$$

As ω_m is a variable, e_m is not a linear function of $\sin(\omega_m t)$.

$$e_m = \sqrt{2}\ E_m \sin\left(\int \omega_m dt - \theta_e\right) = \sqrt{2}\ E_m \sin(\beta - \theta_e).$$

$$i_m = [\sqrt{2} E_m \sin(\beta - \theta_e - \phi_m)] \div Z_m.$$

$$T_1 = \frac{2\ P_p\ E_m\ E_g}{\omega_m Z_g} \sin(\omega_g t - \beta) \sin(\beta - \theta_e)$$

$$\frac{2\ P_p\ E_m^2}{\omega_m Z_m} \sin(\beta - \theta_e - \phi_m) \sin(\beta - \theta_e).$$

Considering a three-phase machine, with phases 2 and 3 of E_g respectively $(2\pi \div 3)$ electrical radians ahead of and behind phase 1 as to time, phases 2 and 3 of E_m are respectively $(2\pi \div 3)$ $(\beta \div \omega_g t)$ electrical radians ahead of and behind phase 1 as to time.

As the sum of the cosines of three angles differing by $(4\pi \div 3)$ is zero, some of the terms drop out when the total torque for the three phases is considered. As in all practical cases the induction torque of the rotor is able to bring it within a small fraction of synchronism, we may make a simplification of some of the other terms for three phases. Even with a slip of 10 per cent $(\omega_g - \omega_m = \omega_g \div 10)$, the integral over a slip cycle $(\omega_g t - \beta = 2\pi)$ of the sum of the sines of three angles differing by $[1 - (\beta \div \omega_g t)]\ [2\pi \div 3]$ radians is within 1 per cent of the integral of three times the sine of the middle angle. For the net torque of three phases:

$$T_m = \frac{3\ P_p\ E_m\ E_g}{\omega_m Z_g} \cos(\omega_g t - \beta + \theta_e - \phi_g) - \frac{3\ P_p\ E_m^2}{\omega_m Z_m} \cos(\theta_e - \phi_m).$$

At synchronism $(\omega_g t - \beta + \theta_e)$ becomes θ_s:

$$T_s = \frac{3\ P_p\ E_m\ E_g}{\omega_m Z_g} \cos(\theta_s - \phi_g) - \frac{3\ P_p\ E_m^2}{\omega_m Z_m} \cos(\theta_e - \phi_m).$$

As ϕ_m is always less than 90 deg., being a power-factor angle, $\cos(-\phi_m)$ equals $\cos \phi_m$.

$$\frac{\text{synch. power}}{P_p} = \frac{3\ E_m\ E_g}{Z_g} \cos(\theta_s - \phi_g) - \frac{3\ E_m^2 \cos \phi_m}{Z_m}.$$

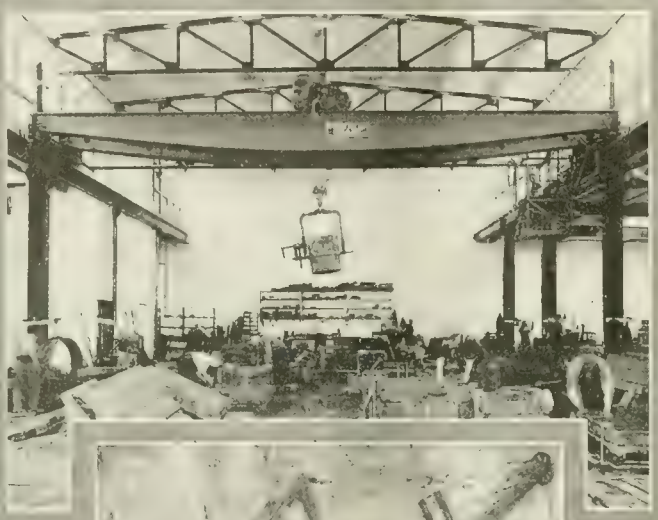
With a suitable change in notation, the above will be recognized as the standard equation of synchronous motor output.

The discussion of this subject will be completed in an early issue.

Modern Methods Used in Material Handling













Electricity has played an important part in the development of material-handling methods and machinery. The central station engineer has realized the efficiency of modern handling methods and hence the coal crane is now a common installation. In the factory orderly progress of materials is maintained with conveyor systems. The foundry benefits by the ease with which crucibles and other heavy loads are handled, while giant shovels such as those used by the Chile Exploration Company or the Ontario Hydro-Electric Commission scoop the earth's surface at a rate never before dreamed of. Trucking and stacking have become an interesting occupation instead of one where the inefficiency of brute strength formerly predominated. All of these have been advanced by electric power.

Economies in Handling Materials in Industrial Plants

Instances of Savings Effected by Electrically Operated Material-Handling Machinery and Examples of Adaptation to Cover Varying Needs

By J. S. Tuthill
Assistant Secretary-Manager Material-Handling Machinery Manufacturers' Association, New York

IN INDUSTRIAL plants attention is being concentrated on "progressive-production" methods by which the use of electrically operated material-handling machinery results in quick and efficient performance. Since the major portion of these devices are electrically operated, it would not be worth while to try to draw comparisons with equipment using other motive power, but to show the great savings effected by substituting mechanical methods for man power allusion to a few installations which are fairly representative of the tendency in the use of these devices will be of interest.

In handling bales of cotton the load-carrying electric truck carries ten bales per load with more speed than one man can carry one bale. The use of these trucks for handling cotton has released hundreds of men for more important work requiring individual service. At one of the big rubber factories in Ohio electric trucks haul loads of 3,100 lb. (1,400 kg.) each trip and make one trip around the department every four minutes. In an average eight-hour shift a truck pulls more than 200,000 lb. (90,000 kg.) of tires and cores, doing work that formerly required the time and energy of twenty-five men. The shops of a railroad in the East have in service four load-carrying trucks and one tractor, and these have displaced twenty-five men with hand trucks, eight horses or mules with drivers and the services of a switch engine for two hours per day, showing a saving over the former method of handling of $34,363 a year.

Savings Effected by Overhead Trolley Conveyor Paid for Installation in Six Months

In the warehouse stockroom of a big brass and copper company material was handled and moved manually in loads averaging about 700 lb. (300 kg.). Recently an overhead trolley conveyor system was installed, costing $700. Reports indicate that the conveyor paid for itself in direct saving in less than six months, and in addition it has released two men for other important work. This installation has also eliminated the annoyance caused the management by having frequently to employ extra men for days or weeks when much material was moved and the work was unusually heavy.

While working both night and day shifts, a large beet-sugar company was confronted with the problem of adequately storing the sugar after it had been bagged. For years the bags of sugar had been trucked by hand across an immense warehouse. Later they were piled by hand, fourteen men being required for each shift, or twenty-eight in all. Finally this company purchased 200 ft. (60 m.) of sectional electric conveyor and an electric portable piling machine. The system is unusually flexible, and when the stacking is done the units of the conveyor may be shifted about to carry sugar, beet pulp or beet seed directly into railroad cars, to motor trucks or any other point desired. Furthermore, the installation has released twenty men for more important work, and, instead of fourteen men on each shift, the present arrangement necessitates the use of but four, and these four exert only half the physical effort that was formerly required of them.

The handling of heavy pieces of scrap in storage yards is easy for a locomotive crane equipped with an electric magnet, whereas by hand this work could not be done at all. With a 10-ton to 20-ton locomotive crane and electrically actuated magnets a 50-ton car can be loaded in thirty minutes by handling pieces of iron and steel weighing 3 tons each trip. These cranes also do the car switching in the yard and they can travel at a speed of eight miles per hour. Though handling scrap is the main job of the cranes, they are also employed for handling coal and similar material in bulk. It is only the work of a few minutes to take off the magnet and hang a 1.5-cu.yd. (1.15-cu.m.) clamshell bucket in its place.

Electric Hoist Causes Reduction in Clerical Force of Cleveland Street Railway

A recent and most novel installation of handling machinery is that of the Cleveland Street Railway Company. By a system of automatic machines in conjunction with an overhead electric trolley hoist, the company's receipts of tickets and currency are sorted, counted, wrapped, and finally transported to proper storage, entirely by mechanical means. Formerly this process required the services of a whole clerical force, but now human labor is virtually dispensed with.

Automobile manufacturers have taken noticeable steps in developing efficient material-handling methods. Throughout their plants and factories such companies as Ford, Studebaker, Buick and others are effecting great economies by the use of electromechanical instead of manual methods. Use is made of numerous locomotive cranes in storage yards to handle raw materials and of traveling cranes to deliver goods direct from railroad cars to the receiving rooms and also to deliver finished product from plant to railroad cars. In machine shops and assembly rooms, to save all handling and movement of the parts, conveyors of the belt and chain trolley types having a continuous movement are used. Where many very small parts are to be handled belt conveyors up to 24 in. (60 cm.) in width are installed, on which two rows of small parts may travel simultaneously, or small boxes containing parts in quantities may be conveyed.

Another operation which deserves mention is the handling of material in skylight-inclosed crane bays, connecting two buildings of two or more stories. The cranes in these bays are of the electric traveling overhead type, spanning the distance between the buildings. On the ground floor there are standard-gage railway tracks running into this sky-lighted areaway between the buildings, so that goods may be brought in in railroad cars and handled under cover in all kinds of weather. From the sides of each of the buildings there are numerous projecting box platforms with wide doorways into the building proper. These platforms are so inclined on the different floors that the overhead traveling cranes may take goods from the platforms between the cars, lift them rapidly to the proper story, travel along to the box-projecting platform where the goods are nearest the point of destination, and then swing the goods to the projecting box platform and drop them onto a trailer truck which has been run out from inside the building. When trailer trucks are used to

receive the loads which are lifted by the crane, the trailers are towed by electric storage-battery tractors or electric industrial trucks to the place on that floor where the goods are to be stored or used.

Many more instances of distinct savings effected by electrically operated material-handling machinery could be cited. These few, however, will serve to suggest the tremendous opportunities to conserve time, labor and money and promote efficiency in the handling of materials.

Improvement of Interconnection by Liberal Co-operation

Team Work in Spirit as Well as by Contract Among the Connected Systems—Unified Scheme Under One System Operator as Goal

By A. T. Throop
Manager Eastern Massachusetts Electric Company, Salem, Mass.

HOW shall two or more electric utility companies contemplating interconnection establish a system of operation that will yield maximum benefits to all interests concerned? Has experience with the commercial and engineering sides of interconnection been sufficient to enable standards of practice to be laid down for general guidance? These questions lead to a few broad comments upon certain fundamental aspects of the interconnection problem which should not be overlooked by those about to enter this promising branch of electrical service.

Above all, the contracting parties should enter into the agreement with a spirit of generous co-operation and the aim should be to work toward the operation of the combined systems as a complete unit. The working out of an interconnection problem must utilize the best results of experience in accord with certain underlying principles if success is to be attained, leaving room for variations in treatment when necessitated by differences among local conditions.

Real co-operation must be agreed upon and practiced among the several companies interconnected if maximum efficiency is to be attained. The parties concerned should enter into an agreement to submit their plants and lines as a group to scientific management with respect to co-operative handling of loads, interchange of energy and equipment direction. The limits of responsibility for the control of operations, inspection and maintenance should be clearly established. Contracts vary widely as to scope. Whether these be elaborate or simple, they must be drawn in a co-operative spirit and carried out with team play as their primary incentive if the best results are desired. Sharp bargains, close cutting of interpretations, narrow and selfish viewpoints are inimical to the maximum efficiency of interconnected service. Fair profits on energy interchanged, or economic advantages reckoned and accepted among the parties to interconnection agreements, are reasonable objects, but local jealousies and rivalries have no place in the working out of such arrangements. In effect, parties to an interconnection agreement enter a species of partnership to pool their resources in the way of efficient handling of loads, and unless confidence is established and maintained the results are bound to be far below the possibilities.

In some cases interconnection arrangements may proceed upon the basis that each company operates its own plants and lines independently of the other, with the exception that stated amounts of energy can be transferred back and forth when stated conditions exist. The larger the ratio of interconnected energy transfer to the output of the individual plants, however, the more important it becomes that the operating problems of the several stations be intelligently and positively co-ordinated. Complete control of plant operations may ultimately be vested in a single system operator; but whether this be done or not, entire frankness is the price of satisfactory interplant administration.

If interruptions occur, full and prompt reports of their cause and remedy should be interchanged or turned in to the responsible system operator in charge of service, and great care should be taken to avoid incomplete reports. Fear for blame for troubles of operation should never be allowed to interfere with the open-handed transmission of information from local plant operating shifts to the dispatching center or from equals to equals who are striving to operate the complex properties under their control at maximum efficiency.

Good Telephone Service Is Essential

Leased telephone connections operated by the local telephone interests are usually a vitally important feature of a first-class interconnection. The saving in time resulting from available leased lines run so far as practicable apart from the transmission lines of the related companies deserves particular emphasis. Modern load dispatching requires quick and accurate interchange of orders and information, and delays are often costly in their inconvenience to the public and in loss of prestige by the companies. Plants of major importance should therefore be provided with adequate personnel to insure the prompt handling of all telephonic business without those delays due to coincident operating work required to be performed by those on duty. Unless an interconnection warrants paying for this extra operating force, at least during the day and evening shifts, it is unlikely that an interplant tie service can be economically justified. The repeating back of all transmitted instructions as in transportation practice is very desirable in the interest of safety and service continuity.

Visits of plant operators between interconnected stations, the interchange of operators among tied-in systems, regular meetings of all system operators in a district to get personally acquainted face to face, and informal monthly discussions of the daily problems of load dispatching and allied subjects, all have their place in raising the efficiency with which this important kind of work is done.

The preparation of instruction books, anticipating so far as possible the procedure under a great variety of operating conditions, may be extremely helpful. A book of this kind that is used on the Eastern Massachusetts Electric Company system in loose-leaf form is most convenient in making clear the relations of the interconnected plants at Salem, Malden, Revere and Boston. It covers a variety of subjects, including routine handling of lines and stations, transmission-line wiring diagrams, switch and transformer-bank numbering, limits of responsibility for inspection and handling of switches and lines, maintenance routine, inspection schedules, and procedure, in case various combinations of plants are in service, and in the event of emergency

switching situations. This instruction book was prepared by the engineering department of Charles H. Tenney & Company of Boston.

Log-sheet forms providing for the daily plotting of load variations, the hours' run of units and auxiliaries, meter readings in stations and at interchange measuring points, fuel, water and other data commonly found in plant performance records are also used by the Eastern Massachusetts company and are essential to the best results in plant interconnection. Here again the cordial interchange of records and information is vitally important to successful service. Testing routine should be thoroughly settled for regular performance; phasing instructions between systems and between plants, and various practical matters connected with instrument calibrations, all deserve consideration and advance provision.

Necessary and useful instruments associated with interconnection include a master clock, curve-drawing wattmeters, watthour meters, indicating voltmeters, curve-drawing voltmeters, indicating and curve-drawing frequency meters, power factor recording meters (graphic type) and a liberal equipment of synchronizing apparatus. The study of data from these instruments with reference to log sheets and more or less extended information as to weather conditions, water-gage readings and flow records in hydro-electric installations, machine duties, load shifts and transfers, and the preparation of economy charts showing the best methods of handling different systems and plants under varying conditions all contribute to that administration of interconnected plants which saves fuel, labor and expense in their combined handling.

Few are the interconnections in which the first year's operations will disclose the standardization of detail practice attainable after a greater experience. Each recurring annual cycle should bring the precision of control for maximum efficiency in fuel, labor and water utilization closer to the ideal results. Remarkable records have been obtained on some systems where co-operative interchange has had full play. A genuine disposition to share plant resources, plus the efforts of a trained personnel, working harmoniously and with enthusiasm, will deliver a given total of energy to an interconnected system at minimum cost consistent with good service, but the collective profits are difficult to forecast. Substantial gains in net earnings and in quality of service are, however, within the reach of interconnected companies that adopt the plan with full appreciation of its opportunities and responsibilities.

Germany's Experience with Iron Conductors Not Successful

A RECENT issue of the "Annales des Travaux Publiques de Belgique" describes Germany's experience with the use of iron for transmission lines and network extensions during the war. Wires were used for conductors up to 6 mm. in diameter, and cables for conductors of larger size. One source of trouble was the inevitable kinking of the line. The galvanizing was easily damaged, and in making joints and erecting the lines extreme care was found necessary. Moreover, iron proved to be 20 per cent more expensive than copper, though the price per kilogram was only 0.71 mark as against 4 marks for copper. The use of copper is being resumed as quickly as possible.

Readers' Views and Comments

How Water-Power Development Can Add Scenic Effects in Yosemite National Park

To the Editor of the ELECTRICAL WORLD:

SIR: In the Dec. 18 issue of the ELECTRICAL WORLD I have read an article on "Beauty of Use" which takes the stand that the proper development of water powers in the national parks can be made without damage to the scenic beauties of the parks and that therefore this development should be fostered. I am thoroughly in accord with this view and feel that in this connection mention might be made of the proposed development by the Merced Irrigation District of Merced, California. This scheme includes the construction of a dam for storing waters of the Merced River in the Little Yosemite Valley, which is in the Yosemite National Park but farther back in the mountains than the Yosemite Valley proper. The water from this reservoir would be let out during the time of low-stream flow in the Merced River and be brought down through the Yosemite Valley and over the Nevada and Vernal Falls, being ultimately utilized for the generation of power at a point outside and below the boundary of the Yosemite National Park. It would then be turned into irrigation ditches, carried out into the San Joaquin Valley and used for irrigation.

Of course, this means the creation of a lake in the floor of the Little Yosemite Valley. However, it would be at a very high altitude, would be a thing of beauty and would further insure a flow of water over two of the most beautiful falls in the valley, even through the dry season, instead of having them virtually dry at that time as is the case now. Such a scheme, instead of detracting from the beauties of the park, would add to them materially and would lengthen the season of full flow over these falls for at least three or four months of every year.

L. J. MOORE,
Electrical Engineer.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Co-operation Between Central Stations and Isolated Plants

To the Editor of the ELECTRICAL WORLD:

SIR: In the Jan. 1 issue of the ELECTRICAL WORLD the article appearing on page 11, entitled "Co-operation for the Central Station and Isolated Plant," is broad-minded in its viewpoint and gives evidences of the true engineering mind of the writer. The long-standing if mild quarrel between the central station and isolated plant has never been settled on a true economic basis, and in most cases where one supplants the other sound engineering principles have not prevailed.

It is true that central-station service has often brought about a reduction in total costs where the reverse would have been the case had the isolated plant been operated with skill and care, and it is probably safe to say that a great many isolated plants have been shut down that might have been run to the advantage of the owners. As a practical matter, however, the

shutting down of the isolated plant may have resulted in reduced costs, and one could only admit that the end justified the means.

It must be admitted that where steam is used for heating there is a valuable by-product in the form of power which should be made available in those cases where the potential power would justify the expenditure. In most cases there is a very poor balance between energy requirements and heating requirements, and the isolated plant finds itself throwing steam away at certain hours and without sufficient load at other hours. The isolated plant is also more or less complicated when compared with the equipment for satisfactory service when energy is purchased, and these things tend to make its elimination rather attractive to the owners.

Forgetting for the moment that there is a "bone of contention," the article suggests a plan of co-operation that, from the standpoint of fuel economy, is worthy of serious consideration. Consider the case of a large department store or a hotel in which steam is required not only for direct heating but for other purposes, the amount per hour varying greatly throughout the day and with the seasons. If such an institution is developing its own electrical energy, there will be many hours when steam will be exhausted to the atmosphere, which is a direct evidence of a loss of energy. If it buys electric energy, steam will be delivered from the boilers to the places where it is used, with a direct loss of energy. In the latter case, however, there is a great deal to be said in favor of simplicity, of reduced labor costs, of smaller repairs and depreciation and so forth.

Allowing our imagination free rein, suppose that in this institution there was a turbine coupled to a generator which was tied in with the service lines entering from the central-station system, and that the turbine was cut into the steam pipe between the boilers and the heating system. Between the generator and the incoming service is a reverse current switch. When heat is required the valve admitting steam to the turbine would be opened in exactly the same manner as would a valve without a turbine in the line. The turbo-generator set would come up to speed, the automatic switch would close, tying the generator onto the service, and energy would be delivered into the system as a whole. If the amount of steam being used was small, very little energy would be generated. If the valve was opened wider, more energy would be generated and delivered to the system, and at times this would be in excess of the energy required on the immediate premises, in which case it would be pumped into the general reservoir, so to speak. No steam would ever be wasted to the atmosphere, and the current delivered to the system would carry virtually no fuel cost. With the present-day design of turbo-generating units very little attention would be required, and it is quite within the bounds of possibility that this might be given through occasional visits of the central-station force.

If the service is alternating-current, the induction generator would seem to be almost ideal. If the service is direct-current, there would be greater complication in the matter of automatic switching, but the method would by no means be impracticable or unreliable.

Admitting that the central station should receive a higher price for energy sold than it should pay for energy bought, whatever the owner of the isolated plant received would be profit after the fixed charges had been deducted, and these would be small for a simple generating equipment that would be adequate. There have been interchanges of energy with privately owned hydro-electric plants which have worked out satisfactorily, and there would appear to be no serious obstacles where the privately owned plant is steam-driven. The small non-condensing turbo-generator is rather inefficient, but, on the other hand, it is very simple and reliable. Just where the dividing line between practicable and impracticable application of this idea may lie would be hard to predict, but a few applications should provide sufficient data to lay down a general rule.

A central-station management might well reason that it preferred to conduct the business of generating energy in one station rather than in a number, but it seems to the writer that the broad question of fuel conservation may justify a modification of present practice.

Warren B. Lewis,
Providence, R. I. Consulting Engineer.

Improving Power Factor by Means of Induction Motors

To the Editor of the Electrical World:

Sir: I have read with much interest the article of Messrs. Warner and Knowlton which appeared in your issue of Nov. 20, 1920, page 1021, on the subject of improving the power factor of induction motors by supplying constant current to the rotor slip rings. I suggested this method two years ago in the *Revue Générale de l'Electricité* of Jan. 5, 1919, page 505. Subsequently I described a scheme of connections in the issue of June 7, 1919, page 831, and I showed that the direct current could be furnished by a little rectifier or an exciter.

I observe that Messrs. Warner and Knowlton propose to feed direct current to the motors from the central station by means of a fourth wire. May I say that I am not entirely of their opinion on this point? The experiments that I have made have convinced me that for ordinary induction motors direct current at low tension (8 volts or 10 volts at the most) is sufficient, because there is only the ohmic resistance of the windings to overcome. In these conditions I believe that to obtain direct current from the central station would be too expensive and would put too much copper out of use. It would, in my opinion, be better to install in every factory one or more exciters which would supply current to the motors near by.

A. Soulier,
Paris. Editor *Industrie Electrique.*

To the Editor of the Electrical World:

Sir: Our experiments with the induction motor were made during January and February, 1919, and the paper was submitted to the Electrical World in September, 1919, in the face of the recognized possibility of operating an induction motor synchronously. Although discussed mathematically by Steinmetz,* we have not found reports of experimental results. Mr. Soulier's reference to an 8-volt or 10-volt drop through the rotor windings comes very close to the value of 11.4 volts observed with 33.5 amp. through the rotor of our motor. To take this direct-current excitation from, say, a 120-volt source would admittedly involve excessive rheostatic losses. Some factories, however, have low-voltage direct-current supply which could more economically be tapped than to install separate exciter or rectifier.

R. G. Warner and A. E. Knowlton.
Yale University, New Haven, Conn.

* "Theory and Calculations of Electrical Apparatus," McGraw-Hill Book Company, 1917

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Standardized Mountings for Outdoor Switches, Coils and Fuses

TO AVOID having to carry a large number of spare parts and to facilitate changes on outdoor types of disconnecting switches, choke coils and fuses, standard interchangeable mountings have been developed for this type of equipment by the Utah Power & Light Company, Salt Lake City. These mountings for four different kinds of construction are shown respectively by *A*, *B*, *C* and *D* in the accompanying drawings. This design is for the 15,000-volt equipment. The drawings show a combination of fuse and disconnecting switch. Separate units for fuses, switches and choke coils are made in the same form. Locke No. 3 insulators are used, and these are mounted 13½ in. (34.3 cm.) apart. The switches are supported on the insulators by means of a cast-iron cap cemented to the top of the insulator. *A* and *B* show two methods of mounting the insulators on pipes, in the first case running parallel with the line and in the second case across the line. The

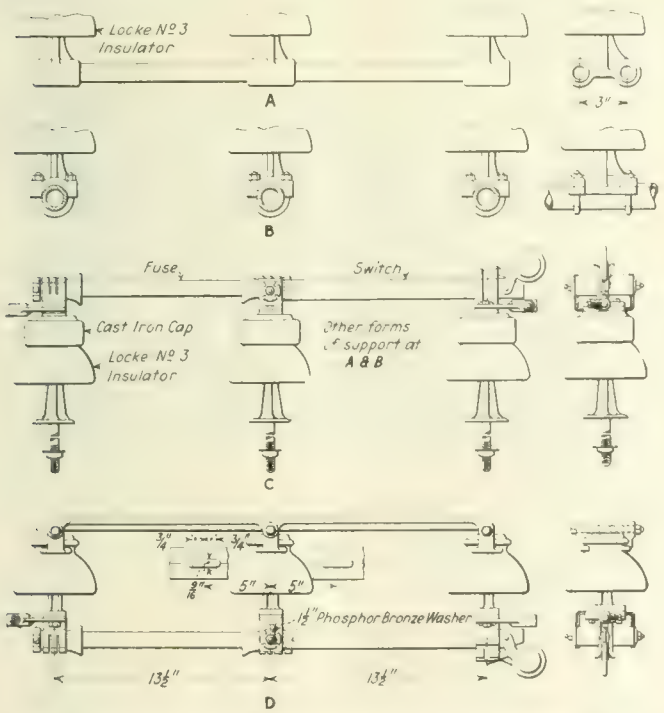


FIG. 1—SAME STANDARD MOUNTINGS USED FOR ALL OUTDOOR 15-KV. SWITCHES, CHOKE COILS AND FUSES

mounting shown in *C* is for bolting to cross-members. A widely used style of mounting is shown in *D*. With this style the equipment is hung below the supporting frame by means of two bolts through the bar, which is clamped on the top of the insulators.

The manner in which the choke coil is mounted on top of the insulator cap is shown in Fig. 2. A supporting block is bolted on to the insulator cap by means of ⅜-in. (9.6-mm.) cap bolts, and the ends of the choke coil are held to this block by means of two ⅝-in. (8-mm.) screws.

This use of standard parts in making up switches and other apparatus means that only one type of insulator need be carried in hand and that similar parts may

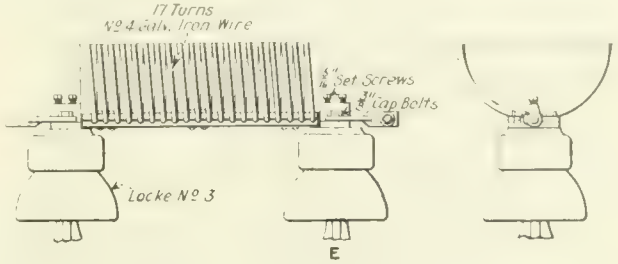


FIG. 2—HOW CHOKE COILS ARE MOUNTED IN STANDARD 15-KV. CONSTRUCTIONS

be carried in stock for whatever equipment is to be mounted. The construction of the supporting frames is simplified by the fact that the span from one insulator to the next is always the same for a certain voltage. As linemen easily become familiar with this standard type of mounting, less time is required for construction work or for making quick replacements in an emergency.

Utah Power & Light Co., Salt Lake City, Utah.
P. P. ASHWORTH, Distribution Engineer.

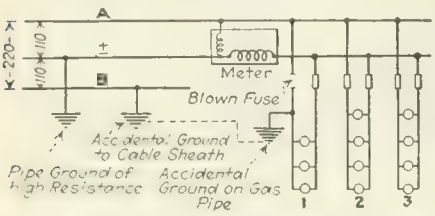
Meter Connected in Neutral Wire Registers Inaccurately

COMBINATION of an accidental ground, a poor permanent ground and incorrect meter connection recently caused a customer's meter to run backward under certain conditions which came to the writer's attention. The trouble was noticed while the meter was being tested using the customer's load. The tester found that the meter ran backward when the lights in a certain part of the house were burning (branch 1 in the diagram), ran forward when the lamps in another part of the house were burning and stood still or ran very slowly if certain combinations of lamps were used. The test of the meter showed that it was registering approximately correctly.

An investigation disclosed that although the lights in the house burned apparently in the normal way one circuit fuse was blown. When replaced this fuse immediately blew again. It was then found that the secondary distributing main was three-wire, 110/220-volt with the middle or neutral wire supposedly grounded. This ground connection was made by driving a ½-in. pipe in the earth and the ground had considerable resistance. The service drop supplying the house in trouble was two-wire and taken from one side of the three-wire bus. The meter had been set improperly with the current coil in the neutral wire.

The circuit having the blown fuse was found to be grounded to a gas pipe on the side which would normally be 110 volts above ground potential. Further investigation disclosed that the remaining phase wire of the distributing main had been accidentally grounded solidly to the lead sheath of an underground service cable, supplying a neighboring residence. This fault brought this phase wire to the ground potential and raised the neutral wire to 110 volts above ground. A 110-volt short circuit was introduced through the regular pipe ground, limited, however, by the high resistance of this ground connection. When the circuit fuse was replaced in the house a 220-volt short circuit took place between the mains through the two accidental grounds.

When lamps connected to circuit 2 or circuit 3 were burned the meter registered correctly, but when lamps on circuit 1 were burned the meter registered backward at approximately the normal rate. With lamps on all three circuits operating the meter ran either forward or backward, depending upon the relative wattage supplied to the circuits.



IMPROPER CONNECTIONS WHICH CAUSED METER TO RUN BACKWARD WHEN GROUND DEVELOPED

The remedy for the trouble was to remove both accidental grounds, to install a better permanent ground connection and to change the meter so that its current coil was in the outside wire of the three-wire system and not in the grounded neutral. HARRY S. RUSH,

Assistant Professor Mechanical Engineering.

North Dakota Agricultural College,
Fargo, N. D.

Using Conduit as Return Circuit Cuts Cost of Street Lights

BY THE use of the conduit for the return circuit in a street-lighting installation at Beverly Hills, Cal., approximately two-thirds of the cost of a similar installation using two-conductor, lead-covered cable and conduit was saved. The Beverly Hills installation was put in during the war period, and as it was necessary to minimize the cost, the usual method of using galvanized conduit containing two-conductor, lead-covered 500-volt insulated cable and series lamps was too expensive.

The cheapest system that could be installed was No. 8 double-braid, rubber-covered wire installed in conduit. The voltage in such an installation would have to be limited to 600. This was satisfactory, but the layout of the city—wide, curving, irregular streets, broad parkways and large lots—made the use of the standard system of complete loops difficult. There were no distribution poles on the streets, and in part of the city all wires were underground. If complete loops were made around the blocks, the voltage would be too high, and there was always an odd number of blocks. It was decided to light all the lamps until midnight and those on one side of the street after midnight. This simplified the system, reducing it to one wire on each side of the street instead of two, but complete loops could not then be made. The plan of using the conduit for the return circuit then took shape. Tests on a system of forty-one lamps as shown in the table indicated that the method was feasible.

The system at Beverly Hills consists of 375 posts, approximately 300 ft. apart on each side of the street, staggered so that the distance between posts is about 175 ft. Each post holds a 100-cp. 66-amp. series incandescent lamp. More than 21 miles of ½-in. conduit were used in the work. The wire was all ordered on reels so that no joints were necessary between posts. The ends of the conduit were bonded together at the post with punched copper strips, special care being taken that the pipe should be clean and the connection good. The cast-iron posts were also bonded to the conduit.

At the feed points the conduit was carried up the post to within 4 ft. of the arm and equipped with a one-wire condulet. To comply with the state law this conduit was protected with fiber conduit; in some cases as many as three pipes were run through one fiber conduit. At the feed points the one wire was connected to one terminal of the transformer and the other terminal was connected to the conduit by means of a copper grounding strip.

In cases where it was known that extensions would soon be made to the system a length of conduit was installed in the post foundation and faced in the direction of the proposed extension. Several extensions have been made to the ends of the circuits. It is only necessary to disconnect the wire from the conduit, splice it onto the new wire and bond again at the end of the new circuit. Posts have been installed in the circuit between existing posts. To do this the conduit was cut at the point where the new post was to be placed, the wires were disconnected at the adjoining posts, extra wire was connected at these points, and then the wire was pulled out at the new post to connect with the lamp. Conduit bonds were put in at the post, with running threads and lock-nuts, and the post was erected.

TEST OF LIGHTING SYSTEM USING CONDUIT AS RETURN CIRCUIT

Current	6.6 amp.
Frequency	50 cycles
Drop per 1,000 ft. of conduit with complete copper circuit	14.2 volts
Drop per 1,000 ft. using conduit as return circuit	10.0 volts
Energy loss with complete copper circuit (per 1,000 ft.)	32.0 watts
Energy loss with conduit return circuit (per 1,000 ft.)	45.0 watts

Lighting system consisting of forty-one 100-cp., 6.6 amp. series lamps; ½-in. galvanized-iron conduit installed in a loop system from post to post; conductor: one No. 8 B. & S. gage D.B.R.C. wire in the conduit; pipe joints put together with graphite paste; and the ends of the conduit bonded together with copper ground strips in the base of each post.

It is easy to locate the source of trouble arising on the system. In the case of a ground all the lamps beyond the point of the trouble are out; in the case of an open circuit it is possible to find the point by grounding the wire at any post to the conduit.

Southern California Edison Co., N. B. HINSON,
Los Angeles, Cal. Distribution Engineer.

Testing Flash-Over of Arcing Horns

TESTS on arcing horns showing flash-overs wet and dry were described by R. H. Marvin, Thomas Insulator Company, at a recent meeting of the Pittsburgh section of the American Institute of Electrical Engineers. Tests made on seven 10-in. (25-cm.) suspension disk insulators 5⅜ in. (13.6 cm.) apart showed the following flash-over voltages: Without horn, 386 kv.; with bottom horn, 364 kv.; with both top and bottom horn, 308 kv. An interesting feature of the use of two horns is that in this case the wet flash-over voltage was identical with the dry flash-over voltage. The flash-over voltage is about 10 kv. per inch of gap.

New York, N. Y. FIELD EDITOR ELECTRICAL WORLD.

Periodic Attention to Small Turbines Will Prevent Shutdown

THE following advice and instructions regarding turbine operation were given at a recent meeting of the operating engineers from different steam generating stations of an Iowa central-station company. It is of prime importance to watch the circulating water at all times. See that the oil temperatures are about the same from day to day. If a wide variation in oil temperature is noticeable, determine whether the cooling coils are clean and free from mud and look for a slimy substance on the inside of the oil tube. Partly obstructed turbine blading can also cause the oil to run hotter than normal. The blading may accumulate scale, and sometimes a gummy substance consisting of a mixture of oil and mud will stop the flow of steam through the blading and build up a back pressure on the dummies. The resulting end thrust may cause very rapid heating. To remove this substance pump coal oil through the first stage of the machine until the oil comes out clear and free of dirt. This procedure should be carried out about once a month if much trouble of the nature indicated is experienced.

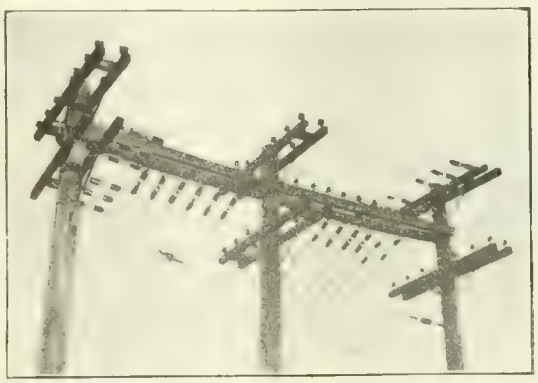
The feed water used in most of this company's plants causes more or less trouble from scale and mud. The trouble seems to be the worst where the boilers have to be forced at high rating in order to hold steam. Forcing the boilers has a tendency to lift the water in them and carry more or less mud with the steam into the turbine. The valves and governor should be watched to see that they do not stick. The sticking may make the machine slow down or overspeed and trip out, thereby causing a shutdown or damage. This trouble, like many others, can and should be eliminated by proper attention to maintenance work.

About 50 per cent of the cases of trouble in most small power plants are due to carelessness on the part of the man in charge. He should not let his work pile up so that when he does start to put his station in shape he will be kept too busy to see other troubles just starting and remedy them before something breaks down. If a man leaves one repair job half finished to go and fix something else which he considers of more importance, he may never get anything finished, whereas if he had worked on each case as soon as the first symptom appeared he would not have had the breakdowns as the trouble would have been remedied before it had time to develop into a serious stage.

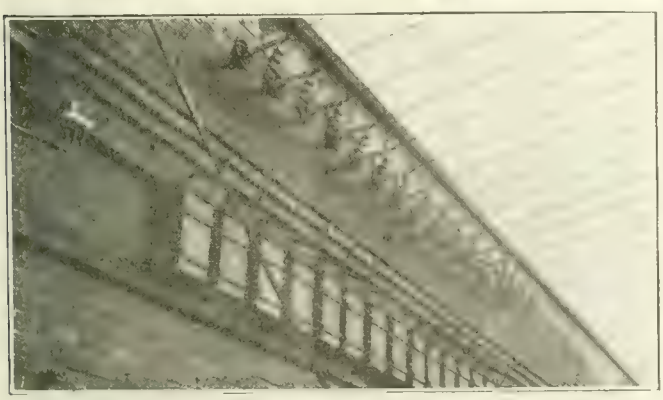
Iowa Railway & Light Company, Marshalltown, Iowa. JOHN M. MAY, Traveling Engineer.

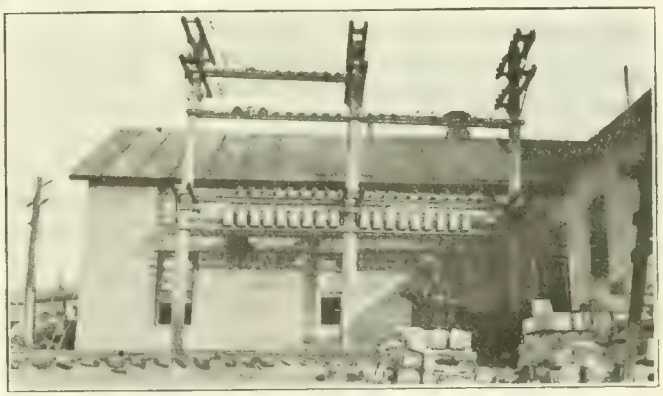
Economical Construction for Outgoing Lines

AN ECONOMICAL construction for supporting outgoing and incoming lines at a station where the expense of steel towers is not warranted is shown in the accompanying photographs. One type of structure of this nature has already been described by the writer in the ELECTRICAL WORLD (Jan. 15, 1921, page 151). In the present case the poles are set close to the building, as shown in *C*, with the cross-arms overhanging. The incoming circuits are dead-ended on the top of the poles, and from this location they pass down on insulators supported by cross-bars to the lightning arresters, which are also supported on a cross-bar lower down on the pole. From here they pass through porcelain insulators into the building.



At *A* is shown a distribution structure about 100 ft. (30 m.) away from the substation built to accommodate six circuits. *B* shows the line entering the substation. The incoming circuits are dead-ended on the cross-pieces at the poles and on suspension insulators fastened directly to the brick wall of the building. In this case the lightning arresters are mounted on wood pieces bolted on the wall. Mounting these lightning arresters outside the station effects considerable economy as regards labor cost and saving of space where the apparatus is liable to be crowded if installed inside the building. In a layout for incoming and outgoing feeders ample provision should be made for taking care of future additional circuits. There should be flexibility so that connections may be made from one circuit to any other and so that circuits may be paralleled.





ECONOMICAL CONSTRUCTION FOR SUPPORTING INCOMING LINES

A. L. JOHNSTON.
Lykens, Pa. Electrical Construction Engineer.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Simplified Diagrams of Motor Connections

IN MAKING drawings showing pole connections of induction motors it will usually add to the clearness of the diagrams if only the connections of one phase are shown. As each phase may be connected exactly like the others, the filling in of all the connections tends to



TWO METHODS OF DRAWING THE SAME DIAGRAM
T shows only one phase connected, while *S* shows full diagram.

confuse rather than to assist the repair man. In the accompanying cut *S* shows the customary diagram for a six-pole series star winding with connections drawn for all phases, while *T* shows one phase of the same winding with the lead-in wires and star connections of the other phases. The second diagram is much easier to follow. In using such a diagram all the groups in *A* phase are connected and then the same connections are made on *B* phase and *C* phase successively.

The Brown Company,
East Berlin, N. H.

RALPH MCKINNEY,
Repair Department.

Cost of a Motor Includes Breakdown Expenses

THE correct way to judge the cost of a motor is to consider its total cost during its useful life, from purchase to scrap heap, estimating probable cost of repairs, lost time and other factors as closely as possible, in the light of past experience.

A breakdown means more than the simple cost of repairs. The cost of taking out the broken-down part of the machine and replacing it must be considered, also the loss of production during the change. Compared to these the cost of repairs themselves is often insignificant, and recognition of the fundamental law that the cheapest machine in the long run is seldom the one which is the lowest in first cost is compelled. For instance, a motor which costs $1,000 new, and which is skimped in some respect, might easily cost another thousand dollars each year for repairs, all told, while a better built machine of perhaps 10 per cent greater first cost, working under the same conditions, might require only a small fraction of its original cost in annual repairs.

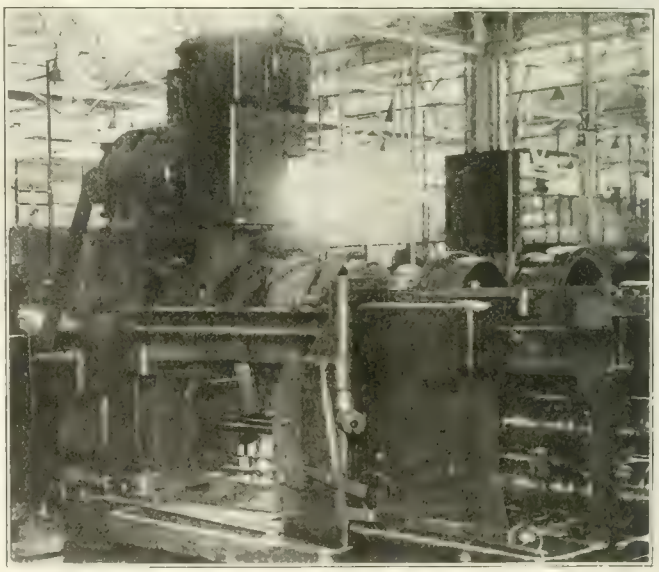
This principle is true of small things as well as large, for example, a lathe tool. Its first cost is not great, and during its life several times its first cost is expended on it in dressing and grinding. For a little greater first cost a tool of high-speed steel can be bought which will do several times the amount of work without redressing. There is no doubt which tool is the cheaper in the long run. When all the points have been duly weighed, it will usually be found that the best obtainable is really the cheapest, and that the best is none too good for modern industrial conditions.

JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Automatic Compensator Mounted on Lathe to Save Room

TO SAVE manufacturing space the automatic compensator was mounted directly on the lathe shown in the accompanying photograph, which was taken in a shop of the Canadian Products Division of the General Motors Company.

This photograph shows a Cone automatic lathe used for rough-turning pistons and cutting the piston-ring grooves. The machine is driven by a 15-hp., 1,500-r.p.m., squirrel-cake motor belted to the lathe and equipped



COMPENSATOR DOES NOT OCCUPY ANY WORKING SPACE

with a belt tightened on the side farthest from view. Stopping and starting is effected by means of push-buttons which operate the automatic compensator shown to the right of the motor.

ALEX. H. MAY,
Works Engineer.
Canadian Products Division of General Motors Co.,
Walkerville, Ontario.

Selecting Electric Locomotives for Metal Mines

IN MANY cases the selection of a locomotive for use in a mine is rather a simple matter, more especially when the tonnage is small and the distance short. In some of the larger copper mines, however, trains of 500 to 600 gross tons are handled and the ton-miles will often be approximately 200,000 per month. Under these conditions the selection of haulage equipment is not such a simple matter. The tunnels are usually sufficiently high to maintain the trolley above the height of a man's head. On the other hand, they are usually more narrow than in coal-mine practice. Track gages run from 18 in. to 36 in. as a rule. This calls for a higher and narrower type of equipment.

Equipment is naturally limited to manufacturers' standards with limited special features. The types offered are mainly rugged machines well adapted to the abuse and severe operating conditions which they are bound to receive. If the conditions of operation are carefully considered, the duty calculated, and the conditions of accessibility for repairs, liberal size of wearing parts, motor capacity and lubrication are studied, very satisfactory results can be attained. The selection of a locomotive for particular requirements is largely dependent on conditions not under the control of the electrical department, and a locomotive must be selected to meet these conditions. In all cases future requirements should be considered.

Battery Locomotive Gaining Favor in Metal Mines

The trolley and the storage-battery types are the only types which have found much favor in metal mines. The selection of the particular type is largely a matter of judgment. The trolley locomotive is probably the most popular, although it is rapidly being replaced by the storage-battery type on the lighter hauls. For heavy, long, main-line transportation the trolley locomotive apparently offers the cheapest over-all cost of all of the means of locomotion. It can also be used to advantage on such branch lines as offer sufficient tonnage or permanency to warrant the installation of trolley wire and bonding. The storage-battery type is very useful in cases where the tonnage is small, the distance short, and for following up development work, even though a trolley may be installed in the new drifts when completed.

Standardization on a few types and sizes will frequently result in savings from interchangeability and will expedite repairs. In this double or triple heading of similar units for increased draw-bar pull will give a considerable range while retaining interchangeability of parts. A compromise between standardization and exact size will often be found to bring the most satisfactory results when the haulage conditions vary considerably on one property.

For light, short hauls the problem does not require a full investigation of all the details, but for important installations the general factors should each be considered in detail. The primary factors to be considered are tonnage distance, time, grades, car friction and car capacity. The secondary factors are curves, track weight, track condition, wind resistance and tunnel clearance. For any given problem some one or more of the secondary factors may become a primary or even a determining factor. Tonnage, distance and time in most cases will be the conditions around which the haulage systems will be designed. The grades encountered usually cannot be remedied in old work but should be carefully considered in planning new haulage ways. The gradient of equal traction can be calculated and will result in a minimum power consumption. The motors will heat more, however, as the current will be the same for both loaded and empty trains. Car friction and car capacity are inherent in the design of the cars and should be made as favorable as possible. In general, the largest cars available will give the lowest costs, other things being equal.

Curves in mining work are ordinarily short and of small radius, but when possible a minimum radius of 50 ft. should be adopted. Where curves are frequent and close together their effect on train resistance may be serious. Under ordinary conditions with well-laid-out curves the resistance will be a negligible factor. Track weight and condition will tend to increase the rolling friction, but the most serious effect is on maintenance costs. On main haulages a heavy rail on a well-ballasted roadbed will rapidly repay the difference in first cost in lowered upkeep costs of cars, locomotives and track. It is almost impossible to keep track smaller than 25 lb.

EFFECT OF CAR-SIZE ON ENERGY CONSUMPTION FOR A TYPICAL HAULAGE PROBLEM

250 tons to be hauled an average distance of 1,600 ft. Storage-battery locomotives to be used. Average speed, 4 miles per hour. Tunnel size limits the car capacity to 3½ tons. Grades level. Loading from chutes. Cars available, 1 ton and 3½ tons

	1-Ton Cars	3½-Ton Car
Total cars hauled	250	72
Cars per train	20	7
Loading time per train, minutes	15	7
Running time per round trip, minutes	10	10
Dumping time per train, minutes	10	7
Total time per round trip, minutes	35	24
Number trips required	13	11
Actual working time for 250 tons	7 hr. 25 min.	4 hr., 24 min.
Car friction, lb. per ton	30	20
Weight per car empty, lb.	1,500	5,000
Weight of empty train, lb.	30,000	35,000
Weight of ore in loaded train, lb.	40,000	49,000
Weight of loaded train, lb.	70,000	84,000
Weight of locomotive, lb.	6,000	6,000
Total weight of loaded train, lb.	76,000	90,000
Necessary draw-bar pull for loaded train, lb.	1,040	900
Coefficient of adhesion, per cent	25	25
Draw-bar pull of locomotive, lb.	1,500	1,500
Maximum kilowatt input at motors	15.1	11 9
Kw.-hr. per day consumed by motors	33 2	22 8
Kw.-hr. delivered to motor-generator per day	83	47
Power cost per shift, at 3 cents per kw.-hr.	$2 49	$1 41
Ton miles per shift	75	75
Kw.-hr. per ton-mile	1 1	0 63



PANTAGRAPH-TYPE LOCOMOTIVE USED BY ARIZONA COPPER COMPANY FOR MAIN HAULAGE

in proper alignment with frequent motor traffic. Wind resistance in the ordinary haulage at low speeds will be a negligible figure, but with the advent of mechanical ventilation systems using the main haulage ways as air ducts it may call for serious consideration. The ordinary formula for wind resistance on moving trains in the open will probably not give correct results, as the action will more nearly correspond to a piston effect, with the main pressure on the first car and a decreasing effect toward the back of the train. Tunnel clearance will determine the limiting size of the locomotives and cars.

As an example of the influence of some of these points the example given in the table will be of interest. It is evident that in this case the tonnage is too great to handle with the 1-ton cars, while it could be very readily handled with the 3½-ton cars. The power consumption will also be less with the larger cars. This is due to



SEVERE SERVICE REQUIREMENTS MUST BE MET BY MINE-TYPE ELECTRIC LOCOMOTIVES

the ratio of total load to the weight of the empty car, to the difference in the car friction and to the increased number of trips. These differences are more marked as the car size is increased, but this example was introduced to show that even on a small tonnage it is well to examine the conditions. The labor cost is about uniform per train; thus the operating labor per ton mile varies inversely with the tonnage per train.

The most widely used voltage is 250 volts, direct-current, although voltages as low as 125 and as high as 600 have been used. The 250-volt lines will cover a large territory with reasonably small feeders if the drop is proportioned somewhat in accordance with traction practice. The load is very intermittent, and it will usually be economically impossible to provide enough copper to keep the drop less than 20 per cent at times of peak load. This does not interfere with starting a heavy train and gives fair regulation at lighter loads. The matter of safety is largely dependent on the care used in the installation of the trolley wire and in the methods used in the protection of the circuits. Where the miners are used to handle the trolley installation they become careless and will not take sufficient precautions to avoid accident. Where the electrical forces make all changes in the wiring the other departments gain a respect for the wires which has a good effect in reducing the accidents from accidental contact. The cost of installing underground trolley with present material and labor costs should not exceed 40 per cent per foot of drift. The cost of bonding is largely dependent on the type and size of bonds used, but should not exceed 10 cents per foot of drift with any of the bonds commonly used in this class of work. While the total of 50 per cent per foot of drift may appear somewhat high, it calls for a very high grade of work upon which the maintenance cost is very low. Where this grade of work is done the trolley maintenance is usually such a small item that it is not separately calculated in the cost accounting. Maintenance work cannot be entirely eliminated as the greater portion is caused by alterations in tracks, timbers or source of ore supply, or by accidents due to falling rock or to broken timbers. These are beyond the control of the electrical department. In general, the better class of material will, if properly selected, give the greater salvage when the drift is abandoned.

Good Brakes Essential to Safe Operation

Proper brakes are essential to expeditious handling of trains. For small units and light trains, on fairly level track, hand brakes will usually suffice. When the locomotive weight required exceeds 8 tons or 10 tons or when excessive grades are encountered little is gained by depending on hand brakes. Under ground a brakeman cannot handle more than two cars, and these must be placed in proper position in the train. The locomotive brakes are slow to apply and release. The general tendency is to run with the brakes dragging, which tends to heavy repairs of brake shoes and wheels and also heats the motors. A straight air system on the locomotive will prove an economy in operation and will tend to increase the amount of work done per locomotive. In the case of heavy trains, 300 tons or more gross, it is well to use automatic air with air brakes on at least a portion of the cars. For medium grades it is not necessary to equip all of the cars with air brakes. A few can be so equipped and the rest furnished with train lines and hose connection only. In such cases it is well to distribute the cars equipped with brakes throughout the train rather than allow them to be bunched together.

A number of different types of collectors have been used in mining work with varying degrees of success. The trolley pole and wheel trolley are quite generally used and are the only practicable type where the trolley wire is placed at the side of the drift or where it is necessary to trough the wire. They have the disadvantage that somewhat greater care is necessary in the alignment of the wire and in the setting of frogs. The pole must also be turned when the motion is reversed. Under conditions where the wire is in the center of the track and overhead clearance will permit the pantagraph with a sliding collector will give better results. A longer life can be obtained for the wire, as the sparking and burning are virtually eliminated. The pantagraph is reversible, and no trouble is encountered from wheel flats, bearing or harp wear or from un-

balanced wheels. The wear plates are cheap, have a long life and are readily renewed when worn.

Oil and waste lubrication have given the best results on axle bearings and are quite generally used on armature bearings. Some of the newer types are offered with ball bearings for the armature shafts and have proved quite satisfactory. Many of the older types, designed for grease lubrication, can readily be converted to oil and waste lubrication with a considerably increased life of bearings. Gears should be inclosed and run in oil, or a suitable pinion grease should be applied in sufficient quantity to allow the lower portion of the gear to pick it up and carry it to the intermediate gears or pinion.

The frame should be of sturdy construction, motors of ample size to accomplish the desired work without undue heating, and the control equipment simple with current-carrying parts of ample size.

El Paso, Tex. T. H. ARNOLD,
Formerly Electrical Engineer Arizona Copper Company.

Factors to Investigate Before Installing Motor Drives

BEFORE installing motors in industrial plants a complete analysis of conditions is called for. The application of electrical drive involves the proper combination of motor, controller and driven machinery. Therefore the characteristics of all three elements must be studied, together with the other features of each installation. A number of questions which must be answered before the type of equipment can be determined are given in the following list suggested by L. H. Adams, General Electric Company, at a meeting of the Engineering Society of Western Massachusetts:

CONDITIONS DETERMINING KIND OF MOTOR AND CONTROL EQUIPMENT NEEDED

1. Alternating or direct current available?

2. Voltage and frequency (if alternating current)? Possible variations in same?

3. Capacity of generating station and lines? Other load on systems? (This information is required for determining effect of starting.)

4. Description of machine to be driven? Continuous or intermittent service? Can intermittently operated machines be arranged to operate not simultaneously? Limited speed?

5. Method of Drive.—Group or individual? Direct connection? (Size of coupling, rigid or flexible, insulated? Shaft extension, sub-base, etc.?)

Belt Drive.—Size of pulley, distance between pulleys, outboard bearing, belt tightener?

Chain Drive.—Size of pinion?

Gear Drive.—Size of pinion?

Friction Drive.—Is motor to be started light and clutch thrown in when motor is up to speed?

6. Load Conditions.—Continuous? Cycle duty, in which a definite cycle repeats itself with more or less regularity, the machine stopping between each cycle? Varying-load duty, in which more or less definite cycles are repeated but motor runs continuously? Load diagram required during a complete cycle of operation. (This gives maximum horsepower, length of time load is on, time off and friction load.) Can any parts of cycles be varied with benefit? Variation in load caused by change of conditions, such as decrease in the head on a centrifugal pump. Allowance must be made in the motor size to take care of such contingencies.

Future Conditions.—Is it possible that the load on the motor may soon be increased? Motor speeded up? Flywheel effect required?

7. Starting Conditions.—Frequent starting, stopping or reversing? Number and time off? Time of acceleration? Does load on motor increase as it comes up to speed?

8. Speed.—Is close speed regulation essential? Constant speed? Adjustable speed? Multi-speed? Speed range required? At reduced speed is horsepower output reduced in proportion to speed (*i.e.*, constant torque)? If not, give the proportion.

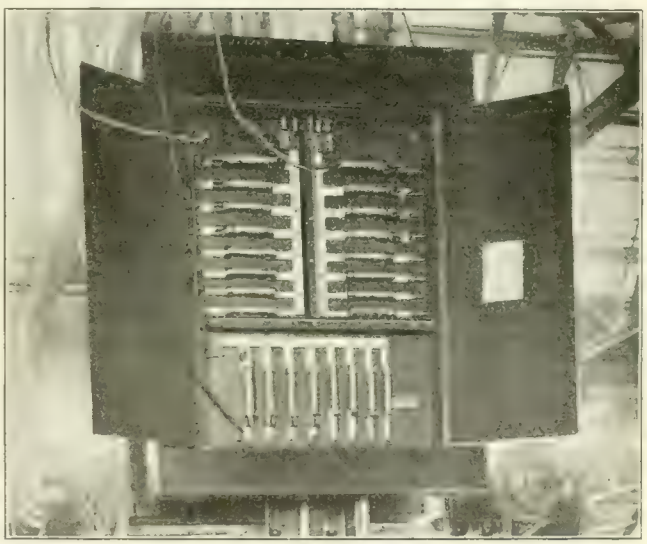
9. Control.—Hand or automatic? Remote? Overload or under-voltage release? (Time setting?) Limit switches? Brakes (mechanical or electrical)? Stopping of large motors?

10. Conditions of Location.—Dust, moisture, acid fumes, inflammable material, high temperature, etc.? Ventilation? Space conditions (method of mounting motor, access for repairs, etc.)? Safety arrangements? Insurance rules?

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD

Compact Panel Box for Three-Phase Branch Circuits

A DISTRIBUTION panel only three-fourths the size of ordinary three-phase panelboards is employed on the 550-volt power circuits in the shops of the Canadian Products Division of the General Motors Company, Walkerville, Ont., Canada. The panel is divided into three parts, as shown in the photograph, with barriers separating the parts. In each section are fuses connected to only one phase of the three-phase



THIS ARRANGEMENT OF FUSES AND BUSES SAVES 25 PER CENT OF PANEL SPACE

lines. The arrangement permits the length of the cabinet to be reduced by 25 per cent while maintaining the same width as the regular standard panel. The cost is therefore less than that of the standard panel. Moreover, the fuses may be removed with greater safety, as all adjacent live parts are of the same phase. This eight-circuit panel is arranged so that three circuits can be fused up to 100 amp. and five circuits up to 60 amp. To change the rating of a circuit all that is necessary is to remove two screws and change the fuse clips. By special permission the bottom of these panels has been mounted 6 ft. (1.8 m.) from the floor, as shown, so that they do not take up any of the manufacturing floor space. Small stepladders kept at convenient points around the plant are used to reach the panels when necessary. L. A. BLACKBURN,
Operative Engineering Division.
Dupont Engineering Company,
Detroit, Mich.

Proper Care of Electrically Heated Oil-Tempering Baths

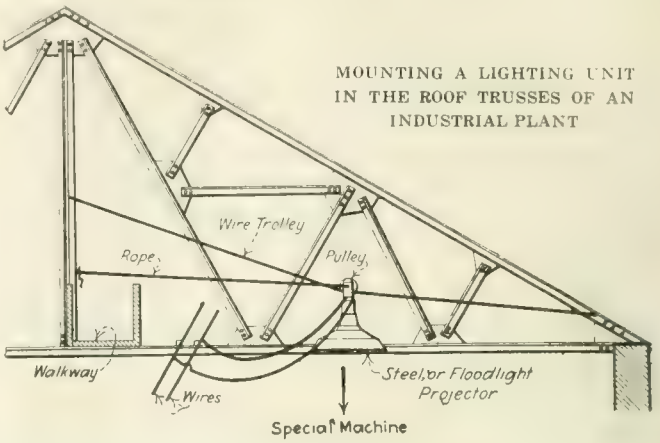
FIVE electrically heated oil-tempering baths are in service at the factory of Pratt & Whitney, Hartford, Conn., and experience has developed the following maintenance routine: The tanks are about 24 in. x 24 in. x 14 in. and will hold about 600 lb. of steel. They have six 220-volt heating elements each. At first some trouble was experienced in keeping the electrodes clean and in washing the oil off the work treated. Every five or six weeks the oil is all taken out of the bath after standing over Sunday or for a similar length of time. The oil is allowed to settle so that the charred oil will fall to the bottom of the bath, whence it is removed as carefully as possible to avoid churning. The carbon sediment can be removed with the loss of only an inch or so of oil. The oil can be strained and used over again if necessary, tending to prolong the life of the heating units.

Every three or four months the electrodes are cleaned from carbon deposits. This is done by removing the heat units, taking out the oil and wiping the tank clean. The heat units are then put back into the empty bath. The switch is closed, the bath being watched, and as soon as the electrodes become red hot the switch is opened and they are allowed to stand. After a minute or so, if the oil does not flash, current is again applied as before, being shut off when the electrodes become red. Should the oil flash, it is customary to let it burn until the fire dies out. Then current is turned on again until the units are red hot to dry up the residual carbon sediment and moisture. After this, the current is again cut off and the bath is allowed to stand until the electrodes can be handled. These are then disconnected, the panel is removed from the bath, and all remaining dirt left on the units is brushed or blown off. About thirty minutes is required for the proper cleaning of electrodes.

C. T. HATHAWAY,
Pratt & Whitney, Hartford, Conn. Electrical Dept.

Local Lighting by Lamp Suspended on Pulley

FOR lighting an area over which a lamp and reflector cannot be mounted in the usual way some mills use a lamp suspended on a rope by means of a pulley, such as that shown in the accompanying drawing. In the case illustrated the lamp could not be mounted below the trusses on account of coming in the way of a traveling crane. Consequently, a pulley was attached to the unit and the entire outfit was hung on a wire trolley rope fastened to the roof girder and to the center girder of the building. The unit is allowed to run out by gravity to the best location for illuminating the work on the floor, and it is held in this position by means of a rope. When it is desired to clean the unit it is pulled up to the walkway shown, where it can be handled without any trouble. Connection is made to the branch feeder by means of two flexible leads. In place of the R. L. M. dome reflector, one plant employs floodlight projectors for concentrating the light. Standard "Mazda C" lamps are used, since the concentrated filaments of the floodlight lamps are unsuited to burning with the tip downward. The development of an extension metal sleeve applicable to small floodlight projectors now enables these units to accommodate the standard large "Mazda C" lamps, and while these do not give so close a concentration, they may be used in any position and therefore have a wider field of application in factory and mill lighting. In addition to the applications mentioned, such a floodlight unit when mounted on a crane where it can be adjusted by the operator may be used



MOUNTING A LIGHTING UNIT IN THE ROOF TRUSSES OF AN INDUSTRIAL PLANT

to illuminate an object that the crane is to pick up or to spot the place where a heavy casting is to be deposited. Such a unit forms an excellent supplement to general overhead lighting.

SAMUEL G. HIBBEN,
Consulting Illuminating Engineer.
Westinghouse Lamp Company,
Bloomfield, N. J.

Vibration from Two Air Compressors Eliminated by Balancing

EXCESSIVE vibration of a substation in a New Jersey shipyard caused by two air compressors was eliminated by balancing the vibrations of one against those of the other. These compressors were driven by synchronous motors, and the balancing was accomplished by making them run so that the piston in one pump was at all times moving in the opposite direction from that in the other.

Although vibration may be caused by compressors operating in substantial buildings, it was especially annoying in the case mentioned on account of the fact that the building was supported on 40-ft. piles driven in filled-in land. It was necessary to fill in this swampy land to provide space for ways, shops and storage owing to the rapid increase in production facilities needed in this yard during the war. The building was a substation containing two 250-kw. rotary converters and two direct-connected air compressors, driven at 180 r.p.m. by two 450-hp. synchronous motors. The vibration caused by the operation of these compressors was so great that the entire building and the surrounding ground vibrated noticeably. Various remedies were suggested, but none of these seemed to be practicable. The shutting down of the substation was under consideration until the engineer in charge decided to balance the stroke of one machine against that of the other.

To carry out this plan an electrical contact was placed on the shaft of each compressor, and the two were connected in series with a bell so that the bell would ring when the respective pistons were moving in opposite directions. One machine was started and thrown on the line and then the other was phased in when the bell rang. Once the machines were started in opposition, they remained in this relation as the synchronous motors kept in step. This balanced the two compressors against each other and the vibration was totally eliminated.

West Collingswood, N. J. L. C. BEATY.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

National Good Will for Electric Utilities the Aim of the N. E. L. A.

NATIONAL good will for the electric light and power utilities has been the goal of the major new activity of the National Electric Light Association during the current administration. A comprehensive program for bringing this about has been built up and as rapidly as possible is being put into operation. This naturally takes the form of a national publicity campaign which has a number of tie-ins.

Member companies have given their hearty support to the campaign and have sent out millions of pieces of literature prepared by the association publicity department. The interest of investment bankers, public utility commissioners, insurance men and others has been secured. The Investment Bankers' Association of America has adopted resolutions favorable to public utilities as a direct result of the activities of the association. The National Association of Railway and Utilities Commissioners has been advised of the activities of the association and the members have expressed their belief in and approval of those activities. Articles have been printed by popular magazines and other and similar articles will be forthcoming.

6,600,000 Kilo Watt Pamphlets

"Kilo Watt" pamphlets to the total number of more than 6,600,000 have been ordered and are being sent out by member companies to their customers. These pamphlets were prepared with a view to interesting users of electricity in some of the problems of the electric light and power industry, the first series being devoted to preparing an approach, and the second series which is to follow being designed to deal with the most important questions now before the electric light and power companies, such as taxation, regulation, finance, etc. Approximately four hundred thousand "Facts Every User of Electricity Should Know" and two hundred thousand "Everyday Electrical Terms and Usage" pamphlets also have been ordered and are being distributed by member companies. A series of investment pamphlets was prepared and two hundred and fifty thousand of these have been ordered.

The preparation and sending out of pamphlets has been but a small part of the publicity program. The publicity department of the N. E. L. A. has taken the lead in the organization of state committees on public utility information throughout the country. Eleven states already have been organized with committees or bureaus composed of representatives of all classes of public utilities, and having for their purpose the dissemination of facts and figures regarding public utility development, and present-day and future problems of the utilities. The organization of similar committees is practically assured in nine additional states, utility men in several other states evincing considerable interest.

Realizing that the development of the entire electrical industry depends primarily upon the prosperity and development of the electric light and power industry, the N. E. L. A. has been working toward a co-operative campaign in which manufacturers of electrical machinery, equipment and supplies would publish with paid advertisements in popular magazines, newspapers and trade journals, supplementing a direct advertising campaign by the association. The association's own direct advertising campaign will begin Feb. 19 with a half-page advertisement in the *Saturday Evening Post*. Twelve similar advertisements will appear in subsequent issues of the *Saturday Evening Post*. Considerable electric light and power company goodwill advertising already has appeared over the names of the G. & W. Electric Specialty Company, the Western Electric Company, the Electric Storage Battery Company, the Jeffery-Dewitt Insulator Company and the Anaconda Copper Mining Company. Many light companies have asked for proofs of these advertisements, to be posted about their plants and to be utilized in various other advertising ways.



M. H. AYLESWORTH
Executive Manager N.E.L.A.

Reprints for Local Advertising

In connection with the association's direct advertising it is arranging to have the advertisements printed on posters twice the size of the original advertisement, and these posters will be sent to all member companies for use in their windows on billboards and elsewhere. Also, these advertisements are being reproduced in matrix form for paid advertisements in newspapers, the advertisements to be two columns wide and 10½ in. deep. These advertisements will be placed and paid for by the local electric light and power companies whenever used.

In addition to the above, member companies are being urged to inaugurate and carry on continuous advertising campaigns in their local newspapers as a part of the program to educate the public to the fact that the progress and prosperity of the electric light and power industry are absolutely necessary to the continued progress and prosperity of any community and of the country as a whole.

There are other phases of N. E. L. A. work which are of comparatively recent origin and which are of considerable importance. In addition to the very extensive

committee work which has been carried on throughout the years of the association's existence, the program includes specialization in engineering through the engineering department, which is directly under the Technical Section, and the work of which includes such important matters as inductive interference, safety rules, standardization, etc.; specialization in accounting and in furnishing statistics and detailed information through the service department, which co-operates with the Accounting Section, and the work of which includes the preparation of a uniform classification of accounts, and assistance to the Federal Power Commission in the preparation of an accounting system. Rate research and the rate book have been brought to national headquarters, and, under the direction of the standing committee on rate research, improvements are being made and an active campaign for increased circulation and more general usefulness is now being conducted. The N. E. L. A. is taking a more active interest and part in the work of the American standardization committee, and there are many similar activities being conducted through the departments.

Facing a period of temporary depression, the Commercial Section is bending every effort to stimulate commercializing of electrical energy and appliances and predicts a return to normal in this branch of the electrical industry in the very near future.

Division of the country into geographic sections naturally means the intensive development of the work of the N. E. L. A. in each of these divisions. Instead of the work being centralized at national headquarters it is to be carried on simultaneously throughout the country in the twelve divisions, and, so far as applicable to conditions there, also will be carried on in Canada simultaneously.

A department of lighting recently has been established, and the industrial lighting exhibit will be demonstrated in many of the principal cities of the country. Demonstrations already have been held during the last few months and an itinerary has been skeletonized and is being completed rapidly.

As a result of the increased activities of the association during the year, 110 new electric light and power companies have been added as class A members and there have been no resignations.

Indiana Rules Governing Rural Electric Service

THE rules and standards of electric service for electric utilities issued by the Public Service Commission of Indiana, under Rule 32, provide the following requirements governing rural service:

Extension of Lines for Rural Service

(a) *Definition*.—A rural consumer is one whose premises are without the corporate limits of a municipality and one requiring an investment per consumer's unit demand greater than is ordinarily required for consumers within municipalities.

(b) *Cost of Service*.—Rural consumers may have electric service, provided they will compensate the utility for the fixed and operating costs of the service.

(c) *Rates*.—Rates must not be discriminatory, and because greater investment is required per rural consumer's unit demand and greater line loss is suffered in rural distribution than with municipal consumers the rate should be higher for rural service than for service in the utility municipal area. All consumers must bear their fair share of the utility's expenses, some of which may be enumerated as follows: Interest on investment, depreciation, taxes, insurance, general office and officers' expenses, operating labor and supplies, maintenance, coal, meter reading, accounting and collecting, etc.

(d) *Form of Rate*.—The rate shall consist of two parts: (1) A "minimum bill" partly to cover the fixed charges; (2) an "energy charge" to cover the operating costs of generating, transmitting and distributing the electric current.

(e) *New Consumer*.—A new consumer proposing to take service from an extension paid for by a group of consumers shall share in the cost of the extension.

(f) *Guarantee*.—The utility may require of the prospective consumer a satisfactory guarantee that he will fulfill all the obligations made by him to the utility.

(g) *Safety*.—Safety in construction and maintenance is essential. Divided ownership and responsibility are not good public policy, and the construction of electric lines by inexperienced persons or companies is discouraged.

(h) *Acquisition of Lines*.—To the end that safety and uniformity may be obtained in the rehabilitation and maintenance of electric lines the utility may acquire lines owned and constructed by others.

Duties of Commonwealth Edison New Industrial Relations Department

THERE has recently been established in the organization of the Commonwealth Edison Company an industrial relations department, which is specially charged with the promotion of the well-being of the employees of the company and harmonious relations between the employees and the management. This department is headed by a manager of industrial relations, who reports directly to the president, except upon special occasions, when upon the written direction of the president, to be given on each occasion, he will report to an executive council made up of the vice-presidents.

One of the general duties of the manager of industrial relations and his department is to supervise in an impartial manner, as between the management and the employees, the development, introduction and operation of an employees' representation plan.

The manager of industrial relations has the administrative responsibility for developing and carrying out a comprehensive personnel and employment policy in the company service and for the management of the units of the company organization performing functions of personnel administration. He is also responsible for co-ordinating the work of these units of organization and the personnel activities of company committees and employees' associations. The functions of the management concerning the employees which have been delegated to and centralized in the industrial relations department are (1) employment, (2) health, (3) safety, (4) education, (5) welfare, (6) employee-management relations.

The position of dean of women in the department of industrial relations has also been created. The dean of women is charged especially with the duty of promoting the well-being and the representation of the women employees. She reports to the manager of industrial relations on all matters, but is free to take up directly with the president any matter relating to women employees or women applicants for positions. A separate office for the dean of women is maintained in the industrial relations department, and any woman employee or applicant has free access to the dean of women for confidential interviews.

The following heads of departments report to the manager of industrial relations: Superintendent

employment bureau; chief surgeon, in charge of the medical department; inspector of safety and fire prevention, in charge of the safety bureau; supervisor of lunch rooms and recreation rooms, and superintendent accident liability department, in reference to all matters of employees' compensation.

The company's co-operation with the Commonwealth Edison Mutual Benefit Association is under the direction of the manager of industrial relations, and the administrative force of the association provided by the company reports to the manager of industrial relations. The services of the Central Station Institute in connection with the education and training of the employees of the company will be under the general direction of the manager of industrial relations.

The manager of industrial relations co-operates with the following committees and their respective subcommittees which deal with personnel matters: The budget and expense committee, the advisory committee, the employees' savings fund committee and the service annuity committee. He also co-operates with the Edison Club in reference to all its activities, including the Electra, the Edison symphony orchestra and the publication of the *Round Table*.

Thrift Pamphlet to Promote Sale of Utility Securities

"SAVE with a Smile" is the title of an interesting pamphlet that is being distributed by H. M. Byllesby & Company, designed to arouse interest in thrift and systematic saving and in this connection call attention to the value of the company's securities for investment or saving purposes. Each page of the booklet contains one or more quotations from famously successful men on the value of saving or thrift. The first chapter is entitled: "Why We Should Save." Others are "Thrift," "Compound Interest," "Investment," "An Easy Way to Save and Invest" (the Byllesby partial-payment plan), "How to Judge an Investment," "Why This Is the Greatest of All Times to Save," and a final chapter on "Byllesby Sponsored Securities." A feature of the booklet is a compilation showing how rapidly wealth accumulates when certain sums are saved regularly and invested semi-annually at 7 per cent.

Sales Campaigns a Valuable Part of Merchandising Policy

THAT campaign methods are a valuable adjunct to the merchandise sales program of a gas or electric company was emphasized in the recent report of the sales campaign committee of the American Gas Association. From a survey of eighty-eight companies the committee found that 80 per cent have conducted campaigns in the past and 20 per cent have not. However, of this 20 per cent virtually all were small companies having no sales force. Of the companies which have conducted campaigns 89 per cent considered them successful, 10 per cent considered them unsuccessful and 1 per cent were non-committal. In general those companies which were not successful in their campaigns were small companies, although in one or two cases the reason given for their failure was that the campaigns were handled improperly by a special crew furnished by an outside company.

Typical opinions of the results obtained with campaign sales methods are given in the following expressions from several companies: "Sales campaigns stimulate and increase sales." "They bring to the attention of the public appliances about which they know little." "They increase sales." "They create good will." "They replace with new appliances those which are worn out and antiquated." "They add new customers." "They make selling easy." "They can be conducted successfully on a profitable basis." "The combined efforts of salesmen and advertising in the promotion of sales of seasonable appliances always produce great results."

Willful Destruction of Electrical Apparatus a Menace to Public Safety

MISCHIEVOUS breaking of insulators by stones thrown by boys caused shutdowns of from four to ten minutes on the light and power system and twenty minutes on the railway system of the British Columbia Electric Railway of Vancouver, B. C., as well as the Western Power Company on Dec. 20. Short-circuiting of the high-tension lines threw a surge onto the other circuits and caused the interruption, which occurred at 2 o'clock in the afternoon while the streets and stores were filled with Christmas shoppers.

Why the Power Went Off

The British Columbia Electric Railway regrets the shutdown of electric power on its and the Western Power Company's whole system yesterday afternoon.

The cause was the mischievous breaking of ten insulators on high-tension poles in North Vancouver by boys, according to the evidence available.

As a result, light and power circuits were out four or more minutes, depending upon the district, and the railway lines up to twenty minutes.

Such willful destruction of electrical apparatus, on which the life of the community depends, is punishable under the criminal code, because the cessation of electric current for a moment is liable to cause death (in hospitals), injury to person and loss and destruction to property.

We take this opportunity to acquaint the public with the circumstances surrounding this case, in order that they may co-operate in safeguarding the public service and preventing any recurrence of such criminal interference with the service on which the community relies.

British Columbia Railway Company

STATEMENT ISSUED EXPLAINING SERVICE INTERRUPTION

To explain the situation to the public and call attention to the dangerous consequences of malicious destruction of electrical apparatus the company issued the accompanying statement in the daily newspapers. It is also offering a reward for the arrest and conviction of the persons causing the damages.

That there was no more serious result attending the interruption than the inconvenience to the public is indeed fortunate. Throwing stones at insulators or using them for target practice has long been a favorite pastime, and—more is the pity—the mischievous small boy is not the only offender. Fatal accidents have been caused by various kinds of tampering with transmission lines and their appurtenances. Legislation, warning signs and safety rules are all designed primarily to protect the human being against himself, yet there is a type of individual who will not learn until it is just too late.

Power companies have "gone" the limit to make their apparatus safe and as far as possible foolproof, and they are not responsible for the person who deliberately contributes to his own destruction.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

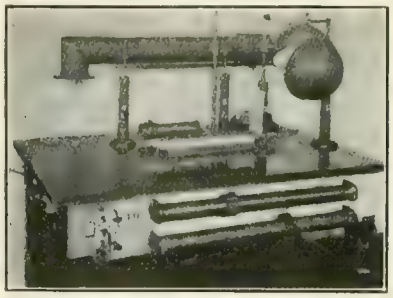
Efficiency of Adjustable-Speed Motors.—R. W. OWENS.—The author enumerates the common methods of speed control for direct-current motors and alternating-current motors. He states that although it is impossible to give data for the effect on efficiency of speed variation which would be applicable to all types of motors, it is possible to arrive at a few simple rules for estimating with fair accuracy the efficiency for any change of speed of any motor.—*Electric Journal,* January, 1921.

A Large Converter.—P. HARTIG.—Lack of space prevented the Peiner rolling mills (Germany) from installing several needed synchronous converters, and a special converter therefore was built which is rated at 5,000 kw. on the direct-current side. The machine has twenty-eight poles and makes 215 r.p.m. It is capable of delivering 9,600 amp. direct current continuously at 520 volts. A 265-kva. induction regulator on the input side provides means for regulating the voltage. The machine is started by means of a 165-kw. direct-current motor. The converter is provided with interpoles, compensating windings, etc., and many other refinements are features of the design. To prevent accidental runaway, the machine has two tachometric dynamos. One of these starts a siren whistling when the speed exceeds normal by more than 5 per cent, and the other dynamo operates tripping relays, so that the converter is disconnected on both the alternating-current and the direct-current side if the speed rises 12 per cent above normal. The over-all efficiency of this converter is about 94 per cent, as against 81 per cent reached by the 970-kw. converters installed earlier at the plant. At an average load of 4,000 kw. the converter thus saves about 4,900,000 kw.-hr. a year. The big converter, asserted to be the largest in the world, was built by the Siemens-Schuckert works, and another converter of just the same type has recently been ordered from the same concern.—*Stahl und Eisen,* 1920, page 845; also *Elektrotechnische Zeitschrift,* Oct. 21, 1920.

Lamps and Lighting

Pleasing Proportions of Direct and Diffused Light from a Floor Lamp.—J. R. CRAVATH.—This paper gives the results of preference tests on twenty-five observers as to the most pleasing proportions of direct and diffused light from a floor lamp under certain specified conditions in a given living room. Curves and tables show the range of illumination and brightness offered and the proportions preferred, also the distribution of the light flux about the lamp with the most popular proportions. —Paper presented at the convention of the Illuminating Engineering Society, Oct. 18, 1920.

Commercial Photometry.—A. L. POWELL and J. A. SUMMERS.—The authors believe that distribution curves of lighting devices or the results of photometric tests are often misinterpreted. They point out some of the features frequently overlooked. The selection of equipment for tests and some of the diversified factors in illumination problems receive careful consideration. It is pointed out, furthermore, that there are many phases of light measurements which do not come under the category of laboratory methods and which only come to the attention of the investigator through actual experience. Several of these features are briefly discussed. —*Bulletin L.D.-122, Edison Lamp Works,* October, 1920.



A 12-IN. (30-CM.) SPHERE PHOTOMETER FOR TESTING MINIATURE AND LOW-WATTAGE LAMPS

Generation, Transmission and Distribution

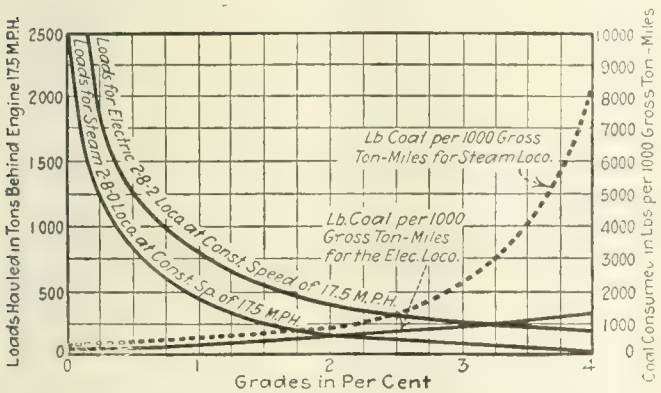
The Switchgear Problem in the Power House.—R. A. R. BOLTON.—The proper arrangement of the main wiring and equipment in the generating plant is considered in connection with typical plant connections. The author then discusses the insertion of current-limiting reactors to reduce the effects of short-circuit currents. —*English Electric Journal,* October, 1920.

Water Power in Germany.—The necessity to save Germany's coal supply has given much impetus to old and new plans for utilizing the hydraulic power available in German rivers and streams. Quite in line with the general political situation is the tendency toward a "socialization" of the electrical power industry. On the last day of December, 1919, a bill of the most far-reaching consequences was passed. This bill gave the national government the power and right to use or take over, at a "fair" price, all plants used for the interconnection of power stations and for transmission of electric energy at a tension of 50,000 volts or more, and all privately owned generating plants with an installed machine capacity of 5,000 kw. or more, except those used almost exclusively to supply the needs of the owners themselves. In certain other cases the government received the right to require that the ownership of plants be transferred to semi-official companies with the government as a shareholder. The original owner of the plants then receives his compensation in the form of shares in the new company. In an article in the *Elektrotechnische Zeitschrift,* Sept. 23, 1920, Sympher discusses the consequences of the electric power bill and also deals with some questions bearing upon the relations between hydraulic power development and internal waterways. The tendency is to combine canal and power interests in the hands of state-backed companies. The return from a hydro-electric development thus may be made to carry a canalization project which is by itself economically impossible. An example is the Neckar Canal, where the shipping business according to estimates would run with a clear loss of 3,400,000 marks

a year, while the net income from sales of electric energy, made available by a complete hydraulic regulation including canalization would be 6,600,000 marks, giving a net income of 3,200,000 marks for the combination. The work on such a combined development is to be started immediately, and the national convention already has forwarded 10,000,000 marks for the first year's expenses. Sympher, in the article referred to above, also describes a great number of similar projects concerning the Rhine, Main, Isar, Inn and other rivers in Germany. The technical difficulties in dealing with large quantities of water at low heads are discussed by Block in the *Elektrotechnische Zeitschrift* of Sept. 30, 1920. The new Kaplan low-speed turbine is said to be of great importance for low-head developments. If used in connection with herringbone drives with ratios up to one to seven, it permits the use of generators with a reasonable number of poles. In a report to the national convention Koehn has estimated the available twelve-month power in post-war Germany at 350,000 kw., the nine-month power at 890,000 kw. and the six-month power at 1,200,000 kw., while he considers a total installment of 1,700,000 kw. necessary for a complete utilization of all hydraulic resources. Halbfass, in the *Elektrotechnische Zeitschrift*, Oct. 7, 1920, quoted these and other figures from Koehn, adding the remark that the Koehn estimates appear to be 25 per cent too low.

Traction

Electrification of the Indian Railways.—A paper which enumerates the advantages of electrification of



REDUCTION IN HAULING CAPACITY OF STEAM LOCOMOTIVES ON HEAVY GRADES ENTAILED BY INCREASING SPEED TO 17.5 M. P. H.

	Steam Locomotive	Electric Locomotive
Total weight, tons	117.7	89
Adhesive weight, tons	63.1	63

Indian railways, including a comparison between steam and electric locomotive performances. — London *Engineer*, Nov. 26, 1920.

Electrification in East Prussia.—Under the name of Oestpreussische Aktien-Gesellschaft a public service company has been formed for the immediate and systematic electrification of the province East Prussia. The company proposes to build two hydro-electric plants in the lower part of the River Alle, about 55 km. (34 miles) from Königsberg. One of these plants will be operated as a top station with 10,500 kw. maximum capacity, at a maximum head of 14 m. (46 ft.), and the other will be run continuously at a maximum head of 6.5 m. (21 ft. 4 in.), developing 1,700 kw. Both plants are to be interconnected with the 15,000-kw. steam generating station in Königsberg and will supply some 35,000,000 kw.-hr. to the common distribution system. For transmission and interconnection about 640 km. (400 miles) of high-tension lines are to be constructed, and in addition 5,700 km. (3,550 miles) of lines for medium voltage will be needed to supply the two thousand transformer stations to be erected all over the country. Every consumer with a direct connection to the network must pay for the necessary transformer and housing and also has to pay a sum once for all for the privilege of being admitted. Needed lightning and small power distribution networks are constructed and operated by the power company if the communities themselves do not care to own their distribution systems, but the necessary funds must then be supplied to the company as a loan from the served communities. — *Elektrotechnische Zeitschrift*, Sept. 16, 1920.

Power Plant to Be Constructed at Spuller Sea for the Austrian Railroads.—In connection with the electrification of certain railroad stretches in Austria a power plant with an ultimate capacity of 48,000 hp. is being built at Danofen. The plant is intended to have a hydraulic regulation period embracing one whole year. The drainage area is 10.7 sq.km. (4.1 sq.miles) with an average run-off of 17,250,000 cu.m. (610,000,000 cu.ft.) of water per year. By damming up Lake Spuller at an altitude of 1,800 m. (6,000 ft.) a hydraulic storage of 13,500,000 cu.m. (480,000,000 cu.ft.) capacity is obtained. The storage basin thus takes in nearly four-fifths of the whole year's water supply. The power house will ultimately be provided with six high-pressure turbines of 8,000 hp. each, working at a head of 800 m. (2,600 ft.). This development is to be carried out gradually during a number of years. At present a smaller dam is constructed, while only three turbines are being installed.—*Elektrische Kraftbetriebe und Bahnen*, July 14, 1920.

Installations, Systems and Appliances

Enameling in the Automobile Industry.—M. R. ARMSTRONG.—The author holds that great progress has recently been made in the manner of applying paint and enamel to automobiles. The gas oven, he asserts, is supplanted by electrically heated ovens. Methods used in the Jordan Motor Car Company and the Cleveland Automobile Company and the results of tests made on their electrically heated ovens are discussed. Typical operating characteristics of these electric ovens are given in the table.—*Electric Journal*, January, 1921.

OPERATING CHARACTERISTICS OF ELECTRIC OVEN

Bake	1	2	3	4	5	6	Avg.
Pounds baked	555	293	1,043	683	381	638	597
Minutes for dipping	21	12	22	23	14	16	18
Minutes for dripping	37	53	37	36	44	41	41
Minutes baking	72	60	60	60	65	45	63
Kw.-hr.	65	67 2	78 4	57 6	54 4	52 8	67 7
Lb. baked per kw.-hr.	9 8	4 4	13 3	11 8	7 0	12 1	9 0
Minutes current was on	22	22	28	21	20	19	22

Typical Relay Connections.—LEWIS A. TERVEN.—Reference is made to the series of articles on the subject which appeared in the *Electric Journal* during 1908 and 1909. This article, it is said, is the first of a series which have been written to bring the former articles up to date and to give information regarding present switchboard practice in relay connections.—*Electric Journal*, January, 1921.

Electrophysics and Magnetism

Mathematical Analysis of the Mechanical Forces Acting on Switches and Busbars.—L. B. W. JOLLEY.—The author offers a criticism of the method of calculating the forces on switches and busbars during periods of short circuit which is known as "action at a distance." He then explains the "energy" method, which he holds should be substituted for the first-mentioned method. The author suggests that his formulas will serve the dual purpose of insuring a correct fundamental view of the method of dealing with problems of this nature and of presenting such a view in a practical form which will be of use to designers of switchgear and station equipment.—London *Electrician*, Dec. 3 and 10, 1920.

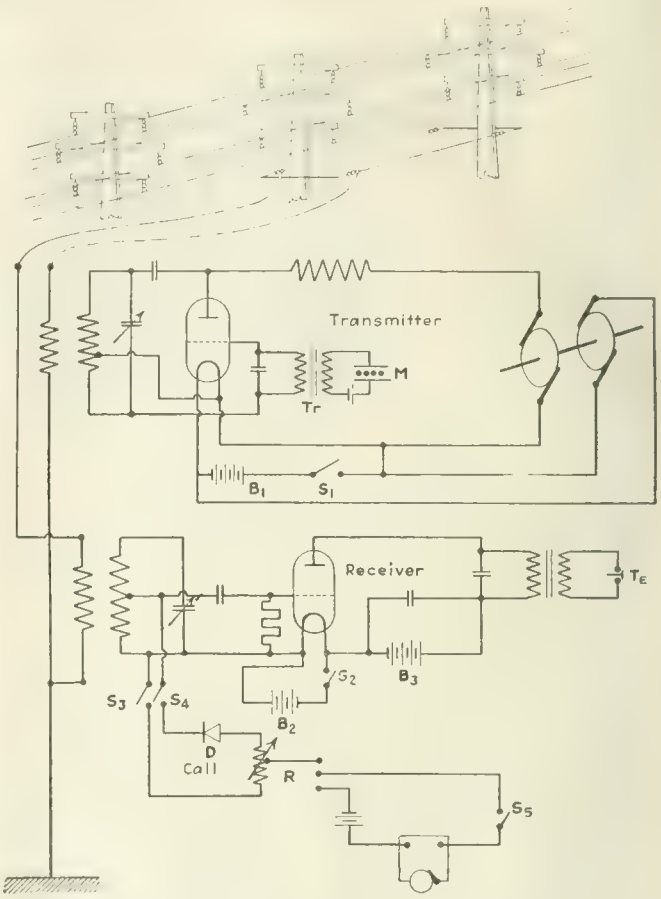
Skin Effect in Round Conductors.—BREITFELD.—The Kelvin theory of skin effect in round conductors is further developed by the author, who takes into consideration the possibility of a dielectric displacement current inside the conductor itself. The solutions come out in the form of Bessel's functions of complex arguments, and by aid of these functions the resistance and inductance per centimeter conductor can be computed as functions of the frequency. The author states that the metals may have a dielectric constant ε of the order of 10^{12} in the electrostatic system, but does not offer any experimental evidence substantiating this hypothesis. The resistance and inductance per unit length, according to the developed theory, at extreme frequencies both tend toward constant limiting values, which are simple functions of the permeability and of the hypothetic dielectric constant of the metal, thus permitting an experimental determination of ε.—*Elektrotechnik und Maschinenbau*, Nov. 14, 1920.

Units, Measurements and Instruments

Integrating Wattmeter Accuracy and Testing Practice.—W. K. HERVEY.—The importance of proper setting of permanent magnets is brought out, the effects of dust on bearings and lubrication are dealt with, and the accuracy requirements of various state commissions are given.—*Electrical Review*, Dec. 18, 1920.

Telegraphy, Telephony and Signals

Conductor-Directed Wireless for Interplant Communication.—GEWECKE.—The Telefunken company has developed into commercial form a system for wireless telephony especially adapted for intercommunication between high-tension stations at great distances. The signals, talk, etc., are not transmitted by ordinary wireless, but the property of a conducting wire to direct the electromagnetic waves and thus cut down energy dispersion is made use of in the following way: An ordinary set for wireless telephony, with triode oscillators, for continuous oscillations, feeds into a small antenna hanging between two transmission-line poles parallel to the high-tension conductors. At the receiving end of the line there is a similar antenna connected to wireless telephone receiver. Two-way communication may be obtained either by using two antennas at each station or else by coupling to the same antenna one receiver and one transmitter, tuned to different wave lengths. Experience shows that the energy will follow the transmission conductors without much dissipation so that very great distances may be covered with a quite limited primary energy. The author describes a conductor-directed wireless installation at the Zschornewitz (Germany) plant, where quite good communication is obtained over the 135-km. (84-mile), 110,000-volt line from Golpa to Rummelsburg. The connections are indicated in the figure. A 10-watt or 20-watt, three-electrode tube set serves as a source of energy, and the receiver simply contains a modulating tube, without any



STATION FOR CONDUCTOR-DIRECTED RADIO TELEPHONY

amplifiers. A special call-receiving device is shown in the lower part of the figure. When calling, a continuous wave train is sent out by the transmitter. This is picked up by a rugged but sensitive detector *D*, which sends a rectified current through the windings of the relay *R*, and starts the bell calling. When the receiver is hanging on the hook the switches S_1 and S_2 are open, thus disconnecting the filament batteries of the two bulbs, and the call device switches S_3, S_4 and S_5 instead are closed. As soon as the receiver is lifted from the hook the bell stops and the vacuum-tube filaments light up, thus putting the station in talking order. The tube replacement cost is estimated at 120 marks (about 35 cents) a year for a daily half hour of conversation. The communication is very little affected by disturbance on the lines, and even with a short circuit with intermittent arcing, a quite clear communication is maintained. —*Elektrotechnische Zeitschrift*, Aug. 26, 1920.

Undamped Oscillations in Coupled Circuits.—The author shows that any problem involving inductive coupling may be algebraically treated in just the same way as a case of parallel connection of two branches. This method of dealing with problems of stationary oscillations in coupled circuits is applied to some practical cases, and an explanation is given of the sudden frequency changes which may sometimes be observed when tuning up an arc oscillation generator to an inductively coupled antenna circuit.—*Elektrotechnische Zeitschrift*, Dec. 2, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

New York State Opens Fight on Water-Power Act

OBJECTIONS have been filed by the Attorney-General of the State of New York to the applications made by twelve western New York associations and corporations for leave to divert and utilize the waters of the St. Lawrence and Niagara Rivers for power purposes. The objections will be argued before the Federal Power Commission at a hearing in Washington, Jan. 24.

The action represents the State's first attack on the water-power act, which permits the Federal Power Commission to exact a rental for use of the water of boundary streams and gives the commission jurisdiction over water-power sites on boundary streams. If the objections filed are over-ruled, it is stated that the state will institute an action to test the validity of the law as well as proceedings held by the Federal Power Commission to determine the relative power of the state and federal government in connection with the licensing and use of such waters for power purposes.

The State of New York has taken the position that the province of the federal government with respect to these waters is limited to taking such steps with respect to the use made of them for water-power purposes and with respect to dams and structures to be erected as will insure that they do not operate to impair the navigability of the streams. The state insists that the financial benefits derived from the use of surplus waters shall go to the state rather than to the federal government.

Lower Living Costs Bring Lower Wages to St. Louis Utility Employees

THE Union Electric Light & Power Company, St. Louis, Mo., has announced that the wages paid to 1,400 of its employees and to 150 of the employees of the St. Louis County Gas & Electric Company, a subsidiary, have been reduced by an average of 8 per cent, effective Jan. 1, 1921, "due to a declining cost of living."

The reduction is according to the terms of a perpetual wage agreement between the companies and their employees, represented by the employees' mutual benefit association, entered into on May 22, 1911, which provides for wage adjustments every six months. A stipulation is that in such adjustments the cost of living shall be reckoned as approximately a two-thirds factor. The cost of living is to be measured by the *Annalist* "Index Number of Cost of Living," which is a compilation of the wholesale price of twenty-five articles regarded as comprising the food budget of the average family. The other factors governing the wage adjustments are length and proficiency in service.

The employees have invoked the contract at six-month intervals and have obtained advances totaling an average of 84 per cent since May, 1918. The invocation of the contract at this time was by the company.

The wage adjustment now made effective was recommended by a board of adjustment, comprising two employees selected by the benefit association, two persons selected by the company and a fifth one selected by the other four. The finding of the board of adjustment was accepted by the general labor committee of the association in behalf of the employees and by the company.

Delay in Water-Power Personnel Amendment May Hold Up Permits

DELAY in reporting out the amendment to the water-power act by the select committee on water power of the House of Representatives makes it appear doubtful if legislation empowering the Federal Power Commission to hire its needed staff can be obtained at this session of Congress. Since an extra session of Congress is to be called late in March or early in April, there still will be time to pass such an amendment before the end of the fiscal year. This also would be the basis for securing additional appropriations. Valuations cannot be started and no license probably will be issued until additional funds are made available. The present arrangement of borrowing help from the Departments of War, the Interior and Agriculture also is endangered by the heavy reductions being made in departmental appropriations.

Massachusetts Public Utility Financing May Be Aided by Legislation

THE Massachusetts Gas & Electric Association has filed four bills, designed to facilitate financing utilities, for consideration by the present Legislature. The first bill is to authorize the issue by gas and electric companies of capital stock without nominal or par value. This bill seeks to authorize any company desiring to do so to call in and retire its outstanding capital stock having par value and issue in place of it stock without nominal or par value. Such laws have been passed in a good many states, and among others in Massachusetts, but the Massachusetts act at present applies only to business corporations and not to public service corporations.

The second bill is one to equalize the cash and share capital of certain gas and electric companies. It specifically provides that any gas or electric company which has received in payment for its outstanding capital stock more than its aggregate par value may under the provisions of the act issue additional shares at the par value thereof to an amount equal to the difference between the aggregate par value of its then outstanding capital stock and the total amount received in payment

for it. The purpose of this is to extinguish artificial par values of stock, which rarely, if ever, correspond to the fact, and to authorize corporations issuing par value stock to issue it to the extent to which it is paid for at par. That requires the approval of the Department of Public Utilities, which is required to audit the capital accounts of the company and find out what the actual amount of money paid in has been.

A third bill provides that the Department of Public Utilities shall have authority to authorize the issue of stock at less than its par value, making such requirement as may be thought necessary for the amortization of the discount; provided, however, that the commissioners shall find that such issue is reasonably necessary for the purposes of the company and that, in the opinion of the commissioners, it cannot be disposed of to the stockholders or others at or above the par value thereof.

A fourth bill authorizes the issue of bonds at such price and bearing such interest as may be approved by the Department of Public Utilities. It is merely an extension of Chapter 581 of the Acts of 1920 and is for the purpose of meeting the radical changes which have recently taken place in financial conditions.

Worcester Company Suffers Slight Loss in Serious Fires

TWENTY-EIGHT fires occurred at Worcester, Mass., on Jan. 19, chiefly in the business and manufacturing center, with an estimated loss exceeding $1,600,000. President R. W. Rollins of the Worcester Electric Light Company informed the ELECTRICAL WORLD by telephone that little damage was done to the company's property and that its losses were chiefly confined to meters and would probably be well under $1,000. Elevator service in the City Hall district was somewhat impaired for a short time, and the Chase Court substation was threatened with water damage which fortunately did not prove serious. Underground service supplies substantially the entire district affected, and the absence of overhead wires proved a great advantage.

Murray Declares Superpower System Must Have Adequate Return

SPEAKING before the Boston Sections of the A. I. E. E. and A. S. M. E., and the Boston Society of Civil Engineers on Jan. 18, W. S. Murray, chairman of the Superpower Survey, declared that a return of at least 10 per cent on the investment will be necessary at present for the success of the program, and that if the yield should be limited to 6 per cent the project would be doomed to failure. The speaker said that while the initial construction expedient for the system is unsettled, a 300,000-kw, steam plant and a superpower transmission line from the Hackensack Meadows to Philadelphia would pay now. Not a dollar has been sought from the United States Treasury for financing the proposed superpower development, Mr. Murray said, and he strongly affirmed the intention of those interested in the scheme to keep clear of the morass of government ownership or operation. It has not yet been determined whether it will be better to operate through a federal charter or through synchronized state charters. Consideration is being given to transmission of hydroelectric energy from the St. Lawrence River in connection with the superpower project. It is estimated that by 1930 the present general plan, if carried through, will save 50,000,000 tons of coal and that between now and then the energy requirements of the so-called Superpower Zone will be about doubled. In the forthcoming report problems of industrial and generating-plant heat balance will receive special attention.

Security Issues of the Week Reach Total of More than $12,000,000

THREE large issues of securities have been announced this week by lighting and power companies. The largest of these issued is $7,500,000 in two-year 8 per cent coupon gold notes by the United Gas Improvement Company of Philadelphia, designed to retire notes of the same amount which mature on Feb. 1. The Mississippi River Power Company is floating $3,600,000 in fifteen-year 7 per cent sinking fund gold debentures, also for refunding purposes. The specific purpose of the Southwestern Power & Light Company's issue of twenty-year 8 per cent bond-secured gold notes is not stated in the advertisement announcing them. The U. G. I. notes are offered at 99.45 and interest, to yield about 8.30 per cent; the Mississippi River Power debentures at 91⅜ and interest, to yield 8 per cent, and the Southwestern Power & Light notes at 97 and interest, to yield about 8.30 per cent.

Marine Electrical Engineering to Be Discussed in New York Next Week

MARINE electrical engineering is the subject of the joint meeting of the New York sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers to be held on Jan. 28. Alfred E. Waller, chief engineer of the Ward Leonard Electric Company and chairman of the marine committee of the A. I. E. E., will preside. The opening remarks are to be made by Admiral W. S. Benson, chairman of the United States Shipping Board. The following papers are scheduled to be presented:

"Electricity Applied to Ship Auxiliaries," by H. L. Hibbard, manager marine department Cutler-Hammer Manufacturing Company and formerly chief of the bureau of construction and repair of the United States Navy. This paper treats the subject historically and gives efficiency data where Diesel engines instead of steam power have been used to drive ships' auxiliary motors.

"Electrical Terminal Facilities," by Commander C. S. McDowell, U. S. N., inspector of engineering material. This paper considers facilities for loading and unloading ships to get the greatest possible effective service.

"Electric Ship Propulsion," by Eskil Berg, engineer of the turbine department General Electric Company. In this paper the author discusses the relative merits of steam turbines geared directly to the propeller and steam turbines with generators and motor drives. The conclusion drawn is that the motor drive is preferable except in some special cases.

"Ship Propulsion," by Walter Thau, marine engineer Westinghouse Electric & Manufacturing Company. A description of the turbine drive of the U. S. S. *Tennessee*.

Written discussion by a number of prominent marine electrical engineers has been prepared for presentation.

Great Falls Hearing Postponed

IN ORDER that the chief of engineers may have more time in which to review the report made by Major Max Tyler on the possibilities of water-power development at Great Falls, on the Potomac, the hearing on that project scheduled for Jan. 20 has been postponed. Another date will be set when the chief of engineers shall have concluded his review of the report.

Southern California Edison Company Issues $10,000,000 in Bonds

THE Southern California Edison Company has been authorized by the California Railroad Commission to issue $10,000,000 face value of its general and refunding mortgage 6 per cent twenty-five-year gold bonds. The company also has been given permission to use not over $3,000,000 of these bonds as collateral securities for short-time loans. It is understood that the sale of the bonds has been completed and they are now being offered to the public on a basis to yield about 7 per cent.

Permanently to finance its properties already constructed and to carry forward its construction program during 1921, the Southern California Edison Company has prepared a budget calling for an expenditure of $20,000,000, of which half will be supplied by this bond issue. It is planned to raise the additional $10,000,000 through the sale of stock in the territory served, and extensive plans are being made to accomplish this. The greatest amount of stock sold in any one previous year has been approximately $5,000,000.

Synchronous Motors Favored for Rubber Mills

EMPHASIS was placed on the use of synchronous motors and direct-motor drive at the Akron-Cleveland meeting of the American Institute of Electrical Engineers on Jan. 14, when William E. Date, chairman of the sub-committee of the industrial and domestic power committee on the rubber industry, pointed out the possibilities of improvement in the use of power by the proper study of the application of motors to the various machines in the rubber factory. The question whether electrical efficiency had been sacrificed by splitting up the motor equipment into a large number of units to get production efficiency was raised, but not answered, Mr. Date indicating that the answer will depend on determining whether any sacrifice in efficiency from the power viewpoint means a total saving in production costs. The committee report suggests the advisability of grouping, as far as possible, the units of any one process into one mill drive where possible, also the units should have contrasting characteristics to improve motor-load factors and avoid the tendency toward overmotoring that exists where the use of individual drive is carried out.

In the discussion the use of synchronous motors was very strongly advocated, B. H. Clingerman pointing out that poor power-factor conditions were due in large measure to underloaded motors and that the larger-sized motors in many cases could be used advantageously. On breaking-down operations they can be adjusted to operate at unity power factor and used to correct the power factor due to the smaller-sized motors that are necessarily of the induction type. A considerable difference of opinion on the use of gear or direct drive developed, A. T. Lewis asserting in a written discussion read by B. T. Mottinger that the replacements in some cases had been of the order of one in five hundred gear-years' life, while others asserted that an expense of $500 per year was required to keep herringbone gears in order. C. A. Rice cited one case where a direct-current direct-mill drive had been in service since 1908 with no expense of upkeep and said that future installations would be of this type with alternating-current motors. In Mr. Lewis' discussion objection was made to the low-speed slip-ring motor for direct drive on the ground of its size, and because it is not economically justified.

Industrial heating was brought up by W. S. Scott, who thought that future demand might possibly be as great for power for this purpose as for motor applications, and the suggestion was made by A. M. McCutcheon that the better control of heat possible with electric heating might result in a better product.

Safety stops that would act quickly enough to prevent serious accidents were discussed. Some form of brake that would result in a quick stop rather than a clutch was favored. Instances of brakes that would stop a 450-hp. motor in three and one-half to four revolutions were given.

The use of heavy flywheels to reduce the magnitude of the sudden peaks was suggested by H. McFarland, but J. H. Vance and B. T. Mottinger pointed out that the peaks in machine operation were so long continued that the flywheel effect was lost.

Washington Cities Want Right to Sell Power Outside Their Territory

A BILL drawn up by city attorneys of western Washington to be introduced in the Legislature this session provides that any city in the State of Washington may acquire the right to sell electrical energy outside its territory. The bill provides that cities or towns so served must own their own distribution systems. The act as drawn up further provides for the sale of electric power to industries or corporations within 1 mile of the transmission line. Theb ill is backed by Seattle, Tacoma and other Puget Sound cities.

Senate Passes Bill to Place Muscle Shoals Under Government Corporation

THE bill to provide for a government corporation to operate the Muscle Shoals nitrate plant was passed on Jan. 14 in the United States Senate by a vote of 34 to 29. The bill provides for a corporation with $12,500,000 capital stock, owned by the government and managed by a board appointed by the President and under the jurisdiction of the Treasury Department.

The bill also would require the nitrate corporation to issue bonds up to half of the expenditures of the government in construction of the nitrate plants and for full value of hydro-electric installation at Muscle Shoals, if taken over by the corporation. The corporation also would be required to earn 5 per cent interest on these securities under penalty of ceasing operation to await further dispensation from Congress. An amendment relieving the government from responsibility for debts of the corporation was also passed by the Senate. Another amendment adopted took from the proposed corporation all right to condemn or acquire property by right of eminent domain.

California Commission Under Fire by Legislature

CLAIMING that a number of the recent decisions made by the California State Railroad Commission have been unfair to the consumers, and discriminated in favor of the public service corporations, members of the State Legislature have proposed a thorough investigation into the conduct of hearings before the Railroad Commission and into the decisions rendered.

Massachusetts Commission Seeks to Regulate Service Charges

THE power to annul or modify any service or similar charge adopted by a gas or electric company on its own initiative is sought from the Massachusetts Legislature by the Department of Public Utilities in a special report signed by the full board. The department is not of the opinion that service charges should be indiscriminately adopted, but is convinced that such charges may not only be justified at times—notably in companies handling exceptional summer loads—but may be in some cases perhaps the only practicable means of adjusting fairly the relative payments which the customers should make for the services rendered them.

Common Interest of Utilities and Public Is Theme of Indiana Meeting

THE intimate association of the interests of the utilities and the public, a relation so close that they prosper or suffer together, was proclaimed by Paul P. Haynes, a member of the Indiana Public Service Commission, in an address before the first annual meeting of the Indiana Public Utility Association at Indianapolis on Thursday of last week. This association was formed to sponsor the Indiana Committee on Public Utility Information, which devotes itself to promoting general acquaintance with utility problems and to fostering good public relations. Mr. Haynes combated the contention that there are two sides to the utility business and contended that there is only one. He specified seven things that should be brought plainly before the people. Briefly summarized these are: (1) That increases in utility rates in the last four years have been much less than increases in the price of other necessities; (2) that utilities generally have earned less than a fair return; (3) that existing rates are not based on the peak war costs; (4) that deferred maintenance expense has reached an immense total and must be provided for; (5) that Indiana utilities should expend $100,000,000 in the next two years for extensions and improvements; (6) that impaired utility credit must be restored through increased revenue; (7) that a sympathetic understanding of these facts by the public is essential in its own interest. Good service, Mr. Haynes said, is the primary obligation of the utility, and it is the duty of a commission to see that the utility is in a condition where it can give such service.

Martin J. Insull, president of the National Electric Light Association, took issue with Mr. Haynes' assertion that service was the first consideration. Service and rates, in Mr. Insull's opinion, must go together, for good service is impossible with inadequate rates. Where the utilities of a community are run down the community itself is going backward. The present, Mr. Insull held, is the right time to educate the public both by the printed word and by word of mouth. He dwelt on the exhaustion of utility reserves and the slow turnover as compared with other businesses and concluded by a reference to the national good-will advertising campaign of the N. E. L. A.

E. K. Hall, vice-president of the American Telephone & Telegraph Company, discussed the question of how to make the public understand that the period of punishment for former misdeeds on the part of some utilities is past and that the second era of regulation, devoted to making and keeping the companies strong enough to do their work, is here. It was time to stop apologizing and to take the aggressive.

The following officers were elected for the ensuing year: President (re-elected), Charles L. Henry, president Indianapolis & Cincinnati Traction Company; first vice-president, S. E. Mulholland, vice-president Northern Indiana Gas & Electric Company; second vice-president, F. J. Haas, vice-president and general manager Public Utilities Company, Evansville; secretary, Marshall V. Hoff, treasurer Wabash Valley Electric Company, Clinton; treasurer, Charles C. Perry, president Indianapolis Light & Heat Company.

Missouri Bill Would Abolish Public Service Commission

A BILL to provide for the repeal of the law creating the Missouri Public Service Commission was introduced into the Missouri House of Representatives by Representative Chaney of Kansas City on Jan. 13. The proposed measure covers only a few lines and provides for the repeal of the whole law relating to the creation and scope of action of the Public Service Commission. In introducing the bill Representative Chaney declared he did so because of the sentiment in the state for abolition of the commission on account of the increased rates granted utilities during the past three years.

According to advices from Jefferson City, there is apparently a great deal of sentiment in the House against the commission, but it is not believed that the bill will receive sufficient support to pass it. If the measure should pass the House, it is doubtful if it will receive favorable action in the Senate. A similar measure introduced two years ago was killed in committee.

Judge Wade Condemns Propaganda Against Utility Commissions

DECLARING that two-thirds of the difficulties in public utility matters arise out of a misunderstanding or lack of information upon essential fundamental considerations, Judge Martin J. Wade of the United States District Court of Iowa a few days ago granted a temporary rate increase to the Des Moines (Iowa) Gas Company. "There seems to be a determined effort on the part of some individual or individuals in every city to carry on propaganda which inspires doubt and suspicion," Judge Wade continued. "This aims to destroy confidence in officers of the law who have duties to perform in relation to public utility matters and to convince the people that they are being robbed in the interest of certain corporations. The people will be fair if they only understand, and those who spread misinformation and misrepresentation are guilty of a grave wrong against the community."

Water Storage Essential to Western Development

FUTURE hydro-electric development must carry with it ample and well-surveyed storage. This declaration is one of the anxioms laid down by A. G. Wishon, vice-president and managing director of the San Joaquin Light & Power Corporation of Fresno, Cal., who is in the East this week and was asked by a representative of the ELECTRICAL WORLD to give his views on the water-power situation in the West, its determining features and what its development means not only to the coast but nationally. It will be remembered that Mr. Wishon, with his son, A. Emory Wishon, who is now general manager of the Fresno property, advanced and advocated the widely discussed "self-interest" plan for financing electric power development which has been so successful in California.*

HEAVIEST LOAD IN DRY YEAR

"As a chain is no stronger than its weakest link, so is a hydro-electric development no greater than its dependable storage," said Mr. Wishon, mindful of the California power shortage that because of low water occurred last fall. "The driest year is the year of largest kilowatt-hour output. The drier the year the more the water is needed by the farmer and the larger is the irrigation pumping load. This load, therefore, can be served properly only with adequate storage.

"Power companies can make no progress talking electrification to steam railroads until they can first prove that service will be continuous even under the most adverse conditions. That is reasonable because the railroads must always be in continuous operation. Storage, then, is the only answer."

At this point Mr. Wishon pointed out that water power is absolutely essential to the West. The cost of coal for power production is prohibitive. The available fuel is oil, and the supply of that is limited, while the cost in its case also is becoming prohibitive. It is evident, therefore, Mr. Wishon pointed out, that if the West is to continue to serve the country in an ever-increasing measure a progressive development of its water powers is an economic necessity.

NATIONAL PARK DANGER

"It is to the 'self-interest' of the nation," he pointed out, "that the waters miles back in the mountains be stored and put to work. There are some people, however, who in their zeal to create in the undeveloped West vast national playgrounds will not heed the economic needs of the nation. They would forever prohibit any development of waters now running to waste not only in the present national parks but in the proposed enlarged parks. This is dangerous.

"The public utilities do not object to withholding the waters within the present national parks. They do, however, see the danger of eliminating from the provisions of the water-power act national parks except as now constituted. If the program of the national park enthusiasts is carried out these parks will ultimately cover the high range from Greene Horn Pass near the mouth of the Kearn River on up, taking in the Klamath and Crater Lake country, which includes Tahoe and all the intervening territory. Were this excluded from the provisions of the water-power act it would shut off the possibility of power development and, what is more important, water storage for both power and irrigation throughout the entire Sierra Nevada Range."

When asked how much of the available storage would thus be shut off Mr. Wishon said he did not know positively because existing water-storage data were unreliable. He ventured to guess, however, that fully 50 per cent of available storage would be shut off were national park enthusiasts to have their way unchecked.

"It is perhaps difficult for the great mass of people who have never been west of the Mississippi," continued Mr. Wishon, "to understand what water power means to the West, and especially to realize that although there is a temporary depression in the great manufacturing regions of the East the West is not so badly off and that we are going ahead now with big construction programs. They do not yet realize that we are helping to shorten this period of depression because the bulk of all the materials that we shall require must come from the East. We have had bumper crops of raisins, oranges, lemons, walnuts, prunes, rice and other things, and the money will almost all be in our hands—hundreds of millions of dollars—within a few months and, after paying the Eastern jobbers and manufacturers for the millions due for what we buy from them, will go back into the agricultural and industrial, and therefore into the power, development of the West. It is fundamental with us that the West can grow no faster than the development of its potential water powers. Is it so strange then that the 'self-interest' idea should be so strong and that money should be forthcoming from our own people for power development? The farmer and the factory owner on the Pacific Coast see these things and invest their surplus funds in power development for two reasons: First, to bring the power, so that they themselves can expand, and, second, as a safe dividend-paying investment.



A. G. WISHON

HEAVY PREPARATION COSTS

"Nor are all our powers to be developed as easily accessible as in the East. So treacherous are some of the trails that only goats and donkeys can navigate them. To secure surveys of watersheds and storage basins we have in some instances been forced to use airplanes. On the Kings River development, for instance, we have already spent more than $400,000 on engineering and road work, and we haven't yet started the tunnel excavation and dam construction. The last 3½ miles of road cost $45,000 and is not yet completed. It is estimated that the 50 miles of main road and 20 miles of laterals for the development of the north fork of the Kings River will cost $1,750,000.

"Just as soon as these roads are built we will start construction on this development. We now expect to

*See ELECTRICAL WORLD, May 1, 1920, p. 997.

get under ground during the coming winter. A series of plants is proposed with regulated storage beginning at the bottom and working up to the higher altitudes. First will come the Balch power house, with one unit using 100 sec.-ft. of water operating under a 2,600-ft. head and developing on the switchboard 32,000 kw. This will involve the storage of about 45,000 acre-ft. of water. For this development a 150-ft. dam will be erected, which later will be increased in height in two steps of 50 ft. each, making it ultimately 250 ft. high. It will require up to two years, or till the end of 1922, to complete this plant. This will be in time to fill the reservoir for the 1923 season. The second unit—the Haas power house—will operate under a little over 2,400-ft. head without increasing the amount of storage.

"In the third year there will be added a little more dam and another unit in each power house. The fourth year will see the project completed. Ultimately the stream will be regulated for 550 sec.-ft., and there will be eleven power houses located from 8,100 ft. elevation down to 900 ft. elevation for water control.

"The territory we occupy is not more than 10 per cent developed from a power and development standpoint. From this construction will come the development of the surrounding country. Agricultural expansion and the building of industries essential to the West will result.

"SELF-INTEREST" FINANCING

"All of this is being more and more appreciated by our people. So much so, in fact, that a new development has come—the placing of junior financing locally. Twenty-five per cent of our financial requirements is absorbed in our own territory. We are aiming to spend in our company alone around $10,000,000 annually, of which $2,500,000 will be provided locally by the purchase not of funded securities but of preferred stock, which is 2 per cent of the annual value of products grown in the San Joaquin Valley. Already under this 'self-interest' plan of junior financing we have placed about $1,500,000 among 1,800 new stockholders, or about $830 per stockholder, and the first year will not be up until the spring. A great many of our new stockholders are rebuying, and there is one case where a local stockholder has purchased eleven times. Not more than fifteen or twenty stockholders out of the 1,800 have canceled their orders, and these were mostly employees who left the company. We have about 800 employees—not counting the construction gangs, whom we do not urge to buy—and of these 50 per cent are stockholders. We sell our employees on a time-payment plan of $7.50 down and $10 per month per share or $1 per share less than it is sold to the public.

Achievements, Activities and Aims of Electrical Development Society

IN MANY places separate pieces of information relative to the activities and purposes of the Society for Electrical Development have been printed, but at no time until now has the entire story been embraced in one piece of literature. To do this and to inspire continued confidence throughout the industry the society is distributing an attractive booklet setting forth its achievements, activities and views. Special attention is given to its research and publication work, merchandising ireas, campaigns and field co-operation.

Definition of Purpose of Water Power League Expected

AT THE annual meeting of the Water Power League of America, held in New York on Tuesday of this week, a change in the method of electing officers was made so that the directorship and officers may be more representative of the membership, which includes many large power and manufacturing interests. A nominating committee was appointed, and its report is expected within the next two or three weeks. There has been some feeling that the purpose of the organization should be better defined, and this, it is expected, will be one of the first things the new administration will take up. It is also proposed that the association select a more representative name, and already the name "American Water Power Association" has been suggested.

New Hampshire Hydro-Electric Report Expected Soon

A REPORT to the Governor on the hydro-electric resources of New Hampshire will soon be published under the direction of George B. Leighton, Commissioner of Water Conservation and Water Power, supplementing the first report on this subject, which appeared under date of Jan. 1, 1919. In this report Commissioner Leighton will recommend the extension of storage facilities, an appropriation for the continuance of systematic stream gaging and a resumption of the topographic mapping of the state, now less than half completed, under a joint appropriation with the United States Geological Survey. Data prepared by C. H. Pierce, district engineer of the Geological Survey at Boston, as to storage possibilities and the development of potential power sites and a section of a report by Prof. C. M. Allen of the Worcester Polytechnic Institute covering sources of inefficiency in hydro-electric stations will be included in the report.

State Storage Development Favored in Maine Water-Power Report

DEVELOPMENT of storage facilities is recommended in a recent report of the Maine Water Power Commission to Governor Parkhurst. Edward P. Ricker is chairman and George C. Danforth of Augusta is chief engineer of the commission. This body was authorized to take over the water-power resources work of the Maine Public Utilities Commission and to continue the investigation of the hydraulic developments and possibilities within the state which was embodied in a special report of the Utilities Commission about two years ago.

In view of the answers of the judges of the Maine Supreme Court to the questions of the Maine House in February, 1919, it has seemed to the Water Power Commission impracticable, if not legally impossible, to work out a satisfactory plan for the state control of storage resources unless by some proper amendment of the state constitution such work could be legally recognized as a public purpose within the accomplishment of which the state could exercise the right of eminent domain or some special method of assessment of the particular interests to be benefited. If the constitution should be amended so as to make possible state control of storage facilities, the commission believes that such control could be best applied and most effectively worked

out by the creation of river regulating districts. A plan for this has been prepared for presentation in case the necessary constitutional amendment is brought before the Legislature. The commission has been unable to ascertain that the state has any rights in the storage reservoirs and in the developed and undeveloped water powers except that limited right of control of the waters of the Great Ponds as stated in the Supreme Court answers referred to. The commission recommends that its work be continued.

It is not believed that sufficient knowledge is available either of the resources of the state or of the effect on Maine of the federal water-power law for the state to commit itself to a course of storage development. Every possible effort, it is pointed out, should be made to retain within the boundaries of the state control of its own resources.

The trend of the report is against the state development of water power, with the exception of storage facilities. The importance of water-power development in Maine is strongly emphasized, and the economic benefits as set forth in the report of such development received the approval of the engineering council, which has contributed a supplementary report to be published with the main report of the water-power commission.

Would License Engineers in Missouri

LICENSING of all professional engineers in the State of Missouri by a board of engineers to be appointed by the Governor is provided in a bill to be introduced in the Missouri Legislature, it was announced after a meeting a few days ago of the newly organized Missouri state organization of the American Association of Engineers. The proposed bill affects all electrical, mechanical, structural, mining, highway and civil engineers in the state. It provides that a state board of five engineers from different branches of the profession be appointed by the Governor within thirty days after the passage of the bill, each to serve for four years, with the exception of two members of the first board who are to serve for only two years.

The proposed state board of engineers is to have authority to examine all applicants and issue licenses. A maximum penalty of $500 fine and three months' imprisonment is fixed for any person attempting to practice as a professional engineer without a license.

Wisconsin Electrical Inspectors Organize

THE initial meeting of the Wisconsin Chapter of the Association of Electrical Inspectors was held at a luncheon at the Blatz Hotel in Milwaukee on Jan. 17, given by the Wisconsin Inspection Bureau. The following officers and executive committee were elected: President, William Haig, chief inspector of the city department of Milwaukee; vice-president, R. M. Schleck, electrical superintendent of South Milwaukee; secretary, A. C. Schultz, electrical inspector of the Wisconsin Inspection Bureau; executive committee—Frank R. Daniel, chief engineer Wisconsin Inspection Bureau, chairman; H. P. Hempsing, electrical superintendent of Wauwatosa; Archie Middlemass, inspector of Milwaukee city department; W. H. Snyder, electrical superintendent of Menominee Falls; A. C. Schultz and William Haig.

Tacoma Upheld in Right to Condemn Water-Power Site

THE right of the city of Tacoma to condemn property for the acquisition of the Lake Cushman power site has been upheld in the Superior Court by Judge Wilson. The city will now proceed in accordance with an order of the court authorizing the bringing of condemnation suits and will start without delay suits to acquire lands and other property which cannot be obtained by purchase outright, including water rights, dam sites, transmission line franchises and other rights. For the acquisition of the site there is available $300,000.

Attorneys seeking to block the city's efforts took the stand that the law provides that a city may condemn a power site only if it proposes to make public use of the power. They pointed to the fact that if the city were to discontinue the sale of power for toasters, household devices, curling irons, etc., it would have sufficient energy for lighting purposes for years to come. In handing down his decision Judge Wilson said, in part:

"I cannot agree with the contention that the use of electricity in the homes of the inhabitants of the city for heating, toasters, carpet sweepers, curling irons and the like is not a public use in the light of the rapid development of electrical uses of the present day, nor do I think there is such a showing of the commingling of public and private uses as would preclude the petitioner's right to condemn."

American Capital to Finance Swiss Railway Electrification

COMPLETE electrification of the federal railway system of Switzerland within the next twenty years is included in a comprehensive hydro-electric development program laid out by the Swiss government. Electrification of two railroad divisions, one from Luzerne to Bellinzona and one from Berne to Domodossola, Italy, was recently completed and operation has begun, while the work on two others is now under way. At the Swiss Consulate in New York it was stated that the plan contemplates full electrification of all main lines within six or seven years, and branch roads of the second and third class are to follow within the time limit set. Extensive hydro-electric developments have been made, and others are projected, as, in addition to supplying energy for the operation of the railroads, the Swiss government expects to export a considerable amount of power, a limited quantity of which is now sold in northern Italy.

A good share of the financing and purchasing of supplies will be done in the United States. The proceeds of the Swiss loan of $25,000,000 offered here last July were used in connection with the program, about two-thirds of the amount having been spent in America for the purchase of electrical equipment and machinery and of raw material.

Further Swiss government financing in the American market to the extent of approximately $75,000,000 for the same purpose is anticipated in the next twelve or eighteen months. No definite arrangement has been made, although a financial operation involving the sale of $25,000,000 in bonds may be expected in the course of the next two or three months.

Consulting Engineers Take No Action on Joining Federation

AT ITS annual meeting, held in New York on Jan. 17, the American Institute of Consulting Engineers, in accordance with the recommendations of the investigating committee, voted to take no action at this time toward joining the Federated American Engineering Societies. While the consulting engineers will remain independent for the present it will be their policy to co-operate with other engineering bodies, and the action does not preclude their affiliation with the Federation at some time in the future.

In a paper entitled "Engineering, Past and Future," by Col. George D. Snyder, the trend of engineering practice was reviewed, and among other things a large volume of engineering work along the lines of railroad electrification and hydro-electric development was predicted.

To fill vacancies occurring in the council Allen Hazen of New York, Morris Knowles of Pittsburgh and Charles W. Leavitt of New York were elected for the ensuing year.

Power Engineers Affiliate with New England N. E. L. A. Division

CLOSER relations with the New England Division of the National Electric Light Association have been established by the New England Association of Central Station Power Engineers, an organization which has intensively studied the problems of commercial power service in the Northeast for the last six years. At a meeting of the power engineers on Jan. 5 it was voted to become a standing committee of the Power Sales Bureau of the New England Division for the gathering and discussion of power sales data. This plan enables the organization of the power engineers' association to continue to function efficiently and avoids duplication of work within this geographical division of the N. E. L. A.

V. M. F. Tallman is chairman of the power engineers' organization and John West is chairman of the power sales bureau of the New England Division. It is expected that through the above affiliation the divisional membership of the N. E. L. A. will share the benefits and participate in the work of the power engineers' association through the distribution and analysis of data and papers from time to time in advance of the divisional conventions.

October's Energy Output 100,000,000 Kw.-Hr. Ahead of September's

FIGURES of electrical generation by public utilities for the month of October have just been issued by the United States Geological Survey. They show a total of 3,733,304,000 kw.-hr. as compared with 3,624,279,000 kw.-hr. for September. Hydro-electric generation was 21,000,000 kw.-hr. ahead of September, the October figure being 1,337,079,000 kw.-hr. Unlike the central-station statistics published monthly by the ELECTRICAL WORLD, the figures of the Geological Survey include electric railways.

Average daily production of electricity in kilowatt-hours by public utility plants for the first ten months of the year was as follows: January, 124,700,000; February, 119,800,000; March 120,700,000; April, 119,100,000; May, 115,600,000; June, 118,800,000; July, 116,800,000; August, 119,500,000; September, 120,800,000 and October, 120,400,000. The total output for the ten-month period from January to October, 1920, was 36,484,000,000 kw.-hr., an increase of 15.8 per cent over 1919.

The output for October, 1920, involved the consumption of more than 3,160,000 tons of coal, more than 1,150,000 barrels of fuel oil and 2,370,000,000 cu.ft. of gas.

Central Maine Power Acquires More Properties

PERMISSION has been granted to the Central Maine Power Company by the Maine Public Utilities Commission to take over and consolidate with its organization eight electric light and power companies, with a combined capitalization of more than $2,000,000. The companies to be merged are the Hartland Electric Light & Power Company, Newport Light & Power Company, Union Light & Power Company, Waldoboro Water, Electric Light & Power Company, Solon Electric Light Company, Wiscasset Electric Light & Power Company, Brunswick & Bath Light & Power Company and the Penobscot Bay Electric Company, with exception of the gas plant of the last-noted organization at Belfast.

About six months ago the Central Maine secured a majority interest in the public utilities controlled by W. S. Bird and H. J. Chisholm. These included the Oxford Electric Company, the Knox County Electric Company, and an interurban trolley property.

Boston Jobbers Co-operate for Home Beautiful Exposition



LEADING electrical supply jobbers at Boston have agreed to occupy a centralized space at a "Home Beautiful" exposition to be held in the Mechanics' Building in that city, April 16 to 30, under the direction of Chester I. Campbell, and about $8,000 has been appropriated to make the electrical side of the show a success. The purpose of the exhibition will be to encourage the use of improved furnishings and devices in the home. No electrical products will be sold at retail, but all jobbers exhibiting will direct inquiries to proper retail channels. The electrical display will be one of the best ever staged in Boston. At a meeting last week in the office of F. S. Price, president Pettingell-Andrews Company, Boston, Miss Lola Fisher, leading lady of the "Honors Are Even" company, then playing in Boston, drew by lot the space location for the jobbers' exhibits, which proved to be one of the best in the hall.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Technical Advertising to Be Taught at Ames.—Courses in technical advertising arranged especially for engineering students are being offered by the Iowa State College at Ames. The aim is to prepare engineering students to take hold of advertising problems in the technical field.

Telephony in Sweden.—In Sweden, which has the reputation of being from a telephonic point of view the best developed country in Europe, a 200-pair cable similar to that which runs from New York City to Buffalo is about to be installed by the Western Electric Company, which has sent three of its cable experts to the Scandinavian kingdom to direct the work. The cable will run from Stockholm on the east coast to Gothenburg on the west coast, a distance of about 400 miles, and will pass through five or six large towns. It will have full repeater equipment.

Hydro-Electric Progress in New Zealand.—The extensive hydro-electric program on which the government of New Zealand purposes to spend about £20,000,000 for generating plants and transmission lines is beginning to get under way. The government already has a big station in operation at Lake Coleridge, which has proved a financial success, and preliminary work has been done on another great station to be built at Manganhoe, near Wellington. This is intended as the first section of a complete system of transmission lines in the North Island. Only 500,000 hp., however, is estimated to be available in this island as compared with nearly twenty times as much in the South Island.

An Unusual Report to a State Commission.—The following "return" was sent to one of the New England public utility commissions, written in pencil on ruled letter paper by the owner of a small public service plant: "Public Utility Commis. Dear Sir: Find inclosed Rates charged for Electric Light Current used by what few people there are on my Circuit: 15c. Pr. Killerwot, $12 a year for Street Lights and there is 18 of those. Operating expenses for Last year, $650.00 and amt. of current used $650,00. I don't run this plant for a business as I have a General Store and am Postmaster, also run Picture Show here, so you see I have to have light, and I have taken on a few other to help Pay running Expenses. There are 20 Houses and Stores on Circuit beside my own. Yours Truly, —— ——. P. S. There is no Company to it and have never bin Incorporated."

Eliminating the Question Asker.—"While the field for the larger electric signs has been very successfully covered," the *Edison Monthly* remarks, "resulting in the use of these signs for almost every purpose where signs are required, the field for the small electric sign for interior use has only just started to be developed." In hotels, railway stations, theaters and public buildings of all kinds these signs are being multiplied. Uniting the two most desirable features of a directional sign, conspicuousness and ornament, their advantages, more especially in dark corners, over painted signs are indisputable. A statistician might find employment in estimating how many million questions and answers they cause to remain unspoken in the course of a week or a year.

Advertising the Public Service Commission.—The Public Utilities Commission of Idaho has issued an order requiring every public utility operating in that state to post notices to be furnished by the commission reading as follows: "Notice to the Public.—The Public Utilities Commission has jurisdiction over (1) boat, (2) electric power, (3) express, (4) gas, (5) railroad, (6) sleeping-car, (7) street-railroad, (8) telegraph, (9) telephone, (10) water, (11) warehouse, (12) wharf, rates, service and regulations, except those of cities and villages and mutual companies. If you have any question, complaint or suggestion as to any rate or fare charged, or as to the kind or adequacy of any service furnished, or as to the scope or effect of any regulation or rule, please inform the commission. We can help you only when we know your needs. Address, telephone or call on Public Utilities Commission, Boise, Idaho."

Hydro-Electric Project at Elephant Butte Dam.—A scheme is on foot to bring about the production of 33,000 hp. in electrical energy by the construction of three power plants on the Rio Grande—one at the Elephant Butte Dam, one at Tortugas and one at Canutillo. These plants, according to the promoters of the project, can be built for $4,000,000, will pay for themselves in less than ten years and thereafter will produce a net revenue exceeding $500,000 a year. The Elephant Butte Dam was completed under the auspices of the United States Reclamation Service in 1916 at a cost of $10,000,000 and has provided irrigation for approximately 80,000 acres of land. The proposal now submitted to the Reclamation Service is that if the United States will build a canal designed to double the present extent of the irrigation district, the farmers of the territory to be developed, in New Mexico and Texas, will finance and build the power system and furnish power to the government for the purposes of the project at cost. The city of El Paso will extend the canal to its boundaries and pay for its share of the benefits to be derived from carrying out the plan described.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Recent Institute Meetings.—On Monday last, Jan. 17, the Vancouver (B. C.) Section, A. I. E. E., listened to a paper by E. E. Walker on "Electrical Energy Rates." The speaker at the Pittsfield (Mass.) Section meeting on Thursday evening last, Jan. 20, was B. R. Baumgardt, whose topic was "On the Frontiers of the Universe, or an Evening with the Stars."

Coming Institute Meetings.—The subject of the meeting of the Chicago Section, A. I. E. E., to be held on Monday next, Jan. 24, will be "Research, a National Issue and How to Meet It in a Practical Way." On Feb. 28 this section will discuss "Dependence of Aërial Transport on Electricity." The Portland (Ore.) Section will meet on Monday, Feb. 7, when George Meyers will give an address on "Public Utility Financing."

St. Louis Section, A. I. E. E.—This section has elected as officers for the year 1921 J. L. Woodruff of the Century Electric Company as chairman and Walter H. Millan of the Union Electric Light & Power Company as secretary. The chairmen of the principal committees are: C. C. Robinson, meetings and papers; Stanley Stokes, membership, and C. H. Lankford, entertainment. Members of the section intend to nominate H. W. Eales, chief electrical engineer of the Union Electric Light & Power Company, for vice-president of their district.

Coming Meetings of Electrical and Other Technical Societies

Western Association of Electrical Inspectors—Detroit, Jan. 25-27. (For program see issue of Jan. 1, page 58.)

American Institute of Electrical Engineers—Chicago Section, Jan. 24; Portland (Ore.) Section, Feb. 7.

Association of Municipal Electrical Utilities of Ontario—Toronto, Jan. 27 and 28.

Association of Iron and Steel Electrical Engineers—Birmingham Section, Jan. 27; Philadelphia Section, Feb. 5; Cleveland Section, Feb. 14.

Indiana Engineering Society—Indianapolis, Jan. 27 and 28. (For program see issue of Jan. 15, page 168.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, Jan. 28.

Institute of Radio Engineers—New York, Feb. 2.

Florida Engineering Society — Lakeland, Fla., Feb. 7 and 8.

A. I. E. E., A. S. M. E. and A. S. C. E. (joint meeting)—Boston, Feb. 8.

New Mexico Electrical Association—Albuquerque, Feb. 14 and 15.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 14-17.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see issue of Jan. 8, page 111.)

American Physical Society—New York, Feb. 25 and 26.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Inefficient Operation.—Necessity for an electric plant to shut down a part of its service in order to furnish required energy for another service division can only be the result of inefficient operation, in the opinion of the North Dakota Board of Railroad Commissioners, where the plant is made up of two generating units rated at 75 kw. and 50 kw. and the highest load ever reached was 75 kw. and the average peak not more than 50 kw. or 60 kw.

Discontinuance of Steam-Heating Service Without Sufficient Notice Prohibited.—The Winona Electric Light & Water Company having asked permission to increase its rates for steam heating or else to abandon its heating service, the Indiana Public Service Commission ordered the service continued and the rates increased, declaring that inasmuch as the application had not been filed until the middle of August and the hearing was approximately thirty days thereafter it was not only difficult and expensive but in some cases would be impossible for customers to substitute individual heating plants before cold weather.

Where Electric Heating Service Is Discriminating.—In denying a petition from the Idaho Power Company to make a change in the application of rate schedules applied to domestic and commercial air and water heating the Idaho Public Utilities Commission asserted that the continuation of electric heating service would be discriminatory if the installation required to carry the heat load were demanded by other types of service and the heating service could not, because of its cost, be supplied at less than a prohibitory rate. An increase in electric heating rates was held to be equitable where the service was originally offered and accepted in competition with coal and the cost of coal had greatly increased since that time.

Cost of Fuel Affects Rate Fixing in North Dakota.—The North Dakota Board of Railroad Commissioners recently granted substantial increases in electric rates to the Union Light & Power Company at Fargo, the Red River Power Company at Grand Forks and the Northern States Power Company at Minot. In handing down its decision in the first-mentioned case, which has been reversed by the District Court and the case appealed to the Supreme Court, the commission said: "The commission appreciates and approves the purpose of this company of endeavoring to make a saving by securing at present prices the coal it shall require for the ensuing nine months. While it is not inclined to grant surcharges as a general principle, it is fully of the opinion that the emergency condition presented by this case is such as to require immediate action. The commission is in favor of the application of a surcharge inasmuch as it is disinclined at this time to make any change in the rate structure and steps on the present existing rates. The commission requires that the company exercise the best judgment possible in the purchase of its coal, that it profit at all times and whenever possible by adequate coal for its purposes at the lowest possible cost, and that it use every effort possible to secure its required fuel as near the point of consumption as possible in order to effect a saving in the freight charges."

Thirty per Cent Surcharge to Cover Transition Period of Municipal Plant.—The city of Oconomowac, Wis., having decided to abandon the operation of its steam-electric generating plant and to purchase all its electrical energy from a high-tension transmission line in the neighborhood, applied recently to the Wisconsin Railroad Commission for authority to increase its rates 30 per cent during the period that will elapse before the change can be completed, after which rates will once more be adjusted. According to the operating statement for the six months ended Aug. 31, 1920, as adjusted by the commission, the city had suffered a deficit of $3,281 before taking into account any depreciation charges or tax assessments. The commission on the showing granted the requested temporary surcharge, allowing it to be applied to minimum as well as to all other bills.

Municipal Plant Not Free from Need for Depreciation Reserve.—In granting to the city of Independence permission to raise its rates for electrical energy from 7 cents to 10 cents within and from 10 cents to 13 cents without the municipal boundaries, the Public Service Commission of Missouri took issue with the contention that a municipal plant does not need to have a depreciation fund. "The same necessity for a depreciation fund with which to make replacements exists with reference to a municipal plant as in a private plant," the commission declared, "and it is the practice to consider the necessity for such a reserve in fixing the rates of a municipal plant. It is a good business policy to treat a municipal plant as an enterprise separate and distinct from the municipality itself and to have accounts kept accordingly. If this policy is followed, the city should pay the utility at a reasonable rate for all service rendered the city, in order to avoid unjust discrimination in favor of the taxpayers of the city as against consumers. The utility, in turn, should pay the city a reasonable amount to cover local taxes and interest on the city's equity in the property, in order to avoid unjust discrimination in favor of the consumers as against the taxpayers."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Definition of "Proximate Cause."—"Proximate cause," declared the Court of Civil Appeals of Texas in a recent damage suit, "is that which in a natural and continuous sequence, unbroken by any new independent cause, produces the event, without which the event would not have occurred, it not being necessarily the cause which by measure of space or time stands next in proximity to the occurrence." (225 S. W. 421.)*

Utility Company May Sue to Establish Fair Rate.—Holding that the Public Service Commission has no power to make an order fixing a rate in excess of the statutory maximum, even though the statutory rate has been adjudged confiscatory and void, the New York Supreme Court (special term, Kings County) has also declared, in Morrell vs. Brooklyn Borough Gas Company, that under such circumstances the company may not resort to the common-law right of owners of public utilities within reasonable limits to fix their own prices for services rendered, but may bring an action in equity to establish a fair rate binding on public officers and consumers. It is an error to take the position that courts may determine that a rate is too low to be fair to the company or is too high to be fair to the consumer but cannot determine the rate that will be fair to both. (184 N. Y. S. 651.)

Climbing Decayed Pole Not Necessarily Negligent Act on Part of Lineman.—Failure of a lineman to examine a pole before climbing it does not necessarily constitute contributory negligence, that being a question for the jury, according to the decision of the Supreme Court of New Hampshire in Record vs. Manchester Traction, Light & Power Company. The company, appealing from a verdict for the plaintiff, had held that inspection of the poles had been turned over to the linemen generally, the company being thus absolved from responsibility for their condition. Evidence showed that it was the practice of the company to delegate linemen to inspect poles once a year, and the Supreme Court held that the lineman in the case under review had a right to assume the safety of the pole on which he was to work if it appeared sound and that the company was responsible for failure of the inspecting lineman previously to condemn the pole, as he should have done. (111 At. 629.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Homer Eldredge Niesz, by appointment of President Samuel Insull on Jan. 7, has become manager of industrial relations, in charge of the new industrial relations department of the



H. E. NIESZ

Commonwealth Edison Company, Chicago. Mr. Niesz is a member of that group of electric central-station men of the United States to whom the term "well known and well liked" may be truthfully applied. He was born at Canton, Ohio, and was graduated from Mount Union College in 1886. Soon afterward he went to Chicago and was engaged in electrical work as a wireman. In 1888 he became connected with the Chicago Edison Company, since succeeded by the Commonwealth Edison Company. For some years he was assistant superintendent of construction, and in 1899 he was advanced to be assistant to Louis A. Ferguson, then general superintendent and now vice-president of the company. On July 15, 1909, Mr. Niesz was made manager of the Cosmopolitan Electric Company of Chicago. Returning to the Commonwealth Edison Company in 1913, when the Cosmopolitan company was absorbed, he became secretary of the advisory committee and of the budget and expense committee. On April 1, 1919, he was appointed assistant to Vice-president Ferguson, a position he has now resigned to take up his new work. Mr. Niesz has been active and effective in many directions. He has been active in the National Electric Light Association for years, his memorable "question box" having been presented at the Denver convention of 1905. He was manager of the Chicago Electrical Show for several years and in 1911 was president of the Electric Club of Chicago. In 1913 he was chairman of the Chicago Section of the Electric Vehicle Association, and in 1914-1915 he served as reigning Jupiter of the Jovian Order, then a large, influential and prosperous national society of electrical men. Mr. Niesz is a member of a number of clubs and societies other than those mentioned, and he has written magazine articles relating to technical subjects and public utility problems. He is a man of ability and versatility, with a genius for friendship and conciliation which should stand him in good stead in the wide field of usefulness now opening before him.

W. L. Hillin, chief engineer of the Galveston (Tex.) Electric Company, has resigned and is now engaged in the automobile business at Navasota, Tex.

M. B. Wheeler, who recently resigned from the Dakota Gainaday Company of Sioux Falls, S. D., was from 1916 to 1920 associated with the American Utilities Company of Grand Rapids, Mich., being active as commercial agent with the company's largest subsidiary, the Wisconsin-Minnesota Light & Power Company, with general offices in Eau Claire, Wis. Prior to that time Mr. Wheeler was general sales manager of the Tel Electric Company of



M. B. WHEELER

Houston, Tex., and was prominent in electrical activities in the South. Mr. Wheeler is planning to enter the commercial side of electrical utility work. His address for the present is Hotel Carpenter, Sioux Falls, S. D.

W. G. Vincent, Jr., who has recently been promoted to the position of executive engineer of the Pacific Gas & Electric Company of San Francisco, will have charge of all studies made by the engineers of that company which pertain to the economic factors affecting its construction program, operation, valuation and rate making. Mr. Vincent was born in Louisiana in 1882 and was graduated from Tulane University, New Orleans, in 1902 and from Cornell University in 1904. He was first employed by the Telautograph Company to conduct its activities in San Francisco, resigning in 1905 to become assistant electrical engineer of the Ocean Shore



W. G. VINCENT, JR.

Railway of San Francisco. From 1907 to 1909 he engaged in consulting practice with Dean C. L. Cory of the University of California, and during 1909 and 1910 he was superintendent of the power and light works of the University of California. In 1911 and 1912 he was employed by the J. G. White Company as valuation engineer, being afterward transferred to the Pacific Gas & Electric Company as valuation engineer, a position he held until his recent preferment. Mr. Vincent has been very active in association work during the past few years and has just completed a term as chairman of the San Francisco Section of the American Institute of Electrical Engineers.

P. D. Gardner, formerly in charge of the new-business department of the Public Service Electric and Gas companies in Jersey City, N. J., has been appointed agent for the two companies at Bayonne, N. J.

E. A. Palmer has been appointed manager of the railway division of the San Francisco office of the Westinghouse Electric & Manufacturing Company.

William Baum, consulting industrial engineer with the Holeproof Hosiery Company, formerly in charge of the operating research bureau of the Milwaukee Electric Railway & Light Company, opened a consulting practice in Chicago on Jan. 3 as William Baum &

Company, industrial engineers. The firm will specialize in the development of industrial management systems and the betterment of industrial relations. Prior to Mr. Baum's connection with the Milwaukee Railway & Light Company he was for two years dean of the School of Engineering of Milwaukee and for thirteen years electrical engineer and European representative of the General Electric Company.

F. N. Averill, president of the Fobes Supply Company, electrical jobber with branches in Portland and Seattle, has been appointed chairman of the finance committee of the recently organized



F. N. AVERILL

Northwest Electrical Service League. Mr. Averill is well known in the Northwest owing to his active interest in association work. Recently he purchased for the Fobes Supply Company the Holabird Electrical Company, San Francisco.

Charles S. Voorhees, who has been associated with the sales organization of the Western Electric Company since November, 1895, has resigned as assistant telephone sales manager to assume the duties of general purchasing agent of the Western Union Telegraph Company. Mr. Voorhees entered the Western Electric organization as a boy in the cashier's office in New York. From that position he worked himself up through the switchboard and telephone sales departments into the executive department in 1908, when he became assistant telephone sales manager.

Garnet Blocksidge, railway department, Philadelphia office of the Westinghouse Electric & Manufacturing Company, has resigned to become sales engineer in the London office of the Westinghouse International Company. After graduation from the Virginia Polytechnic Institute in 1906, he joined the Westinghouse Electric & Manufacturing Company as a graduate student, remaining at East Pittsburgh until 1912, when he was transferred to the Baltimore office as salesman in the railway and light department. On Jan. 1, 1916, he was sent to Philadelphia.

E. W. Kendall, formerly in charge of the Boston office of Pass & Seymour, Inc., Solvay, N. Y., has been appointed general sales manager, succeeding F. S. Baldwin, who recently resigned. Mr. Kendall's experience covers the electrical contracting and jobbing fields. He was also associated with the Westinghouse Electric & Manufacturing Company in its Buffalo and Syracuse offices. Two years ago Mr. Kendall joined the sales organization of Pass & Seymour, Inc.

George C. Rough, president and director of the Packard Electric Company, Ltd., St. Catharines, Ontario, Can., having disposed of his interest, has resigned and terminated his connection with the company. Mr. Rough has been associated with the Packard Electric Company, Ltd., for nearly twenty years and worked himself up from salesman to chief executive. He will be remembered as a prominent Jovian, a member of several Jovian congresses and author of the French-Canadian dialect stories which appeared in the *Jovian Bulletin* before the war. He will soon leave on a business trip to Europe, and on his return will permanently locate in Montreal, where he will become actively engaged in electrical work.

Charles L. Cadle of Rochester, N. Y., has been appointed State Superintendent of Public Works by Governor Miller of New York State. Mr. Cadle is a graduate of the Case School of Applied Science, Cleveland. He is president of the Clark-Cadle-Harmon Manufacturing Company of Rochester, chief engineer of the New York State Railways, chief engineer of the New York & Harlem Railroad Company, first vice-president of the American Electric Railway Association, member of the Rochester Engineering Society and of the American Institute of Electrical Engineers.

F. S. Baldwin, who has retired as sales manager of Pass & Seymour, Solvay, N. Y., was recently tendered a farewell dinner by B. E. Salisbury, president of the company. At that time Mr. Baldwin was presented with a watch as a mark of the esteem in which he is held by his associates. E. W. Kendall, who has been manager of the Boston office of the company, succeeds Mr. Baldwin as sales manager.

Frank D. Fagan, who holds the position of vice-president and general manager of the Edison Storage Battery Company, came East from San Francisco last fall to take up those duties.



F. D. FAGAN

Mr. Fagan was born in California, and previous to his connection with the Edison Storage Battery Company he was manager of the lamp department of the General Electric Company. Mr. Fagan is well known on the Pacific Coast for his activities on various committees.

Obituary

Dr. William Robinson, inventor of the closed-track-circuit semaphore system for use on steam railroads, the coaster brake on bicycles and the Robinson radio truck used on trolley cars to enable them to get around curves and narrow switches, died Jan. 2 in Brooklyn, N. Y. Dr. Robinson was eighty years old. In 1878 he organized the Union Electric Signal Company, of which he was president, and later sold it to George Westinghouse. He was graduated from Wesleyan College in 1868 and at a later period received the degree of Ph.D. from Boston University.

George A. Cragin, formerly assistant general sales manager American Steel & Wire Company, Worcester, Mass., and general sales manager of the wire rope division of the National India Rubber Company, Bristol, R. I., died at Worcester on Jan. 3. He was born in Chicago fifty-seven years ago and was at one time president of the Electrical Manufacturers' Club.

Dr. Alexander Muirhead, a pioneer in telegraphic science, well known for work in connection with transmission, retransmission and reception on submarine cables, died in England on Dec. 13 at the age of seventy-two. He was born in Scotland and in early life did laboratory work under Dr. Matthiesen and work on electrical standards for Latimer Clark. In 1874 he carried out, in conjunction with the late Herbert Taylor, experiments to solve the problem of duplexing long submarine cables. They established the first ocean system of this kind between Ireland and Nova Scotia in 1878. About 1896 Dr. Muirhead became associated with Sir Oliver Lodge in developing the Lodge-Muirhead system of wireless telegraphy. He was a Fellow of the Royal Society.

Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Open versus Closed Shop Question Nearing Critical Stage

WHILE on the surface industrial conditions appear to be dull and quiet, there is an undercurrent of strife that has potential possibilities of becoming of tremendous national importance. The question of open shop versus closed shop is the point at issue.

There are other and equally important reasons for the coming strife besides the one just suggested. First, the greatest industrial employer, the United States Steel Corporation, refused to have anything but an open shop. This organization won out and in so doing made it apparent to other large employees that an open-shop plan was possible. Secondly, the courts have within the past few weeks taken from organized labor one of its most feared weapons—the secondary boycott.

Organized labor has sensed the situation and has called a meeting for Feb. 23 in Washington of representatives of 109 national and international unions affiliated with the American Federation of Labor "for the purpose of considering attacks now being made on the trade union movement."

An indication of how the manufacturers are lined up on the subject may be gained from the following resolutions, which were adopted last week in Chicago by a vote of 36 to 27 (half the assemblage voting) of the National Conference of State Manufacturers' Associations:

"It is recognized as fundamental in this country that all law-abiding citizens or residents have the right to work when they please, for whom they please and on whatever terms are mutually agreed upon between employee and employer and without interference or discrimination upon the part of others.

"We hereby express our purpose to support these fundamental principles of the American plan of employment by the maintenance of the open shop.

"We urge upon our members to secure by discussion and education the active support of workers, merchants, bankers and professional men and all other elements of their prospective communities in favor of American ideals and the open shop."

In the discussion as to the meaning of the open shop the definition given by A. J. Allen, secretary of the Associated Employers of Indianapolis, seemed to meet the general view. This was based on a definition given in "United States Bulletin 46" in the case of a coal miners' labor dispute a few years ago. According to this definition the open shop implies that it is the right of the laborer to enter into any wage contract with any employer without regard for any union and that he may work in any plant without the use of a union card or working permit.

Heavy Sales of Watt-Hour Meters

DEMAND for watt-hour meters has held up so strongly that consumers are being forced to enter the market as long as six months in advance of their immediate needs in order to insure delivery. The largest proportion of the buying, it is stated, comes from central stations. Manufacturers are gradually cutting down the number of their unfilled orders, it is true, for production capacity has been on the increase these past few months with better labor, raw material and shipping conditions. Then, too, the demand for watt-hour meters, while large at present, is naturally not so great during the winter season as it was some time ago. Stocks of the finished product, however, have not as yet and will not for some time start to accumulate.

Deliveries vary considerably according to the size of meter and the manufacturer. On single-phase watt-hour meters the best delivery that can be promised is six weeks, and deliveries range as long as twelve weeks. Polyphase meters are quoted from six to twenty weeks, and the direct-current type from five to ten weeks. Manufacturers are steadily increasing their production and these figures are expected to improve. One of the large producers that was turning out only 12,000 meters per week, and even considerably less than that last summer, is now producing at the rate of about 20,000 meters each week. The raw material supply is good and labor conditions are, of course, favorable.

Prices have held stationary since increases effective the early part of last May were made. Little likelihood of lower prices coming about very soon is seen as labor and material costs are reported to remain high. Optimism is the general keynote expressed regarding pospects for good sales in this line throughout 1921. If the building industry takes a boom commensurate with the need for housing that exists, meter sales will undoubtedly be heavy.

Brighter Market for Farm Plants Foreseen in Northwest

CERTAIN jobbers and dealers in the territory contiguous to Seattle and in Seattle are making optimistic statements regarding prospective sales of farm-lighting outfits. Up to date, sales have been light—much less than originally predicted—but it is believed that a change for the better will be manifested immediately.

The reason for this optimism is that the farmers in this section, sensing the futility of longer holding their produce, principally fruit, wheat and potatoes, have begun selling and already are making inquiries looking toward buying farm-lighting plants.

The various outfits have been well advertised during the past two years at the county and state fairs; the field work has been well done; nothing remains but signing the contracts for installation. Speaking as a whole, the jobbers and dealers are stocked sufficiently to meet all demands. Many jobbers, in an effort to stimulate sales, are guaranteeing against any price reduction prior to June 1.

Development of Japanese Market Expected by Summer

THAT Japan is in the market for electrical apparatus and supplies is well shown by the number of Japanese engineers who have been traveling through the United States during the past year, inspecting large hydro-electric stations and visiting manufacturing companies. Electric apparatus manufacturers and importers consider the market in that country with considerable optimism in view of the orders which have already been placed, and particularly because of several large propositions for hydro-electric development and railway electrification which are expected to break along in the middle of this year. A few of these have been held up temporarily. Specifications on these new propositions will probably be finished within the next few months, based on the data and findings of the visiting engineers to America.

It is understood to be the plan of the Japanese government to take over the operation of electrified railways and of central stations, although no final word has been received that this plan has been consummated. Consideration has been given it by governmental authorities. One of the plans embraces a hundred-million dollar corporation, one-half government, the other half private capital. At least the government is morally behind the electrical development of the country.

Improvement has been noted in the financial condition of the country. Electrical exporters and manufacturers have reported little difficulty in getting quick payment for goods shipped. Cash on bill of lading at the dock or a certain percentage with the order, more at the dock, further payment on receipt in Japan and final remittance when apparatus is in operation may be termed ruling methods of payment. There seems to be plenty of money in the banks in Japan, but comparatively little that can be pried away for developments. Conditions in this respect are not so different from those existing in the United States. The exchange rate is considered favorable.

Present Prices of Motors in Germany

FROM information just received from Germany it is interesting to note the prices for which electric motors are sold in that country. These are given in marks in the table below. A three-phase, 1,500-r.p.m. motor of 5-hp. capacity is quoted at 1,130 marks plus an addition of 550 per cent, which, at an exchange value of 2 cents per mark, would bring the figure to $146.90. A 30-hp. motor, same rating, at 3,600 marks, would be valued at $504. From the speed given these motors undoubtedly are for 50 cycles, while the American standard is 60 cycles. For purposes of comparison a 5-hp., 60-cycle, 1,800-r.p.m., three-phase, 220-volt motor of American make is being quoted at about $130, pulley and base included. Similarly, a 30-hp. motor, also without starter, is quoted around $340.

Horsepower	Revolutions	Price in Marks — Three-Phase	Price in Marks — Direct-Current	R.p.m.
0.5	1,500	290	485	....
1	1,500	440	620	....
2	1,500	520	920	....
3	1,500	640	1,010	....
4	1,500	1,010	1,140	1,800
5	1,500	1,130	1,430	1,500
10	1,500	1,820	2,320	1,300
15	1,500	2,320	3,150	950
20	1,500	2,800	3,640	900
30	1,500	3,600	5,270	850
40	1,500	4,400	..	..
50	1,500	5,000	..	..
60	1,500	5,800	..	....
75	1,500	6,840	.	..
100	1,500	8,480	..	..

To the above prices the following increase has to be added:
Motors up to 20 hp., 550 per cent; motors, 20 hp. to 100 hp., 600 per cent.

Jobber May Be Manufacturer Under Excise Tax Change

IN REGULATION 47, just issued, the Bureau of Internal Revenue places certain constructions upon the meaning of "jobber" whereby jobbers may be put in the class of manufacturers for the purpose of the tax. Article 7 has been modified to provide that while a manufacturer is generally a person who actually makes a taxable article, or by the combination of two or more articles produces a taxable article, or by the combination of two or more articles produces a taxable article, under certain circumstances such a person is not a manufacturer for the purpose of the tax; but that if a dealer or jobber owns a patent, trademark, formula or recipe for a taxable article and contracts with another person or firm for the manufacture thereof, the contract specifying that the article can be manufactured only for such dealer or jobber and that it will be sold by such dealer or jobber as the manufacturer, the dealer or jobber is held to be the manufacturer for the purpose of the tax.

Furthermore, Article 34 has been revised to permit a manufacturer who is also a retailer to arrive at an average wholesale price, for purposes of fixing his tax on his retail sales, by taking his actual wholesale sales for a given month and using this average until such time as his records show a material change.

These changes affect certain jobbers of electrical supplies who sell their own trademarked articles and certain manufacturers who retail.

Fair Volume of Commercial Glassware Trade

A GOOD year ahead is seen by manufacturers of lighting glassware for commercial buildings. At the present time the larger mills are working full time, as a whole, although some of the smaller properties are closed down for a short time. There is always a regular volume of business coming through because of building changes and alterations, and right now there are quite a number of new constructions just coming into the lighting glassware stage. At the same time back orders are still running through the mills in fair volume.

The pressure is off the buying at this time, it is true, and the mills can begin to make shipment in two and three weeks, depending on the amount of special finish required on the glassware.

There is plenty of labor available, and raw materials provide no delay in production. The only exception reported is the shortage of natural gas in certain Mid-Eastern states, necessitating rationing for industrial use. German clay is again on the market for use in making the melting pots, the breaking of which when domestic clay had to be used caused needless expense and delay.

Foreign business is quiet, but is still holding up to some extent.

Metal Market Situation

A LITTLE better tone is noticeable in the copper market, such that producers hesitate to quote spot delivery under 13⅜ cents a pound. For February, March and April their prices are from 13¼ to 13½ cents. Some sales were recently made for first-quarter delivery at 13¼ to 13⅜ cents. At the same time producers are unwilling to sell to any but consumers, and the outside market is very desirous of getting the metal.

The demand from domestic sources has improved, and along with it have come some sales to Europe.

According to the United States Geological Survey, exports of refined copper for 1920 amounted to 610,000,000 lb., while there went into domestic consumption 910,000,000 lb. To these estimates the Survey adds that of refined copper stocks on Jan. 1, 1921, as 684,000,000 lb.

Lead is holding a strong market. Buying was active a week ago, but it is somewhat off now. With the official price at 4.75 cents in New York, the outside market is holding for 5.10 to 5.20 for prompt, and a good deal of the business is going on among these buyers.

NEW YORK METAL MARKET PRICES

	—Jan. 10, 1921—	—Jan. 18, 1921—
Copper	£ s d	£ s d
London, standard spot	74 0 0	70 7 6
	Cents per Pound	Cents per Pound
Prime Lake	13.75	13.75
Electrolytic	13.00 13.25	13.00 13.12½
Casting	12.75	12.75
Wire base	16.25	15.75
Lead, trust price	4.75	4.75
Antimony	5.15	5.10
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Zinc, spot	6.00	5.95
Tin	38.75 39.00	35.00
Aluminum, 98 to 99 per cent.	28.30	22.50-23.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.00-10.75	11.00-11.25
Brass, heavy	6.00 6.50	6.00 6.50
Brass, light	4.00- 4.50	4.00- 4.50
Lead, heavy	3.50- 3.75	3.75- 4.00
Zinc, old scrap	3.00- 3.25	3.00- 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

IN CERTAIN parts of the country, as reported from Atlanta, Boston and Chicago, there is a little better inquiry in the jobbing field and to a small extent better buying, but in general the electrical trade is quiet. Conditions are reflected in the labor situation, the number of men being released increasing as the weeks go by. It has been found necessary for the largest electrical manufacturer to cut his forces about 10 per cent because of decreasing business. Other producers have been cutting forces or reducing wages to a limited extent. At the same time, there is more activity in the textile field, and this has caused better inquiry in the industrial lighting and in the motor markets.

Prices continue on a downward trend, easier quotations having been reported on rubber-covered wire, loom, conduit, flexible armored conductor and insulation; at the same time no radical changes have been announced. Stocks are being kept only up to day-by-day demand, and this is done with ease except in the case of porcelain ware; conduit is better and sufficient for current needs.

No better collections are reported, and in some cases they are not all that could be desired. From the Northwest is reported the liquidation of some of the smaller electrical dealers because of decreasing prices and light trade.

NEW YORK

Spasmodic buying in an otherwise listless market characterizes the trade at present. Prices in some instances seem to be touching bottom, but there is no inclination to increase stocks and both jobbers and dealers are keeping their purchases down to the narrowest margin of current requirements. Shading of prices to stimulate sales is not uncommon, especially in the case of those stocks which are long.

Noticeable activity in the demand for industrial lighting fixtures has appeared, which is attributed to the textile industries resuming operations. There is a general impression that other industries are coming into the market, particularly for maintenance supplies, indicating that manufacturing activity is opening up.

While there is a considerable amount of building in the electrical stage the demand for wiring supplies is negligible, and as might be expected at this time little new construction is being started. Stocks of all materials, with the exception of porcelain, are plentiful for the present demand and prices are soft. Should there be a renewal of building operations it is predicted in several quarters that there would be a sudden upturn in prices with a considerable shortage along some lines. Collections have shown no improvement, and up to ninety and 120 days have been reported in some cases, although sixty to ninety is nearer representative.

Conduit.—Manufacturers' price reductions were reflected in jobbers' prices this week. Quotations on ½-in. black pipe ranged from $70 to $79 per 1,000 ft. and $85 in small lots. Prices vary considerably, depending on the stock to be moved. Demand continues small, with a plentiful supply of all sizes.

Rubber-Covered Wire.—There is little or no demand for the large stocks which are being carried and prices are unsteady. On No. 14 in 10,000-ft. quantities quotations can be had from $7.50 to $8.50 per 1,000 ft.

Flexible Armored Conductor.—This market was broken last week owing to unloading of surplus stocks. Nominal quotations by jobbers are from $62 to $65 per 1,000 ft. for No. 14 two-wire, although a price slightly under $60 has been reported. Stocks are long, with demand from slight to nothing.

Heating Appliances.—Price reductions by manufacturers as reported became effective on Jan. 15. Demand has shown no increase, and there is a tendency on the part of dealers to mark time. Stocks are ample, and buying is in small quantities to meet immediate requirements.

Heaters.—Jobbers report long stocks with light demand on account of open winter. Present indications are that there will be a considerable quantity carried over.

Weatherproof Wire.—Prices are nearly uniform, leading jobbers quoting a base price of 21 to 22 cents. Stocks are ample, but sales are light as requirements along this line are small in this section.

Outlet Boxes.—Prices remain unchanged and stocks are comparatively low. Supply about equals demand, and no surplus is reported.

Non-Metallic Flexible Conduit.—Stocks are ample, but demand is always small. Nominal quotations range from $22 to $27.50 per 1,000 ft. for the ⅜-in. size.

Vacuum Cleaners.—No change in price has been reported in this line and sales are slow. Jobbers' stocks are long and dealers are inclined to await developments.

Washing Machines.—Sales are light all along the line, and stocks are kept at a minimum. No change has been noted in prices.

CHICAGO

Increased activity, mentioned last week as being confined largely to inquiry, is still thus limited. The volume of inquiries being received by most jobbers is quite large and is spread over the entire range of electrical goods. Most interest is shown in inside wire, schedule material and residence fixtures.

Architects throughout the district report that many clients are asking for estimates on proposed residences and small flat buildings. Prospective builders are now shopping to find if the recent widely heralded price reductions in all lines are so distributed as to justify their proceeding with building plans. Unfortunately, most of this shopping results in a decision to wait a while longer, for in spite of radical cuts in lumber building cost is still very high.

Retail trade is active in that many clearances are under way. No price cutting is in evidence, particularly on standard lines. Jobbers report that few orders outside of routine replacements are being received from dealers. No price changes have been reported in the manufacturing or jobbing end of the business.

Motors.—Stocks are still spotty, but most sizes are readily obtainable. Sales are at a low figure and inquiry on this line is only fair.

Meters.—Deliveries remain some weeks behind orders, and from the volume of inquiries it is thought that this condition will continue indefinitely. Central stations are unable to obtain meters in sufficient quantities to supply their needs, and the building up of stocks by jobbers is out of the question.

Transformers.—Some improvement in sales of transformers for farm-line equipment is expected, and some inquiry has been noted in the past few weeks. Prices are firm, and with the establishment of the idea that no radical reduction can be expected good business should result. Deliveries are quoted from ten to fifteen weeks.

Safety Switches.—Supply is getting easier, most suppliers being able to fill orders from stock or on short notice. Demand remains about normal, with no indications of a change in conditions.

Locknuts, Washers, Bushings.—Many inquiries are being received on this class of material, but few actual orders are placed. In most cases stocks are in excellent shape. In general prices are firm at old levels.

Knobs and Tubes.—Production remains on a low scale compared with the needs of the market. Owing to the light

sales of the past few weeks jobbers are being enabled to build up stocks, but in most cases they are not yet what they should be. Prices are unchanged.

Household Appliances.—Electrical goods remain in fair demand, with no price shading in evidence. Makers and distributors of washing machines report the week's business as good. Considerable sales effort is being made with encouraging results. The feeling throughout the industry here is that prices are going to remain where they are.

BOSTON

Little change has occurred during the past week in trade conditions, but sentiment is a bit more hopeful. Small orders are increasing somewhat. Building and engineering contracts in New England for the week ended Jan. 11 totaled $2,715,600, a gain of $50,000 over the preceding week. Wage difficulties at Boston present an unstable situation, with a threatened protracted slow-down of building operations, which may, however, be averted at the last moment. Contractor-dealers are buying little from the jobbers, but orders from large industrial plants are coming in fairly well. A moderate amount of central-station purchasing is reported, but as a whole the war-time policy continues. Prices are holding up firmly.

Collections are giving distributers some trouble, but the situation is not alarming where active follow-up work has been done. Stocks are over full in many cases, but in others the bins have been allowed to dwindle so much that considerable hand-to-mouth buying with small order shipments by mail is in evidence. Price guaranteeing has clearly stimulated some trade.

Wire. — Stocks are easily meeting current demands. Rubber-covered No. 14 sells for $8.50 per 1,000 ft. in 10,000-ft. lots. Weatherproof base holds at 20 cents and bare base at 18 cents.

Non-Metallic Flexible Conduit.—Sales were made at the rate of $22.50 per 1,000 ft. in the ½-in. size early in the week. Not much ⅝-in. was moving but the Boston price Monday was $25 per 1,000 ft. Stocks are plentiful and demand is easy.

Tape.—A little friction tape is moving around 50 to 52 cents per pound in 100-lb. lots, ¾-in. black. Compound is quoted about the same.

Sockets.—In case lots pulls are selling at 48 cents net, keys at 27 cents and keyless at 26 cents. It is reported that the 250-unit standard package of ⅛-in. cap pulls has been restored after a few days' trial of the 500-unit package. The convenience of the smaller package was undoubtedly a factor in this change.

Knobs and Tubes.—This material is in quiet demand without further price changes. "Nail-its" are selling at $27 per 1,000 in barrel lots and 3-in. tubes are moving sluggishly at $11.35 per 1,000. No trouble in getting porcelain supplies has been reported of late, with the exception of insulators.

Insulators. — Porcelain insulators are very scarce, one large house being cleaned out on Monday. Glass insulators are far from plentiful, but were selling early in the week at 15 cents net in barrel lots, 600-volt rating.

Rigid Conduit.—Well-rounded stocks now exist. There is an occasional break in sizes, but deliveries are excellent in relation to the present moderate demand.

Radiators.—Jobbers and retailers are well stocked; trade is a little quiet, barring a fair amount of staple business.

ATLANTA

Reports from jobbers indicate that the end of the holiday season brought with it a noticeable revival in their line of business, orders being received consistently, primarily for materials for current needs. There is also a fair volume of orders to replace depleted stocks. The latter class is showing a slow but continued increase. While construction in the section as a whole is at a low ebb building in Atlanta is on the increase, quite a healthy volume of construction, both of the residential and commercial type being proposed and under way. The strike of the building trades mentioned last week has served to check construction on one or two of the larger buildings, but has not interfered with activities as a whole. Quite a number of inquiries for transmission-line material in large quantities are being received, several of the inquiries being for high-tension construction. Hesitancy is to be noted in the placing of heavy orders, as there seems to be a feeling that prices in general will shortly reach a lower plane.

The credit situation, especially in the rural districts, seems to be on the road to permanent improvement, even though farmers as a rule are loath to release their cotton at the present low price of 14¾ cents. The movement of cotton, however, is in excess of what it has been for some weeks past.

Meters.—Manufacturers have not been able to fill all back orders, and some difficulty is reported in obtaining instruments of the popular sizes in sufficient quantities for immediate needs. Practically no stocks are on hand and shipments continue to be quite long.

Wire.—Orders are being placed in greater volume, thus reflecting the opinion that wire prices have reached their low ebb. Sizes of from No. 14 to No. 40 are moving fairly well, with rubber-covered on 18-cent base and weatherproof on 23-cent base.

Conduit.—No heavy stocks have been accumulated; in fact stocks of the popular sizes continue to be somewhat spotty. Prices are down approximately 12 per cent, quotations on lots of 2,500 lb. being: Galvanized, ½-in., $8.49; 1-in., $16.66; 2-in., $36.27.

Heating Devices.—Socket heating devices continue to hold up unusually well for this period of the year, flatirons being as usual the best seller. Stocks, with the exception of hollow ware, are in excellent shape. No reductions in prices have as yet been reported.

Air Heaters.—The recent cold snap has stimulated the sale of these heaters, and retailers report that this winter will undoubtedly make a record in the volume of sales. Local stocks are in good shape.

Electric Ranges.—One of the largest jobbers reports quite a movement in this line, most of the shipments going to Florida territory. The high price of fuel undoubtedly accounts for the demand being so well sustained. Local stocks are in excellent condition.

ST. LOUIS

Another quiet week has been passed by local jobbers and manufacturers, though reports from some sources place the amount of orders billed and new orders received as ahead of that of the previous week At the present rate the volume of business for January will be behind that of December and from 15 per cent to 25 per cent below that of January, 1920. Caution seems to be the watchword on every hand, and though much confidence is expressed in the future there are very few who are willing to place orders or come back to normal production at present.

That production has decreased materially here is shown by the Department of Labor survey just completed, which estimates the number of unemployed in St. Louis as 40,000. The electrical industry is not so seriously affected as some others. Two large motor manufacturers have just completed additions to their plants, and their production has been curtailed very little. Transformer factories are operating at about normal capacity. Taken as a whole, it is estimated that electrical production locally has shrunk from 10 to 20 per cent.

Local power sales are reported to have shown a slight decrease due to the decreased industrial activity. Local jobbers report the same condition prevailing generally among their utility customers in the St. Louis trade territory. In spite of this the utilities are proving the most consistent buyers, though they buy usually for immediate needs only. Sales to industrials have been low for some time. Contractors are still doing a fair amount of work, but their needs have been cut also. The collection situation has not become any worse during the past week, seventy days being a good average. Talk is heard of money becoming easier, but this has not been reflected in collections.

Poles.—Demand is characterized as fair to good, with much of the buying coming from the railroads and a smaller percentage from central stations and telephone companies. Practically all jobbers have complete stocks of all sizes and can make immediate deliveries on large quantities.

Line Hardware.—Stocks are all good. Demand is not quite so good as it is for poles, but stocks are moving.

Motors.—Jobbers report a good movement of popular sizes and report also that they have more complete stocks of those sizes now. By shopping around buyers now can get whatever size and type they want in any reasonable quantity. There is very little movement of fractional motors.

Lamps.—Lamps are moving well, though the demand is not up to that of last year. Lamps for street lighting are moving steadily. Stocks are very complete.

Wire.—Rubber-covered No. 14 is being quoted around $8.75 per 1,000 ft. with small demand. There are very few prices below this. Weatherproof is being quoted on a 17.5-cent base.

Fixtures.—The volume of orders for special designs continues to overshadow the call for standard lighting units.

Lamp Cord.—Jobbers have large stocks of both the silk and cotton cord. Movement of both is slow.

Guy Wire.—The shortage of guy wire seems to have been alleviated recently, some jobbers reporting an ability to get immediate delivery on all they want. There is a fairly good demand from central stations, whose needs for this item went unfilled during the fall.

SALT LAKE CITY—DENVER

A co-operative drive to stimulate the householders' interest in more electrical outlets is now on in the jobbing centers of the Intermountain district. The impetus for the campaign came from the Pacific Coast, where co-operative work of this kind has proved signally successful. The plan at present is to use the direct-by-mail appeal to the housewife and later to extend the scope on publicity work.

Consumer buying has not increased in volume to an appreciable extent, although most dealers are hopeful of improvement in the market in the near future. Liberal time-payment contracts are now the rule. A representative dealer reported that his 1920 business was on a 25 per cent cash basis. Persistence in making collections is therefore a vital part of every merchant's business operations.

Heater Cord.—Consumer demand is steady and satisfactfactory, No. 16 retailing at 25 cents a foot. There is no trouble in keeping stocked.

Lamp Cord.—Demand is good and stocks are plentiful, No. 18 cord selling at 5 cents a foot.

Toaster Stoves and Grills.—Not much consumer interest is being manifested. Jobbers and dealers report stocks ample.

Bell Transformers.—Dealers that push the line report many installations for doorbell service. Standard types, installed, cost about $5.

Two-Way Plugs.—The demand is large and constant and orders are filled quickly.

Key Sockets.—These are not moving well during the period of inactivity in building. Retail price is 65 cents.

Motors.—There is little activity and jobbers are prepared to meet demand. Dealers are not disposed to stock heavily.

SAN FRANCISCO

The rainfall that has extended pretty generally over the state has continued the good wetting that should make 1921 a banner year for crops. A heavy snowfall on the Sierras is reported.

The tens of thousands of extra horsepower soon to be marketed by the Great Western Power Company and later in the year by the Pacific Gas & Electric Company will be the cause of energetic campaigns for its distribution. First of all must be served the irrigated districts and districts not previously reached through shortage of power. Such is the case in Kern County, where the San Joaquin Light & Power Corporation is reaching out to districts newly planted with cotton.

An instance where building is so necessary that it must be carried out may be noted in a new project reported from Santa Barbara, where it is proposed to construct about 200 homes at an average cost of $5,000 each.

Wire and Cable.—Telephone wire in the No. 19 size, commercial grade, is selling for $13.10 per 1,000 ft. in 5,000-ft. lots. The No. 18 size, 100 megohms, which is approved by the telephone company for use on concealed circuits connected to its system, is selling for $22.30 per 1,000 ft. with a 5 per cent advance over this 5,000-ft. price for 1,000-ft. quantities. These prices have been fairly steady, barring slight adjustments, for several months. No. 14 solid, single-braid, rubber-covered wire is now selling for $10.25 per 1,000 ft. in coil lots or $9.75 per 1,000 ft. in 5,000-ft. lots assorted with other sizes. Local stocks are very good but not alarmingly heavy.

Boxes and Covers.—Standard package prices are now list prices for galvanized with a further 5 per cent for black finish. These prices have been generally effective since last September, despite recent conduit decreases of 5 per cent and a drop of 12½ per cent on bushings and locknuts.

Batteries.—After a period of stagnation, because the automobile business was the first of the big industries to be affected by the pinch of retrenchment, the storage-battery market has been marked by recent sharp decreases.

SEATTLE—PORTLAND

With inventories which, because of price declines, have required more than ordinary care and thought out of the way, the electrical industry has turned to the task of getting new business in a more cheerful frame of mind and with rather better results than might naturally be expected. In other business and in financial lines there is also manifested a more cheerful feeling now that sales to establish losses have been made and covered. Both jobbers and dealers in the Puget Sound district report that trade during the past week showed considerable improvement over the previous week, although the sales volume is still extremely light. Certain lines of electrical appliances have dropped in price and other types are expected to follow. With but few exceptions stocks are in excellent shape. The credit situation is very tight, but collections continue reasonably good. Reports from various sections in the Northwest show slight resumption of operation in lumber mills. Production is estimated at 66 per cent below normal as compared with 76 per cent for the second week in January.

There is a general feeling from manufacturers down that there will be a gradual price reduction during the next few months but that no radical changes will be made. Plans are being made for considerable business, which is expected to develop in the spring. Lumber mills throughout Oregon are opening up slowly. Some woolen mills are continuing operations at reduced wages, and wheat is beginning to move because farmers are hard pressed financially. Jobbers in Portland report business slack, about one-third that of early December. There is a continuous downward tendency in price of wire, and reductions are also noted in pole-line hardware of from 5 to 10 per cent and also in sockets. Stocks are reported far ahead of a year ago and are very uniform, nearly all lines being in good shape with the exception of insulators. The credit situation is very tight, with practically no loans being extended and collections exceedingly slow. There have already been some liquidations and probably will be more inside the next two or three months, those concerned being the smaller dealers who are unable to stand the strain of decreasing prices and poor trade.

In Portland vacuum cleaners and washing machines are not very active except for one or two types in general stock. The recent drop in washing machines has stimulated trade. Wire manufacturers will not accept future orders on any guaranteed price. Shipments have improved from six and eight months down to four and five months, but prices are unstable. Schedule-material stocks as well as shipments are improving in many lines, although stocks are somewhat spotty at the present time.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and Record of New Devices and Trade Literature

Hygrade Lamp Company Gets $50,000 Contract

A contract for about $50,000 worth of lamps has been secured by the Hygrade Lamp Company, Salem, Mass., covering the requirements of the Boston & Maine Railroad for about a year. The lamp company has just resumed operation on a two-thirds-time basis and reports that its 1920 business exceeded that of 1919 by about 50 per cent.

Wetmore-Savage Company Enlarging Quarters

The Wetmore-Savage Company, Boston, is enlarging its quarters to afford about 25 per cent more room, and to effect this has taken the entire building adjoining the offices of the company at 76 Pearl Street and is now remodeling one floor for increased office space. The total space occupied when this work is completed will be about 125,000 sq.ft.

New Miniature Lamp Packing Effects Economies

Following the adoption last summer by the Westinghouse Lamp Company of a new method of packing S-11 automobile headlight and spotlight miniature bulbs, it has definitely been determined that breakage has been greatly reduced. In applying this packing to candelabra lamps it is reported that breakage has dropped from a previous figure of about 30 per cent under the old method of packing to virtually nothing under the new.

The new method embraces the wrapping of each lamp in a separate corrugated paper and soft, tough paper package, with ten lamps to a carton instead of five. The Edison Lamp Works are about to use rather similar packing, tests on which show a saving of about 40 per cent in weight and about 60 per cent in space. It eliminates the use of excelsior and admits of making up an assortment of lamps easily and quickly. The flashlight, automobile side, instrument and tail-lamps will be placed in trays with holes opposite one another instead of staggered.

Waterwheel Manufacturer in New Quarters

James Leffel & Company have recently completed and occupied an entirely new factory and offices in Springfield, Ohio. The main factory is 75 ft. wide by 800 ft. long, from which extend the boiler shop, power plant, foundry, pattern shop, pattern storage, warehouse and garage. Concrete, steel and glass form the construction, while wood block floors are used on concrete foundation.

National Lamp Advertising for Half Year Issued

Following a plan similar to the one tried during the last half of 1920, the National Lamp Works has put out a "Right Book" outlining its advertising plans and features for the first six months of the present year. Formerly the company published each month a folder illustrating the month's advertising and dealer tie-ups. Postcards in the back of the book can be used for current helps.

Dodge Company Sells National Advertising to Employees

A variation in national advertising which the Dodge Manufacturing Company, Mishawaka, Ind., finds is working out with success is that of selling its national advertising to its workers by means of billboard displays. The underlying idea, of course, is to stimulate morale and pride of craftsmanship in the company's employees. The interest displayed by the men at plant No. 1, where the billboard was erected reproducing the double-page spread entitled "Faithful to All Industry," which appeared in a national publication last September, has convinced the Dodge company that its idea is fundamentally sound. The erection of other billboards at the various plants of the company is being planned.

Accused of Making Contracts Preventing Use of Competitors' Equipment

The Federal Trade Commission at Washington advises that, upon application for the issuance of complaint, the Federal Trade Commission has, as required by law, the public interest appearing, cited the Western Electric Company, Inc., New York City, in complaint of unfair competition in the sale of telephone equipment in interstate commerce.

This citation is for the use of "tying" contracts. By these contracts, which are made with the "Bell System" and with many independent telephone companies for the sale of equipment upon the condition that these companies will not use the equipment of any competitor of the Western Electric Company, it is alleged, the Western Electric has created for itself a monopoly in this line of commerce.

Further averment is that false statements are made to induce the making of the "tying" contracts and to procure the cancellation of contracts between competitiors of this respondent and independent telephone companies. Forty days are allowed in which to file answer, after which the case comes on for trial.

Wage Cut of 20 per Cent at Remy Works

The Remy Electric Division of the General Motors Corporation, Anderson, Ind., announced a general wage reduction of 20 per cent recently. The service department was the first one affected. It was reported at the factory office that fewer than 100 men were called back to work in the service department, that other departments will probably not resume operations before Feb. 1, and that a wage reduction of 20 per cent would apply to all departments. The Remy company was employing 1,000 persons when it shut down early in December. Two years ago the same plant employed more than 3,000 persons.

Waterwheel Maker Eliminates Union in Dealing with Men

Because of the action of 500 workers of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, maker of the I. P. Morris hydraulic turbines, in going on strike on Dec. 22, announcement is made that the agreement of a year ago with the metal trades department of the American Federation of Labor has been discontinued. Consequently, it is stated, relations between employer and employee will no longer be carried on through a representative of the union, but by direct intercourse.

General Electric Finds Cut in Force Necessary

With a payroll reported to be the highest in its history, and with bookings of new business at a rate of about $200,000,000 at this time, while early in 1920 they were at the rate of about $350,000,000, it is not surprising to learn that the General Electric Company finds it expedient to make reductions of about 10 per cent in the working force in the factory departments of its various apparatus and supply plants. At the same time there is a sufficiently large volume of back orders to keep the plants working for several months.

Maker of A B C Laundry Equipment Issues $550,000 Bonds

An issue of $550,000 in first mortgage 8 per cent sinking-fund ten-year convertible gold bonds is being offered by Altofer Brothers, Peoria, Ill., maker of the A B C electric clothes washers, wringers and ironers. They are dated Nov. 1, 1920, and are in denominations

of $100, $500 and $1,000, redeemable at 110 and interest on semi-annual interest dates during 1921, or on any subsequent interest dates, the premium to be reduced 1 per cent of par from 110 for each year elapsing thereafter. The present plant includes seventeen acres of land with about 165,000 sq.ft. total floor space in its manufacturing buildings. Net tangible assets are given as $3,129 for each $1,000 bond.

Record Foreign Cable Order Going to Sweden

In the manufacture of the cable which the Western Electric Company is now shipping to Sweden there is required 6,500,000 lb. of lead and 3,350,000 lb. of copper. The first installment of this cable is in transit, and when the total amount of 320 miles is installed between Stockholm and Gothenburg it will make what is said will be the greatest underground cable system outside of the United States. There will be necessary 425,000,000 conductor feet of cable, 25,000 loading coils and eight repeater stations with 300 repeaters, all of which are being manufactured at Hawthorne, Ill., of American materials. It is expected that a year and a half will be required to put the system into operation.

Southern Electric Occupies New Quarters

Announcement is made of the removal of the Southern Electric Supply Company, Atlanta, Ga., from 31 Peters Street to its new building at 557 Whitehall Street. The new building is a modern fireproof structure in the wholesale district of Atlanta. It is of three stories and designed particularly with a view to the most improved methods of handling and storing electrical materials.

Black & Decker's Increase in 1920 Is 40 per Cent

In spite of general conditions in 1920 the Black & Decker Company, Baltimore, Md., announces that it was the most successful year in the company's history, net sales being nearly 40 per cent greater than the highest previous year, 1919. Dividends of about 7 per cent were paid on the common stock of the company, the last one being on Dec. 31, 1920.

The board of directors has been augmented from five to seven by the election of Charles C. Homer, Jr., and William G. Baker, Jr., both of Baltimore.

The Eclipse Electric Machine Company, 660 Second Street, St. Louis, Mo., has awarded contract for construction of a one-story and basement factory, 56 ft. x 150 ft., on Thirty-first Street, to cost about $17,000.

The General Electric Company, Schenectady, N. Y., has prepared plans for the erection of a four-story addition, 76 ft. x 125 ft., to building No. 76 at its plant in Lynn, Mass., to cost about $175,000.

S. H. Stover & Company, Pittsburgh, has taken over the sale and distribution of the Walger connectors, manufactured by the Walger Connector Company, Toronto, Canada.

The Protective Electrical Supply Company, 130 West Columbia Street, Fort Wayne, Ind., has recently filed notice of increase in capital stock from $200,000 to $300,000.

The General Electric Company, Schenectady, N. Y., has prepared plans for the erection of a four-story addition, 76 ft. x 125 ft., to building 74 at its plant in Lynn, to cost about $175,000.

The Western Electric Company has closed a lease for 100,000 sq.ft. of floor area at the corner of Winchester Street and Pershing Road, Chicago. This space will be utilized for the storage of raw materials and finished products, and the company's branch houses throughout the Middle West will be supplied from this point.

The Hale Electric & Engineering Company, Cleveland, Ohio, announces that the manufacture of the "Halectric" radiator has been taken over by the Hale Electric Company, which expects to start production soon with a plant at Massillon, Ohio. The Hale Electric & Engineering Company, which formerly manufactured this radiator, is making curb boxes, automatic motor-driven air compressors, automatic electric controlled unloaders and accessories.

The Edward N. Riddle Company, Toledo, Ohio, has recently moved into its large factory building at 27 Broadway. The new building provides a working floor space in addition to offices and display rooms. Considerable new equipment has been installed for the manufacture of its various lines, including lighting fixtures, lighting novelties, lamps, etc.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has established offices in the Railway Exchange Building, St. Louis, Mo. This is a branch of the Chicago district office and is in charge of Harold Phillips, formerly of the engineering department of Chicago and later manager of the Chicago district office.

J. Livingston & Company, 70 East Forty-fifth Street, New York City, have filed notice of increase in capital stock from $600,000 to $1,000,000.

The American Insulating Company, Norwalk, Conn., is reported to be receiving bids for the erection of a two-story factory building at its plant in Norwalk.

The Connecticut Blower Company, Inc., Hartford, Conn., is offering for public subscription $150,000 in 8 per cent preferred stock, the proceeds to be used for the erection of a new plant. The buildings occupied by the company have been sold.

The Emerson Electric Company, St. Louis, Mo., announces that arrangements have been completed for stocks of Emerson fans to be maintained by the Triumph Electric Company, 211 South Third Street, Minneapolis, Minn., the Electric Supply Company, 386 Jackson Street, St. Paul, Minn., and the Southern Incandescent Lamp Company, Nashville, Tenn.

The Apex Electric Manufacturing Company, Chicago, has filed notice of increase in capital stock to $100,000.

The Warsaw Elevator Company, South Main Street, Warsaw, N. Y., has filed notice of increase in capital stock from $250,000 to $500,000.

The Dayton Engineering Laboratories, 329 East First Street, Dayton, Ohio, has decided to put off the erection of the superstructure for its new five-story-and-basement addition, 200 ft. x 330 ft., until spring. The cost of the plant is estimated at $1,000,000. The foundation work has been completed.

The Briggs & Stratton Company, 1047 Louis Avenue, Milwaukee, Wis., has filed amendments to its charter authorizing an increase in capital stock from $1,700,000 to $1,950,000.

The Syracuse Washing Machine Corporation, Syracuse, N. Y., has filed notice of increase in capital stock from $6,500,000 to $7,000,000. The company manufactures laundry machinery and has recently erected a new plant.

W. H. Corddry, of the Harrisburg office of Gannett, Seelye & Fleming, Inc., consulting engineers, has been placed in charge of the Memphis office of the firm, which covers engineering design, construction, reports and valuation for municipalities, industrials and public utilities.

The Electric Power Equipment Corporation, which was formerly the Lewis & Roth Corporation, has its office and factory at Thirteenth and Wood Streets, Philadelphia, and its officers are L. R. Lewis, president; J. H. Gledhill, vice-president; N. S. Moore, secretary, and F. W. Dinsmore, treasurer.

The Mutual Electric & Machine Company, Detroit, Mich., announces a change in its address owing to the city of Detroit renumbering all properties. The new number for its general offices and factory is 858 Fort Street, West; factory 1, 851 Porter Street.

The Wellman-Seaver-Morgan Company, Cleveland, Ohio, announces that its Atlanta district office has been transferred to Birmingham, Ala., room 302, American Trust Building. Quin W. Stuart continues as district manager.

The United States Light & Heat Corporation, Niagara Falls, N. Y., has filed notice of increase in capital stock from $7,000,000 to $8,500,000.

The Vim Electric & Motor Company, 58 Cortland Street, New York City, has increased its capital stock from $10,000 to $20,000.

The U. T. Hungerford Brass & Copper Company, New York City, announces that it has established a

monel-metal department in charge of John J. Dillon, who for eight years has made a specialty of this metal and its products.

The Wagner Electric Manufacturing Company, St. Louis, Mo., has removed its Cincinnati office to 20 East Ninth Street, where a service station will also be opened. I. W. Pettingill is in charge.

The Chicago Pneumatic Tool Company has appointed E. F. Eissler assistant to the vice-president, with headquarters at 6 East Forty-fourth Street, New York. W. C. Straub, formerly New Orleans district manager, has been appointed to the Pittsburgh branch to succeed Mr. Eissler, and Ross Wyeth, formerly connected with the Pittsburgh office, is in charge of the New Orleans branch, succeeding Mr. Straub.

Landers, Frary & Clark, New Britain, Conn., have purchased the Greenwood mills property at New Hartford, Conn., at a cost of about $280,000. New machinery is being installed at the works. The plant will be ready to start about Feb. 1.

The Post-Glover Electric Company, Cincinnati, Ohio, is considering increasing its capital stock from $120,000 to $720,000.

The Trumbull-Vanderpool Electric Manufacturing Company, Litchfield, Conn., has filed notice of increase in capital stock from $125,000 to $200,000.

The Washkosh Manufacturing Company, Oshkosh, Wis., manufacturer of domestic washing machines, contemplates extension to its works this spring. It has not yet decided whether to erect a new factory or an addition to the present plant. At present the plant is running two or three nights a week to fill orders.

The Electric Sun Company, Miami, Fla., recently incorporated with a capital stock of $220,000 to manufacture electrically operated display signs, will be affiliated with the company of the same name at Asbury Park, N. J., where headquarters are maintained. The incorporators are Charles D. Winters, Ray R. Morgan and William J. Van Vleck, all of Asbury Park.

The Baraboo Manufacturing Company, Baraboo, Wis., recently incorporated to manufacture electrically operated refrigerating units for domestic and commercial use, has leased the former Ruhland Brewing Company's plant, which will be remodeled and equipped as a machine shop. The company is capitalized at $100,000.

Foreign Trade Notes

FIRST INTERNATIONAL INDUSTRIAL FAIR IN HOLLAND.—From Sept. 6 to 16, 1921, there will be held in Utrecht, Holland, the First International Industrial Fair, the directors of which have appointed the Chamber of Commerce for the Netherlands and the Netherlands East and West Indies, Inc., 11 Beaver Street, New York, as their general representative in the United States. Electrical apparatus and supplies will be exhibited, among other wares.

FURTHER HYDRO-ELECTRIC DEVELOPMENTS ON THE CAUVERY, INDIA.—According to *Indian Engineering*, the Mysore government, India, is considering proposals for erecting power stations at two new sites on the Cauvery River, one at the Shimsha Falls and the other at the Makadatu Falls. The first, the higher of the two, is four miles from Sivasamudram. Preliminary investigations have shown that water can be carried from Sivasamudram to Shimsha by a canal and conduit about 11 miles long. The Makadatu project would be on a smaller scale. A fall of 140 ft. would be available about 4 miles below Arkavati Junction, which could develop about 8,000 hp.

BRITISH CORPORATION CONTEMPLATES BUILDING POWER STATION.—The Salford Corporation, England, according to the London *Engineer*, has decided to apply to Parliament for permission to erect a new electric power station on the banks of the Irwell River at Agecroft to supply electricity for the borough. The proposed plans provide for an initial installation of three 15,000-kw. turbo-generating units. Provision will be made in the power station for installation of additional machinery to increase the output by 60,000 kw. It is proposed to transmit at 33,000 volts. The cost of the project is estimated at £1,250,000.

LANARK CORPORATION CONSIDERING AN ELECTRIC PROJECT.—The Council of Lanark, according to the London *Electrician*, has submitted to the Electricity Commissioners four schemes for an electric supply for the Lanark Corporation as follows: (A) Bulk supply from the Clyde Valley Electric Power Company, to cost £58,000; (B) water power from the river Clyde, £45,000; (C) steam turbines, £48,000; (D) gas or oil engines, £30,000.

DEVELOPMENT OF WATER POWER IN CEYLON, INDIA.—Plans are being considered for utilizing the water-power resources in Ceylon to generate electricity. The conversion of some of the railways for electrical operation is also under consideration. Investigations, it is reported, are being made under the supervision of J. W. Meares, electrical adviser to the Indian government.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An inquirer in India (No. 34,280) desires to receive information and quotations on ceiling and desk fans, rated from 220 volts to 240 volts, direct current, and on rubber-covered wire made in accordance with British standards.

A mercantile firm in Bulgaria (No. 34,282) desires to secure an agency for the sale of electrical materials, etc.

A merchant in Canada (No. 34,283) desires to purchase an electric lighting plant for country house, automatic without storage battery, of not less than 1,500 watts.

A mercantile firm in Australia (No. 34,288) desires to secure exclusive agencies from manufacturers for the sale of labor-saving machine tools and electrical fittings of all kinds, etc.

An electrical company in India (No. 34,289) desires to receive quotations from manufacturers of electric ceiling fans of 32, 48 and 56-in. size, with four wooden blades, to operate on 230 volts or 250 volts, direct current, portable fans of 8, 12 and 16-in. sizes, and standard types of metallic-filament lamps, both vacuum and gas-filled types. Sample fans are desired.

A mercantile company in Norway (No. 34,299) desires to secure an agency for the sale of electric specialties, etc.

A manufacturing company in Scotland (No. 34,300) desires to secure an agency for the sale of materials and appliances used by contractors in electrical trades, etc.

THE CHAMBER OF COMMERCE for the Netherlands and the Netherlands East and West Indies, Inc., 11 Beaver Street, New York City, invites communication with manufacturers who desire to make connections in Holland or India for the sale of electrical products. The chamber has branch offices in Amsterdam, Holland, and Batavia, Java.

New Apparatus and Publications

RUBBING AND TRIMMING MACHINES.—The Mattison Machine Works, Rockford, Ill., is distributing two four-page pamphlets, one describing its electric rubbing machine for varnished surfaces and the other covering its electric edge veneer trimmer, both for 110 volts or 220 volts.

INTEGRATING SPHERES AND PHOTOMETERS.—Foote, Pierson & Company, Inc., 160 Duane Street, New York City, has published catalog No. 32, covering its integrating spheres and photometers and accessories.

HEATERS, CONDENSERS AND PUMPS.—The Ross Heater & Manufacturing Company, 1407-11 West Avenue, Buffalo, N. Y., is distributing catalog "F," in which it describes and illustrates its various types of heaters, condensers, expansion joints, coolers and airjector pumps.

OIL CIRCUIT BREAKERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No 47419A, superseding bulletin No 47419, in which it describes its type FP-10 small-capacity industrial oil circuit breaker, 50 amp., 600 volts, for three-phase and quarter-phase induction motors of 25 hp or less.

AUTOMOBILE ENGINE HEATER.—The National Electrical Supply Company, 1330 New York Avenue N. W., Washington, D. C., is distributing a sheet describing and illustrating the Calorel automobile engine heater for garage use, operating on 110 volts.

FLOODLIGHT PROJECTORS.—In bulletin No. 304-A, just circulated by the Crouse-Hinds Company, Syracuse, N. Y., there is described the Imperial floodlight projectors and reflectors developed since the publication of bulletin No 304, which is still effective.

WIRE AND CABLE.—General Electric Company's bulletin No. 49,305 covers its "Wires and Cables."

New Incorporations

THE BENNETT FLUE BLOWER COMPANY, New York City, has been incorporated by A. J. Ward, L. F. Hulton and G. H. Jett, 206 West Sixty-ninth Street. The company is capitalized at $250,000 and proposes to manufacture flue-cleaning equipment and other power-plant specialties.

THE EFFICIENT ELECTRIC PROTECTION COMPANY, 30 Kent Street, Newark, N. J., has been organized to manufacture electric alarm systems and equipment. Frank Silsen, 86 Jefferson Street, is interested in the company.

THE CONNECTICUT DYNAMO & MOTOR COMPANY, Irvington, N. J., has been incorporated with a capital stock of $150,000 to manufacture electrical machinery. The incorporators are Harry J. Brewer, Gerald Hannay, Lyons Avenue and Woolsey Street, Irvington, and Donald B. Munsick, 786 Broad Street.

THE MAPLES WASHING MACHINE COMPANY, New York City, has been incorporated by R. Lasker, D. H. Lehman and L. Maples, 311 Fifth Avenue. The company is capitalized at $1,000,000 and proposes to manufacture electrically operated washing machines and parts.

THE ELECTRIC AUTO SIGNAL COMPANY, Wilkinsburg, Pa., has been incorporated by B. Hudson, Wilkinsburg; A. J. Henseler, Pittsburgh, and C. R. Blakely, Trafford, Pa. The company is capitalized at $100,000 and proposes to manufacture electrically operated automobile products.

THE LIBERTY MACHINE COMPANY, Wauwatosa, Wis., has been incorporated by William J. Grede, A. E. Stroud and Jeremiah Keeler. The company is capitalized at $10,000 and proposes to manufacture metal products, principally electric and gas-lighting fixtures.

THE PRICE MACHINE & ELECTRIC WORKS, 115 West Pico Street, Los Angeles, Cal., has been organized to manufacture machine parts and electrical apparatus. Morris Price, 4323 South Olive Street, is interested in the company.

THE PARAMOUNT ELECTRIC FIXTURE COMPANY, 6278 Hollywood Boulevard, Los Angeles, Cal., has been organized to manufacture metal electric lighting fixtures. J. J. Strauss, 5737 Virginia Avenue, is interested in the company.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 28, 1920)

1,363,806. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; William B. Moses, Brookline, Mass. App. filed Oct 18, 1915. Eliminates trouble from vibration.

1,363,807. ELECTRICAL BODY-CONTACT DEVICE; James W. Murphy, Chicago, Ill. App. filed April 28, 1920. Medical.

1,363,813. ATTACHMENT FOR ELECTRICAL CONTROLLERS; Estell C. Raney, Columbus, Ohio. App. filed April 21, 1919. Drum controller.

1,363,814. AUTOMATICALLY RECLOSING CIRCUIT BREAKER. Estell C. Raney, Columbus, Ohio. App. filed June 13, 1919. Sectionalizing breaker.

1,363,815. ELECTRODE HOLDER; Byramji D. Saklatwalla and Arthur N. Anderson, Crafton, Pa. App. filed April 24, 1919. For furnaces.

1,363,827. APPARATUS FOR THE TREATMENT OF GASES BY ELECTRIC DISCHARGE. Ernest E. Werner, St. Louis, Mo. App. filed March 4, 1920. Inclosed electrodes.

1,363,841. ELECTRIC CLOCK; Norman Collins, London, England. App. filed July 25, 1919. Oscillations maintained by electromagnet.

1,363,877. ELECTRIC RIVET HEATER; Arthur Imbery, Halifax, York, England. App. filed May 10, 1920. For cleaning rivets before or during the heat.

1,363,889. BATTERY-TEMPERATURE CONTROLLER; Charles E. Linebarger, Chicago, Ill. App. filed March 17, 1919. Thermostatic.

1,363,919. LIGHTING FIXTURE; Grosvenor P. Robinson, Summit, N. J. App. filed April 3, 1920. Modified indirect.

1,363,924. BATTERY-LIGHT ATTACHMENT; Arthur D. Saborsky, Lakewood, Ohio. App. filed Dec. 30, 1914. Miniature electric bulb upon any dry cell.

1,363,942. ELECTRICAL CONNECTING AND SUPPORTING DEVICE; Ernest C. White, New York, N. Y. App. filed Jan. 10, 1920. For hanging a fixture.

1,363,947. ELECTRIC HEATER; Henry J. Youngblood, Los Angeles, Cal. App. filed Oct. 9, 1919. Attached to ordinary spigot.

1,363,948. ELECTRIC HEATER; Henry J. Youngblood, Buffalo, N. Y. App. filed Feb. 28, 1920. Electrically heated liquid-discharging faucet.

1,363,965. SURGICAL AND MEDICAL INSTRUMENT; Ernesto Fuchs, Guadalajara, Mexico. App. filed Jan. 26, 1920. For electrically treating cavities of human body.

1,363,991. ELECTROMECHANICAL JACK. Edward L. Monnot, Canton, Ohio. App. filed Jan. 15, 1920. For dental, surgical and barber chairs.

1,363,995. TROLLEY; Joseph Privarnik, Mc Adoo, Pa. App. filed Aug. 21, 1920. Will not jump.

1,364,011. INSULATED AND PROTECTED GRID; Malcom O. Smith, Indianapolis, Ind. App. filed April 16, 1920. Battery.

1,364,013. TELEPHONE TRANSMISSION SYSTEM; Ray S. Silbur, Lyndhurst, N. J App. filed Dec. 11, 1917. Two-way, two-repeater circuits.

1,364,026. TROLLEY-WIRE CLAMP; Glenn H. Bolus, Mansfield, Ohio. App. filed Sept. 7, 1917. Readily inserted.

1,364,027. TROLLEY-WIRE CLAMP; Glenn H. Bolus, Mansfield, Ohio. App. filed July 27, 1918. For severe conditions.

1,364,028. INSULATED TROLLEY HANGER; Glenn H. Bolus, Mansfield, Ohio. App. filed June 19, 1919. Installed easily. For automobiles.

1,364,048. LOCK; Homer E. Gilland, Grand Rapids, Mich. App. filed June 7, 1919.

1,364,051. PROCESS OF ELECTROPLATING; James S. Gross, Newport, R. I. App. filed Aug. 18, 1920. For preventing erosion or oxidation.

(Issued Jan. 4, 1921)

1,364,078. TELEGRAPHIC ALPHABET OR CODE; Albert C. Cochrane, Yonkers, N. Y. App filed Dec. 13, 1918. Abbreviated.

1,364,080. BALLASTING DEVICE; Clinton J. Davisson, Maplewood, N. J. App. filed Dec. 23, 1919. To steady fluctuating current.

1,364,086. TELEGRAPH SYSTEM; Andrew D. Dowd, Hoboken, N. J. App. filed Jan. 4, 1918. Printing.

1,364,106. AUTOMATIC TELEPHONE SYSTEM; Charles L. Goodrum, New York, N. Y. App. filed March 28, 1918.

1,364,129. SYSTEM OF ELECTRICAL TRANSMISSION AND DISTRIBUTION. Frederick W. Meyer, Milwaukee, Wis. App. filed March 29, 1918. High-tension direct current.

1,364,148. CUPPING DEVICE; Thomas H. Springer, Waterloo, Ia. App. filed March 15, 1920. Medical.

1,364,158. METHOD OF AND APPARATUS FOR TESTING REPEATER CIRCUITS; John F. Toomey, New York, N. Y. App. filed Jan. 31, 1917. Testing transmission efficiency and ringing apparatus.

1,364,159. THROUGH-RINGING REPEATER CIRCUITS; John F. Toomey, New York, N. Y. App. filed Jan. 31, 1917. Two-way two-repeater circuits.

1,364,162. TELEPHONE-EXCHANGE SYSTEM; Horace W. Ulrich, East Orange, N. J. App. filed Jan. 4, 1918. Automatic ringing.

1,364,167. CURRENT CONTROLLER FOR INDUCTION COILS; Paul R. Werner, Philadelphia, Pa. App. filed Feb. 24, 1915. For producing sparks.

1,364,170. INDICATOR FOR TELEPHONE-EXCHANGE SYSTEMS; Edgar W. Adams, East Orange, N. J. App. filed Oct. 23, 1918. To indicate number of calling line.

1,364,208. TROLLEY; William Rennie, Shadyside, Ohio. App. filed April 22, 1919. Prevented from leaving wire.

1,364,212. HEATER FOR ELECTRIC AUTOMOBILES; Jay I. Sharpe, Zanesville, Ohio. App. filed Dec. 15, 1919.

1,364,227. RECORDER; James M. Wight, Lakewood, Ohio. App. filed Dec. 15, 1916. Graphic meter.

1,364,258. TROLLEY-WHEEL GUARD; George Dzurko, Pleasant City, Ohio. App. filed Oct. 25, 1920. For retaining trolley wheel in engagement.

1,364,299. STORAGE BATTERY; Irvine M. Noble and Walter E. Gossling, Indianapolis, Ind. App. filed July 23, 1919. For isolated plants.

1,364,335. ELECTRICAL CONNECTING AND SUPPORTING DEVICE; Ernest C. White, New York, N. Y. App. filed Jan. 10, 1920. Connects and supports fixture simultaneously.

1,364,358. BATTERY TRAY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Dec. 13, 1915. For supporting and securely holding group of cells.

1,364,359. PROTECTING VARNISH FOR ELECTRODES OF ELECTROLYTIC CELLS; Thomas A. Edison, Llewellyn Park, N. J. App. filed Sept. 29, 1919. For electroplating.

1,364,364. METER-TESTING SWITCH; Benjamin E. Getchell, Plainville, Conn. App. filed Nov. 17, 1919. Tested without interrupting local circuit.

1,364,377. ELECTRIC METER; Charles F. Jenkins, Washington, D. C. App. filed June 22, 1918. Hot-wire.

1,364,382. ELECTRIC SWITCH FOR STOVE LIGHTERS AND THE LIKE; Milo W. Kibbe, Los Angeles, Cal. App. filed June 2, 1920. Plurality of actuating buttons.

1,364,390. STORAGE-BATTERY ASSEMBLY; Lamar Lyndon, West Orange, N. J. App. filed April 30, 1919. For cells of great size and weight.

1,364,393. BATTERY HAND LAMP; Thomas J. Madigan, Brooklyn, N. Y. App. filed April 6, 1920. Flashlight.

1,364,419. ELECTRICAL CONNECTING AND SUPPORTING DEVICE; Ernest C. White, New York, N. Y. App. filed April 9, 1920. Fixture hanger and connector combined.

1,364,469. STORAGE-BATTERY CONTAINER; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Feb. 13, 1919. Cover satisfactorily sealed.

1,364,488. STEAM-PROPELLED VEHICLE; John A. Doble, San Francisco, Cal. App. filed May 15, 1917. Means for condensation of exhaust steam.

1,364,493. METHOD OF MAKING STORAGE-BATTERY SEPARATORS; Bruce Ford and Edward W. Smith, Philadelphia, Pa. App. filed Feb. 28, 1918. Slit sheet.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—In connection with the reorganization of the Boston Suburban Electric Company, the stockholders have arranged for the disposition of a security issue, the proceeds to be used for operations, extensions, etc.

THREE RIVERS, MASS.—The Palmer Mills are having plans prepared for a 30-ft. x 70-ft. transformer station at their plant. Lockwood, Greene & Company, 60 Federal Street, Boston, are architects and engineers.

Middle Atlantic States

CAMPBELL, N. Y.—The Aulls Electric Corporation, with a capital stock of $10,000, has been granted a charter to generate electricity for light, heat and power purposes in Campbell and Savona. The village of Savona voted to issue bonds for the installation of the electric system with the main plant at Campbell.

ENDICOTT, N. Y.—Arrangements are being made for the installation of electrically operated pumping equipment at the municipal waterworks to replace the existing steam-driven apparatus. Energy will be served by the Binghamton Light, Heat & Power Company, Binghamton.

OGDENSBURG, N. Y.—The New York & Ontario Power Company has applied to the Federal Power Commission, Washington, D. C., for permission to erect a dam across the south channel of the St. Lawrence River for the development of approximately 25,000 hp.

ORANGEBURG, N. Y.—The Rockland Light & Power Company has filed notice of increase in capital from $1,300,000 to $1,600,000 for proposed expansion.

WEST BURLINGTON, N. Y.—D. T. Gardner of this place has applied to the Public Service Commission, Second District, for permission to construct and operate an electric lighting plant under franchises granted by the towns of Burlington and Edmeston supplying West Burlington and Edmeston lighting district.

BLOOMFIELD, N. J.—The Clark Thread Company, Clark and Ogden Streets, Newark, has had plans prepared for the erection of a power plant to cost about $63,000, to be used in connection with its proposed bleaching works, to cost $133,000. A. H. Groel is general manager.

LYNDHURST, N. J.—The Board of Education will receive bids until Feb. 1 for electrical equipment to be installed in the proposed new school at Stuyvesant and Kingsland Avenues. A. L. Vegliante, Garfield, is architect.

TRENTON, N. J.—The Trenton & Mercer County Traction Corporation, 137 East State Street, plans to make repairs and improvements to its electric power station. C. Hackel is chief engineer.

HARRISBURG, PA.—An ordinance has been passed by the City Council authorizing the employment of Dr. W. L. Robb, head of the electrical department of the Rensselaer Polytechnic Institute, Troy, N. Y., to make an investigation for the city of the plant and system of the Harrisburg Light & Power Company, with a view to making recommendations for adequate service. The work will be conducted under direction of Commissioner Hassler.

NEW HOPE, PA.—The Clay Products Corporation of America, Liberty Building, Philadelphia, contemplates the erection of an electric power plant in connection with its new brick manufacturing plant at this place. A railway system will also be constructed from the plant to the clay properties. The total cost is estimated at $900,000.

PITTSBURGH, PA.—Application has been made by the West Penn Power Company to the Public Service Commission for permission to issue stock for $2,500,000, the proceeds to be used for operations, extensions and improvements.

STEELTON, PA.—The finance committee of the City Council and the water department are planning for the installation of one 30-hp. and one 150-hp electric motor to be used in place of boilers. Centrifugal pumps will also be installed. G. H. Roberts is president of the water department. The cost is estimated at $50,000.

WHEELING, W. VA.—The Sisters of the Good Shepherd, Edgington Lane, contemplate alterations to the power plant. S. F. Heckert, Bessemer Building, Pittsburgh, Pa., is engineer.

North Central States

DETROIT, MICH.—The Park-Davis Company, Atwater Street and McDougal Avenue, contemplates the erection of an electrically operated factory for the manufacture of drugs. The first unit of construction is estimated to cost about $4,000,000. Smith, Hinchman & Grylls, 710 Washington Arcade, are engineers and architects.

CLEVELAND, OHIO.—The city officials will receive bids until Jan. 27 for electric and power wiring to cost about $60,000 for a convention hall now under construction. J. W. Bean, 5716 Euclid Avenue, is engineer.

COLUMBUS, OHIO.—The Board of Trustees of the Ohio State University has asked for appropriation of $4,000,000 to carry out a construction program. Plans include a new unit for the power plant to cost $381,666.

COLUMBUS, OHIO.—It is planned to install cluster lights on West Broad Street, Cleveland Avenue, Mount Vernon Avenue, Main Street and Long Street. The total estimated cost is $240,919.

MILFORD, OHIO.—The village officials will receive bids in about two months for motor-driven centrifugal pumps or steam-driven pumps to be used in connection with the waterworks plant. S. T. Bateman is clerk.

ST. CLAIRSVILLE, OHIO.—The city officials plan to make improvements to the municipal electric light plant.

LOUISVILLE, KY.—A wireless plant will be erected at the College of Arts and Science Building at the Louisville University.

CHAMPAIGN, ILL.—Plans are under way for the installation of a lighting system on various streets, to cost about $25,000. F. C. Lohman, City Hall, is engineer.

CHICAGO, ILL.—Felt & Tarrant, 1717 North Paulina Street, have plans under way for the construction of a factory for the manufacture of adding machines and a 60-ft. x 100-ft. power plant, to cost about $1,000,000. Power-plant equipment will be required. L. G. Hallberg & Company, 116 South Michigan Boulevard, is architect.

EDGERTON, WIS.—G. T. Simmons, R. F. D. No. 8, Janesville, contemplates the erection of a factory for the manufacture of spark plugs, estimated to cost about $100,000. The construction of a separate power plant is being considered.

MILWAUKEE, WIS.—The Sewage Commission will readvertise soon for new bids for equipment and boiler for the Jones Island power plant. Former bids rejected. T. C. Hatton, City Hall, is engineer.

HASTINGS, MINN.—The State Board of Control, Capitol, St. Paul, will submit to the Legislature a construction program, including the erection of a power plant and the installation of equipment at the State Asylum for the Insane at this place. The cost is estimated at about $70,000.

ROLLA, MO.—Bonds to the amount of $25,000 have been voted for the installation of equipment in the power plant, giving the plant a double unit for light and water service.

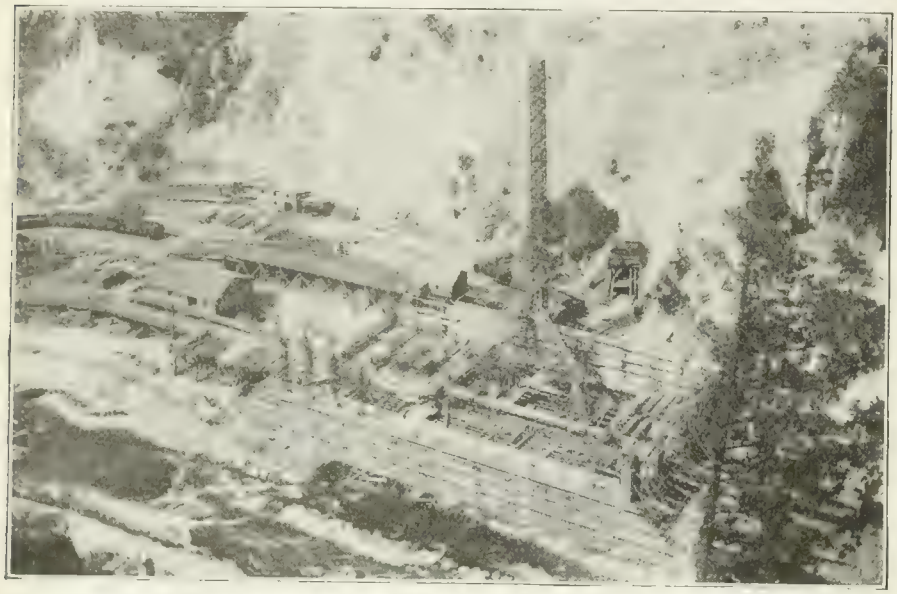
ST. LOUIS, MO.—The United Railways Company, Thirty-ninth and Park Avenues, contemplates the erection of four new substations of 1,000 kw. each and changing two existing substations, to be of 2,000 kw. each, from alternating current to direct current. Rotary converters and control equipment for the six substations will be required. The cost is estimated at $285,000. W. E. Bryan, above address, is engineer.

GRAFTON, N. D.—The State Home for the Feeble-Minded plans to erect several buildings, including a workhouse, millhouse and power house. The cost is estimated at $583,500. A. R. T. Wylie is superintendent.

ELK POINT, S. D.—The city officials contemplate holding a special election for the purpose of submitting a proposition to make light and power improvements at a cost of about $20,000. M. R. Hendricks is city recorder.

PARSONS, KAN.—The city officials have plans under way for rehabilitation of the waterworks system, including the rebuilding of power plants, installation of filter equipment and machinery for 6,000,000 gal. capacity, etc. The cost is estimated at about $350,000. Burns & McDonnell, Interstate Building, Kansas City, Mo., are designing and consulting engineers.

TOPEKA, KAN.—The city officials contemplate the erection of an electric power plant building, 32 ft. x 76 ft., to adjoin the waterworks plant. W. A. Stanfield is commissioner of the water department.



GREAT WESTERN POWER COMPANY, CALIFORNIA, NEW 40,000-KW. HYDRO-ELECTRIC PLANT UNDER CONSTRUCTION 186 MILES NORTHEAST OF SAN FRANCISCO IN THE HIGH SIERRAS

Southern States

MOUNT HOLLY, N. C.—Surveys have been made by the Blue Ridge Development Company, Hickory, for an electric railway from Mount Holly to Blowing Rock, to cost about $100,000.

POMPANO, FLA.—The Pompano-by-the-Sea Company, 39 N. E. Second Avenue, Miami, plans to install an electric and water plant at this plant. A. T. Barkdull is secretary.

SAFETY HARBOR, FLA.—The Town Commissioners have ordered an election to be held for the purpose of submitting a proposition to issue $10,000 in bonds for the purchase and establishment of an electric light plant.

CHATTANOOGA, TENN.—The Du Bois Rubber & Tire Company, 315 Volunteer State Building, is having plans prepared for a power plant, 42 ft. x 50 ft., in connection with its proposed automobile tire manufacturing plant. The cost is estimated at $75,000. W. L. McLane, above address, is architect.

BELLWOOD, ALA.—An issue of $750,000 has been proposed by the city officials for the erection of a power plant on the Choctawhatchie River.

BIRMINGHAM, ALA.—The Birmingham Waterworks Company is receiving bids for two 10,000,000-gal. turbine centrifugal improvements, including the installation of pumps at the Cahaba River pumping station. Other equipment and fitting will be installed. The total cost is estimated at about $400,000. H. Horner is superintendent of the waterworks.

TUSCALOOSA, ALA.—The building committee of the Alabama Home for the Feeble-Minded will receive bids until Feb. 15 for the construction of a power house, main dormitory and laundry at the institution, to cost about $175,000. D. O. Whilldin, Title Guaranty Building, Birmingham, is architect.

COLEMAN, TEX.—The city officials contemplate remodeling and improving the electric light plant.

Pacific and Mountain States

TACOMA, WASH.—The city officials contemplate making extensive improvements and additions to the municipal light and power system during the year, independent of the development of the Lake Cushman project. A substation will be erected in the north end of the city, designed to transform 8,000 kw. or 10,000 kw. high-tension lines for residential use, to cost between $70,000 and $100,000. A second substation will be erected for South Tacoma at the pumping station of the water department, where transformers are already installed for the use of that department. L. Evans is superintendent of the light plant.

ASHLAND, ORE.—Mayor Lamkin at a recent meeting of the Chamber of Commerce suggested that the proposition to erect a municipal power plant be submitted to the voters.

MODESTO, CAL.—The city officials will open bids about April 1 for the construction of the Don Pedro Dam for the development of power at this place. The cost of the project is estimated at about $3,075,000. A. J. Wiley is engineer.

PAYSON, UTAH.—Plans have been approved by the City Council for the erection of seventy-two iron posts for an ornamental street-lighting system to be installed in the spring at a cost of about $7,000. C. A. Swan, Provo, is engineer.

SALT LAKE CITY, UTAH.—L. E. Cluff, Felt Building, has filed application with the state engineer for the diversion of water from Fish Creek, Piute County, for the development of 1,200 hp. to supply energy for seven counties.

Canada

VICTORIA, B. C.—The Minister of Public Works will receive bids until Feb. 1 for two 20,000 Imperial g. p. m. centrifugal pumps, for the Maple Ridge diking district. J. A. Wilson is engineer.

ST. JOHN, N. B.—The Madawaska Light & Power Company has plans under way for the construction of a power plant for the development of from 20,000 hp. to 25,000 hp.

KITCHENER, ONT.—A by-law providing $37,800 was voted on for the erection of a power house and the installation of an elevator at the Kitchener-Waterloo Hospital.

MONTREAL, WEST, QUE.—At a recent election it was voted to expend $117,000 to provide for a new lighting system with underground conduits.

Miscellaneous

TAMPICO, MEXICO.—The Standard Oil Company of New Jersey, 26 Broadway, New York City, contemplates the erection of a pumping station in the oil fields at this place, to include twelve large pumping units, a battery of twenty-eight boilers and auxiliary operating equipment. The company will also erect two central power plants for oil-field service.

Electrical World

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Generous Foreign Credit Will Help Domestic Business

THE spirit of optimism, which knew no bounds when orders came in batches and one industry bid against another for labor and material, has in some quarters given place to a spirit of gloom. As a result production, the only remedy for most of the industrial ills of the world, has been restricted and a return to normal times has been retarded in the same degree. Because the farmer cannot now fix the price of next year's crop he refrains rather foolishly from planting cotton and grain, although no conservatively managed and essentially sound enterprise engaged in the production of a necessity need concern itself unduly about the adequacy of price. That is merely relative and in normal times is invariably reasonable. What is true of agriculture is true also of manufacture. In this country any restriction in output because our productive capacity is considerably above our normal consumption is unwise. The rest of the world not only needs our surplus but in the present crisis even asks, besides, to share in our superabundant home supply. Our own welfare and business prosperity depend to an appreciable extent on export trade, and we have an anomalous situation where Europe and the rest of the world are really begging us for material and foodstuffs but lack the ability to pay in gold. If, therefore, some adequate means of credit could be established, an immense foreign trade would immediately result. The exigencies call for a much greater amount of credit than that provided by the Foreign Trade Financing Corporation recently formed. Europe in its present chaotic and starving state is becoming a menace, and if her civilization means anything to the world, she must be helped. It is apparent that our credit system is not flexible enough to meet the emergency, but if each industry will paraphrase the Red Cross slogan and "Give credit till it hurts," a happy solution will be found.

The Backfire of Rate Increases

INCREASES in the rates paid for the service rendered by public utility corporations have not been a whit more popular than have other increases in the cost of living. Moreover, the very fact that the utility rates have been raised through the authority of and after investigation by the utility commissions has resulted in an antagonism toward these commissions by the same people who first demanded utility regulation. After fighting attempts of the commissions even to get at the facts necessary to render just decisions, the municipal authorities who vociferously inject themselves into the proceedings under the guise of "protecting the innocent consumers from the extortions of the bloodless corporations" claim that the commissioners favor the corporations when they allow them a return to cover the cost of doing business. Then comes a move to demand an end of regulation and a return of control to the municipal authorities. There are also demands that "political" appointments be made to fill forthcoming vacancies in some commissions. The really unfortunate thing is that the utilities cannot urge the continuance in office of able men who have shown wisdom in regulation. Their good faith would immediately be questioned and their ends defeated. However, there is yet hope in the fact that the tens of thousands of loyal employees of the utilities have it in their power convincingly to prove to their friends, and through them in an ever-widening circle to the whole public, that regulation is wise and must be sustained.

The Superman and the Average Man

AN ENCOURAGING philosophy is taught by Dr. C. P. Steinmetz, who is one among a group of engineers and industrial experts to whom is due the course in foremanship lately introduced into several hundred industrial establishments. Dr. Steinmetz's views on "incentive and initiative" were recently expressed by him through the New York *World*. "I am not a superman," he says. "I am not exceptionally qualified by nature for creative work. If we had a general recognition of the powers that exist in the human organism, and if we would organize our industrial machine so as to bring those powers into play, there is no reason why the average man might not accomplish at least as much as I accomplish. It is the function of the new leadership to release those powers and to give everybody his utmost opportunity." Supermen, as a matter of fact, are myths. Geniuses occasionally arise and in their moments of inspiration accomplish wonders, but they are far too erratic for reliance and often progress into insanity or degenerate into charlatanism. It is the man of average talent raised to the *n*th degree who counts, and raising one's talent to this degree is a matter of individual determination and perseverance, which are always responsive to and often dependent upon such leadership as Dr. Steinmetz champions.

A Time to Buy and to Produce

ACTION is more potent than theory or intent, and if the present depression in the business world is to be dispelled trade and not talk must be encouraged. It is idle to expect living costs to come down permanently unless production is increased, and with shops closed how can that condition be achieved? The time has come for the exercise of some common sense in the matter of buying. Of luxuries and non-essentials we have had our

fill and we need not concern ourselves with the fate of those who cater to extravagance. It is the essentials in which we are interested and in their constant and adequate supply. If these are priced unreasonably high, there must be a readjustment, but if not, their production should be encouraged. For instance, to cite concrete cases, copper is an essential metal and one greatly used in the electrical industry. The price of copper is now lower than it was at any time during the ten-year period before the war. We are not prone to giving commercial advice, but it is obvious that a thrifty manufacturer of electrical apparatus or a prudent electric light and power company manager would lay by a store of the red metal now. Cotton and aluminum have also come down in price, and since these materials too are used in the electrical industry advantage should be taken of this means of reducing the cost of apparatus still further. Nor are these by any means the only raw material used in electrical manufacture to which the reasoning applies. If there ever was a time for confidence in basic industries, it is now, and if there is any salvation in thrift, now is the time to put it into practice.

Power Distribution for Industrial Motors

A BRIEF paper by Fred Morgan in this issue gives an instructive study of several of the various types of distribution service for motors in industrial plants. The three types which he selects for investigation are the general radial system, with one switchboard and a feeder to each motor; the ring system, with a closed loop on which motors are cut in, and the compromise system of radial groups, in which the main supply feeds localized switchboards each with its radial group of motors. The case directly under notice is a thoroughly typical instance of about 1,000 hp. in two large factory buildings with a substation between them. Three-phase service at 60 cycles supplied from step-down transformers was assumed, and then careful estimates of all costs for motor voltages of 220 and 440 were made based on the three systems of installation. Obviously there are opportunities for varying and combining the three which might be practically advisable on account of special location of motors or by reason of grouping of buildings other than that described. For a comparatively simple instance like this, however, the results obtained are fairly comparable.

As worked out with all foreseeable items appropriate to the three cases included, Mr. Morgan finds the ring system of installation at 440 volts slightly the cheapest, followed closely by the radial group at the same voltage. A pure radial system does not seem well adapted for an installation of the area here considered, as might indeed have been foreseen. The advantage of the higher voltage is rather striking but somewhat less than a casual guess would indicate. It amounts on the average to somewhere around fifteen per cent, and of course the advisability of using 440 volts would depend very much on the character of the work to be done and the size and location of the motors with respect to the question of safety, which necessarily has to be considered in a 440-volt installation. Detailed estimates of this sort are not, of course, universally conclusive, but they have in this instance a good deal of practical value in that Mr. Morgan has made them on a somewhat typical installation estimated on a uniform and well-considered plan.

Progress in Relay Protection

PROGRESS in the application of automatic relays for circuit and network protection is admirably outlined in this issue by R. N. Conwell. The situation as it stands today is indicated, the various methods used here and in England are described, and the relative success of these methods is recorded. A warning is also issued not to build systems and then design their protection, but rather to design systems that can be effectively protected by simple means. Though perfect adjustment, great sensitiveness or even uncanny intelligence may be credited to relays even at this day, it is well not to expect too much of them. The result might be infinite complication, possible of adjustment it is true, but liable to serious trouble due to human shortcomings in installing, inspecting and operating.

The increased application of relays in central-station systems has been urged by us before. There are probably no companies that would not profit in a large measure by studying the possibilities of increasing such protection on their systems and making installations that would best suit their present conditions and be best adaptable to their future development. More accurate knowledge of their network, shorter interruptions, better service and savings in energy losses due to parallel operation of lines or better division of load would be certain rewards. We therefore feel that Mr. Conwell's contribution, in its authoritative and clear presentation, will inspire engineers to devote more energy to relay protection.

Rational Selection of Circuit Breakers

RAPID growth in size of central-station plants has emphasized circuit-breaker trouble and prompted the safeguarding of operation by the adoption of the most rugged switches. Experience, in fact, has shown that in some locations breakers with the highest possible rupturing ability are none too large. In the short article by H. L. Wallau in this issue attention is called to a phase in selection of circuit breakers that may not have received sufficient attention in the past. Mr. Wallau points out that there has been neglect in many places to take account of actual conditions, in forgetfulness of the fact that the voltage drops below normal under short-circuit current, and that consequently economy in the selection of circuit breakers has not been achieved. Aside from the size of the generating plant, the physical constants of equipment and the line, the determining factor in the selection of circuit breakers is the time setting of the relays for their automatic operation. It is therefore essential in selecting the breaker to know exactly the operating conditions to which it will be submitted when it takes its position in an extensive network. A slight reduction in time setting may result in overtaxing its current-rupturing ability. It would seem that often it would be more economical to plan the replacement of a breaker by a larger one when conditions demand it, rather than provide at first the extra capacity, which at best can only be arrived at by guesswork. The old axiom of the chain being as strong as its weakest link finds its application in this instance again and points to a design of circuit breakers in a system that will give approximately the same factor of safety at all points. Mr. Wallau provides means for arriving at this rational design.

Reducing Voltage Stresses in Transformer Coils

IN THE winding and assembling of the ordinary single-phase distributing transformer for reducing the pressure from 2,200 volts primary to 220 volts secondary, the maximum voltage that can be obtained between any pair of terminals by voltmeter is 2,420, when two appropriate terminals are brought into contact. The minimum voltage that can be obtained in this way is 1,980. The difference between maximum and minimum is not so great as to call for close attention to internal connections or groupings of coils. When, however, the primary pressure is, say, 66 kv. and the secondary 22 kv., their sum is 88 kv. and their difference 44 kv. These values are so different that it is worth while studying the internal connections of the transformer, with a view to minimizing the internal dielectric stresses in the event of a contact between primary and secondary conductors. The mode of assembling and connecting primary and secondary windings which promotes the development of the summation voltage, in case of a contact between conductors, is known as connection for additive polarity, and that which promotes the development of the difference voltage is termed connection for subtractive polarity.

C. W. Piper contributes an article in this number to the subject of subtractive or additive polarity for single-phase transformers. It is shown that the connection for subtractive polarity suffers no material disadvantage, while it offers the distinct advantage of minimizing the internal and external pressures which might be set up in consequence of an accidental contact between primary and secondary conductors.

Electrical Maintenance Must Not Be Neglected

BEFORE the superiority of electrical service was so thoroughly acknowledged in mining and manufacturing circles as it is today, the ruggedness of electrical apparatus was used by salesmen and engineers as an argument for the installation of motors and other electrical apparatus in preference to or in place of machines operated by other forms of power. When intelligently applied, electricity has done everything that was claimed for it and even more, but unless more attention is paid to the maintenance of electrical equipment than has generally been the case its reputation will suffer and its advocates will be disappointed.

The impression has been created in the minds of many industrial executives and master mechanics that so long as such details as oiling are attended to when necessary electrical apparatus can be virtually forgotten after it has been installed. Electrical engineers have been laughed at when they advised their companies not to change over from steam to electric service unless they were prepared to maintain the electrical apparatus properly by frequent inspections and cleaning. In one instance, which is typical of many, the electrical engineer's recommendations for maintenance were not carried out and his so-called pessimism is still thought to be groundless. The electrical applications were all well made, and the average age of the apparatus is only about four years; but during the next four or five years there will probably be regret that maintenance has been neglected.

Maintenance means keeping equipment in proper operating condition, not waiting for it to break down and then curtailing manufacturing production to restore service. Proper maintenance extends the useful life of electrical apparatus more than seems to be generally recognized. In one large factory with about 1,500 motors averaging 1.5 hp. the total cost of maintenance, including frequent inspection, oiling, renewing bearings, rewinding and so forth, is about $4 per motor horsepower per year. The cost of maintenance elsewhere will be affected by the distance apart and accessibility of the motors and by their average size, but it has been found that in nearly every case it is cheaper, all items considered, to keep motors in service by proper care and attention than to neglect them until they break down.

Every concern operating electrical equipment should give the subject of maintenance renewed consideration in an effort to improve present methods now. Unless action is taken along this line soon, the expense of electrical breakdowns and repairs will increase greatly during the next few years.

Rural Electricity Supply in England

A BRITISH contemporary gives some interesting facts regarding an experiment carried on at Hereford, England, for conveying electricity to a strictly rural district. The reason for the work in this instance was that the plant which had been installed there twenty years ago had never prospered owing to the small population (a little more than 20,000) and the absence of any considerable mechanical industries. To obtain business and put the plant on a sound basis a rural distribution was inaugurated, which, growing slowly at first, now covers a radius of 12 or 15 miles (20 or 25 km.) from the plant in all directions and supplies a steadily increasing number of customers.

The plant in its present state presents a good many points of interest. Its main equipment is 4,000 kw. in three turbo-units, delivering three-phase, 50-cycle energy at 3,300 volts. The supply in the center of the town is direct current, as was common practice when the plant was built, and the main outlying territory is served at present direct from the generators, the load being small and scattered, although the transmission system has been planned for 33,000 volts, with a view to further extensions, and the main distribution will soon be raised to 11,000. Cheap fuel in the unusual form of coke-oven dust eked out by oil has enabled the fuel cost to be cut far below any figure which could be reached with coal. The oil is used only at peak load, increasing the working capacity of the boilers by some 50 per cent. The transmission system for the main lines is lattice-girder steel poles, with wooden poles for low-tension distribution and services, such circuits being three-phase, four-wire, at 400 volts.

The result of all this activity has been a steadily increasing load of lighting, appliances and small motors for farm use, and this business has enabled the plant to show a clean profit beyond all fixed charges, including sinking fund, and to bring to a genuinely agricultural territory the full advantages of electric distribution. The point of the case is that under somewhat unfavorable circumstances, in a conservative farming community, electrical service has been extended to cover thoroughly a large area and that the enterprise has succeeded.



Walter Robbins

A prominent engineer-executive to whose efforts in securing for the government the whole-hearted co-operation of the electrical industry during the war can be attributed in no small measure the industry's splendid war performance

DURING the war one of the achievements of the electrical industry was its hearty and prompt response to every call of the government. This has been officially recognized by the government itself and also by numerous war industries whose outputs were so essential to modern warfare. Many things that had been talked of for years previously and accomplished under war conditions might still be the subject of frequent heated discussions except for the emergency that forced the experiment. Among those who gave their entire time to this work with marked credit to themselves and the industry was Walter Robbins, vice-president of the Wagner Electric Manufacturing Company, who served as chief of the electric power and equipment section of the War Industries Board from October, 1917, to December, 1918. His knowledge of the electrical productive capacity of the country made it possible to work out certain standardization of many devices through the elimination of a number of odd sizes and types. But greater than the result of bringing about this standardization was the masterly way in which he helped the electrical industry to serve the country during the war, so that the government was able to obtain all the electrical equipment needed in much quicker time than ordinarily. In meeting this unusual demand the orders were so distributed that regular production of apparatus for other purposes was not seriously affected. It was Mr. Robbins' department that saw to it that essential electrical equipment went to the place where it would count for most. His section took over complete control of turbine, boiler and other power-machine production schedules. In addition charge of the machine-tool, crane, brass and wire and cable sections was given to Mr. Robbins. As an indication of the volume of work that came under his supervision it is interesting to note that the electrical power and equipment section alone made recommendation to the priorities commission on approximately 30,000 applications.

Mr. Robbins was born in Marquette, Mich., March 8, 1875. His electrical engineering education was obtained at the University of Michigan, from which he was graduated in 1896. Prior to joining the Wagner organization in 1906 as assistant general manager, except for a year and a half with Pierce, Richardson & Neiler, consulting engineers, he was employed by the Western Electric Company at Chicago, where he became superintendent of construction. He has continued a vice-president of the Wagner Electric Manufacturing Company ever since his election to that position in 1914.

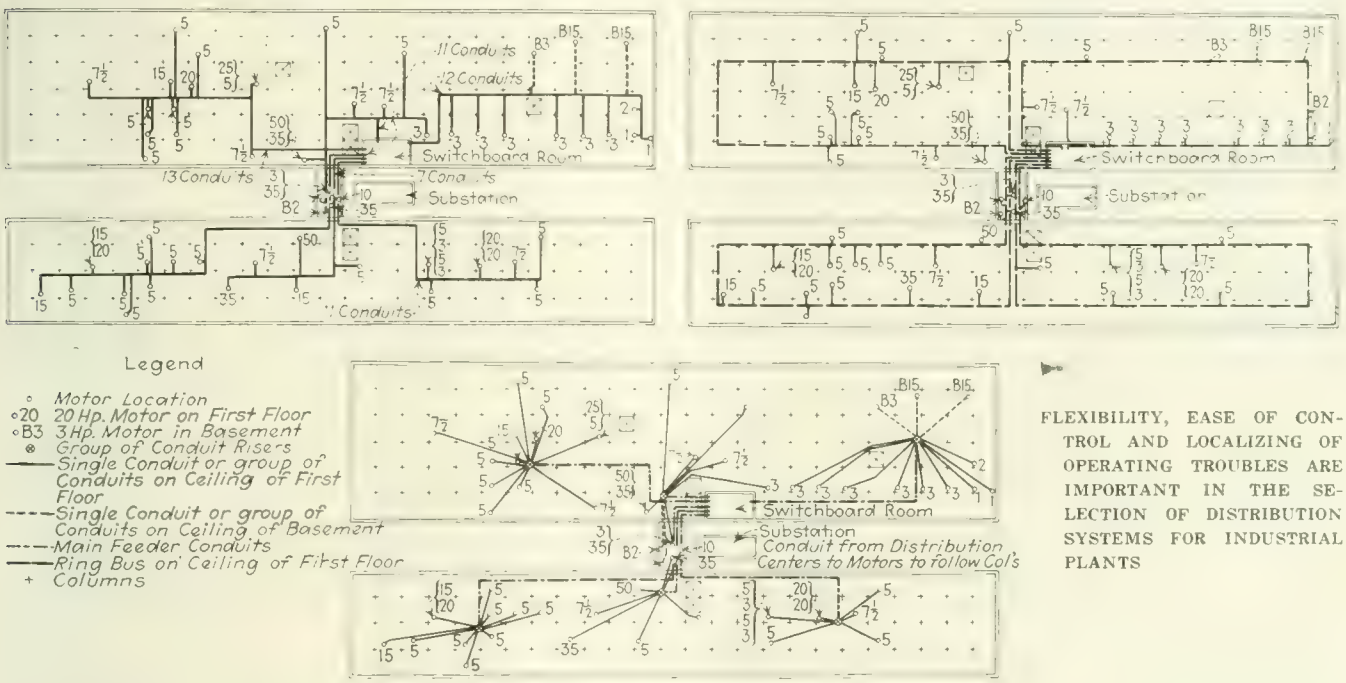
Industrial Distribution Methods Compared

Ring Feeder System Has Advantages Over Radial and Radial Group Systems—Radial Group and Ring Methods Compare Closely as to First Cost — Factors Influencing Choice

By FRED MORGAN
Engineer Sessions Engineering Company, Chicago

EXPERIENCE with numerous industrial distribution systems has shown three methods to be in common use, generally known as the "radial," the "ring" and the "radial group." The radial system consists of one feeder to each motor from the main switchboard. The ring system, as the name implies, consists of a closed loop feeding from the main source of supply and serving a certain group of motors. individual drive motors are distributed over large floor areas. Motor locations are the same in all cases.

The plant selected may be classed as an average industrial establishment, there being no processes that require special service. It consists of two buildings covering a total area of 240 ft. x 500 ft. (73 m. x 152 m.), with a substation in the center. Each building has a basement, first and second floors, with monitor



FLEXIBILITY, EASE OF CONTROL AND LOCALIZING OF OPERATING TROUBLES ARE IMPORTANT IN THE SELECTION OF DISTRIBUTION SYSTEMS FOR INDUSTRIAL PLANTS

The difference in the three general systems from the standpoint of wiring is clearly illustrated here. In the upper layout is shown the radial system, which has been the standard installation in earlier development and holds its place even today. Below is shown a radial-group layout, while on the right is the feeder-ring method of distribution. The ring system is the latest advance in distribution and offers interesting possibilities. These plans are for first floor and basement only.

The radial group consists of one large feeder from the main switchboard to a small distribution switchboard placed near the center of a group of motors from which single feeders run to each motor.

In order to draw a useful comparison between these three schemes of layout, types of apparatus have been selected which are commonly grouped together in each case. The estimates are based on present-day prices of material and labor with a contractor's profit of 15 per cent added. The results obtained will, of course, not be applicable at random to any specific layout, but will be valuable for comparative purposes as each system is designed to serve the same factory load and the unit prices are the same for the three cases throughout. This analysis does not consider the developments where any of these systems have been laid out in special cases to permit any desired shift of motors and equipment without wiring changes being necessary. It also does not consider the cases where large numbers of small roof. Construction is steel framework with brick walls and concrete floors.

The total connected motor load is 1,034 hp., typically distributed. Motor sizes range from 1 hp. to 50 hp. inclusive. Service is alternating current, three phase, 60 cycles, supplied from step-down transformers. Costs estimated include all switchboard apparatus, buses and lines from transformer buses to switchboard and motor feeders.

For all three systems the same load conditions and yearly power losses have been assumed. The same allowance (30 per cent) has been made in the main feeders in each case for future addition of load. All feeders consist of three single-conductor wires which are run in galvanized conduit. But voltages of 225 and 450 were assumed with a maximum drop of 5 per cent to any motor. Comparative costs and lists of equipment are given in the table which is shown at the bottom of page 246.

Reliability and flexibility rather than low first cost are the advantages claimed for the "radial" system, because of the individual handling of the motors. Automatic breakers mean that there are no fuses to blow and that there is less delay in restoring service when a breaker trips. By using conduit of a size greater than necessary motor feeders can be enlarged within reasonable limits without the cost of installing new conduit.

Reliability and flexibility as well as less first cost are features of the "ring" system. It possesses all the advantages of the "radial" system and in addition greater flexibility because of excess capacity in the "ring" and ability to relocate motors on the system. Oil switches on all incoming lines and at the motors increase reliability over the air-type breaker. Maintenance costs will be lower than with the radial system because of the use of oil switches in place of air-type breakers and the simplified feeder layout. Approximately 30 per cent less floor area will be required for the switchboard as against that for the radial system.

First cost is the greatest argument for the radial group system, for at 220 volts it is the cheapest of the three, while at 440 volts it is cheaper than the radial but slightly more expensive than the ring owing to the high cost of distribution boards, which is the same for both voltages. It is not so flexible as the other two systems and the installation of small distribution boards in valuable shop space is objectionable. The multiplication of control points makes an inherently weaker system, and operating expense will be higher because of the large number of widely scattered switchboard panels.

COMPARATIVE COSTS

Taking the radial 220-volt system cost as 100 per cent, the comparative costs are as follows:

	Radial		Ring		Radial Group	
	220 volts	440 volts	220 volts	440 volts	220 volts	440 volts
Total	$58,913	$48,704	$49,713	$42,898	$47,103	$43,757
Per cent	100	82 7	84 5	72 8	80 1	74 3

An interesting fact in this comparison is the lower cost of the higher voltage distribution, and on reference to the table below it will be seen that this is reflected in all cost items.

The costs per horsepower of connected motors for each scheme is as follows:

	220 Volts	440 Volts
Radial	$56.97	$47.10
Ring	48.08	41.49
Radial group	45 55	42.31

FACTORS INFLUENCING CHOICE

The factors influencing choice as between the various systems may be summarized as follows in the order of their relative importance:

	Radial	Ring	Radial Group
Reliability	2	1	3
First cost	3	1	2
Flexibility	2	1	3
Maintenance	2	1	3
Operation	2	1	3
Floor area for switchboards	2	1	3

For the average plant the ring system will give the best service and prove economical to install. Voltage selection, however, must be governed by the class of service to be rendered; but for the majority of plants 440 volts will prove a better operating voltage than the next lower pressure, 220 volts.

Coal By-Products and High-Voltage Protection

These Topics Received Particular Attention at a Recent Convention in Hanover of the Verbandes Deutscher Elektrotechniker

SEVERAL very timely subjects of considerable interest to engineers in this country were discussed at the twenty-sixth annual convention of the Verbandes Deutscher Elektrotechniker in Hanover, Germany. Ten of the leading engineering societies of Germany besides the V.D.E. participated in the meeting, more than one thousand members of the latter organization being present.

Of the subjects discussed the following are particularly interesting: Recovery of by-products from coal in power plants, mechanical removal of ashes; and

COMPARISON OF EQUIPMENT AND COSTS FOR RADIAL, RING AND RADIAL-GROUP SYSTEMS OF INDUSTRIAL DIS TRIBUTION

RADIAL SYSTEMS	RING SYSTEM	RADIAL-GROUP SYSTEM
SWITCHBOARD: Two three-section 40-in. by 12-ft. 10-in. slate panels with automatic circuit breakers and knife switches controlling incoming lines; tie switches and necessary meters, 112 19-in. by 22-in. slate panels, each with automatic air circuit breaker controlling one motor circuit; panels in tiers seven high and sixteen long.	Eleven 24-in. by 62-in. slate panels, two with automatic oil switches controlling incoming circuits; necessary meters; one panel for main indicating and recording meters, eight panels with automatic oil switches controlling ring feeders.	Thirteen 24-in. by 62-in. slate panels. Same as ring system with two extra panels for controlling radial feeders; ten panels for distribution switchboard made up of small slate panels, 19 in. by 22 in. each with an automatic air circuit breaker controlling one motor circuit; each board inclosed in wire mesh cage.
FEEDERS: One for each motor; minimum-size wire, No 10, minimum size conduit, 1¼ in. for 220 volts and 1½ in. for 440 volts.	Eight rings, each starting from oil switch and returning; wire one size throughout; branch boxes at points to provide for tapping in additional motors; to eliminate fuse branch motor-circuit conductors made same size as ring feeders.	Ten radial feeders, each controlled at main board by automatic oil switch and connecting directly to bus on distribution board.
MOTOR CONTROL: Compensator with no-voltage release.	Automatic oil switch with no-voltage release on line side of compensator.	Compensator with no-voltage release.

SUMMARY OF ESTIMATED COSTS

	220 Volts	440 Volts	220 Volts	440 Volts	220 Volts	440 Volts
Main switchboard	$30,097	$26,542	$14,480	$12,739	$15,868	$14,548
Oil switches at motors	.....	.....	13,408	13,408	.....	.....
Distribution switchboards	.....	.....	.....	.....	18,539	18,539
Wire and conduit	28,816	22,162	21,825	16,751	12,696	10,670
Total	$58,913	$48,704	$49,713	$42,898	$47,103	$43,757

protection against high voltages. The chief points of some of these outstanding papers are reported below.

The latest progress in the distillation of by-products from coal at power plants was outlined by Mr. Kreyssig, manager of a large generating plant. He explained that the process consists of drying, roasting or smoldering and distilling or gassing the bituminous coal. The drying should be done at temperatures from 120 deg. to 400 deg. C., and the smoldering is best accomplished between 400 deg. and 500 deg. C. In one of the systems which are in actual operation superheated steam is used to dry the soft coal in a small bunker situated above the smoldering drum. The steam escaping from the coal is then used in the gassing generator, thus avoiding loss of heat. The smoldering compartment of the gas generator has rectangular section similar to those of the well-known coke ovens for anthracite coal. The gassing compartment has a mechanically moved grate on which the fuel is fed uniformly.

The other system, built by Thyssen, consists of a slowly rotating horizontal drum, in which the drying and roasting of the coal take place, and a vertical, round-pit gas generator. The drum is heated from the outside, and a conveyor spiral transports the coal slowly through its full length, dumping the half-coke at its end into the generator. In the drum the coal gives off up to 90 per cent of the amount of tar which may be obtained from the coal in the laboratory. The economy of such a generating plant will, of course, depend not only upon the complete recovery of such by-products as tar and ammonia, but largely upon the heat efficiency of the process. The amount of heat necessary for the generation of one kilowatt-hour has been found to be:

	Heat Units per Kw.-Hr
With steam turbines:	
1. Direct burning of the coal under boilers, without recovery of any by-products	5,400– 7,150
2. Coal distilled, but no by-products recovered, except gas for heating boilers	6,400– 8,500
3. Coal distilled and all by-products recovered; gas-heated boilers	9,500–12,000
Large gas engines:	
1. Coal distilled; use of excess heat under boilers; includes generation of gas; no by-products	4,200– 5,150
2. Same with recovery of tar	4,400– 5,450
3. Same with recovery of tar and ammonia	5,400– 7,150
Gas turbines:	
Includes gas generator and recovery of tar	4,300– 5,400
Diesel engines:	
Without usage of excess heat and cooling water	2,800– 3,400

After obtaining good results with a 1,000-hp. gas turbine, Thyssen is now building a gas turbine for 12,000 kw. The thermal efficiency of this gas turbine, including the gassing plant for the coal, is calculated to be 26 per cent, as against only 15-16 per cent with boilers and steam turbine. The Prussian Railways have placed an order for a 33,000-kw. gas turbine for the single-phase road from Magdeburg to Leipzig. Should the results be satisfactory, the gassing of bituminous coal on a large scale will be taken up on this road.

Another interesting discussion was led by Mr. Scholtes concerning the mechanical removal of ashes in large power stations. Six large stations had on their hands a combined amount of 527,000 metric tons of ashes, which required 600 men to remove by hand. By substituting mechanical means of removal 500 of these men have been released for other work. Mechanical removal is today of increased importance, because hand labor has increased tenfold in the last few years, Mr. Scholtes said.

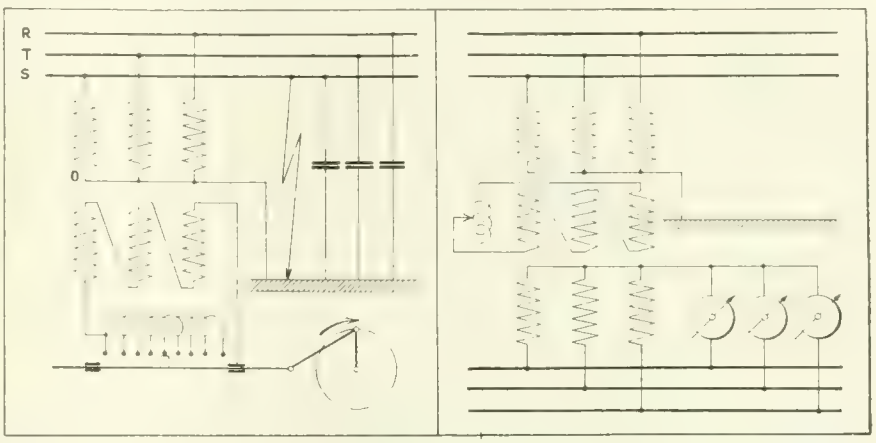
Requirements in Mechanical Removal of Ashes

The following requirements are essential:

1. The system should be fully automatic, requiring only supervision.

2. At night and on holidays it should be possible to shut down the conveyors without interrupting plant, in order to inspect or overhaul the apparatus. Sufficiently large bunkers should be available to store ashes for these periods of idleness.

3. The system should operate without producing dust. In case of trouble hand removal of ashes should be possible. Unskilled supervision should prove sufficient.



FIGS. 1 AND 2—TRANSFORMER ARRANGEMENTS FOR PREVENTING TEMPORARY GROUND FROM DEVELOPING INTO A PERMANENT ONE

Objection was raised to the third point on the grounds that stokers have to operate continuously and that therefore the ash-removal systems should also do so. Any accumulation of ashes is objectionable.

Replies to a circular letter sent to twenty-nine plants indicated four different ways of removing ashes—(a) Mechanically, (b) wet, (c) dry and wet, (d) pneumatically. With the mechanical method, which is especially used for anthracite fuel, the cinders are broken up and dumped onto endless belts or chains with buckets.

In the wet method water is used as a vehicle for ashes and slack, quenching the hot cinders at the same time. An interesting installation of this kind is at the coal mine Hibernia, in Westphalia, where twenty-two boilers discharge their ashes into a central trough. This is inclined from both ends toward the middle at a grade of 17 per cent, with 33 liters of water per second flowing from each end. By means of a pump the water is used over and over again.

On board of ships ashes are ejected by water and steam.

The pneumatic method is suitable only for pulverized fuel, the speaker said, because any ashes of larger size quickly eat through the metal chutes.

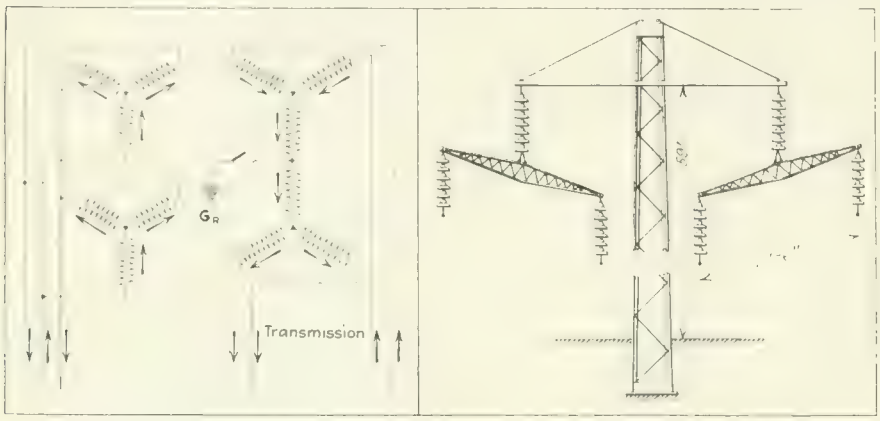
Protection Against Surges

"High-Voltage Protection and Safety of Electric Plants" was the subject of a paper presented by Prof. W. Petersen, in which he emphasized that, contrary to conditions in days gone by, when complicated and

non-homogeneous apparatus was used for protection, there is today a gratifying uniformity and simplicity of such protecting apparatus. Proper grounding, steep-wave-front protection for transformers and circuit breakers constitute the principal safeguards. For testing indoor insulators graded voltages are employed as follows:

Rating (kv.)	Test Voltage in per Cent of Operating Voltage
Up to 12	500
Up to 35	300
Up to 50	260
Above 50	230

Considerable research and investigation have yet to be conducted to determine the proper internal insulation of transformers. Some plants specify such heavy insulation between adjacent coils as to make any outside protection like choke coils unnecessary. It may be possible that manufacturers will ultimately insulate even moderate and small sizes of transformers so well as to eliminate the necessity of external choke coils.



FIGS. 3 AND 4—TRANSFORMER AND LINE ARRANGEMENT FOR CHANGING A TWO-CIRCUIT, THREE-PHASE LINE TO A FOUR-WIRE LINE WITH INCREASED CARRYING CAPACITY

To assure the most reliable service, the speaker suggested test voltages for transformers as follows:

Rating (kv.)	Test Voltage in per Cent of Normal Voltage
10	375
24	250
110	200

Beginning at 10 kv. or 20 kv. operating voltage, the same simple protective apparatus as for highest voltages should be used; that is, ground protection; choke coils and protective circuit breakers. Ample protection against excessive ground currents is given by use of the so-called grounding coil. On lines with moderate voltage it is not recommended that a ground cut-out be employed. Such lines should be built sufficiently strong and safe to maintain operation even during a ground. Using ground detectors at both ends of the lines, it is easily possible to locate, separate and remove such a ground.

Interesting details of the so-called quenching transformer (Lösch-transformator) were given by Chief Engineer Schrottke. The apparatus prevents a temporary ground from developing into a permanent ground. It consists of an ordinary Y-open-delta transformer, the Y-point of the primary being grounded and the secondary delta being closed by a regulating reactance coil (see Fig. 1). It will be seen that if a ground occurs on one of the lines, for example S, the branch SO will be more or less short-circuited, causing a flow of current in the secondary which the primary derives from the line. This current may be so regulated by the reactance coil as to be equivalent to the charge current of the line to ground. The ground is thus deflected from the grounded line, and the line S is brought to the potential of ground, obviating any arc between line and ground. Any station transformer may be used as a quenching transformer by equipping it with a tertiary winding, as shown in Fig. 2.

Some large transmission problems were considered by chief engineer Tröger (A.E.G.). A total of 4,000 km. of line is operated today in Germany at 100,000 volts. Of this 1,200 km. have aluminum conductors, 2,400 km. have copper and 400 km. have aluminum-steel. The opinion is quite prevalent that the three-phase system requires the least amount of material. However, at the same current density and the same voltage to neutral all symmetrical systems, including the single-phase, require the same total cross-section for a given capacity. With the same insulation, dead-grounded systems permit of an increase of voltage in the ratio of the Y-voltage to the phase voltage, and therefore permit for the same capacity the use of a somewhat smaller conductor. Provided the wires have sufficient distance between them, a dead-grounded 100-kv. line may be operated at 173 kv. A similar result, without increasing the voltage between adjacent wires, may be obtained, according to Fig. 3, by connecting two three-phase circuits (transformers) together and grounding the connecting line, which results in four outgoing lines. Such a line transmitted before the grounding connection was made (with therefore six conductors) $2 \times \sqrt{3} \times 100 = 346$ kw. per ampere. After the connection with four conductors and the same current it transmitted $4 \times 100 = 400$ kw. This represents an increased capacity of 1 to 1.73. Of course, one disadvantage is that each ground is a short circuit. By using a suspension tower, as shown in Fig. 4, this quadruple line may be installed with the same number of insulators as the ungrounded system of six conductors.

In the discussion of this paper Professor Petersen expressed the opinion that the three-phase system is by no means the ideal one. At a cost of 60 to 70 per cent, with fewer towers, less installation and a higher safety factor, a single-phase system has the same transmission capacity. A system with constant voltage was not, in his opinion, the best solution of the transmission problem. A transmission line on which the voltage is adjusted so that at each lead the relation between current and voltage is definite (equal to the wave resistance) operates like a direct-current line and is far superior economically to a three-phase line.

Dr. Stern of the Allgemeine Elektricitäts-Gesellschaft expressed an opinion against aluminum-cell arresters, saying that they would operate satisfactorily if it were possible to connect them directly to the line. However, it is not possible, for chemical reasons. Aluminum cells when connected to the line via a spark gap constitute a wonderful generator of traveling waves.

Simplifying Electric Meter Maintenance

One Type of Demand Meter Should Be Chosen for Given Class of Service Wherever Possible - Selection of Standardizing Equipment and Frequency of Tests Are Also Dealt With - Measures for Making Meter Installations Safe

By J. C. LANGDELL
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ON ACCOUNT of the fact that metermen who actually maintain the demand meters on a system can master the characteristics of one meter more readily than those of several meters it is advisable for central-station companies to adopt a single type for any given class of service wherever possible. Meter installations should also be standardized and made safe so that there will be no risk to persons or to property. Meter service cabinets for enclosing live parts at the customers' premises and adequate grounding of secondaries are essential safety measures. Under favorable conditions the periods between tests of meters may be increased beyond those commonly adopted. Meter clocks, in particular, should be repaired or adjusted only by factory experts.

Accuracy of electric meters is a factor in the utility business of first importance and has a direct bearing on all of its incomes. Unfortunately no device for registering energy has yet been developed that will remain accurate indefinitely. The general tendency is to under-register owing to the wear of bearings. A satisfactory frequency of tests depends upon several factors; namely, income derived from the meter, type, age, location and periodic accuracy performance. Roughly speaking, the minimum time-interval test of alternating-current residence meters should be about thirty months, which can be extended to forty-eight months if the accuracy is adequate. A further extension may be permissible for the modern house-type meter, provided that the accuracy report shows the performance to be satisfactory. Old-time types of meters require more close supervision than modern types, and in extending the schedule it will be necessary to consider the performance of these meters. We have found by experience that direct-current and alternating-current meters of large capacity require testing in some cases at monthly intervals, in others less frequently, down to intervals of a year, on account of the large amount of revenue involved and the loss that would result should errors occur. One of the most important details of proper meter operation depends entirely upon the attention which the meter tester gives the meter in making his periodic test and inspection; that is, he should if possible determine the cause of inaccuracy and not make adjustments unless it is impossible to eliminate the cause of the error. It is of little use to recalibrate a meter which is found inaccurate because of excessive friction unless the cause is removed. The use of a much lighter moving element on the modern meter has added considerably to its life and reduced the wear of the moving parts.

Standardizing Primary Meter Installations

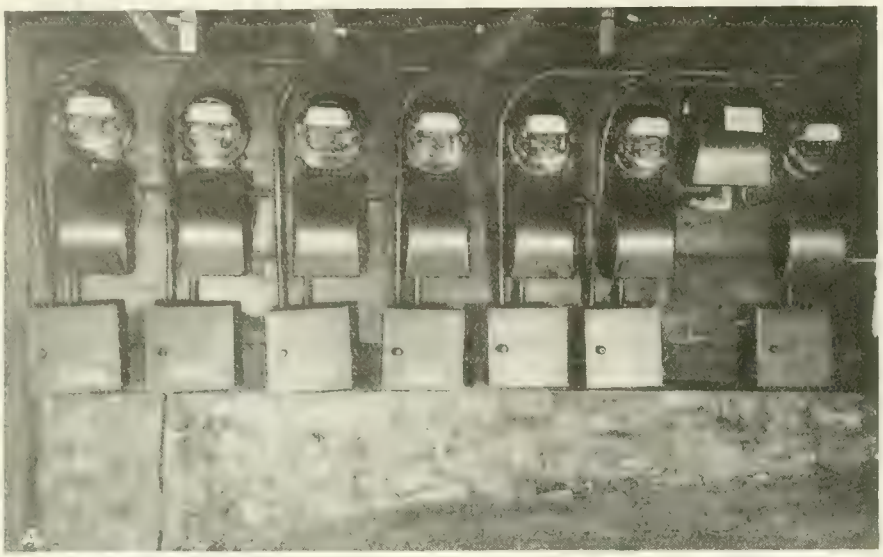
Practically all large power customers, those using 100 kw. and over, are metered on the primary side of the power transformers, both as to watt-hour and demand, by the Consumers' Power Company. Standard specifications have been made for the suitable housing of current and potential transformers and necessary meters. Wiring diagrams are also included, and so far as possible it has been the endeavor to standardize on the use of current and potential transformers as well as on demand and watt-hour meters. These installations are inspected weekly by an employee of the meter department, who makes a careful test as to the satisfactory operation of the meters, winds the clock, installs a new chart and tests the potential fuses, also inspecting the meter for rotation of both elements. A careful electrical test is made every six months by the use of a phantom load, and in addition a meter is tested on the customer's operating load. All of these installations are equipped with special testing blocks, and lamps are placed on the potential wires in order to detect quickly any trouble with the fuses.

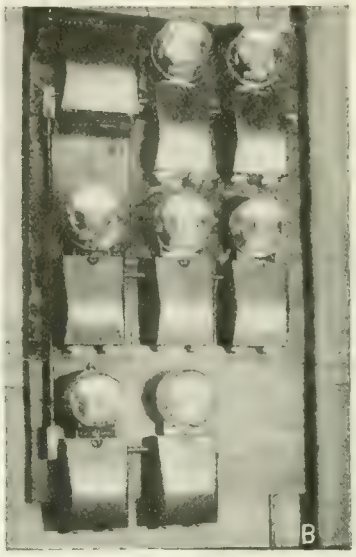
Since many of these installations are subject to atmospheric conditions it has been necessary to arrange for the use of thermostatic devices in order that the even temperature so necessary to good clock operation may be maintained. The company at the present time is using almost universally the type G-2 demand meter, which is provided with a temperature device, the operation being entirely automatic. It has been the practice to use lamps in series with this device, but in view of difficulty due to its change with age it is planned to use a Ward Leonard resistor, which should operate more satisfactorily. An even temperature in connection with the G-2 type of demand meter is necessary because wax charts are used, which become hard under low temperatures, the result being a poor record.

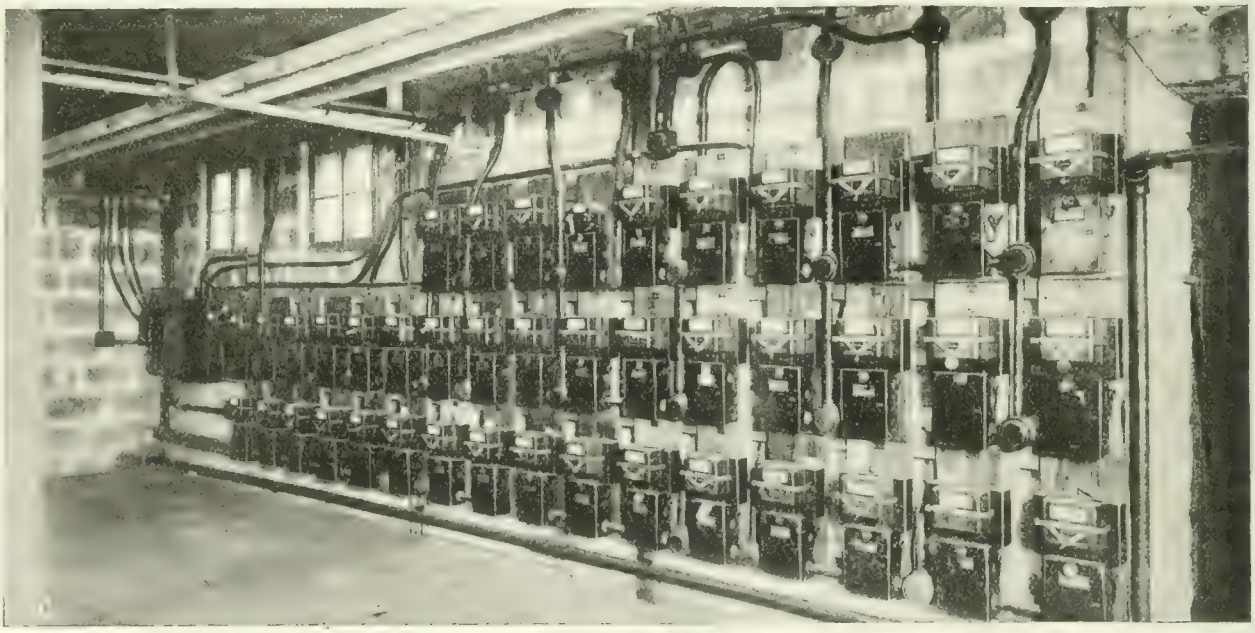
One Type of Demand Meter Is Used

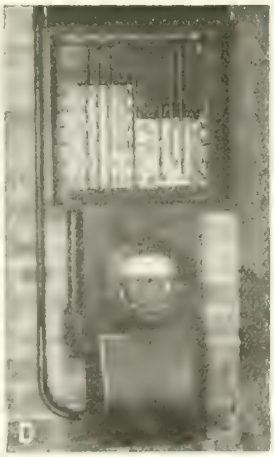
The selection of proper demand meters is most important, and in view of past experiences the use of type G-2 has been virtually standardized, principally on account of the elimination of ink difficulties and because of low maintenance costs. These meters can be used, moreover, with the same degree of accuracy on either constant or fluctuating loads. The G-2 chart is very easy to explain to the customer as the demand is clear and can be filed readily. Explaining to the customer the use of the curve-drawing wattmeter chart in obtaining demands has caused us considerable trouble, especially where fluctuating loads are concerned. In adopting this type of demand meter for general use in preference to the indicating type, such as the M-4, it was felt that trouble would be experienced in the operation of any demand meter. It has been exceedingly difficult to determine the cause of inoperation of the indicating type, a condition which does not occur with the type having a graphic chart; that is, it is assumed in using any demand time-interval device that it will not always function properly, and to remedy these troubles just what happened must

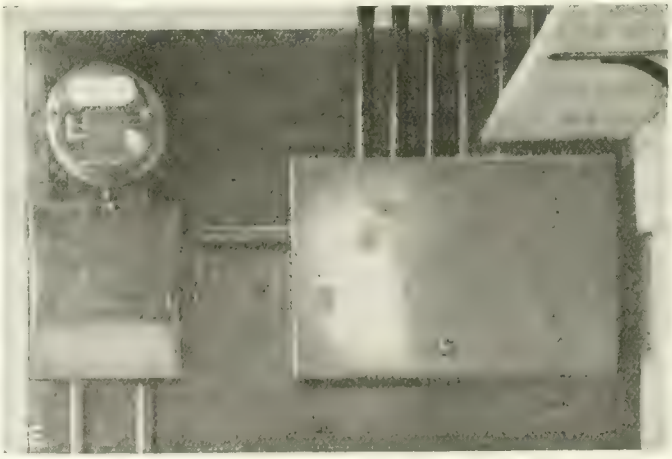
Some Examples of Good Meter Installations

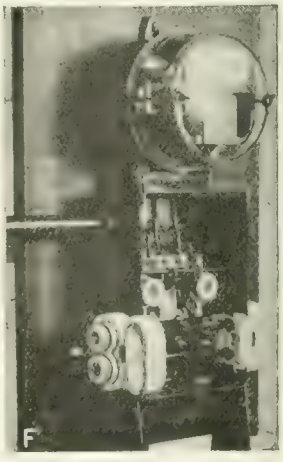












Safety, prevention of theft of energy, compactness and low cost have been the objects strived for in the development of better types of customer meter installations. Protecting all wiring with conduit and the use of safety switches have eliminated dangers to persons and property. Covering the meter terminals with the switch box prevents "jumping" the meter and simplifies wiring. All of the installations shown above have these features, but simplicity and compactness are carried further in B and F, where the customers' fuses are mounted in knockouts in the safety switches, thus eliminating the separate boxes for fuses. Photograph A shows individual fuse boxes for each customer, while D and E show in one box the fuses for several circuits on one meter. At C is an installation with side-feed meters, of which the leads are protected from tampering. Here customers' fuses are not located at the meter.

be known. The use of demand meters in connection with the driving gears of the clock on the watt-hour meter involves direct gearing, and should this mechanism fail to operate it might affect the registration of the meter, entailing a loss of both demand and kilowatt-hours, a condition hardly possible with a separate contact device operating a record chart meter actuated by contacts in connection with the gear register. In this case, if the demand meter fails, which some do occasionally, the kilowatt-hour record is still correct. The writer believes that fully one-half of the difficulties experienced by the central stations, especially the smaller companies, are due to the fact that the men handling demand meters are not thoroughly familiar with their operation.

Demand meters are a much more complicated device than the watt-hour meters, and men handling these should have special training either at the factory or with some one who thoroughly understands their operation. It appears to be a mistake to endeavor to use three or four different types of demand meters, each with its own problems and different type of mechanism. This company is receiving very good results from demand meters because its men are trained to care for only one type. All measuring equipment is being standardized as far as possible, since more economical maintenance results and the tester becomes familiar with the device which he is endeavoring to maintain. It has been our practice for several years to send the foreman of the meter department to the factory yearly for instruction on demand-meter operation. This has resulted in improved operation of these devices reaching fully 50 per cent, and the manufacturers are eager to assist these men in order that satisfactory operation may be obtained.

An instance might be cited that happened several months ago in one district. Fully 80 per cent of the clocks were not operating properly. An inspection was made as to the probable cause, but it was not determined until an expert clock maker was sent to us from the factory. It had been the practice to allow local jewelers to clean and repair these clocks, and in doing so they had made adjustments that prevented the proper operation of the demand meter. The demand-meter clock is not to be compared with the ordinary timepiece and should not be repaired or cleaned at any other place than the factory.

Functions of the Standardizing Laboratory

An electrical laboratory has been established at Jackson, Mich., and provided with necessary standardizing apparatus, such as a potentiometer and standard cells, as well as with precision meters for the purpose of checking periodically rotating standards and with indicating instruments for the entire system. The laboratory maintains all meters and instruments, and in addition tests and adjusts relays as advised by the operating department. The supply is furnished by the use of a special three-unit testing set consisting of a 15-hp. direct-current motor driving two small generators, one furnishing three-wire, three-phase potential at 110 volts and 220 volts and the other being a 20-volt current generator for 150 amps., three-wire, three-phase. The speed of these machines can be varied from 20 to 64 cycles with a range of from 2 kw. to 5 kw. per machine. These machines were specially designed to produce true sine waves, and taps are brought out on the voltage machine for the testing of steel. The current generator is provided with a rotating armature that permits us to obtain any power factor between the potential and current generator from 20 per cent leading to 20 per cent lagging without any distortion of wave form. The electrical laboratory is held directly responsible for the accuracy of rotating standards and portable instruments, and the various meter departments are not permitted to break seals or readjust calibration.

Once a year a representative of the laboratory makes a complete inspection of the meter installations of the various primary customers, checking connections, current and potential transformer data, meter register, ratio dial constant, teeth on cam and operating demand meter, inspecting charts as to proper billing demand, and attending to other details in connection with the installation, in order that the highest accuracy possible may be obtained. This rigid inspection has more than paid for the expense. In addition to the electrical inspection a careful survey is made regarding safety, particularly that of the tester who makes the necessary calibration of the meters.

Making Meter Installations Safe

It is the writer's belief that the average utility has not taken a sufficient interest in the proper installation of meters. Many companies are confronted with outside conditions that result in the loss of energy or greatly increased cost of maintenance and tests. These conditions are squarely up to the central station, and would never have existed if rules and requirements had been published by the company specifying the proper location of the electric meter and insisting upon certain specifications that would provide satisfactory wiring. A survey of the average outside installation, especially on consumers' premises, shows that meter locations and wiring are far from ideal.

The three most important items in connection with customers' installations are: Conduit entrance, steel service cabinets and the proper grounding of secondaries. The enforcement of these requirements will result in a great deal of improvement to installations and wiring conditions and will be of great benefit to the consumer and the utilities. The writer would urge that the central station co-operate with the city and insurance authorities in requiring that the wiring on customers' premises be as safe as possible.

An open service exposes the utility to a loss of income from theft of electricity. The use of solder, iron, wire and miscellaneous material in the main-line cutout has resulted in the loss of thousands of dollars to the consumer from fire. While central stations should not exercise any authority over customers' interior wiring, they should specify the proper location of meters, and the service supplying these meters should be placed in metal and the main-line switch be suitably protected. The city or municipal authorities should require a thorough inspection as to the condition of the interior wiring, and the power company in no case should furnish energy to consumers unless a certificate of inspection can be produced showing that the wiring is safe and will not expose the customer to unforeseen life or fire hazards.

The use of open switches on main-line cutouts, or in any place where they are exposed to persons not having the proper respect for electricity, is a relic of the dark ages and represents a life and fire hazard. Their use in such places should be immediately discontinued and inclosed types required for all new installations. An inclosed switch, however, unless means are provided for

sealing, is of very little value to the company or consumer, and in order to obtain a completely steel inclosed installation the company should require that standard service boxes be installed. There has been considerable discussion as to why the central station should standardize on one make of service cabinet at one time. This is absolutely necessary providing an installation is required inclosing all wires and live parts, owing to a lack of interchangeability of meter trims or adapters.

The parties most vitally interested in the adoption of a proper service cabinet are the company and the consumer, the contractor only indirectly in its installation, and his responsibility ceases when the work is completed. The company is required to maintain a satisfactory service through this cabinet and should be supplied with means to permit a safe method of testing. The sealing of these cabinets is of considerable benefit to the consumer, as it prevents the use of material other than the proper fuses and is of benefit to the municipal authorities, as a switch can be locked, opened and sealed when the inspector considers the wiring unsafe. The use of service boxes should not be limited to single-phase residence use, but a cabinet should be adopted that can be installed on three-phase service simply by changing the interior, parts of the cabinet being limited by the actual dimensions of the box.

It is the author's opinion that the proper method should be for the company to adopt a standard box or a box on the market that would meet most of its requirements, and in co-operation with the municipal authorities and contractors' association arrange to have these installed by the contractors. This has many advantages over the other methods and provides a complete steel inclosed installation, standardization of meter installations and gives 100 per cent protection to the consumer and the utility.

Testing Instrument Transformers and Shunts

As in the case of most central stations, the revenue of the Consumers' Power Company is registered through transforming devices such as instrument transformers and shunts, in connection with direct-current meters of large capacity. The accuracy of this equipment is very important and provision should be made for periodically testing it in addition to the tests of meters or measuring devices. It is the intention to check the resistance of these shunts approximately every five years at the Jackson laboratory by the use of the Kelvin double bridge furnished by the Leeds & Northrup Company. This instrument is extremely reliable, its accuracy being guaranteed within one-fiftieth of 1 per cent. It utilizes the potentiometer method and can be used with comparative ease and simplicity. The question of checking the ratio and phase angle of current and potential transformers is rather complex and requires extreme care to obtain proper results.

The testing of those in service is exceedingly inconvenient and difficulties might be experienced in obtaining several points of the curve. It is the intention to remove current and potential transformers from the installation and test these in the meter department. The Bureau of Standards some time ago submitted what is known as the two-watt-meter method, the chief limitation of which is that it is slow. An instrument can be obtained which will read directly in ratio and phase angle and which will indicate the difference between the transformer under test and the standard transformer. A set of Siemens-Halske current and potential transformers has been purchased, the current ranging from 10 amp. to 1,200 amp., and the potential from 1,000 to 6,000. These transformers will be certified by the Bureau of Standards as to accuracy, after which they will be considered as standard transformers and service transformers will be checked against them. The results obtained by this method are extremely accurate, and it is possible to make a complete check on a current transformer both as to ratio and as to phase angle within a period of thirty minutes.

Selecting Oil Circuit Breakers

Advantage Should Be Taken of Fact that Voltage as Well as Current Drops When Reactance Is in Circuit and Breaker Opens at Voltage Below Normal

By H. L. Wallau
Electrical Engineer Cleveland Electric Illuminating Company

THE proper selection of oil circuit breakers for electrical systems is a matter the importance of which is coming to be very clearly recognized. Not only must a breaker be capable of handling the short-circuit currents of the present but allowances for reasonable growth must be made. Present-day prices make it imperative to select the least costly breaker suitable for the conditions to be met. Calculations, as generally made, have in certain cases the tendency to suggest the use of a breaker larger than is really necessary. The error is on the safe side from the point of view of operation, but may be on the wrong side financially.

For example, in the method commonly used when the station and circuit reactance and the generator capacity and voltage are known, the current is computed for short circuit at any given point and allowance is made for the decrement in short-circuit current due to the time setting of the breaker and relays. Then a breaker is selected having this current-interrupting capacity at

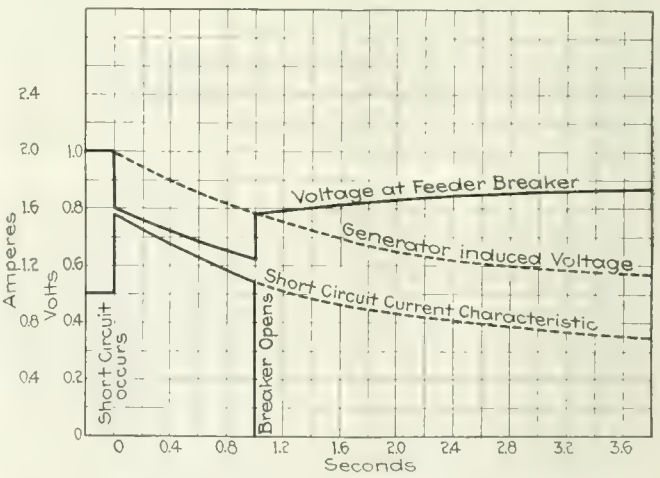


FIG. 1 — DROP IN VOLTAGE AND CURRENT AT FEEDER CIRCUIT BREAKER IN GENERATING STATION DURING A SHORT CIRCUIT

This action is based on the assumption that the generator speed becomes less during short circuit.

normal circuit voltage. It is a fact, however, that the voltage drops below normal on short circuit; consequently a smaller breaker might be used if the time settings are sufficient. Fig. 1 is a reproduction of one of the sets of curves shown by Dr. C. P. Steinmetz in his recent paper on the "Stability of High-Voltage Systems," before the American Institute of Electrical Engi-

neers. This illustrates the case of a feeder fed from a 60,000-kw., 9,000-volt turbo station with a reactor of 0.7 ohm per phase between feeders and station bus. This amounts to a 52 per cent reactance (will give a drop equal to 52 per cent of rated voltage if total generator current is flowing). The feeder was short-circuited for one second just outside this reactance. It will be noted that the short-circuit current to be interrupted at the end of one second (for the constants

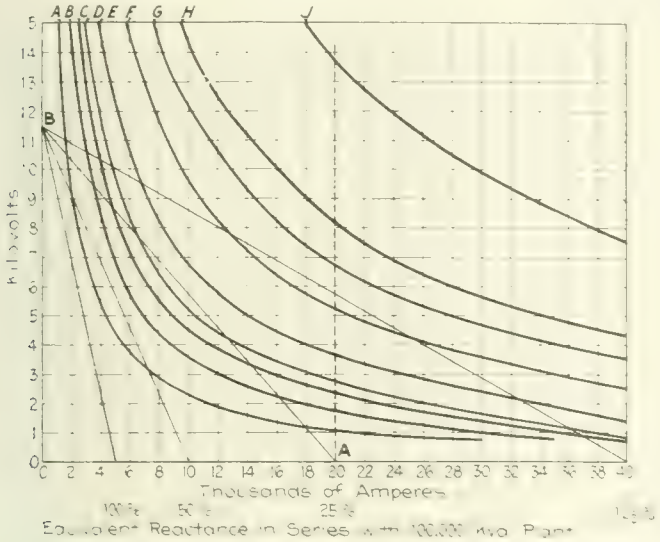


FIG. 2—RUPTURING ABILITY OF CIRCUIT BREAKERS UNDER VARIOUS VOLTAGES

assumed) is but slightly over the rated full-load current of the capacity connected to the bus, and that the voltage at the time of interruption is but 63 per cent of normal.

Now consider that such a line has a second breaker at its load end, and that this is set to open after 0.8 second, and assume a short circuit of zero impedance on the load side of this breaker. The short-circuit current, neglecting line impedance, would be somewhat greater for an interruption after 0.8 second than in the previous case with a one-second setting, but the terminal voltage at the point of short circuit would be zero, or practically so. The duty of the breaker is thus greatly reduced.

In order to select breakers for this class of service it has been found convenient to plot curves of rated interrupting capacity for various sizes of breakers at different voltages, as listed by the manufacturers (see Fig. 2). A series of straight lines may then be drawn on the chart as follows: For a given percentage of reactance the maximum short-circuit current at the system voltage is computed. For instance, take a 25 per cent reactance with a 100,000-kva. plant. This 25 per cent reactance is the sum of the equivalent reactance of the station units, external reactance and internal transformer reactance of the substation. With this reactance and a system voltage of 11,500 the short-circuit current would be 20,000 amp. This point is plotted at *A* in Fig. 2. This corresponds to zero terminal voltage at the substation. For zero current the terminal voltage is, of course, 100 per cent (*B* in Fig. 2). Therefore, by connecting the zero-current, 100-per-cent-voltage point (*B*), to the zero-voltage, 100-per-cent-short-circuit-current point (*A*)—for the equivalent reactance determined—a line is established showing the drop in voltage for increase in short-circuit current at the substation.

Any breaker whose characteristic rupturing capacity curve lies beyond this line will be capable of handling the short-circuit current at the substation. If allowance for increase in short-circuit current due to plant growth has been made in computing the maximum short-circuit current to the substation, the curve nearest the drop characteristics may be used. If not, some further leeway must be allowed and a larger unit selected. Thus, if it be determined that with a 100,000-kva. plant on an 11,500-volt system the reactance to a given substation will never be less than 25 per cent, the maximum short-circuit current would be 20,000 amp.

From this line it can be seen that breakers having the characteristic curves marked *A*, *B*, *C* and *D* are too small, but that the breaker whose characteristic is *E* will suffice. It is not necessary to use the breaker whose characteristic is *J*, as might be thought from the common method of calculating mentioned before. This switch is capable of interrupting the short-circuit current at a voltage in excess of system voltage.

If the substation is fed by a number of parallel feeders, the equivalent reactance for all of the circuits in parallel is, of course, the value that must be used in the numerical computations. Although the current to be interrupted by one breaker in a station fed by N lines in parallel is I/N of the total current, in the case of a fault just ahead of the breaker, where one breaker must open on reversal, the short-circuit current to be handled is $(N - 1)/N$ times the total current. In the case of a second circuit fed from the substation bus it may reach the total short-circuit value, if no additional reactance is interposed.

This also brings out the fact that in the case of substations fed by a number of lines in parallel the duty on the substation breakers may be substantially higher than that on the breakers on the sending end of these lines.

Maintenance of Chain-Grate Stokers

By John M. May
Traveling Engineer Iowa Railway & Light Company

ALLOWING clinkers to accumulate on the side walls of the furnace is about the most common cause of stoker troubles. This causes more grates to stick than almost any other one thing, and it is too often the case that a stoker is allowed to run in this condition until the drive will no longer pull it. When this happens the obvious course should be to find out the cause of the trouble and remedy it, and not to try to force the grate with a bar until the grate or some part of the drive gives way.

Lack of proper maintenance also manifests itself in the stoker drive or gears. If the bearings are allowed to become worn and loose, the gears fail to mesh and begin to climb. This may do damage to several parts of the stoker. Perhaps the gear teeth or the bracket will break, and sometimes the front frame of the stoker is cracked.

The chain grate should be kept taut, and attention should be given to the rollers so that the stoker is always in line and square. There is no excuse for allowing the ashes to build up as high as the grate. When this is done the grate, and often the back roller shaft, are burned. This entails expensive repairs. Consequently, if it is noted that the ashes are touching the grate, the stoker should be immediately shut down before any actual damage is done and the ashes should be removed before the stoker is started again.

Tendencies in Relay Protection

Centralized Supervision of Protective Equipment Increasing—Keener Analyses Being Made of Character of Faults and Limitations of Protective Equipment, More Accurate Applications Resulting—Differential Relay Practice in England Is New Development

By R. N. CONWELL
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SEVERAL of the larger power companies have placed the protective equipment of their respective systems under the centralized control of one department, generally engineering, contact being maintained with the other departments in order that their ideas and experiences may be correlated with the engineering features. The work of these engineers is being summarized by one of the committees of the American Institute of Electrical Engineers so that there may be available an analysis of the results obtained through the use of different protective schemes under a range of conditions not obtainable on any one system. As a result of this action keener analyses are being made of the character of faults and the limitations of protective equipment. More accurate applications are also resulting from these analyses.

There is a wide divergency between the conditions existing on the various transmission systems, the protection of which requires the adoption of different schemes and sometimes new developments in both schemes and relays. Some of the recent developments worthy of notice have been in the field of differential current protection, pilot wire protection, ground protection and service restoring devices. The manufacturers are meeting these demands as rapidly as the new conditions are defined and established.

The problem of protection even under the most favorable circumstances is complex; consequently more consideration is being given to the design of transmission and distribution systems which may be protected by simple, reliable relay installations with a minimum of auxiliary equipment.

Over-Current and Directional Protection

In general, schemes employing over-current and directional relays are still utilized as the principal form of line protection, even in the most complicated networks, but their application on large systems is limited by the danger incurred in holding short circuits for more than two seconds. This condition has forced the adoption of differential protection to eliminate or reduce time settings, and more attention is being given to schemes of this character than heretofore.

Where lines are operated in parallel, differential protection based upon the condition that the faulty line carries the greatest current has been used in a number of instances. Some difficulty has been experienced with these schemes, when applied to systems having high short-circuit values due to surges accompanying the re-establishment of normal conditions after the release of the faulty line, operating the relays and tripping out good lines. Experimental work with time-delay, circuit-opening relays connected to open the trip circuits of paralleling line breakers for a predetermined interval gives promise of overcoming this difficulty. Other schemes of electrically interlocking the trip circuits by requiring the simultaneous operation of two banks of relays in order to trip out the faulty line have been installed, but the experience necessary to render a decision on the value of this scheme has not been obtained.

Practice in England Has Good Points

In England, where a majority of the power systems employ parallel or duplicate lines, there has been a very interesting development in differential protection which undoubtedly is in the right direction. Over-current relays of the so-called "reactive type," consisting of a set of fixed coils forming a field for another set of moving coils, are used. The secondaries of the current transformers in the same phases of each of the parallel lines are connected for circulating current with the fixed coils of the relays in series. The moving coils are connected to the equipotential points in the secondary network; therefore under normal balanced conditions no current passes through these coils.

However, the occurrence of a fault on one line causes a differential current to flow through the moving coils, which are so connected, considering polarity, that the relay with trip circuit to the breaker on this line will close its contacts, while the relay connected to the trip of the breaker on the parallel line will be restrained or held open by the differential current. If the fault had appeared on the latter line, the direction of the differential current would have been reversed, causing a reversal in the operation of the relays. The entire output of the current transformers being used for the excitation of the fields of the relays makes them capable of very sensitive settings—more sensitive, in fact, than can be utilized in practice, since the setting is dependent upon the degree of unbalance between lines. If the lines are balanced to within 1 per cent at normal load and subjected to twenty times normal load on through short circuits, it is evident that a 20 per cent normal-load setting is insufficient to insure stability.

This scheme, when compared with those of the same class in use in this country, presents a number of distinct advantages. These are simplicity, high sensitivity as required, elimination of potential transformers, the fact that only faulty line relays may operate, all others being restrained, and the further fact that the scheme may be applied to two or more parallel lines by simply adding equipment as new lines are installed, no changes in existing equipment being required.

Applications of the same principle have also been made for the protection of transformers, generators, twin lines, and single lines with pilot wires.

Pilot Wire Protection

In several instances the practice of looping a line through a large number of customers' substations has forced the abandonment of over-current and directional

relays, on account of the time elements involved, and the adoption of pilot wire schemes. Generally these substations are installed at short distances from one another so that the installation of short pilot wires means a relatively small initial investment. One of the largest power companies now has installations of this kind and of its own design in satisfactory operation.

Another pilot-wire scheme which has been developed for this type of service consists of three pilot wires and a neutral wire connecting for circulating current the secondaries of current transformers at one end of the line to the corresponding transformer secondaries at the other end. Over-current relays at each end are connected between the pilot wires and the neutral wire. In order to prevent the leakage of part of the current through the relays under normal operating conditions, owing to the resistance of the pilot wires, special current transformers having a secondary rating of 0.5 amp. or 1 amp. are used. This gives a correspondingly small potential drop between the two ends of the pilot and at the same time requires the use of a high-impedance relay operating on small current. When a short circuit or ground occurs on the line, the secondary currents no longer circulate, but are opposed, so that current must flow through the relays and trip the breakers at each end of the line.

Ground Protection

The practice of grounding the neutral of power systems has given impetus to the adoption of ground or residual relay protection. Experience in this country and abroad has shown that in both cable and open-wire systems the majority of faults develop first to ground. The practice of using only phase-to-phase protection results in considerable delay in clearing a faulty line, as the phase relays do not begin to function until after the ground fault has developed into a phase-to-phase fault of considerable magnitude. The release of a line under these conditions frequently causes severe disturbances. On high-voltage systems the fault to ground may never develop into a phase-to-phase fault on account of the wide spacing of conductors. High-resistance grounds limiting the current to relatively small values which will not operate phase relays may occur on any system.

A selective ground-relay scheme to protect transmission systems against the classes of faults referred to has been developed and put into operation on several systems. On outgoing lines a low-impedance over-current relay with low pick-up value is connected in the ground lead between the neutral point established on the ground side of the phase relays and ground. Unbalanced current resulting from a ground on one phase of the line will cause current to flow through this relay, tripping the breaker. On incoming lines a similar installation is made, but in this case the directional elements used in conjunction with the phase relays are used with the ground relay by connecting the trip circuit of the ground relay in parallel with the trip circuit of the over-current phase elements. Discrimination is obtained by use of time and unidirectional elements.

Many of the interruptions occurring on overhead lines are the result of lightning and similar causes. Although these disturbances are transient in character, they frequently cause short circuits and flash-overs which trip line breakers. The undamaged line may be immediately returned to service. A system of relays has been developed to reclose the breaker automatically as soon as it has been opened by the line relays, the speed of the device being such that service has been restored in less than one second after the breaker opened. Should the line be permanently short-circuited, the breaker will continue to open and close any desired number of times in accordance with the setting on a limiting relay.

The use of differential protection for generators and power transformers is being rapidly adopted throughout the country. The only troubles experienced with this form of protection have been due to improper phasing or the use of settings which are lower than justified by the degree of balance obtained.

Modern Practice in Westport Station Design

Safe Operation of Generator Fire-Fighting Apparatus, Prevention of Ceiling Condensation and Welding of Steam Piping Are Important Features

By M. D. Engle
Consolidated Gas, Electric Light & Power Company

A UNIQUE method of handling coal received by water at the Westport (Baltimore) station was fully discussed in the Electrical World, Jan. 15. It was also shown how the plant must supplement the Holtwood hydro-electric station to make maximum use of the water available at Holtwood. In this article a number of features typifying modern thought in steam generating station design, as carried out in the Westport station, are discussed.

Great care has been taken in the layout and installation of all piping so that the whole structure is highly flexible. Nearly all piping over 2½ in. (6.4 cm.), with the exception of galvanized piping, is butt-welded except at valves. Reinforced Van Stone flanges are used at the valves. The use of field welds has proved highly satisfactory and has reduced gasket trouble to a minimum. This installation has definitely demonstrated the practicability and economy of field welds made by the oxyacetylene method. All boiler-feed, condensate and salt-water piping and flanges are galvanized. Pipe bends have been substituted for fittings wherever possible in all steam and hot water lines. As seen in Fig. 1, page 134, Jan. 15 issue, each battery of six boilers supplies steam through a common header to the supply header running parallel to the turbine room.

All piping carrying steam or hot water has been insulated with 85 per cent magnesia covering sewed over with heavy 8-oz. (0.23-kg.) canvas. The canvas is sized and painted different colors to denote the service of the pipe and to facilitate the tracing of lines. High-pressure steam and boiler-feed lines have insulation 3 in. (7.6 cm.) thick and exhaust steam 1½ in. (3.8 cm.) thick. Boiler drums, front and rear, feed-water heaters and receivers are covered with magnesia plastic cement 3 in. thick, reinforced with wire mesh and finished with hard coating. Valves, fittings and flanges are blocked in and given a hard-coat finish.

All 20,000-kw. units are surface condensing, being equipped with 32,000-sq.ft. (3,000-sq.m.) Westinghouse Le Blanc condensers and auxiliaries. They operate at a vacuum varying from 28 in. to 29.6 in. (711 mm. to 742 mm.) Hg. referred to a barometric pressure of 30 in. (762 mm.) Two 25,000-gal.-per-min. (95,000-l.-per-min.) circulating pumps, two Le Blanc air pumps and two condensate pumps are installed in connection with

each surface condenser. Both circulators are driven by means of turbines through reduction gears, and one circulator has in addition to the turbine drive an induction motor attached to the other end of its shaft. One air pump and one condensate pump are mounted on the same shaft, and one such unit is driven by a turbine through a reduction gear and one by an induction motor. With this arrangement fine heat-balance adjustments may be obtained and waste of exhaust steam prevented.

A portion of the condensate from the hot wells is bypassed into small jet condensers which are used to condense the steam which leaks through the labyrinth packing at the high pressure end of the Curtis turbines of the General Electric units. The water from these condensers is discharged into a sump tank in the turbine-room basement and pumped to the feed-water heater surge tanks.

The condensate piping is so arranged that the condensate from any machine may be pumped to weighing tanks on the boiler-room floor. After being weighed the water is discharged into a sump tank in the boiler-house basement and from here is pumped to one of the feed-water-heater surge tanks. This arrangement makes it a comparatively simple matter to run a water-rate test on any unit equipped with a surface condenser.

At the present time the condenser circulating water is taken in through two concrete-pipe intake tunnels and screened by means of two 10-ft. (3-m.) revolving screens as it enters the rectangular intake tunnel under the boiler house. Construction work is now in progress on a new screen well at the water front which is to contain six 10-ft. (3-m.) revolving screens.

All electric ends of the turbo-generator units are cooled with washed air and arrangements made to discharge the heated air into the turbine room or into the blower rooms of boiler house No. 3. The former arrangement is necessary in order that sufficient warm air may be discharged into the turbine room in the winter to prevent excessive condensation on the turbine-room ceiling. By delivering the extra heated air to the blower rooms a considerable heat saving is effected. The air washers take their air either from the turbine room near the ceiling or from outside windows.

Generator Fire Protection

The electric ends of the turbo-generator units are equipped with permanent fire piping. A number of nozzles extend through the end bells from an exterior header and are so directed that they can thoroughly drench the end windings of the generator. To prevent water being turned on by accident, the fire piping header is normally disconnected from the service-water system. In case of fire service may be quickly established by means of a short piece of fire hose and a quick-acting valve inserted at the base of the generator.

Two motor-driven exciters in the old engine room furnish the excitation for the engine-driven units and the first three turbo-generator units installed. The last four units have direct-connected exciters and are so arranged that they may operate from their own exciter or from the exciter bus supplied by the motor-driven exciters. A 300-kw. turbine-driven exciter is now being installed and will be connected to the exciter bus. The turbine-driven, motor-driven or direct-connected exciters will then be used, depending upon the heat balance of the station. In the winter, when there is a scarcity of exhaust steam for the feed-water heaters, the turbine-driven exciter will be run continually, and only such motor-driven exciters as are needed to carry the rest of the excitation load. In summer the conditions will be reversed. There will be a surplus of exhaust steam, and the motor-driven and direct-connected exciters will be loaded. A storage battery floats on the exciter bus.

Provision for Opening Generator Field

All units are switched to either of two duplicate 13,000-volt buses. The turbine-driven General Electric Company machines have 3 per cent reactance coils connected in their neutrals to give them a total reactance of 10 per cent. The Westinghouse machines contain sufficient inherent reactance to make additional reactors unnecessary. All of the generators are operated with their neutrals solidly grounded and are provided with balanced relay protection, so that the generator oil switches will open up owing to any failure in the generator windings or in the leads between generator and oil switch. These switches, however, will not open up on overload. In case a severe short circuit or ground occurs on the system, one which will cause more than 250 per cent of the normal rated armature current to flow, the generator field will be automatically opened. The field will automatically be closed again when the armature current drops to its normal rated value. This gives the feeder oil switches sufficient time to open and clear the system of trouble. The operation of this field-destroying device minimizes the severity of the short circuit and better enables the feeder oil switches to clear the system of trouble.

Service is taken direct from either of the station buses for the 13,000-volt feeders, while the 26,000-volt station ties are connected through four 12,600-kva. three-phase auto-transformers installed in an outdoor substation. On page 136, Jan. 15 issue, is shown the outdoor substation and the transformer repair frame used for disassembling and assembling the transformers. These transformers are operated with their neutrals grounded, and their hot-spot temperature is indicated by an instrument in the operating room. Customers in the vicinity of the plant are supplied with 4,000-volt service from two banks of 13,000/4,000-volt transformers.

Service for the station auxiliaries is taken from the main buses through four banks of 13,000/460-volt transformers. The load is so distributed to these four banks that the loss of two banks will not prevent operation.

A rather interesting system of load dispatching is used by the operators in the Holtwood hydro-electric station and the operators in the Westport plant during times of high flow. At such times it is obviously the best policy to generate the fewest possible number of kilowatt-hours at Westport. It is important, if this policy is to be carried out, that the Westport station should not pick up any load until the Holtwood station is fully loaded, and that Westport should "back off" enough to keep Holtwood fully loaded when the system load begins to fall off. To accomplish this, the operators at Holtwood set their governors for 25¼ cycles and the operators at Westport set their governors for 25 cycles. Under this condition the system frequency will be 25¼ cycles until Holtwood is fully loaded. When this condition is reached the frequency gradually falls to 25 cycles and Westport picks up the rest of the load and maintains the frequency at 25 cycles. When the system load begins to fall off the Holtwood machines, with their governors still at 25¼ cycles, pick up speed and maintain full load, while Westport, seeing the frequency begin to rise, "backs off"—a method automatic and quite satisfactory.

Auxiliary Transformer Reduces Inductive Interference

Transformers with Grounded Delta-Connected Secondary at Receiving End of 60,000-Volt Line Reduces Noise on Parallel Telephone Line

By L. J. Moore
Electrical Engineer San Joaquin Light & Power Corporation

BY CONNECTING an auxiliary transformer bank with grounded delta-connected secondary and operating without a ground wire on the primary of the transmission line, it was found in a recent test by the San Joaquin Light & Power Corporation that noises on a parallel telephone circuit were practically eliminated. These tests were made on the 60,000-volt line from Santa Maria, Cal., to Divide, which parallels a toll line of the Santa Barbara Telephone Company for a distance of about 3 miles (4.8 km.), the two lines being at approximately highway separation. The 60,000-volt line is of equilateral triangle construction, each side of the triangle being about 7 ft. (2 m.). Two power-line transpositions are installed within the limits of the parallel. During the test the telephone company opened its lines at each end of the parallel and readings were taken only on the parallel section. The power transformers at Divide are three 1,250-kva. Allis-Chalmers units star star-connected for 36,000 volts to 6,683 volts. The auxiliary bank used for absorbing the triple harmonics consists of three 299-kva. Allis-Chalmers transformers of the same voltage rating. The connections of these lines and the location of instruments are shown in the accompanying drawing, and the attached table shows the tests and the readings made.

This transmission line is about 10 miles (16 km.) long, and 5 miles (8 km.) from either end is connected a 60,000-volt grounded Y to a 2,300-volt delta bank of transformers at Betteravia. During tests 1 to 6 the Betteravia bank was connected on the line, and in tests 7 and 8 this bank was disconnected.

The tests were made as follows:

Test No. 1—60,000-volt line alive; no transformers connected.

Test No. 2—The line was alive and the power bank at Divide was connected unloaded.

Test No. 3—The same as No. 2, except that the power bank was carrying 1,080-kw. load.

Test No. 4—The power bank and the auxiliary bank were connected and the delta of the auxiliary bank was left open.

Test No. 5—The same as No. 4, except that the delta of the auxiliary bank was closed.

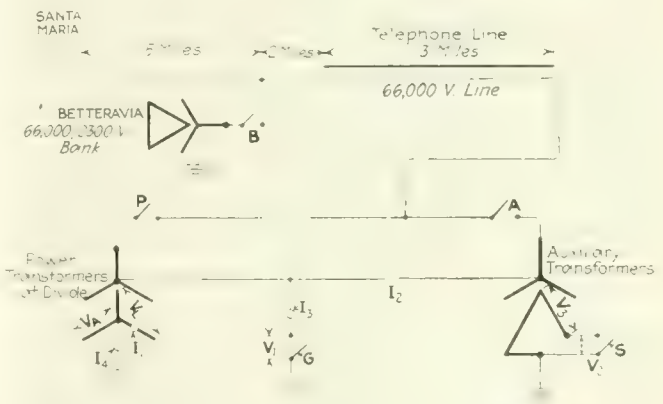
Test No. 6—The same as No. 5, except that the ground was removed from the high-tension neutral.

Test No. 7—The power transformers were carrying load, the high-tension neutral was grounded, and the auxiliary bank was connected with the delta closed. The Betteravia bank of transformers was disconnected in this test. This test was the same as No. 5 with this exception.

Test No. 8—The same as test No. 7, except that the delta of auxiliary bank was open. This removed the short-circuiting path for triple residual currents and changed the inductive effect to an almost entirely electrostatic one. In this test a large triple voltage was obtained.

The interference on the telephone line in the table is given in noise units, twenty noise units being so low as to be scarcely audible, while 200 units on such a short section make the telephone line too nosiy for good operation.

An additional test made with the 60,000-volt line dead and grounded showed practically no difference in noise from that in test No. 1, when the line only was alive. The table shows that with the auxiliary bank connected and with high-tension neutral grounded (test No. 5) some reduction in interference results; but the real correction comes by isolating the high-tension neutral after the auxiliary bank has been connected (No. 6). With such an arrangement there is practically no interference whatever. This is apparently not a dangerous procedure, as test No. 6 shows a maximum of 520 volts between the neutral and ground when the ground is disconnected. By comparing tests No. 2 and No. 3 it is seen that a load on the power transformers has no effect on interference. It is evident from readings V_1V_2 of tests Nos. 7 and 8 that triple voltages have no effect on the voltage between the wires of the 10,000-volt circuits, but with the triple voltages (test No. 8) the voltage between wires and ground increases about 10 per cent. This means that power transformers with delta-connected secondaries would not be affected, but that 6,600-volt star-connected banks would be. However, even if there were no 6,600-volt star banks present the wave form would be badly distorted were not some



ONE-LINE DIAGRAM OF CONNECTIONS FOR INDUCTIVE INTERFERENCE TEST

Letters I_1, I_2, etc., represent ammeter readings and V_1, V_2, etc., represent voltmeter readings.

means provided for the removal of triple voltages and current. Test No. 8 shows approximately 16,000 volts triple emf. added to each phase on the high-tension side where the auxiliary bank is not connected. This means 48,000 volts total for the line between the three transmission wires and ground, which, as may be noted, causes a great amount of noise on the telephone circuit.

With connections as in test No. 6 it was found that the power from triple harmonics carried by the auxiliary bank correcting the three power transformers only was 50 kva. per transformer. When the Betteravia bank was off the line (test No. 7) the power per phase was 126 kva. Thus in neither event are the auxiliary transformers overloaded. The 50 kva. is but 4 per cent of the total capacity of one 1,250-kva. transformer. With the neutral isolated, which is the best condition from an interference viewpoint, a smaller transformer than 200 kva. would operate satisfactorily except for the fact that any unbalance in load between phases of the substation would cause increased current to flow in the auxiliary banks; also an open circuit or a ground in

one phase of the 60,000-volt line would force short-circuit current through the delta of the auxiliary bank. Therefore this bank must be large enough to withstand abnormal conditions. The present 200-kva. bank is 16 per cent of the rating of the main power transformers, which is probably large enough for all conditions, but experience must prove this fact.

Properly designed tertiary windings on single-phase transformers, or three-phase core-type transformers, provide a better solution than the installation of an auxiliary bank. Moreover, although single-phase transformers with a tertiary winding will cost more than

CONDITIONS AFFECTING NOISE ON TELEPHONE CIRCUIT

Test No.	1	2	3	4	5	6	7	8
Switch B	*Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch D	Cl	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch P	Open	Cl	Cl	Cl	Cl	Cl	Cl	Cl
Switch G	Open	Cl	Cl	Cl	Cl	Open	Cl	Cl
Switch A	Open	Open	Open	Cl	Cl	Cl	Cl	Cl
Switch S	Open	Open	Open	Open	Cl	Cl	Cl	Open
I_1		2.5						
I_2					3.9	3.1		
I_3		3 5	3 2	3.9			8 8	4.4
I_4		0	0 88	0	0	0		
I_5					8 8	7 7	20	
V_1							10,400	10,400
V_2a		7,140	.....	.....	6,900	7,080	6,000	6,600
V_1						520		
V_2		.....	.....	1,270	.....	.....	.....	7,920
V_3		.....	.....	6,570	6,480	6,480	5,880	6,400
Noise units:								
Grounded line.	20	200	200		150	20	325	400
Metallic line...	30	30	30		20—	20—	33	60

*Cl means switch is closed.

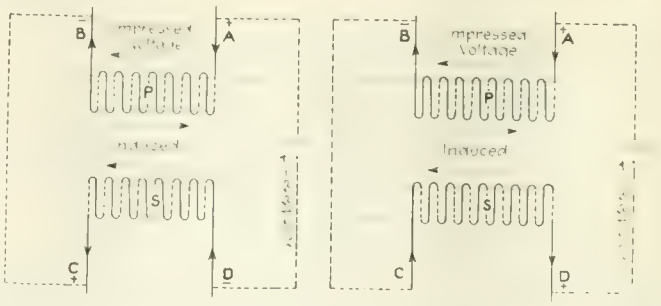
transformers without it, the whole installation would be cheaper than putting in an auxiliary bank. Furthermore, no switching facilities would be necessary in addition to the switches for the power transformers. A three-phase transformer offers a saving in cost, is easier to wire and requires less bus structure, but it has the disadvantage that spare transformers would be expensive.

Subtractive or Additive Polarity for Single-Phase Units

Voltage Stresses on the Insulation Are Less for the Subtractive Polarity as Shown by a Series of Diagrams for Operating Conditions

By C. W. Piper
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EFFORTS to standardize transformers as to polarity of windings as well as to ratings have brought forth considerable discussion as to the relative merits of the connection schemes giving subtractive and additive polarity. The N. E. L. A. committee on electrical apparatus is advocating more complete adoption of a standard subtractive polarity for transformers. A comparative study of insulation stresses in transformers for normal and abnormal operating conditions shows the advantage in this respect of the subtractive polarity scheme. The terms additive and subtractive polarity are best explained by reference to Figs. 1 and 2. The primary current will flow in at *A* and out at *B*, as the counter emf. is enough less than the impressed to permit the magnetizing and load current to flow. In the secondary the current tends to flow out at *C* and in at *D*, as it is produced by the induced emf., which is opposite in direction to the impressed. If the



FIGS. 1 AND 2—TRANSFORMER WINDINGS FOR (1) ADDITIVE AND (2) SUBTRACTIVE POLARITY

adjacent ends *C* and *B* of the primary and secondary winding are connected together, the voltage between *A* and *D* will be the sum of the coil voltage; thus the name additive or positive polarity.

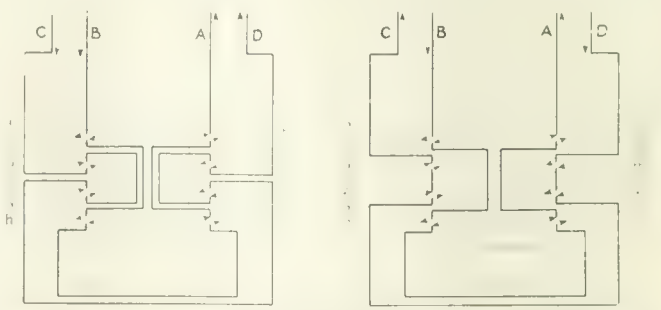
For a transformer of additive polarity the currents on both the primary and secondary sides flow into the transformer on adjacent leads. It will be noted in Fig. 1 that the primary current enters at *A*, while at the same instant the secondary current enters at *D*, which is the reverse of the current in the line.

If the secondary is wound in the opposite direction, the induced emf. will be reversed as in Fig. 2, and connecting *B* to *C*, the voltage across *A* and *D* will be the difference between primary and secondary volts, giving a subtractive or negative polarity. The effect of subtractive polarity as to the relative direction of flow of current in the primary and secondary leads is such that the current in the line might be thought of as flowing into the load as though the transformer were not present in the circuit. The primary current entering at *A* and the secondary current leaving the adjacent secondary side at *D* (Fig. 2).

The polarity of a transformer depends upon two conditions, one the winding polarity and the other the way the leads are brought through the case. There is generally little space or clearance to permit the crossing of leads inside the case as they have to be carefully insulated. The proper way is to bring the leads straight from the coils, and if the polarity has to be reversed make the change outside. There is generally ample room to do so.

A standard core-type transformer of four "high-low sections," with a primary voltage of 66,000 and secondary voltage of 22,000, is shown in Figs. 3 and 4. The direction of the current in the leads at a given instant is indicated by the arrows. It will be noted that the ends of the windings marked positive are above ground potential, while the negative ends are below ground potential.

The normal insulation stresses on the transformer with additive polarity are shown in Fig. 5a. The



FIGS. 3 AND 4—ADDITIVE (1) AND SUBTRACTIVE (2) POLARITY APPLIED TO 66,000/2,200-VOLT TRANSFORMER

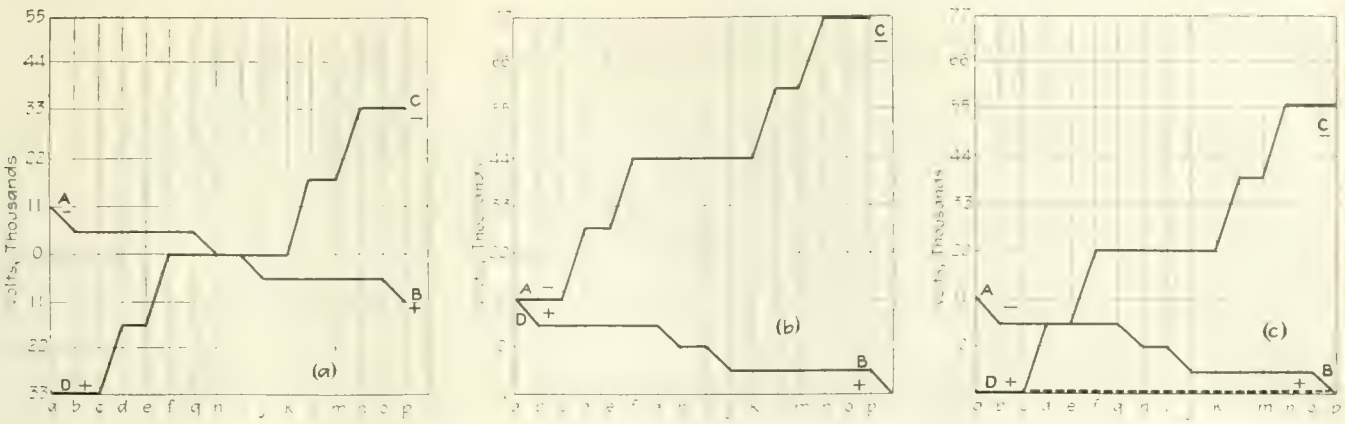


FIG. 5—VOLTAGE STRESSES ON INSULATION OF TRANSFORMER WITH ADDITIVE POLARITY
(a) Normal, (b) when leads *A* and *D* are crossed, (c) *D* and *B* are connected. The most severe strain on the insulation occurs when *A* and *D* are crossed, giving 88,000 volts between *C* and *B*.

induced voltage will cause the adjacent ends of the primary and secondary windings to have potentials of opposite signs at any instant. This gives an insulation stress of 44,000 volts, which is greater than if the two ends were both of the same sign on the same side of ground potential. If by any accident the adjacent terminals *B* and *C* or *A* and *D*, or conductors connected to them should come into contact with each other, the voltage stress between the primary and secondary windings will be as in Fig. 5b, wherein the voltage difference increases from zero at the point of contact to 88,000 volts, the sum of the primary and secondary at the free ends *B* and *C*. Should the primary terminal on one side come into contact with the opposite secondary terminal the potential at the point of contact would be the same and the stress between the windings would be shown in Fig. 5c, which gives a maximum stress of 66,000 volts at the free ends *C* and *B*.

With the transformer wound for subtractive polarity —that is, the primary reversed with respect to the secondary—the relative direction of the voltage and current in the windings will be reversed as shown by the arrows of Fig. 4. The normal insulation stress between windings due to the induced volts will be a maximum of 22,000 volts (Fig. 6a), which shows the insulation stress to be less throughout the entire group of coils than with the additive polarity. If either of the adjacent primary and secondary leads should get into contact with each other, such as *A* and *D* or *B* and *C*, the distribution of the potential is shown by Fig. 6b. Under such a condition the maximum stress between end coils would be 44,000 volts, which is the difference between the primary and secondary voltage. Should *A* and *C*, or conductors connected to them, get into contact with each other, the distribution of stress at any point in the winding is as in Fig. 5c, with a maximum of 88,000 volts, the sum of the primary and secondary, this being between the end primary on one leg and the end secondary on the other.

Insulation Stress Is Less with Subtractive Polarity

A study of the voltage stresses between windings of the two polarities shows conditions in favor of subtractive or negative polarity. The maximum stress between primary and secondary under normal conditions with subtractive polarity is 22,000 volts, while with additive polarity it becomes 44,000 volts, and should adjacent ends or conductors connected to them get into contact with each other, the maximum stress between windings for subtractive polarity is 44,000 volts (for additive polarity 88,000 volts).

The choice of polarity for the small low-voltage distributing transformer is relatively unimportant, as with voltages as low as 2,200/110 volts it makes little difference, so far as insulation stresses are concerned, whether the transformer is of additive or subtractive polarity. Additive polarity was used by the earlier manufacturing companies, so it has come into considerable use in distributing systems. The subtractive polarity is safer and more reliable. The higher the voltage the more true this becomes.

The polarities of transformers that are to operate in parallel have to be the same; thus the polarity should

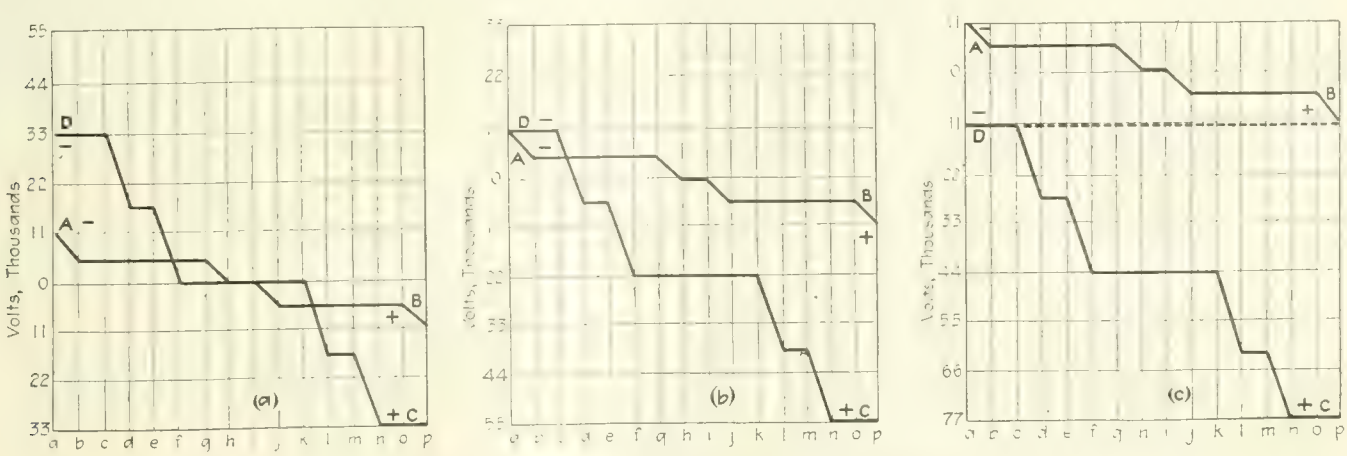


FIG. 6—INSULATION STRESSES ARE DECREASED BY SUBTRACTIVE POLARITY

be known, as it might be necessary to cross the leads of one before they are connected together, provided that their voltage ratio, resistance and reactance are such as to permit parallel operation.

If the polarity is not correct, there will be a serious disturbance caused by the reaction of one transformer upon the others. Transformers in groups of three, for three-phase work, have to be connected with proper regard for polarity, as a study of the vector diagram of a three-phase group will show the difficulty that would exist if one were connected in with a reverse polarity.

Readers' Views and Comments

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: Concerning the editorial in the Aug. 21, 1920, issue of the ELECTRICAL WORLD on "Danger in Valuations at Present-Day Figures," referred to in a letter from Harold Almert in the issue of Dec. 4, 1920, I cannot take any other view than that of the ELECTRICAL WORLD, which advocates the actual or historical cost as the only sound basis of valuation of public utility properties for rates and return.

If a corporation has made an investment for the service of the public of, say, a million dollars, extraordinary conditions of a world war do not entitle the company to reap interest on an additional million, as would probably be the case if the property were valued at reproduction cost during these times. Suppose that extraordinary conditions of depression should follow and the million-dollar property could be reproduced for $500,000. Would it be fair for the public to insist on the rates of this utility being based on the reproduction cost, which would be half of the original value—the investment having been made in good faith and assuming good management for the service of the community? It is a poor rule that will not work both ways, and therefore we must not attempt to establish one that is inconsistent.

An investor who purchased the pre-war securities is in the same position with the one who purchased Liberty bonds. They are both below par, and this is the chance we all have to take in matters of investment. In order to attract sufficient capital for extending utility properties and developing hydro-electric energy, the commission is taking cognizance of the necessity of allowing a sufficient return under present-day conditions to attract the necessary capital for the needs of public utilities.

As to keeping track of our original installation, it is simply a matter of bookkeeping. It is true that certain property loses its identity. However, if the books are properly kept, the value of the original installation less depreciation, under regulation where a depreciation reserve is set up and where replacements are charged against it and the necessary maintenance is charged directly to the operating expense, is carried along as per schedule submitted herewith. When a property is valued by the engineers of the commission or any other engineers, it will not be difficult to ascertain the historical cost of the property and the value at the present time provided that the accounts are kept in the proper manner.

It does not seem to me that it would be sound reasoning to take reproduction cost at any time as the basis for rate making. The actual or historical cost is fundamentally the sound basis to take. Neither the customers of a corporation nor its owners have the right to reap where they have not sown, and this is what happens unless we take the historical cost as a basis for valuation.

C. WELLINGTON KOINER,
Pasadena, Cal. Consulting Engineer.

DEPRECIATION BY YEARS (From which present value is readily found)

Acct. No.	1906-07	1907-08	1908-09	1909-10	1910-11	1911-12	1912-13	1913-14
7		$358.11	$462.11	$469.96	$455.96	$475.93	$584.81	$618.09
9	$657.72	2,008.74	1,962.83	2,616.42	2,671.03	2,960.33	3,295.98	3,518.04
10	681.61	1,930.43	1,877.15	2,838.23	3,233.12	3,884.53	4,658.43	4,704.26
14		11.19	806.85	1,706.13	2,116.14	2,345.62	2,876.93	3,319.63
15		7.51	539.95	1,167.24	1,482.20	1,684.27	1,997.16	2,389.19
16							78.56	139.90
17							13.38	26.77
18								
20		34.56	280.81	646.51	773.58	900.70	1,210.41	1,564.76
21								
22			537.88	1,143.23	1,900.97	2,051.92	2,389.15	2,824.70
23	3,117.29	5,121.10	5,223.39	5,163.52	5,094.18	4,891.04	6,451.47	6,720.06
27								37.15
28	10.00	19.00	37.10	65.81	175.51	334.32	973.05	1,545.70
29								
	*$4,466.62	$9,490.64	$11,728.07	$15,817.05	$17,902.69	$19,528.66	$24,529.33	$27,408.25

*This depreciation covers a period during construction of the plant, 1906-07, and is premature. However, it goes to offset the changing of 60-cycle generators to 50-cycle, which change was made during the year 1910.

Acct. No.	1914-15	1915-16	1916-17	1917-18	1918-19	1919-20	Replacements	Total
7	$654.85	$686.04	$752.92	$810.34	$816.36	$867.06		$8,012.54
9	3,794.72	4,829.15	4,227.30	4,596.86	4,628.65	4,662.54	.....	46,430.31
10	5,375.57	8,048.51	7,136.04	7,445.94	7,566.06	14,086.55		73,466.43
14	3,647.04	4,093.42	−3,166.49†	3,307.35	3,378.81	3,512.31	$980.92	26,974.01
15	2,690.81	2,888.54	−2,433.17†	2,382.50	2,518.14	2,742.48		20,056.82
16	201.13	249.40	247.18†	318.48	358.42	424.98		2,018.05
17	26.77	26.77	26.97	27.16	27.16	27.42		202.40
18	.18	.36	.36	.36	1.91	4.03		7.20
20	1,800.30	2,546.28	2,228.67	2,575.93	2,800.25	3,109.45	472.32	19,999.89
21	68.25	219.32	14,912.17	4,144.99	4,483.55	4,867.83		28,696.11
22	3,266.20	6,360.69	3,971.61	4,197.39	4,351.24	4,632.03	584.17	27,042.84
23	6,987.88	8,713.43	6,880.79†	7,573.82	7,444.08	7,494.27	966.03	85,910.29
27	75.62	76.92	89.89	102.93	102.91	102.91		588.33
28	1,755.34	2,999.83	3,210.28	3,033.16	3,932.07	3,811.19	1,962.85	19,939.51
29	.38	2.01	3.27	3.27	3.27	3.27		15.47
	$30,345.04	$41,740.67	$38,087.79	$40,520.48	$42,412.88	$50,348.32	$4,966.29	$369,360.20

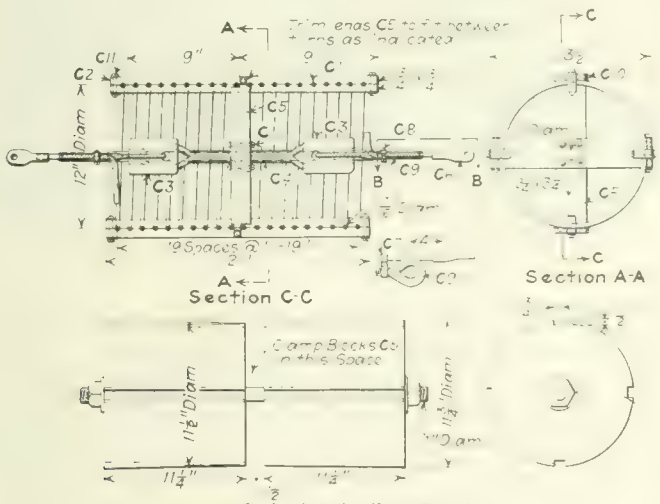
†These amounts were credited with materials used for services, transfer having been made to service account C-21

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Strain-Type 12,000-Volt Choke Coil Built on the Job

A STRAIN-TYPE choke coil built for service on 12,000-volt, 60-cycle lines carrying up to 150 amp. is shown in detail on the accompanying drawing. These coils were made in the fall of 1920 and the labor cost was approximately $20 for a set of three, while $4 per coil would probably cover all material costs. For appearance and service these coils equal the high-grade coils on the market which cost considerably more and on which the delivery is quite long. The coils are made of



DETAILS OF CONSTRUCTION OF 12,000-VOLT, 150-AMP. CHOKE COIL OF STRAIN TYPE

No. 00 B. & S. gage solid, semi-hard-drawn copper wire, not annealed. The wire was wound on two special wooden winding blocks 11¾ in. (29.8 cm.) in diameter and 11¼ in. (28.5 cm.) long, which are shown in the drawing. The blocks were slotted at 90-deg. intervals, ¾ in. (19 cm.) wide and ½ in. (12.7 cm.) deep. Into these slots the inside strips of the clamps *C*2 were placed. The cross-brace *C*5 was mounted on a long bolt between the two wooden winding blocks. After the blocks were tightened on this long bolt by means of nuts the coil was wound on in a lathe. Before the tension was relieved on the wire the top half of the clamp *C*2 was bolted over the wire. The ends of the coil were brought down and clamped to the supporting wire which is attached to the insulators inside the coil. The line wire was then bolted on to the lugs which are shown at the extreme ends of the drawing. After assembling, all steel and copper parts were painted with three coats of insulating varnish. Before beginning the construction all wood parts were oven-dried, then boiled in paraffin until all bubbling ceased, after which they were painted with insulating varnish.

BILL OF MATERIAL FOR CHOKE COIL

Mark	No. Req.	Description	Material	Remarks
C1	85 ft.	2/0 B & S Solid bare wire	Copper	
C2	4	Wood clamps	Oak	See note below *
C3	2	Strain bobs	Porcelain	
C4	6 ft.	¾-in., galvanized messenger	Steel	Soft
C5	2	Cross-brace	Oak	See note below *
C6	2	Lugs for 2/0 wire	Copper	
C7	2	End clamps	Steel	
C8	2	Stove bolts, ½ in. x ¾ in.	Steel	With nut for "C7"
C9	2	Thimble, ½ in. score	Steel	Galvanized
C10	4	Stove bol , ½ in. x 3 in.	Steel	Two washers and nut
C11	12	Stove bolt, ¼ in. x 1¼ in.	Steel	Two washers and nut

* Wood parts to be oven-dried and boiled in paraffin until bubbling ceases, after which they are painted with insulating varnish.

A. U. AVERA,
Assistant Engineer.

United States Engineer Office,
Florence, Ala.

Instructions for Fusing 44,000-Volt Transformers

CORRECT fuse sizes for 44,000-volt transformers and fusing currents of copper and climax wires are shown in the accompanying tables. Table I gives the fusing currents of copper wire in air based on the experiments of Preece. Although the fusing current is decreased somewhat by inclosing the wire in a tube, the values in this table are accurate enough for calculating the size of the fuse for different sizes of transformers. A wire carrying 75 per cent of its fusing current becomes red hot and gradually oxidizes so that it will fuse in from ten to thirty minutes. Therefore if a transformer is fused for double full load it will operate at one-and-a-half load for ten to thirty minutes. For this reason transformers which are not otherwise protected should be fused for approximately double full-load current, but where the low-tension circuits from transformers are all protected by relatively small fuses the high-tension fuses can be increased to three times the full-load current and in special cases may be increased still more if the protection on the low-tension side is exceptional. The table of proper fuse capacity is based on twice normal current for transformers which are otherwise unprotected and three times normal for which they have relatively small secondary fuses.

TABLE I—FUSING CURRENT OF COPPER AND CLIMAX WIRE IN AIR

Size of Wire, B. & S. Copper	Fusing Current, Amp.	Size of Wire, B. & S. Copper	Fusing Current, Amp.
0	1,895	24	30
2	1,340	26	22
4	940	28	15
6	670	30	10
8	470	32	7 3
10	325	34	5
12	240	40	1 7
14	165	Climax	
16	120	26	6.5
18	82	28	4 5
20	60	30	3 3
22	40	32	2.4

The use of the ordinary lead-composition fuse wire

is not recommended for fusing high-voltage transformers, particularly at outdoor substations, because of its poor mechanical strength. There is, however, no objection to the use of composition or aluminum fuses in the small fuse tubes used with indoor potential transformers. For outdoor work the fuses should be tin-coated to prevent corrosion except in sizes as large as

TABLE II—PROPER FUSE SIZES FOR 44,000-VOLT TRANSFORMERS

Size of Entire Bank, Three-Phase, Kva.	Full-Load, Amp. at 44,000 Volts	Size Primary Fuse When Transformer Is Not Protected on Low-Tension Side	Size Primary Fuse When Transformer Is Protected On Low-Tension Side
100	1.3	32 Climax	30 Climax
150	2.0	28 Climax	26 Climax
200	2.6	26 Climax	32 Copper
300	4.0	32 Copper	28 Copper
400	5.2	30 Copper	28 Copper
450	5.9	28 Copper	26 Copper
500	6.6	28 Copper	26 Copper
600	7.9	28 Copper	24 Copper
750	9.8	26 Copper	24 Copper
1,000	13	24 Copper	22 Copper
1,500	20	22 Copper	20 Copper
2,000	26	20 Copper	18 Copper

No. 22 gage. The small spools of wire sold in hardware stores are not marked according to the B. & S. gage. Therefore fuse wire should be ordered from an electrical supply house specifying "tin-coated climax (or copper) No. — B. & S. gage fuse wire." P. P. Ashworth,
Utah Power & Light Co. Distribution Engineer.
Salt Lake City, Utah.

Too Low Salt Concentration in Boilers Is Not Economical

Although it is desirable to reduce the salt concentration in boilers, too low a concentration may be costly on account of the heat wasted in blowing down the boiler. Not only is heat wasted but additional feed water must be purchased and additional scale-forming materials taken in, causing further loss of heat and expense for their removal. For instance, in plants of the Southern California Edison Company tests have

BLOW-DOWN LOSSES WITH DIFFERENT BOILER CONCENTRATIONS

Make-up water: 6 grains salt per gallon.
Condensate: 2 grains salt per gallon.

Sodium Chloride per Gal., Grains	Blow-Down per Lb. Condensate, Lb.	Fuel Wasted in Blow-Down, per Cent
50	0.0455	1.142
100	0.0213	0.537
150	0.0139	0.331
200	0.0103	0.261

Make-up water: 6 grains salt per gallon.
Condensate: 20 grains salt per gallon.

Sodium Chloride per Gal., Grains	Blow-Down per Lb. Condensate, Lb.	Fuel Wasted in Blow-Down, per Cent
50	0.455	10.35
100	0.213	5.12
150	0.139	3.40
200	0.103	2.55

Based upon steam at 225 lb. gage, 125 deg. Fahr. superheat; make-up water at 80 deg. Fahr.; condensate at 100 deg. Fahr.

indicated that a concentration of 200 grains of salt per gallon (3.4 grains per liter) is satisfactory as regards priming. However, a further reduction in concentration is not desirable. The most economical operation will result when there is the least amount of blow-down consistent with absence of concentration trouble. The losses involved in blowing down are shown in the table.

Thus it is seen that maintaining a low concentration such as 50 grains per gallon (0.8 grams per liter), instead of the maximum allowable of 200 grains per gallon, causes an additional fuel loss of about nine-tenths of 1 per cent when the condensate contains 2 grains (0.13 grams), which may be considered as normally good operation. With an increase in the salt in the condensate the fuel loss becomes extremely serious when low boiler concentrations are maintained. For instance, it is seen that with 20 grains of salt per gallon (0.34 gram per liter) in the condensate and a boiler concentration of 50 grains per gallon the loss is over 10 per cent

Southern California Edison Co. R. J. C. Wood,
Los Angeles, Cal. Electrical Engineer.

Linemen Should Not Try to Set All Insulators Vertically

One of the difficulties in sagging lines is to get the linemen to leave the insulators alone after the lines are sagged. Usually the insulators will not hang vertically and the linemen will change them so that this condition shall be obtained. As there is only one critical temperature at which the insulator will remain vertical it will be only a short time until it is at an angle again. J. S. Martin, Duquesne Light Company, made these remarks at a Pittsburgh meeting of the American Institute of Electrical Engineers. Mr. Martin said that the practice in his company, when sagging lines between towers of different heights, is to allow 1 per cent of normal sag for each 56 ft. (17 m.) of difference in the height of the towers.

New York, N. Y. Field Editor Electrical World.

Potentiometer-Type Resistance Box Facilitates Testing Station Ammeters

Testing direct-current switchboard ammeters without removing them from the boards is accomplished on the system of the Portland (Ore.) Railway, Light & Power Company by the use of a potentiometer resistance box containing a variable resistance and dry battery. This box furnishes both a source of energy and a means for gradually varying the voltage. As an ammeter is in reality a millivoltmeter connected to a shunt which gives a specified drop in millivolts for full-scale reading,

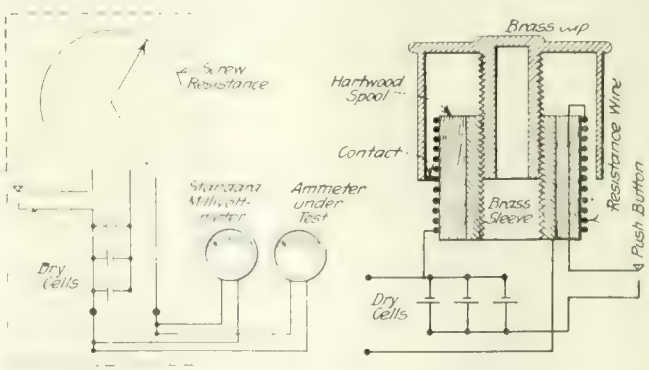


FIG. 1—USE OF SCREW-TYPE RESISTANCE FOR CHECKING SWITCHBOARD AMMETERS

the ammeter may be calibrated by comparison with a portable standard millivoltmeter. Therefore when testing the ammeter the leads are removed from the shunt and it is connected in parallel with the standard millivoltmeter as indicated in the drawing. The leads from both instruments are connected to the terminal posts of the resistance box. By turning the brass

screw cap the resistance is varied, and this changes the voltage on the meters as desired.

The resistance box consists of the screw resistance, the three flashlight dry cells and the push-button contact as shown. The screw resistance is made by winding bare resistance wire on a threaded hardwood spool mounted on a brass stem. The inside of this stem is threaded with the same pitch as the threads on the wooden spool. Into this stem is screwed a brass cap

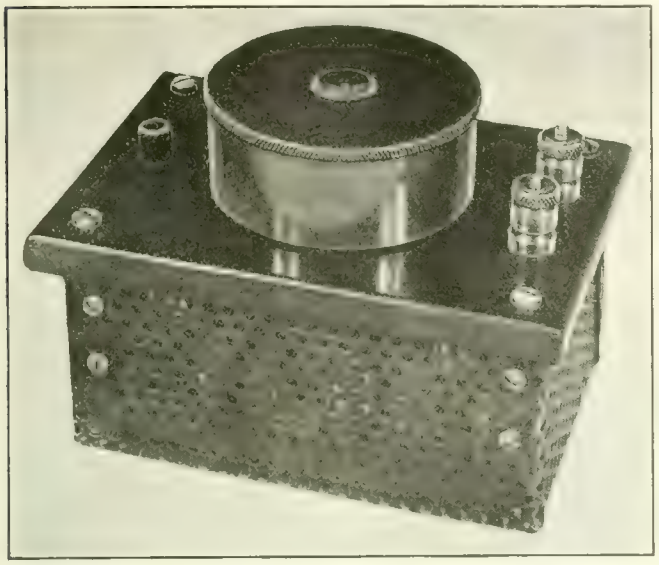


FIG. 2—SMALL PORTABLE RESISTANCE BOX FOR CHECKING SWITCHBOARD AMMETERS

with a contact point on the inside of its outer shell, and this point bears on the resistance wire. This contact follows the resistance wire as the cap is turned down and thus varies the resistance in the circuit and changes the voltage at the terminals. The instrument has a range of from 0 volt to 1.4 volts, using three dry cells.

As may be seen from the photograph, the screw resistance, binding posts and push-button are mounted on a hardwood top, while the batteries and circuits are inclosed in a perforated sheet-iron box.

Portland Railway, Light & Power Company, Portland, Ore.

P. E. ALGER, Laboratory Department.

Locating a Grounded Coil in an Alternator

TO LOCATE a grounded coil in an alternator without disconnecting any coils the test outlined here was employed recently by the writer. A 600-kva., 2,200-volt, two-phase alternator developed a ground of which there was no visible indication but which caused disturbance in a telephone system and radio station in the vicinity. To find the fault an ungrounded 110-volt alternating-current supply was connected directly to the terminals of the grounded phase, which drew 15 amp. at this voltage. One terminal of a 110-volt voltmeter was grounded to the frame of the alternator. The other terminal of the voltmeter was connected to an ordinary shoemaker's awl, the sharp point of which was used to pierce the insulation on the end connections of each coil in the grounded phase. Connection was made with each coil in turn, and readings of the voltmeter were noted. The coil showing the smallest reading was the damaged coil, but the voltmeter readings on three of the coils were so low that it was hard to determine which one of these three coils was the damaged one.

To locate the trouble more definitely an ordinary telephone receiver was substituted in place of the voltmeter. When contact was made with the grounded coil there was no noise in the telephone receiver. When contact was made with the coils on either side of the grounded coil the telephone could be heard several feet away. Consequently it was very easy to find the exact location of the damaged coil and remove it without disturbing much of the other windings.

G. R. SHUCK, Department of Electrical Engineering. University of Washington, Seattle, Wash.

Formula for Calculating Alternating-Current Voltage Drop

FOR determining the voltage drop on alternating-current circuits up to a length where charging current must be taken into account the accompanying formula has been developed by the writer. The factors which must be known are receiving voltage, length of line, resistance, power factor and spacing. The formula follows:

TABLE I—VALUES OF R AND X FOR DIFFERENT SIZES OF WIRE

Wire Size	R	X					
		Distance Between Centers, Inches					
		12	18	24	36	48	60
8	0.627	0.1256	0.1349	0.1415	0.1508	0.1574	0.1625
6	0.394	0.1203	0.1296	0.1362	0.1465	0.1521	0.1572
4	0.248	0.1150	0.1243	0.1309	0.1402	0.1468	0.1519
2	0.156	0.1097	0.1190	0.1256	0.1348	0.1414	0.1466
1	0.1237	0.1070	0.1163	0.1229	0.1322	0.1388	0.1439
0	0.0981	0.1043	0.1136	0.1202	0.1295	0.1361	0.1412
00	0.0778	0.1017	0.1110	0.1176	0.1269	0.1335	0.1386
000	0.0617	0.0991	0.1084	0.1150	0.1242	0.1308	0.1360
1000	0.0489	0.0964	0.1057	0.1123	0.1216	0.1282	0.1333

$$\text{Three-phase voltage drop} = \frac{\text{watts} \times L \times (Rp + Xs)}{Ep}$$

$$\text{Single-phase voltage-drop} = \frac{2 \times \text{watts} \times L \times (Rp + Xs)}{Ep}$$

L = length of line, in thousands of feet.
R = resistance in ohms per 1,000 ft. of one wire.
p = power factor.
X = reactance in ohms per 1,000 ft. of one wire (see Table I for values with different spacings).
s = value obtained from Table II to correspond with the given power factor.
E = voltage at receiving end.

TABLE II—VALUES OF s CORRESPONDING TO DIFFERENT VALUES OF p

p	s	p	s
1.00	0	0.75	0.66
0.95	0.312	0.70	0.71
0.90	0.436	0.65	0.76
0.85	0.526	0.60	0.80
0.80	0.60	0.50	0.867

The value s given in Table II to correspond to different power factors is the sine of the angle of lag and might be calculated from the equation $s = \sqrt{1 - p^2}$ in absence of Table II.

CHARLES E. WARSAW, Engineer. Burlington (Vt.) Light & Power Co.

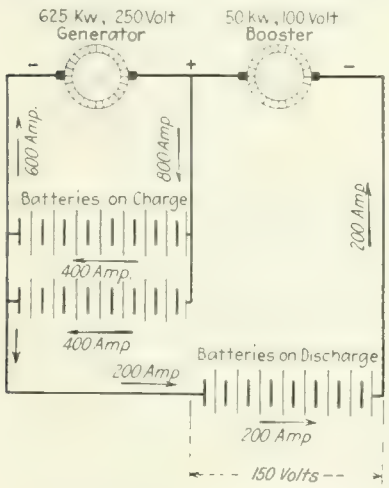
Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Booster Saves Energy in Charging Storage Batteries

AN ECONOMICAL method of charging and discharging storage batteries is in use in the Indianapolis plant of the Prest-O-Lite Company. It is accomplished by pumping the current from discharging batteries through batteries being charged by means of a booster. This operation greatly reduces the size of generator needed for charging.

Energy for charging is furnished by a motor-generator set which converts 4,100-volt, three-phase energy to 250 volts, direct current. The booster which is employed to allow the batteries to be discharged back into the line is mounted on the same shaft with the two other machines. In operation the batteries being charged are connected across the 250-volt generator in the regular manner, each having a suitable charging rheostat connected in series. The batteries to be discharged and the 100-volt booster are connected to the discharge circuit, as shown in the drawing. These batteries are connected in series with a booster which composes the third unit of the converting apparatus, it being a 100-volt direct-current machine. Assume that the batteries on discharge deliver 200 amp. at approximately 150 volts. This current passes through a rheostat and the booster. As the booster voltage is 100 volts the 200 amp. is pumped back at 250 volts into the 250-volt bus. Therefore with a current of 800 amp. flowing through the batteries on charge, only 600 amp. is delivered by the main generator because the discharge circuit is delivering 200 amp. to the charging circuit.



BOOSTER ALLOWS SMALLER GENERATOR TO BE USED FOR CHARGING

Thus with the addition of the boosting generator on the same shaft the effect is obtained of increasing the main generator size. Without the booster the 250-volt generator would have to deliver 800 amp. for charging or produce 200 kw. With the booster the generator will be required to deliver only 600 amp. or 150 kw. However, to raise the voltage of the discharging circuit to 250, 200 amp. at 100 volts must be produced at the booster machine. This amounts to 20 kw. Therefore the same number of batteries are charged with only 170 kw., neglecting the losses in the machines.

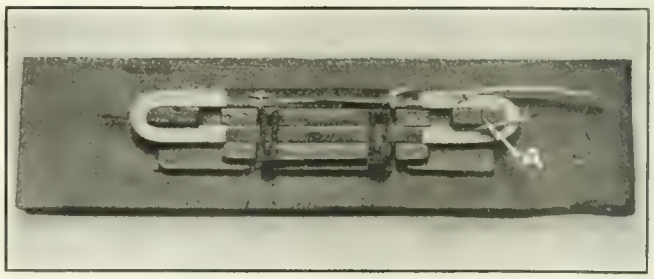
At present there are two sets of three units each. The generators are rated at 625 hp. and 450 hp. respectively and the boosters at 50 hp. each. These sets were made by the Westinghouse Electric & Manufacturing Company. In the near future another set with an 875-hp. generator will be installed. L. R. WEST.

Indianapolis, Ind.

Block for Insulating Coils Before Placing in Motor

FOR tying slot insulation on to coils before they are put into the slots of motors or generators, a wooden block such as shown in the accompanying illustration has been made by the writer. This block enables the insulation to be wrapped snugly around the coil and tied so that it will not be loose when the coil is taped. To use the device, the insulation is cut into strips just wide enough to make about a turn and a third around the coil. A strip is placed into the long groove which is just the shape of an armature slot. The coil is put in on top of the strip and the overlapping insulation is folded over. The two slotted metal pieces are then slipped over the insulation and are held in place by two screws as shown. Then the insulation is tied around the coil by threading a length of twine underneath the coil through the small slots by means of a curved sack needle. If it is desired, tin clips may be used for holding the insulation in place instead of tying it with the twine. The writer has tried several methods and prefers to tie with the twine.

A further purpose of this device is to indicate the position on the coil for the cotton sleeving emerging from the tape. This is done by marking the position



INSULATION IS HELD UNDER SLOTTED BARS WHILE BEING TIED IN PLACE

on the base of the device at the point indicated by the arrow where a line is painted. When the coil is placed in the groove a blue pencil mark is drawn across the coil, thus indicating to the taper where to bring out the sleeving. As a usual thing about 1 in. of the sleeving is taped in.

Such a device is cheap and easily made and a separate one is used for each size of coil. L. E. WOOD.

Glasgow, Scotland.

Electric Logging Equipment Adopted by Snoqualmie Company

ELECTRICALLY driven logging apparatus is being successfully used in the forests of Washington by the Snoqualmie Falls (Wash.) Lumber Company. This company has for this work in the woods a yarder and a loader mounted on the same sled and a portable substation on a separate sled. The yarder is a Willamette Iron Works Humboldt three-drum device, having for motive power a General Electric 200-hp. phase-wound induction motor used on a three-phase, 60-cycle, 550-volt power circuit. The loader, also built by the Willamette Iron Works, is equipped with two General Electric 75-hp. phase-wound induction motors. The two machines each occupy half of a 60-ft. sled, which renders them portable.

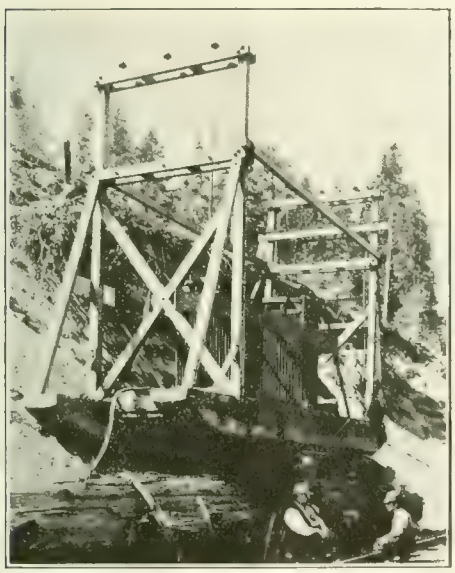
The power supply for the two machines is stepped up to 13,200 volts at the mill power plant by three 250-kva. transformers transmitted through the woods, and is stepped down to operating voltage by two 250-kva., single-phase, 600/13,200-volt transformers on the scene of operations. The transformers are rendered portable by being mounted on a small sled, which is equipped with a disconnecting switch. This sled is set about 500 ft. distant from the one carrying the yarder and loader, energy being transmitted between them by a flexible armored cable laid on the ground.

Some difficulty was experienced at first in obtaining desired low speeds on the yarder, but this was overcome by the insertion of resistance in the phases of the rotor. In 1918 the machine yarded 3,144,898 ft. of timber in forty-four days, or an average of 71,470 ft. per day. In 1919, owing to increase in the transformer capacity, the average per day was raised to 77,000 ft. The same efficiency which characterizes the operation of the yarder is demonstrated by the loader. The application of solenoid load brakes to the motor makes it as successful as a steam-driven outfit. It is also possible by means of this braking system to do one thing which a steam outfit cannot do, namely, to hold a log suspended in mid-air or in any position desired. This is made possible by the fact that when power is shut off from the motor the solenoid brake sets automatically, so as to prevent any motion.

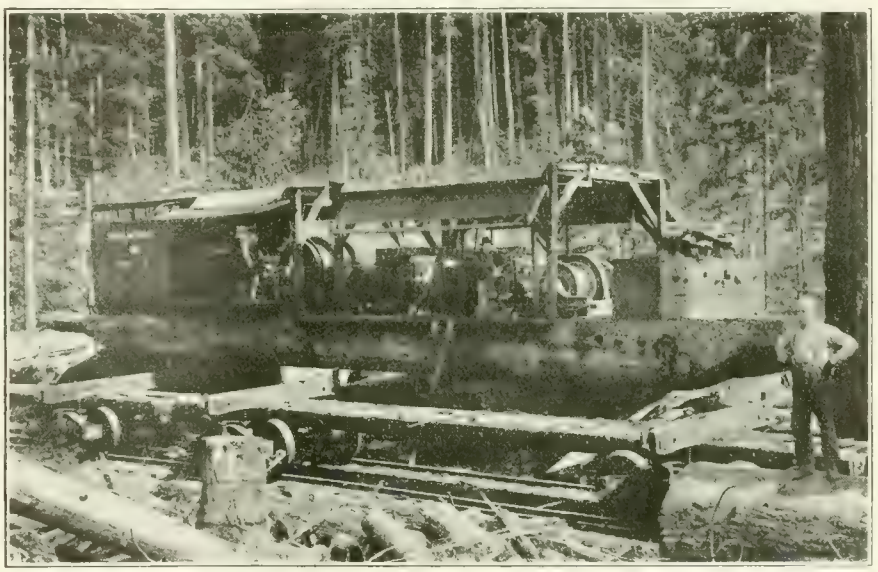
The good results obtained by electrifying the logging operations are the most convincing argument possible in favor of the electrification of the logging industry generally. Methods that increase production and cut costs are as valuable in lumbering as in any other industry and deserve consideration by those interested.

FIELD EDITOR ELECTRICAL WORLD.

San Francisco, Cal.



PORTABLE TRANSFORMER SUBSTATION HAULED INTO THE WOODS



LOGGING IN THE FOREST WITH ELECTRICALLY DRIVEN YARDER AND LOADER MOUNTED ON ONE SLED

Fifty-Ton Sulphite Paper Mill Requires 1,500 Hp. in Motors

AN ANALYSIS of the load requirements for a sulphite pulp mill rated at 50 tons per twenty-four hours has shown that the total rating is approximately 1,500 hp., 400 hp. of which is required for the wood-preparing room, from 175 hp. to 200 hp. for the yard and slasher mill, 77 hp. for the acid plant, 50 hp. for the cooking department, 130 hp. for the washing or blow pit department, 175 hp. for the screening department, 233 hp. for the bleach department and 35 hp. for the finishing or wet machine room. Table 1 gives a full list of the motors in each department, together with the maximum and average load. It will be noticed in connection with the screen department that the total connected load is 711 hp., while the load charged to this department is only 175 hp. This difference is due to the 400-kva. synchronous motor used for power factor connection.

For the most part, the motor loads are not periodic, but are based on fluctuating conditions, which in some cases occur at regular intervals. Each department, however, has certain motor-load conditions which can be analyzed by following the processes through. Wood is brought to the mill yard both by rail and water. The rail handled wood is piled in the yard until used, while the water-handled wood is boomed at the slasher mill, which consists of a two-gang circular saw capable of handling 125 cords of 8-ft. wood per day of ten hours. The wood is sawn in 4-ft. lengths.

The power required for the slasher mill is shown on chart *A* of the load charts. The load is seen to be fluctuating, and the maximum power never exceeds the rated capacity of the motor. However, the saw deck is equipped for a third saw to be used on 16-ft. wood.

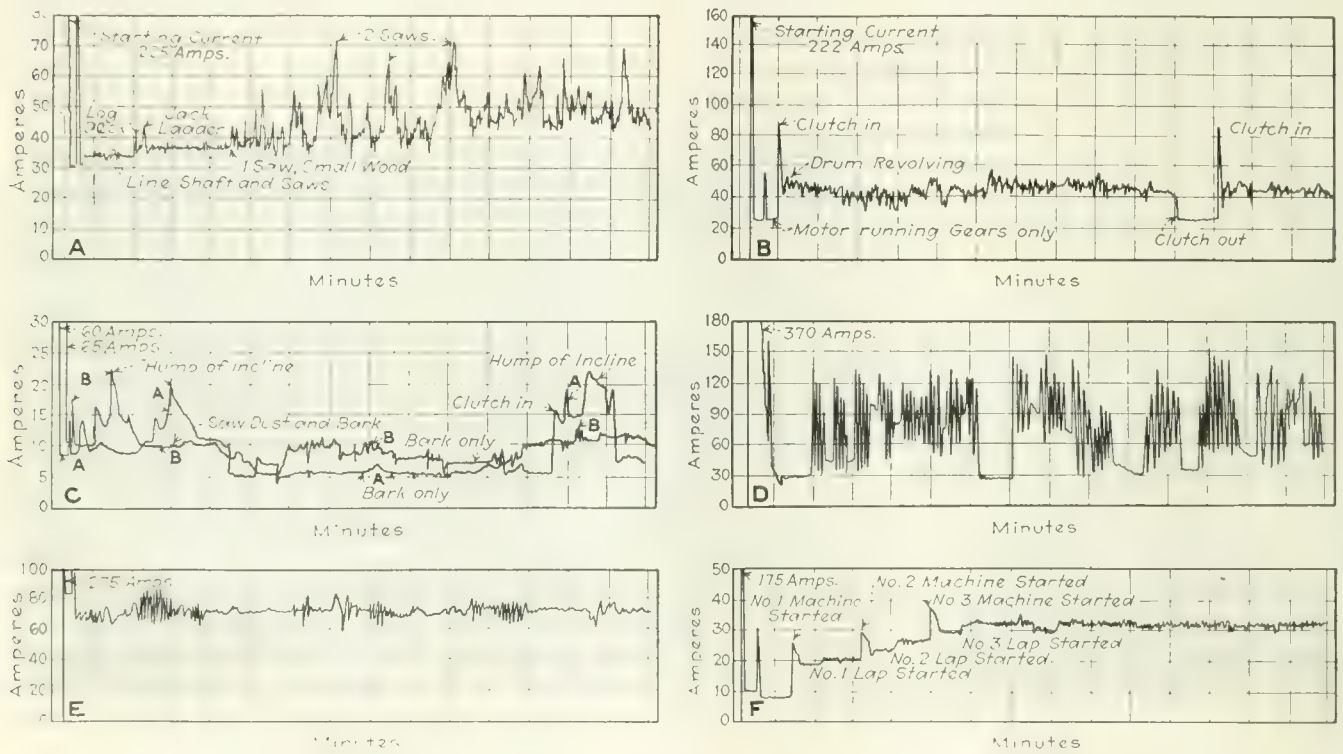
and when this is used the average power will be somewhat greater. From the slasher mill the wood is conveyed to the mill or yard, as the case may be, by a 275-ft. cable conveyor supplied by a 35-hp. motor. The average power is only 22 hp. and is practically uniform. The power required per foot of conveyor is 0.08 hp. The conveyor is inclined, which accounts for the high rate per foot. For conveyors of different types the writer has found from experience that the power range is from 0.043 to 0.09 hp. per foot of conveyor. After leaving the 275-ft. conveyor the wood is either taken direct to the mill or to the storage yard. The wood sent to the mill travels over a 200-ft. and a 50-ft. conveyor driven by a 15-hp. motor and a 170-ft. conveyor driven by a 20-hp. motor. The average power required for the 15-hp. motor is 12½ hp., while the highest point reached is 17 hp. This motor starts with an idle pulley, and the load is thrown on by a friction pulley. The 20-hp. motor has an average load of 12½ hp. and the load is fairly uniform. The wood going to the storage yard travels on a 500-ft. conveyor operated by a 50-hp. motor. This is a double conveyor; that is, the wood travels both ways. The wood pile is in the shape of a horseshoe with a wet pile on one side and a dry pile on the other. The average power consumed by the outgoing wet wood is 25 hp., while the average with incoming dry wood at the same time is 40 hp. It will be noticed that there has been a tendency toward overmotoring. The reason for this is to overcome the necessity of increasing the motor sizes when the conveyors are completed, as at the present time they are built to be extended. A feature in connection with the motor on the 500-ft. conveyor is that it is automatically operated with a magnetic breaker and push-button stations situated along the conveyor and in the wood room. From the 500-ft. conveyor the wood is piled by a portable stacker operated by a 10-hp. motor, the operating characteristics of which are shown in chart *C*. The rest of the yard equipment consists of two portable 10-hp. conveyors and a portable 10-hp. slasher saw. The combined connected load of the yard is 205 hp., shown in detail in the table. The wood-preparing room equipment consists of barking drums, conveyors, screens and chippers.

The power required for the barking drums, of which there are two, is shown in chart *B*. Chart *C* shows the load of a 10-hp. motor hauling coal and refuse to the boiler house under various conditions.

After being barked and washed the wood is conveyed to an 84-in. chipper driven by a 100-hp. motor at 580 r.p.m., with a fluctuating load as shown in chart *D*. The larger chips and slivers are crushed by a Lombard crusher. From the wood room the chips are conveyed on a 300-ft. belt conveyor by a 20-hp. motor, the load of which is constant. The total connected load of the wood room, including a 40-hp. pump, is 400 hp., details of which are given in the table.

The total connected load of the acid-making department is 80 hp. There are four 10-hp. acid-circulating pumps, two having an average load of 8 hp., one an average load of 7½ hp. and one an average load of 10 hp. Another 10-hp. motor pumps the acid to the storage tanks with an average load of 10 hp. and the same operating condition as the others. The gas is kept in circulation by two fans, one on the intake and the other on discharge. Both fans are driven by 10-hp. motors. The limestone rock is elevated by a 10-hp. motor. For more details in connection with the power requirements the table may be referred to.

The only power used in the digester building where the cooking takes places is a 50-hp., 1,150-r.p.m. motor



AN ANALYSIS OF MOTOR-LOAD CONDITIONS IN A SULPHITE PAPER MILL

A—Slasher mill driven by a 75-hp. motor. There are two 4-ft. circular saws, 20 ft. of eight-chain lag deck and 40 ft. of four-chain jack ladder. Average horsepower for the installation is 45. B—Barking drum driven by a 60-hp. motor, the average horsepower being 45. C—Refuse conveyor driven by a 10-hp. motor. The curve A is for mild weather and no sawdust, and curve B is for zero weather and conveying both sawdust and bark. D—An 84-in. chipper driven by a 100-hp. motor. E—Single-stage bleach-engine pump driven by 75-hp. motor. Average load, 72 hp. F—35-hp. motor driving three Rogers wet machines. Average hp., 28.

directly connected to a pump for pumping the acid from the storage tanks to the digesters. The digesters are two in number, of 16-ton capacity each. It takes from eight to twelve hours to cook a digester, and it takes about twenty minutes each time to fill a digester with acid.

From the digesters the pulp is blown to the wash or blow pits, where the liquor is removed and all gases allowed to escape. There are three motors in this department. A 20-hp. motor runs the knot screen above the riffler. The load is virtually constant. The second motor is rated at 35 hp. and drives a pump conveying the pulp to the screens. This motor is started and stopped frequently, and the operating conditions are severe, although the load is not heavy. The third motor is rated at 75 hp., 1,800 r.p.m., and drives a single-stage pump pumping white or used water from the machines to the blow pits and riffler. This motor carries a heavy overload.

The screens are in four lines of nine flat screens each. The power is taken from the 400-kva. synchronous condenser to the line shafting. The power requirement is 75 hp. at 76 per cent leading power factor. The water is pumped by a 75-hp., 1,800-r.p.m. motor using white or used water. A 25-hp., 1,800-r.p.m. motor pumps the stock from a "save-all" to the stock chests. The load on this motor is light as the amount of stock is light, the average load being 10 hp. The "save-all" is operated by a 5-hp. motor. There are in addition two 35-hp. pumps with characteristics identical with those shown in chart *P*.

The bleachers are large steel tanks of 16,898 gal. capacity each. The bleaching is done by heating the pulp with live steam, mixing it with chlorine liquor and keeping it in a whirling motion. This is done by a centrifugal pump driven by a 75-hp., 1,150-r.p.m. motor. The load characteristics are shown in chart E. The bleach pulp is pumped from drainer tanks of 28,163 gal. capacity to the screen by a 35-hp., 1,150-r.p.m. motor. Another 35-hp. motor with the same characteristics pumps the pulp from the stock chests to the machines. A 35-hp., 860-r.p.m. motor drives the agitators for the four stock chests from line shafting. These stock chests are circular wooden tanks of 25,635 gal. capacity each. The bleach powder is mixed in a steel tank of 4,712 gal. capacity by an agitator driven by a back-geared 3-hp., 720-r.p.m. motor, the average load of which is 2½ hp. The load on this motor is constant, and the duty is severe owing to particles of powder coming in contact with the windings and dissolving. This motor is housed in a copper hood and ventilated by two air ducts from the outside air. The weak liquor is pumped from the mixing tank by a 5-in., 1,800-r.p.m. motor driving a pump delivering 250 gal.

ACTUAL LOAD CONDITION CHECKED AGAINST MOTOR RATING

	Motor List					Pump List			
Dept —Duty	Rated, Hp.	Max Load, Hp	Ave. Load, Hp.	Speed	Drive	Head, Ft.	G.P.M.	Intake, In.	Discharge, In.
Acid plant:									
No. 1 tower	10	8 25	8	1,760	Direct	56	300	5	4
No. 2 tower	7 5	7 75	7.25	1,760	Direct	56	300	5	4
No. 3 tower	10	10 125	10	1,760	Direct	56	300	5	4
No. 4 tower	10	8 125	8	1,760	Direct	56	300	5	4
Acid storage	10	12	10	1,760	Direct	50	300	5	4
Exhaust fan	10	12	10.5	1,160	Belt	..	....	..	.
Booster fan	10	12	9	590	Belt	...	....	..	..
Elevator	10	6	5	1,160	Geared	..	....	.	.
Total	77.5								
Digester Blow Pit:									
Acid pump	50	65	63	1,160	Direct	68	1,500	8	8
Stock pump	35	24	22	1,160	Direct	40	900	6	6
White water pump	75	108	90	1,760	Direct	135	1,500	10	8
Knot screen	20	23	21	860	Belt	...	....	..	..
Total	130								
Bleach:									
Stock pump	35	24	22	1,160	Direct	40	900	6	6
No. 1 beater engine	75	87 5	72	1,160	Direct	40	3,000	12	10
No. 2 beater engine	75	87 5	72	1,160	Direct	40	3,000	12	10
Drainer pump	35	50	40	1,160	Direct	40	900	6	6
Weak liquor	5	6 125	6	1,760	Direct	20	375	5	4
Strong liquor	5	5 5	3.5	1,760	Direct	20	375	4	3
Agitator	3	3	2.75	720	Back gear	...	....	..	.
Total	233								
Screen:									
Screens	536*	100	75	600	Belt	...	....	..	.
White water pump	75	105	90	1,760	Direct	135	1,500	10	8
Unbleach pump	35	25	22	1,160	Direct	40	900	6	6
Agitator	35	40	37.5	860	Belt	..	....		
"Save-All"	5	3 125	3	1,760	Belt	.	.		
"Save-All" pump	25	11	10	1,760	Direct	40	750	5	5
Total	711								
Machine:									
Main drive	35	32	285	860	Belt				
Wood room:									
Chipper	100	125	90	590	Belt				.
Crusher	20	50	15	590	Belt				.
Log conveyor	20	20	17.5	590	Belt				
Log conveyor	10	15	12.5	590	Belt				
Chip conveyor	20	20	17.5	590	Belt				
Chip conveyor	10	15	10	590	Belt				
Screen	20	18	17.5	590	Belt				
No. 1 barker	60	55	45	576	Belt				
No. 2 barker	60	45	40	860	Belt				
Machine shop	20	30	17.5	590	Belt				
Refuse conveyor	10	22.5	10	590	Belt				
White water pump	40	25	18	1,760	Direct	135	800	6	6
Total	390								
Yard:									
No. 1 conveyor	35	25	22	860	Belt	.	. . .	..	..
No. 2 conveyor	50	30	25	1,160	Belt	.	....	.	.
No. 3 conveyor	15	25	14	860	Belt		....	.	..
Stacker	10	7	6.25	590	Belt	.	....	..	.
Slasher saw	10	25	6	590	Chain	...	....	..	..
No. 1 portable conveyor	10	.	....	1,160	Belt	These motors can only be used occasionally			..
No. 2 portable conveyor	10	..	...	1,160	Belt				
Total	140								
Main drive:									
Slasher mill	75	70	45	860	Belt	...	....	.	..
Totals	46 1,841 5	1,498.5	1,176.75		.....				

* Sync. condenser, power-factor correction.

per minute, and the strong liquor is pumped by another of the same size and capacity. The average load on the first is 6 hp., while on the second it is 3 hp. The load on each is practically constant.

There are three wet machines line-shaft-driven by a 35-hp., 860-r.p.m. motor, with the line shafting alone and with one, two and three machines. The load is irregular as all three machines are usually not running at one time.

H. E. STAFFORD,
Provincial Paper Mills, Ltd., Electrical Engineer.
Port Arthur, Ont.

Motor with Short-Circuited Slip Rings Will Not Start

AN ATTEMPT to convert a slip-ring motor to a modified squirrel-cage machine by removing the rings and short-circuiting the three leads was not successful because the motor would not always start, although not loaded. A slip-ring rotor is designed with a very low internal resistance as it is intended to be started with external resistance connected across the slip rings, and when the rotor winding is short-circuited, as was the case here, the motor does not have sufficient internal resistance to give the starting torque to start the rotor when in certain positions. The trouble can be corrected only by replacing the slip rings and connecting sufficient external resistance to give the required starting torque. It is possible to increase the starting torque of a slip-ring motor by short-circuiting only two of the rings during the starting period and then short-circuiting the three rings before the motor reaches half speed. This, however, does not as a rule give sufficient torque to start any load.

In many induction motors, and especially those of the slip-ring type, the starting torque varies with changes in the angular position of the rotor, thus producing high and low torque points. If the starting torque of the motor is high, these low-torque points are not noticeable, as the motor has sufficient torque even at the low-torque points to start the motor and load. If, however, the starting torque is very low, a condition may be reached where the torque is just enough to start the rotor at the high-torque points but not great enough at the low-torque points.

Among the factors influencing this low-torque point is the ratio of the number of stator and rotor teeth. If the number of stator and rotor teeth is very nearly or quite the same in most extreme cases, there will be a considerable variation in the average magnetic reluctance over a pole as the rotor teeth come in line with the stator teeth in one position or in line with the stator slots in another position. This variation in reluctance causes a variation in the average main flux over a pole and also causes the leakage flux to vary in such a way that the effects of the two fluxes combine to give a high torque when the teeth are in line and a low torque when the teeth and slots are in line. This condition is remedied by choosing the ratio of primary and rotor teeth so that there will be the least possible variation in the average magnetic reluctance over a pole as the rotor moves. Skewing the rotor one slot pitch also remedies this condition.

Another cause of low-torque points is an unequal distribution of flux caused by the chording and unequal grouping of the windings, irregularities in the magnetic circuits and the resultant harmonics. These conditions are more noticeable in wound-rotor motors than in squirrel-cage motors owing to the fact that in a wound rotor a number of the coils are in series, thus preventing the flow of corrective currents from one part of the winding to another, while in a squirrel-cage rotor all the conductors are in parallel, thus permitting the flow of corrective currents.

R. H. N. LOCKYER.
Trail, B. C., Canada.

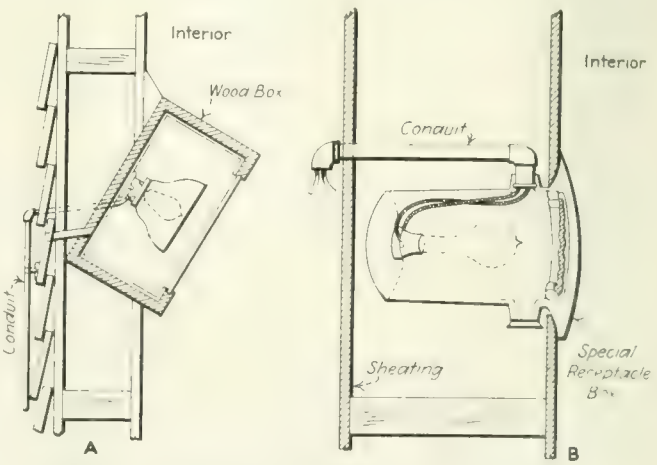
Bending a Large Cable to Fit Close Quarters

FITTING a large cable in close quarters is a job which can be made less difficult by using a strip of solder to measure the length and the shape of the bend. The solder, being easily bent, can be worked into the exact place the cable will occupy. After removing the solder it is straightened, and the cable can then be cut accurately from this piece of solder as a measurement, allowing for the cable being thicker than the solder. By taking the strip solder again and shaping it to the place the cable will occupy, then shaping the piece of cable to match, a very neat and workmanlike fit may be obtained.

HERBERT G. STODDART.
East Orange, N. J.

Safe Lighting Fixtures for Powder Plants and Munition Houses

THE wiring of powder plants, munition warehouses and similar buildings should be on the outside of buildings, preferably exposed for easy inspection, while the lamps themselves should be inclosed. Two lighting fixtures used in such plants are shown in the accompanying drawing. One large explosive plant uses an asbestos-lined box, such as shown at *A*, containing the lamp, reflector and receptacle. The whole box is set in the building wall at an angle depending upon the machine to be illuminated. Occasionally in a particularly dangerous location, such as in parts of flour mills, powder mills or where corrosive-acid fumes are prevalent, a metal receptacle box is set into the wall partition as shown at *B*. The glass front of this receptacle safely protects the lamp and may be removed when changing it. Ventilation is provided by the air which circulates through the conduit.



SPECIAL FIXTURES FOR LIGHTING ACID PLANTS AND POWDER MILLS

Westinghouse Lamp Company, SAMUEL G. HIBBEN,
Bloomfield, N. J. Consulting Illuminating Engineer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Booklets for Helping in the Sale of Securities

"THE Tale of Two Hundred Cities" is the title of a sixteen-page booklet published by the Public Service Company of Northern Illinois to assist in the sale of its securities to its customers. An interesting story is told about the company, the extent of its properties and the diversity of interests served, and a few figures are given to show the growth of the business and earnings of the company. The pages are so filled with maps and attractive photographs that the actual text fills only about six pages.

"The Giant of the Valley" is the manner in which the Missouri Gas & Electric Service Company designates itself in a booklet which has been used to encourage its customers to purchase its securities. The booklet is profusely illustrated, and the interesting photographs of different institutions and sections of the district outnumber many times the illustrations of the company's properties. A human-interest story which is not too long points out what electric service has done and can do for the communities served.

Employee-Investors Build Thrift and Good Will

By George H. Stack
Treasurer Utica Gas & Electric Company, Utica, N. Y.

INTEREST in profit sharing, stock ownership and similar plans for the promotion of thrift education is nation-wide. The development among workers everywhere of a feeling of proprietary interest in, and as a natural corollary a sense of loyalty to, the business which employs them has become the serious concern of all large employers. The Utica Gas & Electric Company recently closed a successful sale of its 7 per cent cumulative preferred stock to employees on a deferred-payment plan which resulted in a large percentage of employees becoming stockholders.

The par value of the stock is $100 per share, and it is preferred both as to assets and dividends over the common stock. The deferred-payment plan calls for full payment in two years, at the rate of $1 per share per week, or in one year at the rate of $2 per share per week. Employees on the semi-monthly payroll pay monthly in amounts equivalent to the weekly rate.

The sale opened Dec. 6 and continued for two weeks to Dec. 20, 1920, reaching a total of $90,600. This amount was subscribed by 377 out of 513 permanent employees. When the total for the first day's sales mounted to $33,000 the success of the sale was assured. Each succeeding day added a goodly quota, but even the feeling of optimism created by a rising barometer did not prevent the result from exceeding the best hopes.

The company had long been desirous of evolving some plan suited to local conditions for educating and encouraging its employees in the way of systematic saving and safe investment. When an issue of preferred stock was first contemplated, about a year ago, it seemed that here was the opportunity, primarily, to encourage in a practical way habits of thrift among employees and, secondarily, to enable them to acquire a financial interest in the company.

Preliminary Survey of Employees' Attitude

Cards of inquiry were sent out in April of last year to ascertain whether or not employees would be interested in subscribing for this preferred stock on easy-payment terms in the event that it was decided to put out the issue. The response was almost unanimously in the affirmative. This was most reassuring because there had been some misgivings as to the general attitude of the employees toward the plan.

Soon after the issue and sale of the stock was authorized by the Public Service Commission, Second District, a circular letter was sent to all employees announcing the fact and inviting them to think the matter over and be ready when an employee-solicitor should call for their subscription. Meanwhile a selling organization had been formed, composed of six teams, each with a captain and from two to eight solicitors, according to the number of names assigned to each team. The total number of solicitors was eighteen, all employees. At the beginning of the second week of the sale a second circular letter was addressed to employees who had not then subscribed, pointing out the value of the saved dollar over the spent dollar, emphasizing that once started right the incentive of seeing their fund grow is pretty sure to keep them at it, and stating that the company was desirous of as wide a distribution of stock as possible among employees, both because economic conditions make it highly desirable that a spirit of saving and safe investment be developed among workers everywhere and because it was glad of the opportunity to enable them to become, with its other stockholders, joint owners of the company and to share in its business. This circular was effective in speeding up the sale and a considerable factor in making it a success.

The number of shares likely to be sold was uncertain. While the response to our inquiry addressed to employees had been favorable, nearly eight months elapsed between the date of the questionnaire and the opening of the sale, and there was no way of measuring any change of sentiment which might have taken place in the meantime. We knew of only one similar sale in a city comparable in size and general conditions to Utica. In that case $50,000 of the company's preferred stock was sold to employees in a two weeks' campaign. With that total in mind we set up a bogey of $100,000 to shoot at. The sale of $50,000 would have been considered a success, and a total of $75,000 was all we really

dared hope for, though, of course, we urged on our various teams the necessity and the possibility of making bogey. The result was quite beyond our real expectation. That nearly 75 per cent of our total employees are now stockholders or prospective stockholders is a gratifying expression of faith in the company's future and denotes a feeling on the part of these employees that they have been getting and will continue to get "a square deal." It is also a most favorable commentary on the progress of thrift education among them.

Large Number of Cash Sales

A most encouraging feature of the campaign was the amount of stock sold for cash. It was evidence that the practice of thrift had already become a habit with many of our employees. Another of the surprises was the class of employees which made the largest cash purchases. One mechanic paid $1,500 in cash and subscribed for $500 on installment. A janitor in one of our plants produced a check for $1,000 and is seriously considering taking another $1,000. Another employee brought in $800 in greenbacks, and many others paid cash in varying amounts. These examples of preparedness had their effect in encouraging other employees to join the company's thrift club.

One peculiar thing in connection with the sale was the fact that while in drives of this nature the sales are usually made on an ascending scale, beginning with small sales and increasing day by day as the campaign progresses, our sale was on a descending scale, opening with a total of more than $33,000 the first day and gradually decreasing to smaller amounts as the sale neared its close. This, we believe, was due to the confidence of our men in the company's securities and their desire to take advantage of the opportunity to purchase stock on the easy terms offered.

The company is now preparing to offer preferred stock to its customers on a cash and deferred-payment plan. The latter plan calls for a 10 per cent cash payment with subscription and 10 per cent monthly for nine months. Not more than ten shares are to be sold to any customer on deferred payments.

Bonus Yields 6,000 Meter Readings per Man per Month

MORE than 27,000 meters a month were read by the meter-reading force of the Worcester (Mass.) Electric Light Company in November, 1920. A bonus system is used to such good effect that during that month three men attained $40 extra pay each, with lesser payments to the others of the force. The regular meter readers attained a maximum of 6,000 per month per man, when a recent rerouting was completed. Meter readers are paid on the following weekly basis:

First year, first half.....	$13 00	First year, second half.....	$14 00
Second year, first half.....	15 00	Second year, second half....	16 00
Third year, first half	17 00	Third year, second half.....	18 00
Fourth year, and after.....	19 00		

Rates change in January and July, and the following bonus is added:

A bonus of $40 per calendar month is paid to each reader, except for the deductions noted.

There is subtracted from the total amount of the monthly bonus $1 for each mistake made, $1 for each morning the reader is late and $1 for each time a customer complains of the reader's conduct. If any meters are skipped, $1 is deducted from the bonus for each day when this takes place.

A bonus of $25 per calendar month is paid to each spare reader under the above conditions, except that spare readers are not penalized if all meters in the route are not visited.

The bonus is paid on the first pay day in the second month after it is earned, but a reader who is discharged for any reason or who voluntarily gives up his position does not receive any bonus other than that due on his regular pay day. Meter readers are paid $5 for each discovery of theft of energy, including all cases of unmetered current, and are paid $3 for each discovery of a meter in use without a meter-reading card.

What and Why of the Coal Clause Explained to Customers

WHY an electric light and power company must apply a fuel clause to its existing rates and how this application is made is explained as follows by the Rockingham County Light & Power Company of Portsmouth, N. H., in a bulletin sent to customers:

The coal clause that is applied by this company to the power and heat rates has become very general throughout the country where electrical energy is produced by coal and, although little understood by the average customer, is the fairest method of proportioning costs that has been conceived.

The original rates of every light and power company were based on some well-established cost of coal. With this company that price was $3.50 per ton. In 1916 our average cost of fuel per kilowatt-hour was $0.0046. This was an average of 2.6 lb. of coal per kilowatt-hour. Contracts with manufacturers and other public utilities were made prior to this time on very close margins of profit, for, needless to point out, we could not have secured their business otherwise.

In 1917 the average cost of coal per ton was $8.45, or $0.0094 per kilowatt-hour, making an increase in our coal bill for the year of $112,244.55. In 1918 the average cost per ton was $9.10, or $0.0129 per kilowatt-hour, an increase of $184,613.15 as compared with 1916. In 1919 the average cost per ton was $10.05, or $0.0130 per kilowatt-hour, and an increase of $192,579.69 as compared with 1916. You will note that the cost per kilowatt-hour did not increase this year in proportion to the increase per ton on account of a better average economy for the year.

These figures show what happens when we are compelled to pay high prices for coal, and, as it is generally conceded that prices cannot continue at this level, no company has tried to redesign its general rates on present coal costs. If the highest cost of coal were taken as a basis, the rate would be prohibitive. If the average cost of coal were taken, no commission would stand for a high enough price to keep the company from bankruptcy in case it had to buy some coal at $20 to $22 per ton, as we did in the months of July and August.

Hence the coal clause, which is designed to pass on to the rates to which it applies all the costs incident to the coal burned to produce that particular energy over and above what it would have cost had the company been able to buy coal at $4 per long ton.

Our records, taken over a long period, show that 1 cent variation in the price of coal results in a change of $0.00015 in our cost per kilowatt-hour, which is equivalent to 1½ mills per dollar.

So we have the coal clause, which is as follows:

"The price for each kilowatt-hour of electricity delivered under any contract or class of service to which a coal clause is applicable shall be subject each month to an addition or deduction, as the case may be, of fifteen one-thousandths

($\frac{1.5}{100}$) of a mill per kilowatt-hour for each and every cent of variation in the price of bituminous coal of 14,500 B.t.u., above or below the price of $4 per gross ton in the company's coal bunker, this price to be determined by obtaining the average cost (after making any necessary adjustments for heating values) of all coal on hand on the first day of each month and all coal received during such month, together with interest at the rate of 6 per cent per annum on the cost of all coal in storage on said first of the month, it being understood the 'cost' shall include all charges for transportation, carting and handling, expenses and losses, if any, incident to placing the coal in storage."

We have been criticised by some on the ground that, with this coal clause, we did not care what we paid for coal. This is not true, for, if we were inclined to be indifferent to our customers' interests, the fact remains that the lighting rates carry no coal clause adjustments, and also the railroads, owned by the same interests that own this company, pay more than one-half the amount received from the coal clause.

There is ample justification for an increase of basic rates of more than 15 per cent (which we made in January), because of the unanticipated advances in wages, cost of apparatus, supplies and all operating expenses, as well as higher interest rates, all incident to or following the war, and the purpose of this article is to explain and justify the increase of monthly billing on account of the coal costs alone, which are not generally understood.

Recommendations for Better Merchandising by Central Stations

FOR the betterment of conditions prevailing in the sale of electrical merchandise by central stations, the merchandising committee of the Southeastern Section of the National Electric Light Association, at its convention in Miami, Fla., made the following pertinent recommendations:

1. Co-operation; closer relationship between the central station and the contractor-dealers.
2. Positive policy of price maintenance.
3. Extensive educational campaigns, using all possible manufacturers' literature.
4. Keeping of actual records showing the cost of doing business.
5. Discontinuance of the loaning of appliances on trial basis.
6. Co-operation with manufacturers and jobbers with a view to educating young men to be used in commercial departments of central stations.
7. A committee to interview motor manufacturers to obtain better discounts for the central station than those allowed to individuals.
8. A committee to interview lamp manufacturers requesting that the exclusive agency for lamps be given to the central station, in order that department stores and hardware stores may be excluded, because of the fact that they cannot intelligently recommend lamps of the proper voltage and the further fact that they are inclined to cut prices.
9. A campaign to interest all central-station representatives in becoming better acquainted with the electrical industry by the use of information supplied by the manufacturers, by reading trade journals, taking N. E. L. A. courses and in other ways identifying themselves more closely with the industry.
10. Special attention to appearance of showrooms in regard to neatness and attractiveness.
11. That a department be organized and maintained in each company for handling all repair work and trouble, in order to give the best service possible.
12. That, in addition to regular electrical appliance stocks, a line of kindred stocks be carried, including ironing boards, automobile lights and accessories, silk shades, portable lamps, fire extinguishers, miscellaneous electric supplies, extension cords, mechanical toys and numerous other non-energy-consuming devices essential to the complete electrification of the household.
13. Endeavor to do more advertising and in better style.
14. That individuality be displayed in national, state and local advertising in newspapers, windows and showrooms.
15. A committee to be appointed to see that the best deliveries and discounts are had from manufacturers, thereby assuring the largest margin of profit possible.

A Human-Interest Security Sales Appeal



Electric Service in Home Saves 84½ Eight-Hour Days per Year

HERE is a list of the most popular household electric appliances showing in eight-hour days the amount of time each device will save the user in the course of a year:

	Eight-Hour Days
Electric clothes-washing machine	19½
Electric vacuum cleaner	19½
Electric dishwashing machine	13
Electric iron	6½
Electric ironing machine	13
Electric sewing machine	3¼
Electric toaster	3¼
Electric percolator	3¼
Electric fan	3¼
Total	84½

In this calculation, which was prepared by the Rochester (N. Y.) Gas & Electric Corporation, the saving merits of the devices are set forth in terms of days, but it is pointed out that there is no way of estimating the additional saving of physical effort accomplished through the liberal use of electric service.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Synchronized Induction Motors.—LE MONNIER.—The Compagnie Générale Électrique in Nancy is building a large type of industion motor, rated at 300 hp. and 750 r.p.m., which may be run synchronously in Danielson connection. For this purpose the motor is equipped with a direct-current exciter put on the same shaft as the main rotor. The machine is started as an ordinary induction motor, but when it has reached full speed it may be pulled in step by switching on the direct-current excitation in the rotor winding. The rotor therefore has a coil winding and slip rings, and the exciter is a special low-voltage, high-current machine. The synchronized induction motor is built as an ordinary slip-ring motor, except for certain details of design. For instance, since the power factor after synchronization is adjustable by varying the excitation it is not necessary to give the motor a very small air gap. Consequently open slots may be used, permitting the adoption of machine-made rotor and stator coils. The efficiency of the machine when running as a synchronous motor with unity power factor is about 92 per cent, exciter included. —*Revue Générale de l'Électricité,* Nov. 13, 1920.

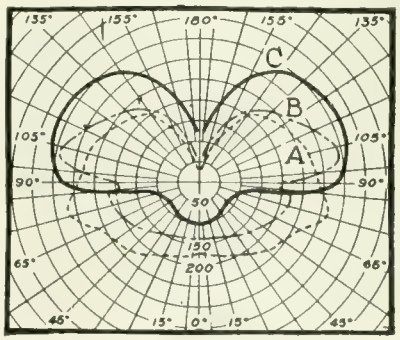
Mechanical Construction of Waterwheel-Driven Alternators.—E. MATTMAN.—The mechanical problems involved in building alternators for waterwheel connections are shown by the fact that in case the load is suddenly disconnected and the governor fails to act promptly excessive speeds of the generating unit develop. The author maintains that overspeeds of approximately 85 per cent must be anticipated in the case of reaction-type turbines. For impulse wheels the generator is designed for overspeeds up to 100 per cent.—*Electric Journal,* January, 1921.

Lamps and Lighting

Lighting of Armories and Gymnasiums.—A. L. POWELL and A. B. ODAY.—Owing to the great height of ceilings, which fixes the elevation of the lamps well above the ordinary angle of vision, high-power gas-filled lamps may be used to advantage in, and with suitable reflectors have become standard for, large drill halls. In modern practice the actual power consumption for armories with wooden floors has varied from 0.25 watt to 0.55 watt per square foot (2.5 watts to 5.5 watts per sq.m.). It is said that with fairly efficient reflecting equipment the coefficient of utilization should be somewhere between 40 and 50 per cent. Actual tests at two armories investigated showed 2.5 foot-candles of illuminations which was quite uniform. The author also discusses maintenance of fixtures and the lighting of miscellaneous rooms in the armory.—*Bulletin L. D. 116, Edison Lamp Works,* Harrison, N. J.

Survey of Voltage Conditions in Automobile Lighting. —H. H. MAGDSICK and HOWARD KARG.—This article states that results obtained with headlighting equipment differ from those anticipated largely because of these five factors: (1) Variation in individual bulbs; (2) variation in individual sockets, including adjustment with reference to the focal point and alignment; (3) variation in individual reflectors as regards finish of surface and contour; (4) variation in cover glasses in respect to directing and proportioning the light; (5) variation in lighting systems as regards voltage impressed at the lamp. The greatest factor in producing variation of the illumination from a given type of headlighting equipment, the authors say, is the range of voltage impressed at the lamps, and the results of an investigation into the magnitude of this variable and an analysis of some of the contributing elements are reviewed.—*Transactions I. E. S.,* November, 1920.

The Bowl-Enameled Lamp.—WARD HARRISON.—This comparatively new lamp was developed to provide a high-powered light source for industrial plants which would be free from the objectionable glare common to various types of unshaded lamps. The enameling on the lower half of the bowl effects almost complete diffusion of the transmitted light, it is said, and when the lamp is used with a suitable steel reflector the resulting illumination is noticeably free from glare and sharp shadows. The enamel forms a smooth surface which does not collect dirt and is also said to withstand the action of water, acid fumes and ordinary mechanical abrasion incident to shipping and handling.—*General Electric Review,* December, 1920.



COMPARATIVE CANDLEPOWER DISTRIBUTION CURVES FOR GAS-FILLED LAMPS: (A) CLEAR, (B) BOWL-FROSTED, (C) BOWL-ENAMELED

Generation, Transmission and Distribution

Economic Study of Secondary Distribution.—P. O. REYNEAU and HOWARD P. SEELYE.—The purpose of the paper is said to be to study from an economic viewpoint the conditions generally met with in secondary distribution and to furnish as far as possible guidance for the designer to aid him in any particular problem with which he has to deal. No definite rules can be established which will fit all conditions on account of the many variations in the problem. The general problem is to determine the proper combination of wire, transformer and transformer spacing in order to give good conditions of operation, and also to show the least cost per year for the load densities expected during the period of time under consideration. Curves and tables are presented facilitating the calculations suggested by the authors.—*Journal A. I. E. E.,* October, 1920.

Operating Performance of Insulators on a 45,000-Volt System.—H. B. VINCENT.—A description of a form used

for collecting data pertaining to the condition of pin-type high-tension insulators removed from service, with an analysis of the data obtained from such a report showing the performance of insulators on various lines from 1914 to 1919 inclusive. The percentage of injured and damaged insulators to the total number installed and the percentage of cases of damage of each particular nature to the total failures are given.—*Journal A. I. E. E.*, January, 1921.

Cockerill Blast-Furnace Gas Boilers.—It is said that in order to increase the efficiency of a common gas-engine installation an attempt has been made to utilize a great proportion of the waste heat contained in the exhaust gases which had heretofore been allowed to exhaust straight into the atmosphere. The increased efficiency of gas-engine installations equipped with exhaust-gas boilers is discussed.—London *Engineer*, Nov. 19, 1920.

On the Design of Insulator Pins.—DONATH.—An article dealing with the mechanical design of insulator pins. Formulas are derived which show what dimensions the pin should have in order to afford the necessary strength with minimum weight of material.—*Elektrotechnische Zeitschrift*, Oct. 14, 1920.

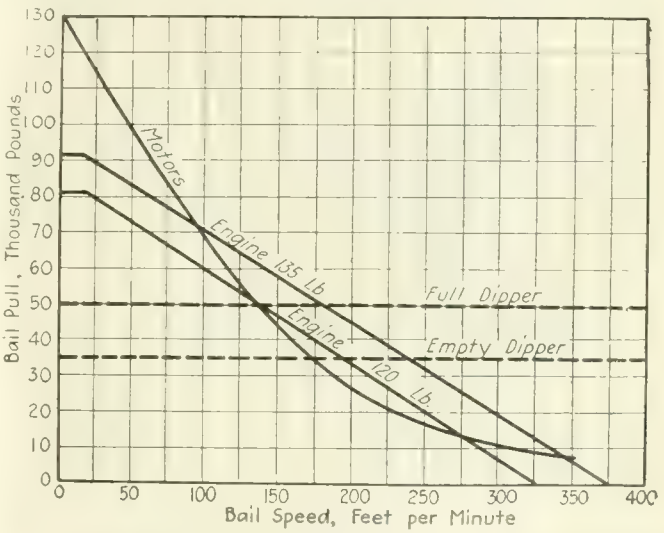
Superpower Transmission. — TRÖGER. — The author questions whether the common three-phase system is the best way of transmitting power over great distances and suggests that a considerable saving of copper would result from combining two star-connected three-phase systems into one four-wire system by connecting two star points so that the voltages in the interconnected legs will be in phase, the common point of the two stars being grounded. He then proceeds to deal from an economical point of view with the question of high-tension three-phase power transmission, with particular regard to the proposed system of 100,000-volt cross-country lines in Germany. It is said to be a general rule that the most economical amount of energy transmitted over one line increases in the same proportion as does the consumption per square mile in the district served by the line. At present from 100,000,000 kw.-hr. to 200,000,000 kw.-hr. is transmitted per line each year over existing lines in Germany, but the future energy transmission per line probably will rise to four times as much as the consumption density increases, and the maximum load on a double line will probably be from 100,000 kw. to 150,000 kw., so that each line must be capable of transmitting from 50,000 kw. to 75,000 kw. On the basis of pre-war prices the author finds that the most economical voltage for transmitting this amount of power 200 km. to 600 km. is about 200,000. A deviation of 20,000 volts from this value, however, will increase the total cost of transmission by only 1 per cent. But a transmission voltage of 100,000 the author considers to be insufficient for Germany's future needs.—*Elektrotechnische Zeitschrift*, Nov. 18, 1920.

Traction

Corrosion Due to Ground Currents.—ZANGGER.—A rather comprehensive article containing a report of the work of a Swiss commission appointed for the purpose of investigating the effects of electrolytic corrosion caused by ground-return currents of direct-current electric railways. The work of the commission supplements some recent investigations made at the Bureau of Standards in Washington. The author describes various methods used in determining the rail currents and the currents in underground pipe lines running along the track. By means of a bridge method measurements were made to determine resistance of several types of rail bonds, and it was found that in general the rail connections used in Switzerland have too high a resistance, so that the corrosion often may be considerably reduced by improving the conductivity of the rail bonds. Methods for computing the ground current distribution are also outlined in the paper and applied to practical cases, the results being checked against the results of actual tests.—*Bulletin Schweizerischer Elektrotrotechnicher Verein*, October and November, 1920.

Installations, Systems and Appliances

The Electric Shovel in Open-Cut Mining.—C. R. FISHER and H. G. HEAD.—Coal deposits with overburden too shallow to permit shaft mining now constitute the most profitable form of coal mining when large electrically driven stripper shovels are used. The principal contributing factors, the authors assert, are the greater depth of cut which the larger shovel can make, the increased bulk of material which its greater radius of action permits it to remove before consuming time to



CHARACTERISTICS OF SERIES MOTORS COMPARED TO THOSE OF A STEAM ENGINE

make a forward movement, and the lower labor and power costs. The performance of the large electric shovel in stripping operations has led to its adoption in other branches of mining, and this article describes the construction and operation of the latest type 300-ton electric shovel as applied to open-cut limestone quarrying, where it has every promise of duplicating its success in coal mining, according to the authors. Curves show that with heavy loads the dipper speed is higher for electric drive and the stalling pull is much greater. —*General Electric Review*, December, 1920.

Analytical Determination of Steps in the Starter of a Series Motor.—STANLEY PARKER SMITH.—In this paper a simple analytical method for calculating the resistance steps in the starter of a series motor is given, and examples are worked out illustrating the application of the method to the series motor and to two series motors arranged for series-parallel control. The solution of the problem entails a knowledge of the magnetization curve, or of the speed curve, of the motor, but no graphical construction is necessary for obtaining the results.—*Journal Institution of Electrical Engineers*, London, August, 1920.

The Liquid Slip Regulator.—GUY F. SCOTT.—A discussion of the liquid slip regulator, which is used in connection with induction motors equipped with flywheels in order to make use of the flywheel energy when sudden loads are thrown on the motors. The use of the flywheel energy is brought about by increasing the slip of the induction motor either by the use of a permanent resistance or by introducing resistance at the proper time by means of automatic slip regulators.—*Electric Journal*, January, 1921.

Oil Switches for Large Electrical Supply Systems.—It is said that the chief problems relating to the control of systems fed from stations with capacities between 100,000 kva. and 200,000 kva. may be summarized as follows: (1) Means must be found to insure maintenance of voltage at all parts of the system and prevent disturbance of running machinery. (2) Arrangements must be made to limit the power which can be concentrated at any point on a fault occurring and to a figure not calling for excessive expenditure in the construction of individual pieces of apparatus. Short-circuit characteristics of alternators and speed of oil-switch openings with units of extremely large size are discussed in this paper.—London *Engineer*, Sept. 3, 1920.

Electrophysics and Magnetism

"K. S." Magnet Steel.—KOTARO HONDA and SHOZO SAITO.—An outline of the characteristics of this type of tungsten magnet steel, which is said to possess extremely high coercive force and strong residual magnetism.—London *Electrician*, Dec. 17, 1920.

Some Optical Effects, Including Refraction and Rotation of the Plane of Polarization Due to the Scattering of Light by Electrons.—J. J. THOMSON.—*Philosophical Magazine*, London, December, 1920.

Electrostatic Transformers and Coupling Coefficients.—F. C. BLAKE.—Starting from the experimentally determined fact that the capacity of an air condenser is independent of the frequency of electrical oscillation, this article shows that for high-frequency conditions, when the resistance is negligible as compared with the reactance, the capacity reaction between the two circuits can be expressed best in terms of elastances. Definitions are given for self and mutual elastances as well as for self and mutual capacitances, and the definitions are tested by knowledge of spherical condensers. The true relationship between Maxwell's coefficients of capacity and the elastances of capacitances is pointed out in the case of the spherical condenser. The ideas developed are applied to the thermionic tube, and thereby the behavior of the ultraudion and the experiments of Van der Pol are readily explained. Attention is called to the alternative view of the behavior of condensers toward alternating currents, namely, that instead of being paths of low impedance they are paths of ready yielding or low stiffness or elastance, as suggested by Heaviside and by Karapetoff.—*Journal A. I. E. E.*, January, 1921.

Units, Measurements and Instruments

Errors in Energy Measurements Due to Phase Errors in the Instrument Transformers Used.—GOLDSTEIN.—There are four different ways of connecting current and potential transformers for energy measurements by kilowatt-hour meters in a three-phase system. The small phase deviations between primary and secondary in the instrument transformers may cause considerable errors in the reading of the kilowatt-hour meter. The author shows how the resulting errors may be computed for the four possible cases when the phase deviations of the transformers are known. By means of his formulas it is easy to determine in any given case what combination of transformers will give the smallest error and how big that error is.—*Bulletin Schweizerischer Elektrotechnischer Verein*, November, 1920.

Telegraphy, Telephony and Signals

German Radio Research.—In a brief report on research in progress at the German Telegraphen-Versuchsamt is included a description of an interesting arrangement for recording radio telegraphic signals. The reception is based upon the beat method. In order to obtain audio selectivity an intermediate resonance circuit, tuned to the beat frequency, is interposed between the detector tube and the three-stage audio amplifier used. From this amplifier the impulses pass on to a special high-power amplifier, consisting of two four-electrode vacuum tubes with extra steep characteristics (audions with double grid). These two tubes are coupled by a transformer with a winding ratio of 15,000 to 60,000. The second tube also acts as a rectifier and translates the audio signals into direct-current dots and dashes. In the plate circuit of the last tube is inserted a 10,000-ohm relay, which in its turn controls a Wheatstone printer. Only four batteries are needed for this equipment, one on 6 volts and one on 12 volts for filament heating currents and two batteries on 90 volts for supplying the plate circuits.—*Elektrotechnische Zeitschrift*, Nov. 4, 1920.

Recent Inventions in Wireless Telephony.—A description of the provision of side-tone and intercommunication on wireless telephone sets for aircraft.—*Wireless World*, Oct. 16, 1920.

Miscellaneous

Guiding Ships by Submerged Cables.—LOTH.—In the summer of 1919 experiments were made on a large scale at Brest with the method of guiding ships through fog by means of a single-pole cable carrying an alternating current of audible frequency. This system was referred to in these columns some time ago. During the Brest experiments the cable current was about 2.5 amp., and the ships were provided with four 3-ft. by 8-ft. (0.9-m. by 2.4-m.) coils with sixty turns each and with different orientation in the ship. The coils were directly connected to telephone receivers, and the author states that the sound could be distinctly heard more than a mile from the cable, so that the cable could be easily picked up and followed by the ship. The same guiding method has been tried with very good results for dirigibles and hydroplanes. Airships provided with suitable search coils may thus be safely navigated even in dense fogs or darkness by aid of a guiding cable, which naturally in such a case does not have to be submerged in water.—*Comptes Rendus*, Oct. 11, 1920.

Foundations for Machinery.—N. W. AKIMOFF.—Considerable contradiction arises from blindly applying the principles of the building foundation to the design of substructures for machinery, and this sometimes results in the necessity for the use of cushions or of adding other yielding adjuncts to the foundation. The writer presents a theory which includes the effect of vibrations which arise from lack of balance or from other causes.—Paper presented at the annual meeting of A. S. M. E., Dec. 7, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Electrical Contractors to Study Installation Costs

PLANS to study installation costs, to further the study on overhead costs and to revise wiring standard symbols were discussed at the annual meeting in New York this week of the executive committee of the National Association of Electrical Contractor-Dealers. James R. Strong of New York was elected national chairman and Thomas M. Templeton of Detroit, B. H. Bendheim of Chicago and James R. Strong committeemen at large. The following were appointed to the labor committee which forms the National Labor Council: L. K. Comstock, New York; A. J. Hixson, Boston; Robley S. Stearnes, New Orleans; K. A. McIntyre, Toronto, and G. M. Sanborn, Indianapolis.

The executive committee discussed and gave the association its sanction to assist in a plan for a revision, in conjunction with engineering and architectural bodies, of the standard symbols for wiring plans.

A subcommittee was appointed to work out a standard system of keeping costs on the installation of electrical materials. The object is to secure reliable cost data that can be compared, along the same lines as the standard cost accounting system for merchandising.

Authorization was given Secretary Morton to go ahead with the collection of overhead costs. He was instructed to send a questionnaire on this subject to the entire membership.

California Commission Welcomes Legislative Investigation

RESPONDING to the attacks made upon it by some members of the State Legislature who are supporting a movement for a legislative investigation of its actions, the California Railroad Commission has issued a statement declaring:

"The Railroad Commission cheerfully and gladly welcomes any honest, fair and impartial investigation of its decisions and acts. It assumes that an inquiry made by a committee under direction of the State Legislature will be an earnest, sincere and thorough-going attempt to ascertain all the facts upon which to base an intelligent report dealing with the subject of the regulation of public utilities, the principles which govern the fixing of rates, the manner of their application and the extent of the benefits which the people dependent upon such service derive therefrom."

In the course of a brief review of the whole industrial and utility situation the commission says:

"Public utility rate increases have been held far below the level of all other commodity prices. Practically every other article which enters into the life of our people has advanced in price to a far greater extent than utility service. The Railroad Commission has seen to it that the public utilities of California were not permitted to make an unjust or an unfair profit."

New York's Governor Against Municipal Operation

WHILE recommending the unification and ultimate municipal ownership of the electric transportation systems of New York City as the only solution to the traction problems there, Governor Miller in his message to the New York Legislature this week condemned municipal operation. "I think," he said, "municipal operation of the lines would be fatal. The railways should be run on an efficient, businesslike basis, and the public never runs its affairs that way."

The Governor of New York has recommended that all utilities of the state, except the New York traction companies be placed under the regulation of one public service commission at Albany. The metropolitan traction companies he would regulate by a separate commission in New York City. At present there are two commissions, the up-state commission regulating all utilities except those operating in New York City which are under a separate commission.

Power Commission Refuses Consideration to Prospective Use of Niagara Water

WHILE the ruling on the part of the Federal Power Commission that it would not consider applications or entertain discussion covering the prospective use of water under an amended treaty with Great Britain lessened interest in the hearings by the commission on Jan. 24, 25 and 26, each session was an animated one and was well attended by those interested directly and indirectly in water-power development.

Several of the applicant companies had filed applications for preliminary permits involving the prospective use of water under an amended treaty. While the commission ruled against hearing these applications, it was made clear that this was not to preclude its consideration of possibilities arising from additional diversions in considering the proposals for the use of existing water. Nothing developed at the hearing to indicate in the slightest degree that the commission will disturb the rights now exercised by the Niagara Falls Power Company.

The Niagara Falls Power Company urged the approval by the Federal Power Commission of the plan which has been approved by the army engineers and by the Secretary of War. A supplemental plan provided for over-all development from Echota to Lewiston. The power company stated that it was ready to accept a license and proceed with such development. The Niagara Power & Development Company's representatives started to discuss the utilization of 10,500 second-feet of the diversion now being used by the Niagara Falls Power Company. It was evident, however, that the commission was not in sympathy with such a proposal. This, together with the recent refusal of the city of Buffalo to

back the plan, doubtless was the cause of the development company's waiving its application to that effect. The Niagara Falls Power Company appeared to support its application for the full 19,500 second-feet, the entire diversion now authorized, except for the 500 second-feet which goes through the Erie Canal. The company proposed either to use the entire amount of the diversion at the falls or to use one-half of it at the existing plant at the falls, taking the remainder over the top development. The opinion was expressed that the more feasible scheme would be to use the entire amount of the diversion at the falls. That would require the construction of a pressure tunnel which would carry the additional 10,000 ft. down to the power house adjacent to the company's new plant and would mean the eventual abandonment of the old plant above the falls, although it would be kept in stand-by condition.

Development in the gorge is proposed by the Lower Niagara River Power & Water Supply Company. The company is affiliated with the Niagara, Lockport & Ontario Power Company. The same scheme is proposed by the Niagara Gorge Power Company, which is owned by the Gorge Railroad Company. It was brought out that the gorge development must go before the International Joint Commission.

Representatives of the State of New York appeared at the hearing and requested and received permission to file a brief subsequently.

A. L. Sweat of the Western-New York Utilities Company urged a larger diversion of water through the barge canal.

Applicants Not to Oppose Decision

In regard to utilization of any additional diversion, the commission was advised by the Niagara Power & Development Company and the Niagara, Lockport & Ontario Power Company that the companies are in agreement that the grant to the successful applicant will not be opposed by the other company. The unsuccessful applicant will surrender to the other company the right-of-way it may possess.

Morris Cohen, Jr., counsel for the Niagara Falls Power Company, told an interesting story of the pioneering work which has been done by his client since the first hydraulic canal was built in 1853. He stated that the Buffalo General Electric Company has the largest single-firm power contract with the company he represents or 57,500 hp.

John W. Van Allen, representative of the Buffalo Chamber of Commerce, told the commission that the distribution of power should not be left to a private concern. He said it should be directed by a utilities commission. His attention was called to the fact that the water-power act vests the Federal Power Commission with authority in the event that the state does not create such a commission. He admitted that the present rates are very reasonable. He urged that a ten-year limit be placed on a license if one were granted to the Niagara Falls Company. He urged that the commission approve development in the lower gorge and questioned the probability of the revision of the treaty. Mr. Van Allen also objected to the allocation of additional power to electrochemical and electrometallurgical companies at Niagara Falls.

A Senate amendment to the sundry civil bill will authorize the Federal Power Commission to employ expert personnel for the carrying out of some of the technical phases of its work.

Western Inspectors Discuss Transformer Hazards and Grounding Secondaries

A LIVELY discussion of the merits of oil-filled apparatus was started at the meeting of the Western Association of Electrical Inspectors in Detroit on Tuesday by the declaration that oil-cooled transformers are considered a hazard by insurance companies. Hubert J. Clark, engineer of the Oklahoma Inspection Bureau, who made this statement, also said that oil-filled transformers should be removed from building interiors. While fires caused by such apparatus are seldom heard of, there is little chance that material modifications will be made in the present code requirements.

W. L. Granger of the Detroit Edison Company outlined the policy of that company in making installations and took issue with Mr. Clark's saying that he believes that the opinion expressed was based on experience with early apparatus that was not up to the present standards. Mr. Granger made a strong plea for the installation of transformers out of doors so far as possible, because the ventilation and handling of transformers indoors are so difficult. In the opinion of Mr. Granger automatic devices used in connection with the ventilation of transformers installed indoors operate so seldom that they are never in condition when they are really needed. It was agreed during the discussion of the paper that burning oil should be drained to a sump rather than to the sewer.

Grounding of Secondaries

F. A. Barron, General Electric Company, reviewed the history of grounding secondaries, in which the early investigations and patents of Elihu Thompson covering the subject were described. Following this paper W. J. Canada compared the safety and fire-code provision for grounding secondaries. There was considerable difference of opinion as to the grounding of circuits where voltages are in excess of 150 volts to ground. Furthermore, the opinion was expressed that grounding two-wire direct-current circuits needs further consideration.

Speaking on the responsibility of the contractor, E. McCleary said that when the work is under the supervision of an engineer or architect his responsibility is limited to the following of the specifications. Where he is wholly responsible for the design and installation of the work, his responsibility for the grounding is still limited if there is any doubt as to what constitutes proper grounding. The contractor should be held only for thoroughly established practices.

The subject of safeguarding electric fixtures brought some very positive statements from Charles H. Hofrichter, for the National Council of Lighting Fixture Manufacturers, and J. L. Wolf, for the Lighting Fixture Dealers' Association, as to the steps being taken to improve the product of this branch of the industry. The two associations through these two men gave a very frank statement of the situation and indicated that steps are being taken that will result in standardization of both the mechanical and electrical features of fixtures.

Vice-President St. John of the Detroit Electric Furnace Company gave a talk on the application of the electrical furnace, which was illustrated by motion pictures.

A theater party Tuesday evening, with the annual banquet Wednesday evening and a stag and smoker on Thursday evening, were the social features of the meeting. Friday was devoted to inspection tours.

Big Daylight-Saving Meeting Planned

AS PART of the efforts to obtain action in the present Congress on daylight saving for the Eastern time zone the commercial organizations of the cities of New York, Boston, Philadelphia, Pittsburgh and Baltimore and the State of New Jersey have called a meeting in New York on Feb. 9. Invitations have been sent to commercial and trade organizations in all the New England States and in New York, New Jersey, Pennsylvania, Delaware, Maryland, Ohio, West Virginia, North Carolina, South Carolina, Georgia and Florida, which compose the Eastern time zone, to send representatives to this meeting. A bill, introduced by Senator Walter E. Edge and Representative E. R. Ackerman of New Jersey, providing for daylight saving in the Eastern time zone for five months, from the last Sunday in April to the last Sunday in September, is pending in Congress.

Daylight-Saving Bills in Congress

A NUMBER of daylight-saving bills are pending before the interstate commerce committees of the United States Senate and House of Representatives. No action is probable in either committee, however. The House committee reported favorably the bill to repeal daylight saving last year and is certain not to reverse itself at this time, and the Senate committee, it is authoritatively said, is equally unlikely to sponsor any of the bills. All of them will die March 4.

New England Electrical League Formed at Boston

SIX HUNDRED representatives of all branches of industry attended a meeting and banquet at Boston on Wednesday evening to celebrate the formation of the New England Electrical League for the development of business and advancement of mutual interest through co-operative service. The speakers were Martin Insull, president National Electric Light Association; Henry C. Attwill, chairman Massachusetts Department of Public Utilities; Bowen Tufts, president New England Geographic Division, N. E. L. A.; C. S. Beardsley, William L. Goodwin, Frank S. Price and Dr. Perry Bush. Guy W. Cox was toastmaster. Mr. Insull also addressed an assemblage of 250 at luncheon, emphasizing the importance of publicity in developing central-station industry and credit to meet further service demands.

Move to Abolish Home Rule in Michigan

DECLARING that "most people now believe that it is good public policy to demand that utilities furnish a reasonably efficient service, and they also believe that it is equally good public policy that public utilities receive an adequate rate for such service," Representatives Defoe of Alpena, Mich., announced a few days ago the preparation of a bill to give the State of Michigan full control of its public utilities. He also declared that "a state utility commission, possessing and exercising complete control over all utilities, with broad powers of regulation, can pass upon the equity or inequity of any rate free from any local bias or prejudice and can keep the rates throughout the state on an equal basis and without any discrimination." Mr. Defoe pointed out the inability of the municipalities outside of Detroit to engage in the investigations required if rates fixed by the local authorities are to stand in court. The long dispute between the city of Detroit and its street railway was cited as an evidence of the need for the proposed legislation.

Society for Electrical Development Attacks Fire Underwriters' Figures

THE National Board of Fire Underwriters has recently published figures covering 1915 to 1919 inclusive which place the fire losses for the five years at $1,416,375,000. The compilation, it is stated, covers the adjustment of 3,500,000 insurance claims, to which 25 per cent was added as a conservative estimate of unrecorded burnings. The most frequent cause of fires is said to be electricity, which is charged with losses totaling $84,086,471—almost 6 per cent of the total reported fire loss.

The Society for Electrical Development has conducted a thorough investigation into the causes of all fires—not simply those for which insurance claims were made—and has on file reports of fire chiefs, department heads, central stations and state officials from 345 towns and cities of more than 5,000 population with an aggregate population of 28,495,851 in 1919, or a very large proportion of the country at that time supplied with electric service. The total number of fires recorded is 138,553, of which number only 3,568 in residences and commercial buildings could be in any way traced to electrical origin. That is, only 2.57 per cent of all fires were traceable to the use of electricity, and a very large proportion of these were due to gross carelessness.

The figures compiled by the society not only rank electricity as a comparatively small fire hazard but show that only about one-third as many fires are started by electricity as are caused by the careless use of matches and the reckless throwing about of cigar and cigarette stumps.

As there is no reason to believe that a fire having its origin in an electrical defect is necessarily more disastrous than one started in some other way, such compilations as that of the National Board of Fire Underwriters are, in the opinion of the society, valueless.

Commission Formed to Secure Action on Colorado River Development

THE Colorado River Commission was permanently organized at Salt Lake City, Utah, on Jan. 21, with the expressed aim of securing concerted action by Utah, Colorado, Nevada, Arizona, Wyoming, California and New Mexico and the federal government in the development of the power and irrigation possibilities of the river and its tributaries. There was tentatively adopted by the commission for presentation to the legislatures of the states involved and to Congress a bill calling for the permanent appointment by each state of a representative on the commission. Frank E. Weymouth, chief engineer of the Government Reclamation Service, was selected as secretary of the organization, and the members pledged themselves to supply him with all available data concerning projects on the Colorado River and its tributaries. This information will be made the basis for concerted action to be determined upon at future meetings of the commission.

Pacific Coast Section, N. E. L. A., Convention, May 25-27

THE annual convention of the Pacific Coast Section of the N. E. L. A. will be held at the Hotel Del Monte, Del Monte, Cal., on May 25, 26 and 27. Partial programs for the divisional meeting have been prepared. The technical committee will present the following papers: "Power Necessities and Resources of California," by P. M. Downing; "Factors Affecting Fixing of Rates Based on Power Factor," by J. P. Jollyman; "Relay Problems in Large Interconnected Systems," by E. R. Stauffacher; "Progress in the Development of 220,000-Volt Transmission," by J. A. Koontz; "Operating Difficulties from the Viewpoint of Load Dispatchers," by F. R. George. The commercial committee will present the following papers: "The Electric Range and Water Heating," "The Convenience Outlet," "Illumination," "Industrial Heating," and "Meeting the Demand for Retail Salespeople."

Prominent Engineers to Discuss New York City Power Development

AS A PART of its program to take up problems having to do with the logical and orderly development of the community that surrounds the waters of New York harbor the New York Section of the American Society of Civil Engineers will hold a joint meeting with the other founder societies at the Engineering Societies Building in New York on Wednesday evening, Feb. 9, at which time Col. William Barclay Parsons will speak on "Light, Heat and Power." A discussion of the engineering problems of this kind that face the metropolitan district in connection with its future development will be participated in by J. W. Lieb, vice-president New York Edison Company, New York; Frank Smith, vice-president United Electric Light & Power Company, New York; Farley Osgood, vice-president Public Service Electric Company, Newark, N. J.; George Otis Smith, U. S. Geological Survey, Washington, D. C.; H. E. Skougor, consulting engineer, New York; George Gibbs, consulting engineer Gibbs & Hill, New York; William Cullen Morris, engineer of construction Consolidated Gas Company, and F. O. Blackwell, consulting engineer Viele, Blackwell & Buck, New York.

United States Chamber of Commerce Adopts Street-Railway Program

BY A VOTE of 1,657 to 24 the organizations making up the membership of the Chamber of Commerce of the United States have declared for the continued private ownership and operation of street railways. The question was one of eight submitted to a general referendum of its members by the Chamber of Commerce and embodying recommendations made by its committee on public utilities. The result of the referendum has just been announced and showed substantial unanimity for all the recommendations, of which the remaining seven were to the following effect: That existing traction facilities should be conserved; that the attitude now taken toward street-railway problems should be based on the present and future needs of the community; that regulation should everywhere be instituted that will follow promptly changes in the situation of the companies rendering services of local transportation; that provision should be made against the consequences of unfair competition; that all burdens unrelated to the service performed should be removed from street railways; that official responsibility should be definitely fixed for the application of regulation, and that each company should seek to have available for the public at all times the facts as to the results of operation and should have resident responsible executives wholly conversant with local requirements.

The referendum on public utilities is the thirty-third taken by the chamber. Lewis E. Pierson of the Irving National Bank, New York, is chairman of the public utilities committee.

Possibilities in Waterwheel Design and Accurate Measurement of Flow

SOME radically new ideas on developing water power and measuring water flow through long penstocks were presented at the hydro-electric symposium held at Philadelphia on Friday of last week. For a local meeting this symposium was conspicuous in attracting engineers of national reputation from coast to coast and representing three national engineering societies—the A. I. E. E., the A. S. M. E. and the A. S. C. E. The meeting, which was held under the auspices of the Engineers' Club of Philadelphia, very nearly filled the auditorium of the Manufacturers' Club, about 300 being present.

As an indication of the simplicity and high specific speed which may be expected in waterwheels in the near future Lewis F. Moody, consulting engineer I. P. Morris department of the William Cramp & Sons Ship & Engine Building Company, referred to a new type of wheel which his company has developed and is investigating that looks very much like a marine propeller.

This new conception of a waterwheel has been made feasible from a commercial standpoint by the recent achievements in converting whirl velocity in the draft tube into pressure head. Since 1907, when the highest specific speeds were between 200 and 300 r.p.m., the speeds have increased to from 500 to 600 r.p.m. With such high specific speeds and very high heads the wheels must be placed very close to tailwater level, or even below this elevation in some cases. This would be possible, Mr. Moody explained, by inverting the turbines and allowing the water to discharge upward against a regainer. Wicket gates could then be dispensed with by placing a conical-topped hydraulic plunger below the wheel in such a manner that raising it would reduce the water inlet area.

The new method of measuring water flow explained by Norman R. Gisbon, hydraulic engineer Niagara Falls Power Company, enables taking readings at each gate opening with only two minutes' shutdown for each. Furthermore, extremely high accuracy can be obtained, the mean error compared with volumetric measurements made at Cornell University being + 0.2 per cent. In general this method of measurement depends on the change in hydraulic pressure accompanying a change in velocity.

Interesting addresses were also made by F. H. Rogers, hydraulic engineer of I. P. Morris department, Cramp company; R. D. Johnson, consulting engineer; John L. Harper, vice-president and chief engineer Niagara Falls Power Company, and David B. Rushmore, chief engineer power and mining department, General Electric Company.

Important requirements of water turbines demanded in hydro-electric development were discussed by Mr. Rogers, particular attention being given to high speed, high efficiency, high power, reliability and durability.

Mr. Johnson emphasized the advantages of using surge tanks, calling particular attention to the merits of the differential type.

Mr. Harper dwelt on the possibilities of developing 6,000,000 hp. at Niagara Falls without marring its beauty and called attention to the benefits which are being derived from the existing development. Some attractive motion pictures were displayed.

The paper by Mr. Rushmore dealt with general features of hydro-electric power production and problems involved in the transmission, distribution and utilization of the energy generated.

Great Falls Hearing Scheduled for Feb. 1

A PUBLIC hearing in connection with the Great Falls water-power project on the Potomac River will be held Feb. 1. The hearing was to have been held earlier, but owing to an unavoidable delay in the completion of the report, it was impossible to discuss the details of the plan which the Corps of Engineers' U. S. A., has worked out. It is expected that the report will be passed upon by the chief of engineers prior to the hearing so that those not in agreement may have an opportunity to present their objections.

Worst Effects from Business Depression Are Over, A. W. Douglas Thinks

ALTHOUGH the general business situation has changed little during the last few months, there are pronounced indications that the first shock of the present depression is over, in the opinion of Archer Wall Douglas, chairman of the committee on statistics and standards of the Chamber of Commerce of the United States, as expressed in his monthly report on business conditions, just issued.

"The most cheering and hopeful feature of the situation is the fast-spreading realization that what we are going through is the only possible way to teach us the indispensable need of hard, conscientious work, some thought of obligation to our tasks, and getting back once more to those temporarily lost arts of salesmanship, of common-sense merchandising, of economical, efficient production and distribution," Mr. Douglas says. "Automatically everywhere production is adjusting itself to demand. This phase has finally reached the iron and steel industry and is general throughout industrial life. Automatically the situation is tending to a more normal relation between supply and demand, which means the solution of many of our problems. The fundamental soundness of the situation is widely felt. The general mental attitude, while recognizing the completeness of the collapse of inflation, perceives that it was not only inevitable but necessary.

"There is much surface, but often superficial, optimism as to the near future. A good deal of it is obviously intended for public consumption. Some of it, too, would be more convincing if it did not come from those who live in a financial atmosphere and have scant personal knowledge of actual conditions prevailing in that vast stretch of country beyond the ken of those in the great congested centers. That so many, living in the scenes of stagnant trade and low prices for farm commodities, still have reasonable confidence in the future is the best assurance we have in the belief, in meteorological phrase, that the center of the depression is now passing over us."

Good-Will Advertising Program Gets Under Way

THIS week the co-operative advertising campaign under the auspices of the National Electric Light Association to promote good-will building for the electric light and power industry will get under way in the popular magazines. The campaign has been under way in the electrical press for some weeks. The association's own advertising campaign will begin Feb. 19 with a half-page advertisement in the *Saturday Evening Post*. Twelve similar advertisements will appear in subsequent issues.

The first of the manufacturers' advertising in popular magazines will appear Jan. 29 in *Collier's Weekly*, and during the months of February and March other good-will advertisements will appear in such magazines as the *Literary Digest*, *Collier's Weekly*, the *Saturday Evening Post* and the *American Magazine*, over the name of the company donating the space, as follows: General Electric Company, Schenectady, N. Y.; Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; Wagner Electric Manufacturing Company, St. Louis; Western Electric Company, New York City, and Mazda Research Laboratories, Cleveland. The Robbins & Myers Company will publish quater-page central-station good-will advertisements during March in Chicago, Detroit, St. Louis, New York, Cleveland, Philadelphia, Boston, Fresno, Santa Rosa, Sacramento and Cincinnati newspapers.

The following companies also have agreed to use space in national popular magazines: Hoover Suction Sweeper Company, New York City; Edison Electric Appliance Company, New York City; Habirshaw Electric Cable Company, New York City; Duplexalite Company, New York City, and Hurley Machine Company, Chicago.

The following additional companies have agreed to use space in the trade papers: Trumbull Electric Manufacturing Company, Plainville, Conn.; Hygrade Lamp Company, Salem, Mass.; Condit Electrical Manufacturing Company, South Boston, Mass.; Kuhlman Electric Company, Bay City, Mich.; Burke Electric Company, Erie, Pa.; Electric Storage Battery Company, Philadelphia; Majestic Electric Development Company, Philadelphia; Locomotive Electric Washing Machine Company, Belleville, Ill.; *Electrical Review*, Chicago; Federal Electric Company, Chicago; Sangamo Electric Company, Springfield, Ill.; Moloney Electric Company, St. Louis; Roller-Smith Company, New York City; Power Specialty Company, New York City; Westinghouse Lamp Company, New York City; Packard Electric Company, Warren, Ohio; Canadian Westinghouse Company, Ltd., Hamilton, Ontario; Hamilton-Beach Manufacturing Company, Racine, Wis.; Syracuse Washing Machine Corporation, Syracuse, N. Y.; Comas Cigarette Machine Corporation, Salem, Va.; Britton & Doyle, Cleveland; Jeffrey-Dewitt Insulator Company, Huntington, West Va.; P. A. Geier Company, Cleveland; Anaconda Copper Mining Company, Chicago; Domestic Electric Company, Cleveland, and ELECTRICAL WORLD, New York City.

New England Electrical Development Committee Formed

TO FORMULATE a commercial expansion plan for 1921 through co-operation by all branches of the electrical industry in New England, an electrical development committee has been organized at Boston. William Gould of the Gas & Electric Improvement Company, Boston, has been named as chairman. This committee is the outgrowth of much recent work along the line of bringing the different branches of the industry into co-operative relations, and its work is to include the correlation of activities and interests of the different branches and unification of activities designed to popularize the development of electrical service and the use of electrical apparatus and merchandise. The following representatives of the various branches of the industry compose the committee: Manufacturers—C. B. Burleigh, S. B. Condit, F. J. Allen, W. S. Davis, D. C. Gidley, G. H. Cox; central stations—William Gould, V. M. F. Tallman, F. H. Smith, R. E. Holden, R. D. Cutler, J. E. Gray; jobbers—W. F. Abely, J. E. Livor, Almon Foster, F. S. Hardy, H. M. Savage, George H. Wahn; contractor-dealers—George B. Quinby, J. E. Wilson, J. P. Coghlin, H. W. Porter, Harry Cole and A. J. Hixon.

Calder Coal-Control Bill Is Securing Consideration

WHILE there is virtually no chance for any legislation at this session of Congress providing for federal regulation of the coal industry, the passage of the packers' bill and the hearings before the Senate committee on manufactures have had the effect of bringing about serious consideration of the Calder bill. This measure provides a rather drastic form of coal control in times of emergency, authorizes price fixing and the licensing of all those engaged in the trade. A permanent feature would be the compulsory filing of costs and profits and other statistical data, which would be made public in a way that would permit the consumer to analyze his coal costs.

Dr. George Otis Smith, director of the United States Geological Survey, told the committee on manufactures that the coal business could no longer be considered a private one. He expressed the opinion that it should be placed in the same category with the public utilities.

At the request of the committee, George W. Elliott, secretary of the National Committee on Gas and Electric Service, appeared and spoke to the following effect:

"The public utilities have suffered tremendously for the past year in their coal supply, principally through the flagrant disregard of contract obligations on the part of the coal operators. The public utilities consume annually 50,000,000 tons of coal. Much of this tonnage is contracted for yearly in advance. Great hardships were placed upon the public utilities, particularly during the period when a runaway market existed. Coal that should have been furnished to public utilities in compliance with the contract obligations apparently was diverted to the spot market, where prices could be obtained far in excess of those stipulated in the various contracts.

"There was a period during the emergency when the utilities were not receiving 50 per cent of the coal for which they had contracted. They were of necessity compelled to go into the open market and pay the outrageous prices that were being asked by the coal operators for export coal. The alternatives would have been either to curtail their output or to close their plants."

Mr. Elliott was not asked his opinion as to whether the Calder bill would remedy the situation and vouchsafed no opinion. It was made clear to the committee by him that the National Committee on Gas and Electric Service had held aloof from all matters concerning prices. Its activities in Washington had been confined generally to securing and expediting shipments of coal that already had been contracted for.

O. P. Hood, the chief mechanical engineer of the United States Bureau of Mines, declared that quality control of coal is just as important as is control of price and distribution.

Last Obstacle to Southeastern Interconnection Removed

THE approval of a writ of convenience issued by the Alabama Public Service Commission giving permission to the Alabama Power Company to construct a high-tension transmission line from Gadsden, Ala., to the Georgia state line removes the last legal obstacle in the way of the construction of a tie line between the Alabama Power Company and the Georgia Railway & Power Company. The Georgia Railway & Power Company will construct a line from its Lindale switching frame, connecting with the line built by the Alabama Power Company's line when completed, and will provide for the interchange of energy between these two large corporations. This is the last link necessary to provide for the interchange of energy between all the large power companies in the Southeast.

The line, which will be designed for 110,000-volt operation, will be of pole-type construction and will make use of aluminum conductors of No. 2/0 equivalent. It is expected that the line will be in operation about June 1, 1921.

Storage Development Recommended in New Hampshire Report

WATER conservation through storage development is recommended in the 1919-20 report of George B. Leighton, commissioner on water power and water conservation, to the New Hampshire Legislature, which was briefly referred to in the ELECTRICAL WORLD of Jan. 22, p. 224.

In the report submitted two years ago the main object was to place in concise form knowledge as to the possibilities for the conservation of water, so that better control of stream flow could be secured and more stable power-plant operation gained. The present report brings to hand the latest data on the power developments and possibilities of the state, which have been rendered doubly important by fuel prices.

"It is hardly possible or desirable," says the report, "that the state should in any wise obligate itself or pledge its credit toward the installation of water power, but in the matter of conservation the commissioner distinctly recommends that the state take some definite step toward assisting in this matter." The expenditure of, say, two million dollars, after proper engineering examination on the headwaters of the Connecticut and

Merrimac Rivers, would be warranted economically, the report declares.

The total developed horsepower in New Hampshire, as listed with the co-operation of the Water Resources Branch of the United States Geological Survey, C. H. Pierce district engineer, is 217,007 hp. in waterwheels. Auxiliary steam power totals 82,540 hp. On the Merrimac River and its tributaries in New Hampshire are 87,553 hp. in waterwheels, and on the Connecticut and its tributaries within the state 70,875 hp. The Androscoggin River in New Hampshire has 41,200 hp. in waterwheels, and the coastal streams in the state account for 17,379 hp. Mr. Pierce's report, which is embodied in the main report, points out numerous opportunities for the development of additional head. These include 1,974 ft. on the Connecticut and tributaries within the state, the total developed head now used being 2,554 ft. On the Merrimac and tributaries, 2,402 ft. additional head is available, with a present development of 3,932 ft., and on the Androscoggin important redevelopment work is already in progress in the Berlin-Gorham district. It is estimated that the development of seventeen sites in the Connecticut River basin would yield 390,000,000 hp.-hr. a year and that twenty-one sites on the Merrimac basin would yield 152,000,000 hp.-hr. Betterment work and interconnection are suggested as means of obtaining much larger output from existing and future installations.

National Electrical Code Submitted to Engineering Standards Committee

THE National Fire Protection Association has submitted the 1920 National Electrical Code to the American Engineering Standards Committee for approval as an "American standard." This code is submitted in accordance with the special provision in the procedure of the committee under which important codes in existence prior to 1920 may be approved without going through the regular process followed in new work. The committee is now making an effort to learn of the extent to which the code is used and any other information regarding the code in meeting the needs of the industry.

No New Development Work Planned by Idaho Power at Present Time

AN APPLICATION has been made by the Idaho Power Company for a preliminary permit under the water-power act to develop 66,000 hp. at the Upper Salmon Falls of the Snake River for public utility purposes, and another to develop 25,000 hp. at Twin Falls, on the same river, for similar purposes. It is stated by officials of the company that it is planning to develop under its filing with the Federal Power Commission 20,000 hp. at Upper Salmon Falls and 8,000 hp. at Twin Falls. The filings were made as required by law and for the purpose of supplying supplemental power to the territory that is held by the company in southern Idaho.

At present, owing to the financial situation, it is not planned to do any new development work or to extend the company's territory, but when the financial situation clears, and within the time limit allowed under the federal law, the necessary installations to carry the supplemental power will, it is stated, take place.

California Commission Bars Out "Good Will" as Element in Valuation

IN A DECISION fixing the price to be paid by the city of Redding for the electric distributing system of the Northern California Power Company in that city the California Railroad Commission a week or two ago made a far-reaching declaration against according any value to "good will" as an element in arriving at a fair price. "The element of good will, as the term is applied to a business in a public utility," it declared, "is not to be considered in estimating the value of a public utility plant, for the reason, among others, that the public utility enjoys a monopoly of a particular business in the community it serves and the public has no choice but to buy from the public utility or do without such service."

That profits made by the utility through rates fixed by the commission cannot be capitalized by the utility as a measure of value was another declaration made by the commission. This declaration was in answer to the company's claim that because of the profits made out of its business in Redding the property had a value of $83,000 over and above the value of the physical property, which amounted to about $50,000. The commission granted that the company is entitled to be reimbursed for reasonable development cost unless it can definitely be demonstrated that this cost of developing the business has been made up in later excess earnings.

Another important rule laid down by the commission was that the general operating condition and efficiency of a plant must receive consideration in the finding of its value. Establishing a "basis of just compensation to be followed in similar proceedings in the future, the commission also fixed the methods of valuation of the plant and of finding the depreciation in the property, these to prevail unless it can definitely be shown that the rules are not applicable in other cases."

In the matter of franchises, for which the company put in a special claim, the commission allowed the amount actually expended. The company also made a large claim for severance damage on the ground that the city of Redding should pay for the loss of business. The commission rejected the company's contention and allowed severance damages only covering the cost of changes in the physical plant. Including severance damage allowed by the commission, the total amount involved in the proceeding is relatively small, the sum to be paid by the city of Redding being fixed at $49,800. The minimum amount claimed by the company for the same property and as severance damage was in excess of $200,000.

The company claimed that the Fourteenth Amendment of the United States Constitution had been violated because Redding had adopted the commission's engineers' valuation and offered no valuation of its own. This contention the commission overruled. Further importance is lent to the case by the fact that it deals with purchase as distinguished from rates and that this is the first decision of the commission in which it unanimously sets up general guideposts to be followed in the future.

Concerned with the Northern California Power Company, Consolidated, in the proceedings was the Pacific Gas & Electric Company, which has purchased the property of the Northern company.

Baltimore Utilities Arrange for Interchange of Service

THE Consolidated Gas, Electric Light & Power Company, the United Railways & Electric Company and the Pennsylvania Water & Power Company of Baltimore have entered into an agreement covering the sale of the electric generating station on Pratt Street, owned by the two last-noted companies, to the Consolidated company and the purchase of power from the latter by the railway company. The agreement provides for a payment of $4,000,000 for the power station and for increased power supply by the Pennsylvania company to the Consolidated company, as required. The railway company in the future will devote its time exclusively to traction operations. Under a perpetual contract, with flexible terms adjusted to changing conditions, it will purchase all electrical energy needed for the operation of its lines from the Consolidated company.

The power station has been operated solely as an emergency plant heretofore, the main source of supply having been the Susquehanna River plants of the Pennsylvania company. The United company has arranged for a note issue of $1,500,000 in connection with the agreement, and the Consolidated company will make a first payment of $1,250,000 on the plant as soon as the contract has been approved by the Public Service Commission, to which it has just been presented.

Contract Closed for Extension of Salt Lake's "White Way"

THE contract between the city of Salt Lake and the Utah Power & Light Company, covering the installation and maintenance of a new lighting system on State Street from South Temple to Fourth South, on Broadway from West Temple to Second East, and on Fourth South from Main to State Street, has been finally executed.

There will be fourteen standards to the block, seven on each side of the street, with three lamps on each standard. The arc lamps to be used will be of approximately 2,000 cp. each and will be exactly similar to the lamps now in use on Main Street. The distribution of light will be so worked out that all parts of the street will be lighted to virtually the same intensity.

The new district will comprise 112 standards and 336 arc lamps, while the total, including Main Street, will be 182 standards and 546 lamps. The new installation represents an investment on the part of the property owners and of the city of approximately $100,000.

Right to Make Connection Charge Taken to Supreme Court of New Jersey

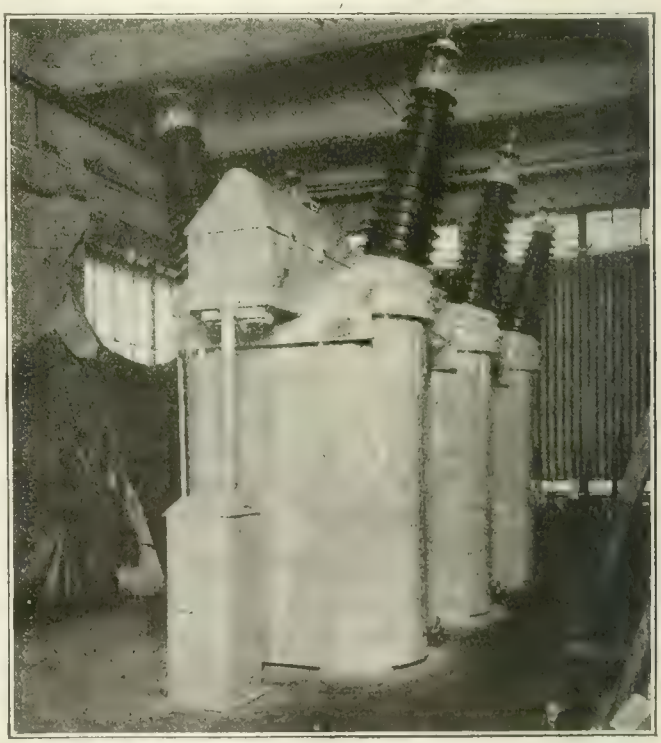
FOLLOWING the refusal of the New Jersey Board of Public Utility Commissioners to allow a connection charge, the Public Service Electric Company has carried the case to the Supreme Court and has obtained a writ of certiorari to review the order of the board, dated Nov. 23.

The Public Service company holds that the order is without warrant in law, that it is not reasonably supported by the proofs taken before the commission, and that it violates the constitutional rights of the corporation, taking for public use its property without due compensation. Further, the assertion is made that the order denies the company equal benefits of the law. In its contention the company points out that in the introduction of its business and in its desire to obtain customers it made connections for service without charge.

Later on, by reason of increased cost and expenses for labor and material and increased demand for additional and more expensive service, the capital outlay of the corporation grew unduly burdensome and it became necessary to reduce it. Accordingly, on Aug. 12 last a schedule of rates was adopted providing under certain circumstances for the payment by a consumer of the cost of wires and conductors upon his private property.

These rates, it is held, were entirely reasonable and conformed to charges made by other companies for similar service. This schedule of rates was refused by the Board of Public Utility Commissioners.

Record-Size Circuit Breaker for Great Western Power Completed



WHAT is, so far as can be learned, the largest oil circuit breaker in kva. rating ever manufactured is shown in the accompanying photograph. This machine has just been finished by the General Electric Company for the Great Western Power Company of California. It is one of seven machines of the same size which are being built for that company.

The breaker is built for operation at 165,000 volts and 400 amp. at any altitude from sea level to 4,000 ft. It is solenoid operated, the solenoid being actuated through a relay energized by a bushing transformer. It is closed by means of a pull switch placed wherever convenient. The contacts, explosion chambers and so forth conform to the standard design for this type of breaker. The total length of the three units is 32 ft., and the height measured from the bottom of the tank to the top of the insulators is 16 ft. The complete apparatus weighs approximately 25 tons and requires more than 4,000 gal. of oil.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A Copper-Aluminum Alloy.—A new alloy of copper and aluminum has been invented and tested by the Aktiebolaget Skandinaviska Armaturfabriken. The name given to the new combination is "alcobronze," and it is said to be harder, tougher and stronger than any other bronze and to resist the action of the air, acids and salt water.

Jerusalem Talks of Water Power.—Hydro-electric development is claiming its own in the most ancient as well as the most modern lands. At a recent meeting in Jerusalem of the advisory council of the Zionist organization concerned with the setting up of the new Palestine it was unanimously agreed that in fixing the boundaries of the state not only water supply for irrigation but the inclusion of sources of hydro-electricity must be assured.

Water-Power Development in New York State.—The proceeds of new bond and stock issues amounting to more than $2,500,000 are to be used by the Northern Utilities, Inc., of Watertown, N. Y., for the construction of a hydro-electric plant at Flat Rock, on the Oswegatchie River, at an estimated cost of $730,182, and for extensions to the existing electric development of the company at Brown's Falls, on the Oswegatchie, in St. Lawrence County, at an estimated cost of $1,782,726.

Great Northern Hydro-Electric Plant to Double Output.—A fuel-oil plant will, it is announced, be constructed at once at the Chelan River hydro-electric development by the Great Northern Power Company which will enable that company to double the present output from this point. The new plant is to furnish the additional electrical energy needed during the two years required to build at a cost of $1,500,000 the great generating plant designed to furnish energy for the contemplated electrification of the Great Northern lines.

Electricity Figures in Far-Reaching Scheme of Development for South Louisiana.—A comprehensive scheme of development in south Louisiana by means of gravity canals is described by a correspondent of the *Manufacturers' Record*, who says that the plan, which has been advocated for years by Welman Bradford, a Louisiana engineer, would involve the expenditure of $28,000,000 and that its inauguration is now waiting only on the passage of a resolution by Congress declaring Bayou Cocodrie a non-navigable stream. This bayou will form part of the system, which would drain waste lands and irrigate a great area of rice fields. The plans include the construction of hydro-electric plants along the canal route. Four sites have been selected, from which, according to the promoter, enough energy to furnish light and power to every city and town in south Louisiana, including New Orleans, could be obtained. It is also planned to build a trolley line along the entire canal route to furnish power to electrically propelled barges. Modern highways are another contemplated feature. The system, as designed, will be in the shape of a giant fan, with the handle starting from Red River above Natchitoches and spreading out radially.

A Medical Treatment for Electric Shock.—In contrast with the prone-pressure method of resuscitation from electric shock and the vigorous physical handling of the victim which has been found an efficient aid in restoring consciousness is the pharmaceutical treatment recommended, according to an English contemporary, by Dr. D'Halluin, presumably a European physician of note, who finds that an electric current kills in two ways—by paralyzing the respiratory center in the medulla and by causing the heart to fibrillate and then to stop. Dr. D'Halluin has found injections of a 5 per cent solution of potassium chloride into the jugular vein very efficacious for stopping fibrillation of the heart. He believes in artificial respiration, but says that "rhythmical tongue traction" may cause cardiac and respiratory inhibition. If the heart is beating, he says, artificial respiration and motion of the limbs are the best method, and he announces as the result of experiments that even where the heart had stopped heart massage was effective in 22 per cent of the cases. Failure ensues if fibrillation has taken place.

Research Graduate Assistantships.—To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois, Urbana, Ill., maintains fourteen research graduate assistantships in the engineering experiment station. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics or applied chemistry. An appointment to the position of research graduate assistant is made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the degree of master of science will be conferred. Not more than half of the time of a research graduate assistant is required in connection with the work to which he is assigned. This year there will be thirteen vacancies, and applications for appointment should be sent to C. R. Richards, director, not later than March 1.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Pittsburgh Section, American Electrochemical Society.—Colin G. Fink, manager of the laboratories of the Chile Exploration Company, New York, was announced to address this section last night, Jan. 28, on "Modern Developments in Metallurgical Research."

Joint Engineering Meeting at Boston.—The third and last of the series of joint meetings at Boston of the electrical, mechanical and civil engineers to discuss water-power problems will be held on Tuesday, Feb. 8, under the auspices of the Boston Section of the American Society of Mechanical Engineers. The speaker will be W. M. White, chief engineer hydraulic department Allis-Chalmers Maufacturing Company, on the topic "Recent Waterwheel Developments and Settings."

St. Louis Electrical Board of Trade.—A new method in the arrangement of a program for the coming year has been announced by the general entertainment committee of the St. Louis Electrical Board of Trade. Instead of making up the complete program for the year itself, the general committee has designated a number of sub-committees to handle the work, each committe representing a certain branch of the industry. Thus the manufacturers sub-committee will follow up the subject of standardization, the utilities sub-committee will arrange for talks on questions involving public utilities, and the other sub-committees will arrange programs dealing with their particular problems. Sub-committees were appointed to represent manufacturers, utilities, jobbers, dealer-contractors, engineers and manufacturers' agents. The general committee will conduct occasional meetings to be devoted to subjects of immediate interest and value to the industry as a whole.

Coming Meetings of Electrical and Other Technical Societies

Institute of Radio Engineers — New York Feb. 2.

Association of Iron and Steel Electrical Engineers—Philadelphia Section, Feb. 5; Cleveland Section, Feb. 14.

Florida Engineering Society — Lakeland, Fla., Feb. 7 and 8.

American Institute of Electrical Engineers —Portland (Ore.) Section, Feb. 7; Chicago Section, Feb. 28.

A. I. E. E., A. S. M. E. and A. S. C. E. (joint meeting)—Boston, Feb. 8.

New Mexico Electrical Association—Albuquerque, Feb. 14 and 15.

American Institute of Mining and Metallurgical Engineers — New York, Feb. 14-17.

A. I. E. E. — Midwinter convention, New York, Feb. 16-18. (For program see issue of Jan. 8, page 111.)

American Physical Society — New York, Feb. 25 and 26.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Eighteen Months' Operation at Loss Sufficient to Entitle Company to Relief.—In passing upon exceptions taken to the report of the special master in Kings County [Gas] Lighting Company vs. Nixon, the United States District Court for the Southern District of New York has asserted that even if a period of eighteen months when conditions were abnormal was insufficient experience on which to fix a reasonable rate, it is sufficient to show that the existing rate was confiscatory where the plant was operated at a loss during the entire period. (268 Fed. 143.)*

Responsibility for Injury from Guy Wire Alongside Public Road.—In Tanner vs. Athens Electric Light & Power Company, a suit brought for damages because of injuries received by a horseman driving cattle along a public road who came into contact with a guy wire of the company said to be in immediate proximity to the road, the Court of Civil Appeals of Texas found that if the wire was so situated that the company might have foreseen by the exercise of reasonable care that injury might result therefrom unless the wire were shielded, the company was negligent. The horseman was not confined to the traveled part of the road, which had no sidewalks, and the distance of the guy wire from the road which would free the company from responsibility and also the question of the company's negligence were for the jury. (225 S. W. 421.)

Order of Public Service Commission on Its Own Motion Void and Open to Collateral Attack.—According to a decision of the New York Supreme Court, Appellate Division, in People vs. Monarch the Public Service Commissions law of New York, although authorizing investigations and inquiries by the commission on its own motion, does not authorize the making of any order, and an order directing a railway company to collect only a single fare between certain points was without jurisdiction and might be attacked collaterally in a prosecution for ejecting a passenger refusing to pay an additional fare. The commission's jurisdiction over the public utilities coming under its regulatory powers, the court holds, applies only when the question is one of reasonableness of fares and service, and not when the question is one of law as to the fares chargeable by a carrier under its franchise. (185 N. Y. S. 5.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System

Cause of Fright of Horse Ascribed to Electric Shock Question for Jury.—Ordering a new trial in Monfort vs. Indianapolis & Cincinnati Traction Company, where the trial judge had directed a verdict for the defendant, the Supreme Court of Indiana declared that the questions of negligence and of the cause of the fright of a horse alleged to be due to electricity escaping from a rail at a highway crossing on the company's interurban railway were matters for submission to the jury. (128 N. E. 842.)

"Casual" Employee May Not Recover Under Nebraska Workmen's Compensation Act.—In finding for an industrial company sued by a workman injured in unloading coal (Bridges vs. Lincoln Feed & Fuel Company), the Supreme Court of Nebraska pointed out that by the terms of the workmen's compensation act of that state its benefits did not extend to "casual" workmen, the word being defined in the act to mean "occasional, coming at certain times without regularity, in distinction from stated or regular." A laborer not steadily employed but engaged by the job and who worked at intervals for other companies as well as for the defendant was a "casual" employee. (179 N. W. 1020.)

State Versus Federal Control Where Nature of Action Is Equitable.—From the decision of the Supreme Court of North Carolina sustaining the lower court in the issuance of a mandamus to compel the Southern Power Company to continue to furnish electricity to the North Carolina Public Service Company at Greensboro and High Point (see ELECTRICAL WORLD, Dec. 25, page 1282) a dissenting opinion was filed by two judges which contains an exhaustive discussion of jurisdiction in such suits as between the state and the federal courts. This dissenting opinion, favoring the transfer of the case to a United States court, says: "The real nature of the action is equitable—*i.e.*, one for a mandatory injunction instead of a proceeding for a writ of mandamus, as the distinction is recognized at common law, in the light of which distinction the terms of the acts of Congress conferring jurisdiction on the federal courts must be construed. Then, even conceding that the state court might, under the code of practice prevailing in the state, award the plaintiff the relief sought in this action in a proceeding which the state court would permit to be brought and described as a proceeding for a writ of mandamus, the federal court cannot, upon this ground or for this reason, be deprived of its jurisdiction of the action if jurisdiction in fact exists under the acts of Congress. . . . Mandamus will not lie unless there has been an actual default on the part of the defendant, nor will it ever be granted in anticipation of an omission of duty. This proposition of law is based upon a fundamental distinction between law and equity jurisprudence and is universally recognized and applied." (104 S. E. 872.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Conditions Governing Permission of Competition in Inadequately Served Territory.—In granting a certificate of convenience and necessity to an electric company to operate in a city already but inadequately served by another company the Missouri Public Service Commission made it a condition that the applicant should file a written offer with the commission to purchase the electric plant of the existing company at a price to be fixed by the commission.

Powers of North Dakota Commission.—The sale of an electric plant and property in North Dakota without an order from the Board of Railroad Commissioners is void, according to a recent decision of the board, and the vendors are guilty of violating the law. When a milling company, which is inherently private in character, desires to enter the field of furnishing a public service it then in so far as the public service is concerned comes within the jurisdiction of the board.

Valuation Practice of North Dakota Commission.—The fair present value of the actual physical property used and useful in producing utility service, and not the amount of the investment, is the basis upon which the North Dakota Board of Railroad Commissioners calculates rate of return. In valuing the property of an electric company the commission made an allowance of 12 per cent for overhead expenses, including engineering, superintendence, interest during construction, taxes during construction, fire and liability insurance, small omissions of inventory, contingencies and so forth. It excluded from consideration the value of a service extension no part of the cost of which had been paid by the utility.

Loose Accounting Methods Condemned.—In passing upon an application from the Cottage Grove Electric Company for increased rates, the Public Service Commission of Oregon condemned emphatically the incompleteness of the data and records furnished by the company and charged that the utility had been "grossly negligent and delinquent in its duty in the making out and filing of its annual reports to this commission and in its accounting system," declaring that the record was insufficient to warrant the commission in making an order fixing rates for lighting and power. It found, however, as the result of its valuation proceedings, that the value of the plant for rate-making purposes is $68,067, and this valuation has been adopted as a basis for rate making.

Men of the Industry

Changes in Personnel, Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

J. P. Jollyman has been promoted to the position of chief of the division of hydro-electric and transmission engineering of the Pacific Gas & Electric Company from that of engineer of electrical construction. He will have charge of all the engineering work relating to hydro-electric stations, substations and communication and transmission lines. Mr. Jollyman was born in California, Oct. 29, 1879, and after graduation from Stanford University in 1903 was employed by the California Gas & Electric Corporation as electrician. From 1909 to 1911 he was employed by the Great Western Power Company of California first as superintendent of the Big Bend station, being then promoted to the position of electrical engineer. He returned to the Pacific Gas & Electric Company as engineer of electrical construction. Mr. Jollyman has designed some of the most notable of the hydro-electric stations of the Pacific Gas & Electric Company and is considered to be one of the leading electrical engineers on the Pacific Coast. He has been a frequent contributor to the technical press and has taken a large part in the affairs of electrical associations and societies. At present he is chairman of the San Francisco Section of the American Institute of Electrical Engineers.



J. P. JOLLYMAN

H. C. Deffenbaugh, who left the Empire State Gas and Electric Association ten months ago to take up important work in connection with a survey of the water-power possibilities of New York State under the direction of Col. William Barclay Parsons, has returned to the association to take up his duties as engineer and assistant to the secretary. Part of Mr. Deffenbaugh's duties will be to assist gas and electric companies of New York State in relation to cost analyses, preparation of rates and schedules.

John Hunter, who was chief engineer of the Union Electric Light & Power Company, St. Louis, from 1905 to 1917, will return to St. Louis about Feb. 1 to become chief engineer of the Heine Safety Boiler Company. Mr. Hunter is well known in engineering circles in St. Louis, having had charge of designing, constructing and operating all of the generating stations of the Union Electric Company. He was closely associated with Hugh L. Cooper, of the Mississippi River Power Company, in building the hydro-electric plant of that company at Keokuk, Iowa. Mr. Hunter's earlier years were spent at sea as an engineer officer, and during the Spanish-American War he was chief engineer of the St. Paul under Captain Sigsbee. After the war he served as chief engineer officer on the same vessel until he went to St. Louis in 1905. In 1917 he was called East by the government to assist in shipbuilding and was first detailed as government representative in charge of the Submarine Boat Company and afterward transferred to the Standard Shipbuilding Corporation at Shooter's Island, New York. While in charge there he has built twenty-five cargo vessels, two mine sweepers and two passenger vessels, and four oil tankers under his supervision are nearing completion.



JOHN HUNTER

Frank Conrad, consulting engineer of the Westinghouse Electric & Manufacturing Company, who has been appointed assistant chief engineer, has been connected with that company for almost thirty years. One of the most important early developments in which he was engaged was the design of alternating-current measuring instruments. Here his shop experience on construction of the Shallenberger ampere-hour meters and his experience with arc-lamp mechanisms served him well. About this time the early work of Shallenberger on induction instruments was in progress. A feeding mechanism requirement for an alternating-current arc lamp suggested to Mr. Conrad the idea of using an "induction-type" or eddy-current-operated disk for an arc-lamp feed. This led directly to the original conception of the disk-type induction-indicating alternating-current voltmeters and ammeters and the original "round-type" Westinghouse watt-hour meter, which he designed and brought out in 1897. During the war Mr. Conrad devoted much time to the development of radio apparatus for the Navy and War Departments. The airplane radio apparatus which he developed was extensively used in France.



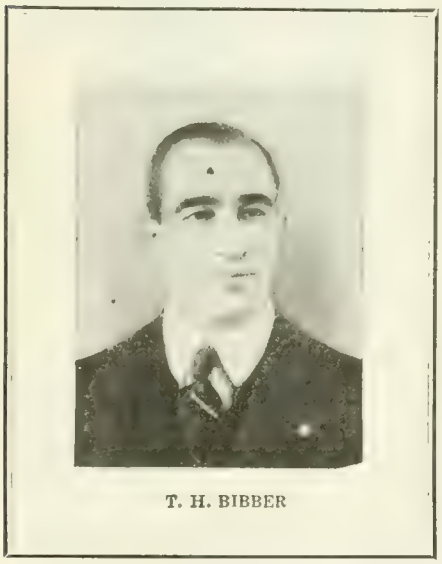
FRANK CONRAD

P. B. Sawyer, vice-president of the Lehigh Power Securities Corporation, which controls the Lehigh Valley Transit Company, has been elected president of the Lehigh Valley Transit Company, Allentown, Pa., to succeed Harrison R. Fehr. Mr. Sawyer has been a vice-president and director of the Lehigh Valley Transit Company and its subsidiaries for three years. He will continue to reside in New York.

Dr. W. R. Whitney, director of the research laboratory of the General Electric Company, Schenectady, N. Y., was awarded the Perkin medal on Jan. 14 by the American Section of the Society of Chemical Industry. This medal was given in recognition of the many inventions through which Dr. Whitney has applied chemistry to the service of mankind.

Robert E. Horton, Harry Barker and Robert C. Wheeler have become associated, under the firm name of Horton, Barker & Wheeler, to continue the consulting engineering practices formerly carried on under the names of Robert E. Horton, consulting hydraulic engineer, Albany, N. Y., and Harry Barker and Robert C. Wheeler, engineers, New York City. The new firm will have its headquarters in Albany, with offices in New York and Harrisburg, Pa., and an engineering laboratory at Voorheesville, N. Y. It will specialize in power development and transmission, water supply, sewerage and sewage disposal, public utility rates and valuation.

T. H. Bibber has severed his connection with the Duplex Lighting Works of the General Electric Company to become sales engineer for the Triangle Conduit Company, Inc., Brooklyn, N. Y.,



T. H. BIBBER

in charge of the merchandising of the wiring specialties made by that company.

Harry W. Osgood has been appointed plant engineer of the Fore River works of the Bethlehem (Pa.) Shipbuilding Corporation, Ltd., at Quincy, Mass., in accordance with the establishment of a policy of decentralizing the engineering of the various plants of the company. Mr. Osgood was formerly electrical engineer of the company, with headquarters at Bethlehem. He was graduated in the electrical engineering course from the Worcester (Mass.) Polytechnic Institute in 1905 and for about a year was employed by the J. G. White Engineering Corporation, New York. He then joined the engineering staff of Stone & Webster, with headquarters at Boston, and remained there until September, 1917, when he was appointed electrical engineer of the American International Shipbuilding Corporation, with headquarters at Hog Island shipyard, having charge of the electrical work at this establishment. In the fall of 1919 Mr. Osgood became connected with the Bethlehem company.

C. H. Minor, general manager of the China Electric Company, one of the Western Electric's foreign subsidiaries, has been decorated by the President of the Republic of China with the Chia-ke (Excellent Crop) decoration of the fourth class. The award was issued by Kuo Isu-Yun, chief of the bureau of appointments. It was given in recognition of the assistance which the China Electric Company has been able to render to the government of the Chinese Republic.

P. T. Carey, engineer of the China Electric Company, who was presented with an honorary medal by the Chinese government last spring for his co-operation with the bureau of communications of the republic, has been further honored by being appointed honorary technical adviser to the Chinese government's electrical testing bureau. The testing bureau is in its infancy, but it has prepared elaborate plans for the future.

Daniel M. Luehrs has established the Daniel M. Luehrs Company, with offices and laboratories at Cleveland, Ohio. A specialty will be made of industrial engineering in all its phases. The company's laboratories will be in charge of C. A. Breed, a metallurgist formerly with the General Electric Company. H. W. Hough, formerly chief electrical engineer of the Cleveland Electric Illuminating Company, will have charge of the company's electrical work.

J. H. Libbey, until recently electrical engineer Eastern Massachusetts Street Railway, has joined the organization of H. M. Haven & Wm. W. Crosby, engineers and architects, with offices at 40 Court Street, Boston. Mr. Libbey is widely known in electrical circles in New England. He was graduated in mechanical engineering in 1898 from the Lawrence Scientific School of Harvard University, and for a time was employed by the Bethlehem Steel Company, Bethlehem, Pa., in connection with high-speed tool-steel development work under F. W. Taylor. For four years he was in the engineering organization of Westinghouse, Church, Kerr & Company at New York and Boston, and his early work included power-plant development and construction on the Boston & Northern Street Railway. During the period of design and construction of the electrified zone of the New York, New Haven & Hartford Railroad Mr. Libbey was assistant electrical engineer under W. S. Murray, and he resigned from this post to join the engineering organization of Stone & Webster at Boston. He continued with this firm for seven years, his work embracing a variety of engineering problems, including central-station and power-plant work, transmission and appraisals. For the last seven years he has been electrical engineer for the Bay State, now the Eastern Massachusetts, system. He had entire charge of the power supply on that property following the resignation of C. F. Bancroft.

H. J. Moyer, who has represented the Yarnall-Waring Company, maker of power-plant devices, and the Nelson Valve Company in the Chicago territory for several years, has severed his connection with the Nelson Valve Company and will represent the Yarnall-Waring Company exclusively in that territory as district manager.

H. L. Ball has been appointed sales manager of the Requa Electrical Supply Company, Rochester, N. Y. For the last three years Mr. Ball has been sales manager of the Rochester (N. Y.) Electric Supply Company. Previous to that he was with the Westinghouse Electric & Manufacturing Company in a sales and engineering capacity.

B. S. Manuel, heretofore manager of the appliance section of the supply department of the Westinghouse Electric & Manufacturing Company at Mansfield, Ohio, has resigned to become gen-



B. S. MANUEL

eral manager of the Electric Railway & Manufacturers' Supply Company, electrical jobber in San Francisco.

David Moore, commercial agent of the El Paso (Tex.) Electric Company, has been transferred to Galveston, Tex., as manager of the sales department of the Galveston Electric Company.

Hugh A. Brown has been appointed sales manager of the Electro Dynamic Company, Bayonne, N. J., and will have charge of the marketing of its motors and generators. Mr. Brown has had an extended experience in sales work, having been connected with the Crocker-Wheeler Company and the Burke Electric Company in the marketing of their products.

J. L. McQuarrie, assistant chief engineer of the laboratories of the Western Electric Company at 463 West Street, New York City, who has just returned from the Orient, was decorated by the Emperor of Japan before he sailed. He also received the order of the Rising Sun, fifth class, in recognition of his services in the telephone engineering field and the aid he has rendered in the development of Japanese transmission progress.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Leniency in Collections May Have Its Advantages

ALTHOUGH the bottom has apparently dropped out of things and sales for the most part are being made from accumulated stocks, American business and industry are solvent. True, failures are on the increase—have been so as a matter of fact ever since the beginning of 1920—still they are by no means commensurate with the depressed condition of business. Business, in other words, is better able to absorb a loss than ever before.

Still, that is no indication that the surplus in the safe is limitless. It is probably true that, except for the inevitable few, the business of the country is strong enough to weather a period of dullness. There is some doubt, however, that industry can continue to keep its head above water and still pay all its debts promptly.

Failures are increasing. According to Dun's they were $30,000,000 in the first quarter of 1920, $57,000,000 in the second quarter, $80,000,000 in the third quarter, and $129,000,000 in the last quarter. During the month of January the reports have indicated that there is no lessening of the upward trend.

This was to be expected, but the curve can be greatly flattened, business strengthened, money made easier and new business stimulated if only the large producers will not be too pressing at this time in their demands for settlement.

Standardization of Washing-Machine Motors

IT IS utterly impossible for all washing-machine motors made by different manufacturers to have uniform physical characteristics even for the same horsepower ratings, but about 60 per cent of the delays in getting out any specific shipment of washing-machine motors could be eliminated if the shaft extension were adopted of a standard size, length and flat.

This conclusion was arrived at by a committee of the American Washing Machine Manufacturers' Association working in conjunction with a committee from the Electric Power Club. The recommended dimensions of the standard shaft extension are ½-in. diameter, 1.5-in. length and a flat running the entire length of the extension. The committee of the Power Club also recommends that any motor manufacturers contemplating a change in design should get in touch through the American Washing Machine Manufacturers' Association committee with the Power Club committee, which will gladly advise with them to the end that eventually standard motors may be produced.

However, the standard base contemplated for the largest and smallest quarter-horsepower washing-machine motors proved impracticable for mechanical reasons. It also had the additional objection that in order to accommodate the largest motor the shaft height would have to be 3⅝ in., which would mean that about 85 per cent of the motor manufacturers would have to change the method of their motor mounting.

Comparative British and United States Exports for Nine Months

AN interesting comparison is given in the accompanying table made up from figures published by *Beama* giving exports of electrical materials from the United Kingdom during the first nine months of 1920 and from returns of the Bureau of Foreign and Domestic Commerce giving the nine months' figures on exports from the United States of electrical articles similar to those exported by the United Kingdom and to the same countries.

The exports from the United Kingdom are given in dollars, based on the equivalent of $3.50 for each pound sterling.

One of the outstanding features in British trade appears in the exports to India. This country has taken more batteries, generators, motors, switchboards and control than any of the other countries listed, and the countries listed are those which provide the most important outlets for electrical goods. India was second in meters and measuring instruments and third in receipt of static transformers.

It would be expected that Canada would use the United States as a market rather than Great Britain. Australian figures show her receipts from the States to be bigger than from Great Britain, and New Zealand the same, while British South Africa apparently is about evenly divided in its patronage. The European countries, Belgium, France, Spain, Italy and Norway, are buying more from the United States than they are buying from their nearer manufacturer, it seems.

COMPARATIVE EXPORTS OF ELECTRICAL APPARATUS FROM THE UNITED STATES AND GREAT BRITAIN FOR FIRST NINE MONTHS OF 1920

	Batteries		Dynamos and Generators		Meters and Measuring Instruments		Motors		Transformers (Static)		Rheostats, Controllers, Switches, Accessories,	Switchboards and Control
	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Gt. Britain	U. S.	Great Britain
Br. So. Africa	$197,591	$80,800	$35,798	$66,700	$27,009	$70,000	$175,518	$129,400	$20,811	$18,600	$42,450	$25,600
Argentina	296,881	46,500	42,862	15,800	47,117	25,800	182,431	39,400	88,317	5,150	24,728	45,200
Australia	228,213	81,400	68,398	66,200	54,853	83,000	435,563	271,000	143,944	51,000	176,844	59,750
Belgium	13,245	17,000	10,590	48,700	23,689	44,000	455,170	173,000	592,617	92,800	48,018	16,900
Brazil	138,636	34,000	112,387	38,500	84,587	29,000	282,958	28,200	140,314	15,500	370,928	7,620
Canada	1,486,175	10,950	415,630	14,600	483,577	12,900	1,776,098	27,000	822,308	.....	94,961	3,600
Chile	41,511	2,640	40,028	8,780	14,177	11,300	89,480	26,950	22,087	.....	56,816	2,240
China	82,217	15,540	633,565	30,200	113,417	71,600	402,242	55,200	154,646	.....	207,044	41,800
France	108,188	7,630	546,397	33,300	43,360	53,500	486,650	163,800	72,852	11,050	27,670	14,500
Hongkong	17,564	35,000	93,079	4,180	11,343	19,800	29,587	147,000	41,602	4,280	14,761	7,950
British India	189,413	318,000	352,302	205,000	14,685	156,400	398,966	686,000	98,693	32,800	270,913	242,000
Italy	4,586	5,920	180,426	12,640	79,134	170,000	302,582	95,000	48,126	.....	26,056	8,100
Japan	129,143	8,080	956,673	12,900	325,177	63,500	935,731	32,600	195,655	.....	391,195	4,160
New Zealand	127,254	28,300	27,493	16,550	34,256	47,500	183,118	63,200	78,354	6,380	47,844	6,380
Norway	72,121	21,850	20,356	12,700	9,661	7,860	41,683	18,800	115,279	25,700	64,795	1,150
Spain	156,333	17,300	59,097	45,500	39,678	42,500	369,155	104,200	833,516	470	196,380	7,880
United States	.....	22,300	.....	15,360	.....	9,700	.....	1,550	.....	.....	.....	450
Great Britain	264,036	.....	90,035	.....	156,185	.....	722,346	.....	108,970	.....	13,941	.....

Station Arrester Deliveries Under Two Months

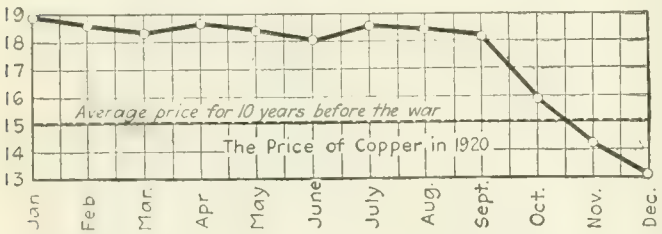
WITH shipments of the station type of lighting arresters running up around four, six and even eight weeks, depending upon the type of arrester and on the manufacturer, it does not seem to be too early to consider the advisability of placing orders for delivery and installation before the spring storms may be expected to set in. Parts for repair purposes and for replacements require virtually the same length of time.

Buying has not been heavy for this equipment, but already many stations have made known their needs and are awaiting shipment. Other stations are still behind and run a chance of having their equipment held up by longer deliveries if they put off their ordering until the factories begin to fill up their production capacity. There is reported a shortage in high-voltage porcelain for use with lightning arresters of the station type, and this is not surprising when the long deliveries of regular high-tension insulators are considered.

Copper Price Below Ten Years' Pre-War Average

FROM the accompanying curve, prepared from figures compiled by the *Engineering and Mining Journal*, there is shown very clearly the course taken by copper during the year just passed. These figures give the average prices for each month of electrolytic copper f.o.b. refinery. The present spot market is quite inactive, and producers are holding at a nominal price of 12.75 cents.

On all sides is heard the criticism that prices of materials are far above pre-war prices. Copper is now quoted well below the average of the ten years before the war, which was approximately 15 cents, delivered. Indications seem to point to a slowly advancing price. Improvements in foreign exchange are expected to assist buying greatly. Manufacturers who expect to build up rapidly a future trade by lower costs must, it would appear, insure themselves against higher cost of raw materials by taking advantage of rock-bottom prices. There are many indications to encourage the belief that copper is now lower than it will be at any other time, certainly during the coming year.



Long Shipments in Porcelain Predicted

THE low-voltage porcelain market has been one of the longest to hold in a stable position, and even now, as far as can be learned, has shown only one instance of a price reduction, and that is a 5 per cent drop in a line of special porcelain. Buying of knobs, tubes and cleats is rather quiet, and the market for special porcelain for parts of other electrical apparatus is in the same state. At the same time, there is an endeavor among certain porcelain manufacturers to get in enough special porcelain business to tide over until the standard lines open up again.

In some quarters there is a certain amount of standard porcelain being made up for stock against the day when the building industry shall again make its demands for wiring materials, and quick shipments will prove of much value. In view of the building which porcelain makers see in the offing, their advice to the trade is to get in requisitions sufficiently far in advance to permit of manufacturing before the need actually becomes acute. Failure to do this, it is pointed out, will certainly result in long and unsatisfactory deliveries once the urgency is apparent.

From some quarters comes the report of a shortage of certain of the raw materials, even to the extent that the mills are now unable to run full time under present orders. A few back orders are still to be filled. No chance of a price recession is seen in the near future, according to the manufacturers. While from some quarters knobs, tubes and cleats can be shipped from stock in not too great amounts, in other quarters tubes are taking from four to six weeks to ship. Knobs and cleats are generally in fair stock. Low-voltage insulators can be had on shipments ranging around thirty to forty days.

Lamp Companies Operating on a Four-Day-Week Basis

IN LINE with what is reported to be a general stock-reducing policy, the mazda lamp companies are operating on a basis of four days a week. Under present conditions of business the companies feel that only as light stocks as can be carried safely should be accumulated, and in order to eliminate as far as possible the necessity for discharging workers, the shorter week has been adopted. The manufacturers expect it to be only temporary, however, possibly only three weeks or so. Orders in general have fallen off, although December has been reported a heavy month. All new building operations at the Fort Wayne works of the Edison Lamp Works have been discontinued temporarily.

The Metal Market Situation

FOLLOWING the firmer tone which developed in the copper market over the first two or three weeks of the year, a reaction has recently set in. Buying interest has now almost entirely ceased and a weaker tone to prices is evident. Export orders, which were recently being booked at a substantial rate, have fallen off too. Producers are now offering electrolytic copper at 12.75 cents delivered for prompt shipment and 13 cents over the first quarter. The coming sale of 48,000,000 lb. of surplus brass cartridge cases by the government is felt to have a depressing effect upon buyers. The outside market is quiet with but little copper offered, as producers are now the cheapest sellers. Standard spot copper under a weak market declined more than £2 10s. at London, to £67 15s. during the fortnight. This is the lowest price touched in London since 1915.

The market for lead is quiet at present, prices remaining unchanged. Little buying interest in zinc is evident, the market being dull and easy in tone with a fractional decline in the price of spot metal.

The scrap market continues lifeless. Some of the dealers are buying metals not because there is any great demand for scraps, but probably to hold for a rise in price, realizing the bottom prices at which most metals now stand. Some of the smaller brass foundries are buying here and there, but the brass industry is quiet. One of the brass companies has just decided to pass its dividend on common stock until manufacturing and general business conditions are more settled in the brass industry.

NEW YORK METAL MARKET PRICES

	Jan 18, 1921	Jan 25 1921
Copper	£ s d	£ s d
London, standard spot	70 7 6	67 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.75	13.50
Electrolytic	13 00 13 12½	12 75
Casting	12 75	12 50
Wire base	15 75	15.75
Lead, trust price	4 75	4 75
Antimony	5 10	5 37½
Nickel, ingot	43 00	43 00
Sheet zinc, f o b smelter	11 50	11 50
Zinc, spot	5 95	5.76 5.80
Tin	35 00	32 75
Aluminum, 98 to 99 per cent	28 30	28 30

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11 00 11 25	11 00-11 25
Brass, heavy	6 00 6 50	6 00 - 6 50
Brass, light	4 00 - 4 50	4 00 - 4 50
Lead, heavy	3 75 4 00	3 75- 4 00
Zinc, old scrap	3 00 3.25	3 00- 3 25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

FROM one and another part of the country come the faintest signs that the times are beginning to turn—not that any great increase of business is reported, but the traces of better business are apparent. This is still the dull season in other places, and it is rather expected to be so.

Stocks as a whole are sufficient for all present demands and in many instances are a little too high for comfort. Still, there is little evidence of real slashing in the general wiring line. Price recessions on the part of manufacturers have about stopped for the moment.

Credit conditions remain as before, but with constant application collections are coming in in no less degree. While many automotive plants have begun operation again, some steel plants and others in the electrical industry have curtailed a bit. There is more labor in the West and Middle West than there is work to do. Car loadings are decreasing, and railroad yards and shops are releasing men.

NEW YORK

Here and there appears a glimmer of brighter times in the prevailing gloom of the market, but trade as a whole is naturally, and perhaps rightfully, loath to put too much trust in these "signs." This week, for instance, one of the largest jobbing houses in the country reports a general slight improvement in sales. Another large house reports a good volume of business. Elsewhere, however, trade for the week continues on the same quiet plane as heretofore.

Prices, temporarily at least, are somewhat steadier in so far as manufacturers are concerned, and no further reductions are reported this week. The price situation, however, is the bone of much contention among jobbers and retailers. Competition is of the very keenest sort, and price cutting is rather freely resorted to by many houses. In an attempt to help stabilize prices several appliance and washing-machine manufacturers are reported to have guaranteed prices for periods varying from three to five months.

Stocks on many of the staple lines are, on the whole, larger than jobbers would like to see, despite the fact that virtually no goods have been on order for some time. Collections have not changed materially and still remain unfavorable.

Heaters.—Recent cold weather has helped move supplies to some extent, but the general demand is not very good. The price of the Majestic heater was dropped from $12.50 to $12, effective Dec. 22. Price cuts are being freely made by retailers as stocks are quite large.

Conduit.—Demand is light and the supply plentiful. In 2,500-ft. quantities the price of ½-in. black ranges from $70 to $79 and the price of 1-in. black from $137 to $155 per 1,000 ft.

Flexible Armored Conductor.—Stocks are more than adequate for the light demand. Competition among sellers is keen, at prices ranging from $61 to $66 per 1,000 ft. for No. 14 two-wire, double-strip.

Rubber-Covered Wire.—Supplies are held down to a fairly normal level under the light buying. Prices are nominal as quotations are more or less readily shaded. In 10,000-ft. lots, jobbers quote No. 14 from $7.95 to $9 per 1,000 ft.

Tape.—A plentiful supply is on hand, but demand is weak. In 100-lb lots friction tape is quoted from 45 to 54 cents and rubber from 41 to 45 cents per pound, depending upon the grade and manufacturer.

Lamp Cord.—A few jobbers report fair sales in small lots, but general buying is weak and stocks are large. The price of No. 18 twisted in 500-ft. quantities ranges from $20 to $26 per 1,000 ft.

Vacuum Cleaners.—One of the large department stores last week offered a sale of 500 cleaners of a well-known make, which lists for $52, at $27.75 each, a reduction of about 47 per cent.

Lamps.—Although curtailed operation of some manufacturers' plants would seem to indicate a lessening demand, jobbers in this territory report that sales continue good with no let-up in sight. The supply is favorable.

CHICAGO

Several things happened during the past week to accentuate and prolong the uncertainty which is felt in Chicago in regard to the immediate future of business. The indictment of many union heads, contractors and woodworking-mill owners under the Sherman act for restraint of trade, alleged to have added many millions to the cost of building in Chicago in the past six years, is the most important one.

No improvement is noted in the volume of building permits issued. Eliminating the three-million-dollar permit mentioned last week, the average for the past fifteen weeks has been $650,000, compared with an average of $1,450,000 a week for the same period in the last ten years. Permits now being issued are confined almost exclusively to alterations, repairs or small garages and other structures of that general kind. The universal sentiment expressed among prospective builders is an intention to wait and see what the next few weeks will bring forth in the matter of prices and labor costs. A conference of building-material men held here this week at the call of the lumber interests passed a resolution calling for a general reduction of building costs.

The announcement on the part of the Pennsylvania, Baltimore & Ohio, Erie and Chicago & Alton railroads that sharp reductions are to be put into immediate effect in the number of men employed presages decreased buying power in the community. On the other hand, certain of the steel plants which had closed are resuming operations and nearly all of the Detroit automobile plants are resuming. Reductions in pay have been accepted by the employees of several large concerns in Chicago.

In the electrical market prices remain unchanged in general, and business is very quiet. Retailers, even though stocks are low, are refusing to stock up until convinced that prices will be no lower. Contractors, because of the building slump, have little to do and contractor-dealers are therefore having a quiet time. Inquiry in all lines is active, but it seems to be caused largely by curiosity or a desire to establish values in figuring inventories. Collections are hard and reported as ranging around sixty days.

Electric Signs.—Standard sign units are unchanged in price, but cost of installation is slightly reduced on account of the decrease in certain material prices. Many forms of business not formerly using this method of advertising are now installing electric signs, large and expensive installations being favored.

Fans. — Manufacturers and jobbers are starting after spring business. Slight advances over last year's lists are known to have been made effective in some cases. Reduced industrial demand will probably induce keen competition.

Heating Appliances.—Summer specialties are beginning to be pushed, and reductions are effective on several lines. The cuts are not uniform in the several lines, nor are all items in any one line similarly affected. In general prices are from 8 to 15 per cent below former quotation. Retailers' stocks are low, and good business, it is felt, should result from new prices and renewed sales effort.

Washing Machines.—Retailers report fairly steady trade, but a universal demand for guaranteed prices. A larger proportion of buyers are taking extended payment privileges than was formerly the case.

BOSTON

Electrical trade in Boston has been sharply cut down by a strike in the building industry which began last week upon the refusal of employers to grant higher wages than 90 cents per hour in leading trades. The unions recently refused to extend agreements on the basis of $1 per hour, and it is reported that great dissatisfaction exists among the rank and file with the present leadership. Owners, contractors and jobbers appear determined to stand together against any present increase in wages. Electrical contractors are marking time and buying virtually nothing except just immediately needed supplies and appliances. Conditions outside of Boston are improving here and there, notably in the Fall River textile mills and in Rhode Island. Buying by shoe manufacturers is reported better in electrical jobbing circles. Collections are poor and delayed payments are made up only by vigorous work. Local stocks are large in many lines, but fittings for flexible armored conduit are a little hard to get. Prices hold at about last week's levels.

Lamps.—Business has held up remarkably well. Stocks are in good shape and prices are steady outside the miniature field. A representative jobber figures that the recent advance in prices represents an increased cost of about 11 per cent on his consignments.

Motors.—Current necessities are being met without serious difficulty. The market for used motors is very dull.

Fuses.—Stocks are in excellent shape to meet increased business. Sales at list less 30 per cent are common in inclosed non-renewable types, but the demand is very quiet.

Flexible Armored Conductor.—The market is sluggish. No. 14 double-strip sells for $72 per 1,000 ft. in small quantities and for about $67 per 1,000 ft. in 5,000-ft. lots.

Ranges.—Deliveries are coming through from the factories for 1921 business, and a fine year's sales are anticipated when the season opens. Improved designs make price comparisons difficult, but no general change is seen in quotations.

Connectors.—Fittings for flexible armored conductor are a little hard to obtain and are selling for list less 10 per cent.

Lamp Cord.—Quiet demand exists, with fairly good stocks well distributed. No. 18 cotton-covered cord sells for $28 per 1,000 ft. in 1,000-ft. lots and for $32 in less-than-coil shipments. Silk cord brings $52 per 1,000 ft. in less-than-coil lots and $46 in 1,000-ft. consignments.

Rigid Conduit.—Better stocks exist than for some time. The demand is very light. Representative prices Monday were $85.15 per 1,000 ft. for ½-in. black pipe in less than 2,500-lb. lots and $89 for galvanized pipe of this size.

Wire.—Very little wire is moving except for mill and central-station use on a small scale. No change is noted in prices compared with last week.

Appliances.—Washers are moving well where the field has been intensively cultivated. Portable lamps, radiators and tableware are not in large demand at present. Cleaners are moving sluggishly, and immediate deliveries can be made from some factory stocks.

ATLANTA

There is to be noticed an increasing number of purchasers, but they are placing their orders for smaller quantities than has been their practice heretofore, the quantity being approximately 50 to 60 per cent below former purchases. Inquiries, however, are being received for material in considerable quantities from utilities, municipalities and industrial plants. Local contractors report their work holding up unusually well, the more progressive having about as much work as they can reasonably handle, and they have not reduced their working force. This is accounted for largely because of the considerable number of fires in this section recently. The strike of the building trades mentioned last week has virtually come to an end, and no construction of moment is being interfered with on this account. Several of the jobbing houses are laying their plans for spring activities and are planning sales campaigns for special lines of apparatus, such as washing machines and vacuum cleaners, etc.

While collections are reported as very slow on orders delivered in the late fall, jobbers state that they are meeting with very satisfactory success on collections for material sold and shipped within the past two weeks.

Switches and Outlet Boxes.—The last few days have seen a sudden spurt in this line, possibly accounted for by the price reduction of 15 per cent. Deliveries have not caught up in this line, and while some fair stocks accumulated during the slack period, they were insufficient to provide a full line of the more popular sizes.

Fans.—In face of the 10 to 15 per cent increase in the price of fans for the coming season, jobbers are estimating next season's business at 60 per cent of that of last year. Jobbers are placing orders for their requirements on this basis, but are, of course, making practically no sales to retailers as yet.

Lamps.—The completion of buildings started in the early fall has caused a well-sustained demand for all sizes of lamps, the 40, 60, 75 and 100-watt sizes being particularly in demand. No shortage is reported and stocks are in good condition, with shipments from four to five weeks.

Non-Metallic Flexible Conduit.—The heavy price reduction has served to create activity in this article. All firms report heavy stocks, with little or no goods moving. Prices, $\frac{3}{8}$-in., $2.50 per 100; ½-in., $2.75 per 100.

Porcelain.—Deliveries on porcelain, while showing some improvement, are still unsatisfactory, and as a result stocks are more or less broken up. While the demand is reported to be holding up fairly well, it is off from its prior volume, the greatest demand being for "Nail-it" knobs and $\frac{5}{16}$-in. by 3-in. tubes. Price on standard packages, $\frac{5}{16}$-in. by 3-in. tubes, $1.09 per 100; No. 1 "Nail-it" knobs, $3.10 per 100.

Wire.—Jobbers report more activity in rubber-covered wire than in almost any other line of material. This is accounted for in a measure by the opinion that prices have reached rock bottom and an advance is expected. Stocks and shipments are both reported as satisfactory, deliveries being on the basis of four to five weeks on carload lots. No. 14 rubber-covered is priced at $9 per 1,000 ft.

ST. LOUIS

Very little change is to be noted in conditions as compared with the previous week. Orders received daily have averaged about half the number received during December, orders billed being slightly above this, because there are a few items on which back orders still exist, such as linemen's tools and power transformers. There have been a large number of inquiries, however, a surprising number of them from industrial companies, showing that a good many manufacturers are planning to take advantage of the decreased production by repairing their plants and making alterations. Inquiries have been received also from public utilities, pointing to a good deal of work in that line in the spring.

Prices are firm on most items, the leaders in the jobbing and manufacturing ends of the industry not making any concessions. There have been a few instances of special price cuts by the smaller people, but this tendency is not general enough to have much effect on prices.

Collections have become a little better owing more to the hard work of the credit departments than to any specific improvement of business or money conditions. The average reported is closer to sixty days than it is to seventy, with one jobber reporting that his collections are down to about fifty days.

Rigid Conduit.—The drop in manufacturers' prices has been mirrored by a corresponding decrease in jobbers' quotations, the ½-in. black conduit being quoted at $77 per 1,000 ft. in 5,000-ft. lots, the ¾-in. black at $102, and the 1-in. black at $150. Jobbers' stocks are more complete than they have been for some time, and there is little difficulty in getting the smaller sizes and none at all in obtaining sizes over 1 in.

Wire.—A stagnant condition still obtains in the wire market and has extended its effect even more noticeably

than before to rubber-covered wire. Current quotations for rubber-covered are between $8.50 and $9 per 1,000 ft., with few sales. Weatherproof wire is quoted on a 22-cent base and bare wire on an 18-cent base, with demand for both inactive. Many manufacturers here have surplus stocks of magnet wire, and this is holding down jobbers' sales.

Knobs and Tubes. — Quotations have not changed and appear to be as firm as ever, though slight decreases have been noted elsewhere. Tubes measuring 3 in. x $\frac{5}{16}$ in. are quoted at $9.90 in lots of 1,000 while the 5½-in. new code rail knobs are priced at $32 per 1,000. Stocks are large and demand is below normal.

Heaters.—Both jobbers' and dealers' sales have been light during the past week under mild weather conditions. Stocks are good.

Linemen's Tools.—Jobbers are still unable to promise delivery of Klein's tools under six to eight months, but are fairly well supplied with tools of other makes.

Meters.—Stocks have bettered considerably and deliveries are much more prompt, being promised in from two to four weeks. Demand has lightened somewhat with the decrease in extension work. Central stations are still calling for them, but not so strongly as formerly. There is more of a demand for the direct-current than for the alternating-current-type.

Sockets.—Sockets are moving, though slowly. Jobbers' stocks are more than ample to take care of the demand.

SAN FRANCISCO

Building is slower because of the widespread rains, which at the same time are preparing the state for what appears to be an exceedingly prosperous year. Business in general is slower too, and all jobbers and dealers recognize that it is the duty of every working unit of the electrical industry to improve the morale of the purchasing public.

The building situation is desperate. This condition has revived building speculation, which, after a lapse of several months, is once again very prevalent.

Credits are being very cautiously extended. Banks and loan agencies seem to be tightening on the appliance business and are requiring gilt-edged references and guarantees both for blanket and individual contracts. Collections are fair because of vigorous following up.

Rubber-Covered Wire.—The recent drop averaged about 14 per cent. Local stocks are good. No. 14 single-braid solid is selling for $9.25 per 1,000 ft. in 5,000-ft. lots, with 50 cents advance per 1,000 ft. in coil lots.

Heating Appliances.—The Edison companies have distributed new price schedules canceling all former heating contracts. Heretofore Edison appliances have been marketed on the basis of yearly contracts with a maximum discount of 30 and 7½ per cent for $1,000 net per year f.o.b. Pacific Coast terminals. It was found that many small deliveries proved very expensive, and henceforward the dealer's discounts will depend upon the value of each individual order. The new prices range from 30 per cent for six assorted devices to 30 and 10 per cent for fifty assorted devices. These discounts have caused a great deal of comment among dealers, who claim that there are very few California dealers who can reach the maximum and who object to paying the shorter discount for small special orders. These discounts, however, are somewhat like those which have been used by the American Electric Heater Company for several years past east of the Rockies and for several months along the Pacific Coast, its maximum discount being 30 and 7½ per cent for $250 list assorted because its grading is by list value instead of by pieces. The trade has been circularized by the American Electric Heater Company to the effect that not only does it not expect any drop in heating-appliance prices, but furthermore that it does not foresee signs of any such drop in the near future, because its labor and material costs average 100 per cent over those prevailing in the pre-war period. Heating business in general has slowed up because of rather large and well-assorted stocks carried over by most dealers from the holiday season. There is a considerable demand for electric curling irons, of which three or four makes are being carried on the Coast.

SEATTLE—PORTLAND

Price recessions spoken of from other sections of the country have not been noticed to any extent in Seattle and the Puget Sound district. As a whole sales during January to date compare favorably with those of last January, and the optimistically inclined state that the outlook for spring business is promising. New construction during the past week showed an excellent increase over any previous week during the past two months.

Merchandising stores in Seattle as a whole are making no effort to replenish stocks of domestic appliances, apparently preferring to wait until period of price recession is ended. Some few are known to be carrying stocks considerably in excess of actual demand, because of light holiday buying.

Bids for contracts to furnish the city of Seattle with hydro-electric machinery, needed at the Skagit River municipal power project, estimated to cost about $1,000,000, will be opened by the Board of Public Works about Feb. 18. Mayor Caldwell suggested that because of dearth of construction equipment houses should be willing to accept bonds in payment for machinery, and urged that the successful bidder be permitted to buy an additional million dollars of bonds at par, intimating that certain prospective bidders had signified their willingness to accept bonds in payment.

Lumber and shingle mills and logging camps in the Puget Sound district are opening up, following the mid-winter shutdown, many starting on a three-day schedule. The non-employment situation is but slightly improved, however, there being between 7,000 and 10,000 idle men in Seattle alone. Portland manufacturers report stocks in better shape than a year ago. In some lines there is much larger stock than last January, and in others they are still short.

The general situation is much improved. They are catching up with back orders on nearly everything which is ordinarily carried in stock in this section. The principal shortage is in transformers and meters. The credit situation is very tight. Collections, however, continue to be reasonably good, running from 60 to 80 per cent each month.

SALT LAKE CITY—DENVER

Jobbers are now beginning to foresee a price recession on electrical merchandise that is quite general in its scope. Announcement of reductions on several lines have already been made, and factories have advised their jobbers of several other cuts that have not yet affected the jobbers or dealers.

It is believed that the inactivity in construction work, amounting almost to stagnation, will soon have passed the low mark. Building materials are being radically reduced in price, which is likely to be a stimulus to building when spring arrives. Non-employment is quite common and widespread throughout the mountain country, although there are few cases reported where large groups of laborers have been laid off. Nearly every business concern is continuing operation, but on a basis of a reduced labor force.

Bare Copper Wire.—The market on copper is still off and the price of wire has reached a low mark. The tendency downward is being reflected also in rubber-covered wire products.

Rigid Conduit.—A recent cut of 10 per cent has taken effect. The slump in building has reduced the demand almost to the vanishing point. Stocks are more than adequate.

Non-Metallic Flexible Conduit.—The factories have announced a reduction, but jobbers are trying to dispose of stocks on hand before applying the new price schedule. At best they will probably have to take a loss.

Motors.—Jobbers are well stocked. Dealers place small orders, and the demand is fairly steady. There are no price reductions reported.

Appliances.—One of the largest dealers of the Intermountain region, with a chain of several stores, reports that more appliances are being sold now than were sold during the corresponding period of a year ago.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Governor Harding Selected to Head Foreign Trade Body

The selection of W. P. G. Harding, governor of the Federal Reserve Board, as president of the recently formed Foreign Trade Financing Corporation was announced at a luncheon of the Merchants' Association of New York on Jan. 19. This hundred-million-dollar corporation, with $1,000,000,000 available through the issuance of debentures, is expected to complete its organization soon and to take a big step forward in reviving the foreign trade of this country on sound financial lines.

New England Jobbers Attempt to Stimulate Business

Under the caption "The Truth About the Prices," leading electrical supply jobbers in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island co-operated on Jan. 24 to publish a newspaper display advertisement emphasizing the stability of present prices for electrical household appliances. The plan sets forth the efforts of the electrical industry to keep prices as nearly normal as possible during the war period and pointed out the comparatively small advance attained in this field in comparison with the prices reached by many other commodities. Relatively small decreases in electrical appliance prices are to be looked for in the next year, it was stated, and there was featured the actual money-saving characteristics of certain kinds of equipment, irrespective of present prices and possible small future reductions. The largest electrical jobbing houses in the Northeast and not a few smaller establishments are represented in this co-operative activity to stimulate business.

Security Subscriptions by Employees Large

Employee subscribers to stock and bond offerings of two of the larger electric manufacturing companies are showing gratifying returns. The Western Electric Company has announced that those employees to whom the privilege was given of subscribing on the installment plan to the corporation's new five-year 7 per cent convertible gold bonds have taken $2,600,000 worth of the securities. There were 6,650 subscribers, or about one employee in four. The heaviest subscriptions were reported from the Hawthorne works.

From the final figures of the General Electric Company's 8 per cent stock offering to employees it is shown that 95,396 shares were purchased by 30,747 subscribers, which was about 36 per cent of the total number of employees just before Christmas.

Course in Exporting Proposed

A course to be devoted to the training of export clerks, going minutely into detail concerning the various duties performed by them, and not touching upon export salesmanship or executives, is being contemplated by Joseph McElroy, export sales manager of Pass & Seymour, Inc., and A. H. Frique, export sales manager of the Solo Brush & Broom Company. It is expected to open on Feb. 8 at the Merchants' and Bankers' Business School at 37 East Fifty-eighth Street, New York City, and run for three months. Export packing, shipping, documentation, credit, financing, insurance, the use of codes, export office routine and correspondence will be covered.

Carter Electric in New Quarters

The Carter Electric Company, Atlanta, Ga., has taken up new quarters in its just-completed warehouse on Mangham Street. The new building, which provides the company with nearly 60,000 sq.ft. of floor space, was described in the Dec. 18, 1920, issue of the ELECTRICAL WORLD.

Washing Machine Association Elects Officers

Optimism regarding the future growth of the washing-machine business was the spirit of the opening sessions of the second annual convention of the American Washing Machine Manufacturers' Association, held Jan. 19-20 at the Hotel Sherman, Chicago. Greater effort toward promoting the idea of laundering at home with the help of the washing machine was arranged for by the appropriation of a larger sum for educational work, including the printing and distributing of six instructive circulars. Reports of President H. L. Barker, Secretary E. B. Seitz and Assistant Secretary Mary E. Keown were presented. Following a well-attended banquet, R. D. Hunt of the Dexter Company was elected president. The other officers will be: First vice-president, W. J. Conlon, Conlon Electric Washer Company; second vice-president, J. P. Monahan, Blackstone Manufacturing Company; third vice-president, Silas Altorfer of Altorfer Brothers Company. The executive committee, elected to serve one year, is: Howard Power, H. F. Brammer Company; J. D. A. Johnson, Michigan Washing Machine Company; S. F. H. Bergman, One-Minute Manufacturing Company; Elmer H. Maytag, Maytag Company; Louis A. Dietz, Boss Washing Machine Company.

Engineers of Twenty Years' Standing Incorporate

The Fargo Engineering Company, Jackson, Mich., a consulting engineering firm which has been active in water-power, steam-power and general industrial work in the Middle West for the last twenty years, has filed articles of incorporation with a capital stock of $50,000, all paid in. The officers of the company are: William G. Fargo, president; Horace S. Hunt, vice president, and Rolla G. England, secretary-treasurer. The company announces that it has engineering work under way in various parts of the United States and Canada. Practically all the designing and construction work of the Consumers' Power Company was done under the supervision of this company.

Salt Lake Jobbers Banquet Contractor-Dealers

The electrical jobbers of Salt Lake City, consisting of the Capital Electric Company, the Intermountain Electric Company, the Mine & Smelter Supply Company and the Western Electric Company, had as their guests the contractor-dealers of that city at a dinner at the Hotel Utah on the evening of Jan. 5. J. A. Kahn, general manager of the Capital Electric Company, was chairman, and C. B. Hawley, general manager of the Intermountain Electric Company, acted as toastmaster. Addresses were made on the electrical jobber, the electrical dealer, the central station, co-operation, the business outlook for 1921 and the Rocky Mountain Electrical Co-operative League. A splendid spirit of optimism prevailed among the fifty-eight who were present.

Frankel Light Expands Market

The Frankel Light Company, 5016 Woodland Avenue, Cleveland, has expanded its market so that it has a representative now in virtually every state in the Union and expects to fill in the remaining states within the next few weeks. The company's special connection is with the contractor-dealer trade in the sale of fixtures.

Northland Electric New Name of Supply Jobber

After having been in operation as a distributer of electrical supplies for ten months and having done half a million dollars' worth of business, the Triumph Electric Company, 211 South Third Street, Minneapolis, Minn., announces a change in name to the Northland Electric Supply Company. This change is

the result of a court order because of the similarity in name to that of the Triumph Electric Company, Cincinnati, manufacturer of generators and motors.

Coffield Washer Triples Plant and Sales Force

While the Coffield Washer Company, Dayton, Ohio, has just moved into a much larger plant, which has a capacity of about triple its previous production, information from the company on the outlook for washing machines is that this additional capacity will be all too little in view of the enthusiastic and optimistic attitude throughout its trade. At the same time with its increased productive organization the company has increased its selling organization in proportion. Furthermore, selling arrangements have recently been made in new territories with several long-established distributers.

Southern Manufacturers' Mexican Business Increasing

In connection with trade in the countries just south of the United States the Liberty Manufacturing Company, New Orleans, announces that the percentage of its Mexican business is increasing at a rapid rate and is many times larger than it was the past year at this time. The company, manufacturing switches, switchboards, electric signs, incubators, etc., is extending its territory to cover the entire South and the Central American countries. Moreover, a sales office has been opened recently at 511 Carondelet Street, New Orleans, as the factory is on the outskirts of the city.

The Inland Wire & Cable Company, Cleveland, is planning to erect a new plant, 100 ft. x 350 ft., one story, at Hammond, Ind., to cost about $100,000.

The A. C. Gilbert Company, Blatchley Avenue, New Haven, Conn., manufacturer of electric fans, toys, etc., is planning to erect a one-story addition, 26 ft. x 240 ft., to its plant.

The Mutual Electric & Machine Company, Detroit, has recently increased its capital stock from $100,000 to $500,000. The item published on Dec. 25 relative to the increase in capital stock of the company gave the address as Wheeling, W. Va. The office at Wheeling has been discontinued for some time.

The Electric Appliance Company, Chicago, held a sales conference from Jan. 3 to Jan. 8, which was attended by the entire sales force. Sales managers of nationally known electrical manufacturers were invited to talk to the men.

The Leonard Electric Manufacturing Company, Cleveland, manufacturer of switchboards, panelboards, etc., is established in its new building at 3907 Perkins Avenue, where it has twice the floor space and much better facilities for serving its customers. The Williams-Beasley Company, 53 West Jackson Boulevard, Chicago, and 1626 Chemical Building, St. Louis, is the representative in those two cities for safety switches manufactured by the company.

The Maring Wire Company, Muskegon, Mich., manufacturer of enameled and cotton-covered magnet wire, announces the appointment of the R. W. Lillie Corporation, 30 Church Street, New York City, as its Eastern representative. The Boston office at 176 Federal Street is in charge of H. D. Steele.

The MacGillis & Gibbs Company, Milwaukee, manufacturer of cedar posts, poles and railway cross-ties, which has completed its twenty-second year in business, is distributing a booklet entitled "Poles of Cedar," in which it gives an outline of its activities and short sketch of its officers. J. E. Gerich, president and general manager, was one of the incorporators of the company and was made president and general manager in 1905.

The General Electric Company, Schenectady, N. Y., is planning to erect a machine shop, 50 ft. x 200 ft., in Atlanta, Ga.

The James Leffel & Company, Springfield, Ohio, manufacturer of turbines, waterwheels, etc., has opened a sales and engineering office at 615 Plymouth Building, Minneapolis. M. S. Bassett, who has been connected with the engineering and sales departments at Springfield for fifteen years, will be in charge.

The Webster Electric Company, Racine, Wis., manufacturer of magnetos, etc., has filed notice of increase in capital stock from $600,000 to $1,000,000.

The Herman Andrae Electrical Company, Milwaukee, has filed notice of increase in capital stock from $50,000 to $100,000.

The Reliance Electric & Engineering Company, Cleveland, has removed its Boston office from 10 High Street to 200 Devonshire Street. Langdon S. Simons is in charge.

The Edward Valve & Manufacturing Company, 72 West Adams Street, Chicago, is planning to rebuild its plant at East Chicago, Ind., recently destroyed by fire. The loss is estimated at about $350,000.

The International Time Recording Company, Endicott, N. Y., has leased the second floor of the building at 846 North Broad Street, Philadelphia, for new headquarters.

The Champion Engineering Company, Kenton, Ohio, manufacturer of electric traveling cranes, has appointed A. E. Hogrebe, mechanical and electrical engineer, sales engineer for the Baltimore territory. Mr. Hogrebe has been identified with the electric traveling crane business since 1891, having been connected with the Yale & Towne Manufacturing Company, Brown Hoisting Machinery Company, Niles-Bement-Pond Company and Pawling & Harnischfeger. Since 1917 he has been with the Chesapeake Iron Works, having severed his connection with that company recently.

The American Enameled Magnet Wire Company, Muskegon, Mich., has field notice of increase in capital stock from $250,000 to $600,000.

The Daniel M. Luehrs Company, Cleveland, Ohio, recently organized to engage in industrial engineering, has established office and laboratories at 2015 East Sixty-fifth Street. Daniel Luehrs, president of the company, was formerly with the McCreary Engineering Company, Toledo, Ohio, and later with the American Blower Company, Detroit. The laboratories will be in charge of C. A. Buld, metallurgist, who was with the General Electric Company for ten years, and E. M. Huemann, chemist, who has been connected with the chemical laboratories of various industrial companies. H. W. Hough, formerly chief electrical engineer with the Cleveland Electric Illuminating Company, will have charge of the company's electrical work. S. J. Brady, who has had experience with various companies in the design and operation of electric furnaces, is also a member of the company.

The Brunt Tile & Porcelain Company, Columbus, Ohio, has recently made extensions to its works, including the erection of two new kilns and three new buildings, making the total floor space now occupied 70,766 sq.ft. The company has added the States of Louisiana, Pennsylvania and West Virginia to its Chicago office territory.

The Roller-Smith Company, 223 Broadway, New York City, announces the appointment of the J. E. Dilworth Company, 493 South Main Street, Memphis, Tenn., as its representative in the western half of Tennessee, the eastern half of Arkansas and the northern half of Mississippi. The electrical department of the Dilworth company is in charge of E. M. Greeson, who was formerly associated with Fairbanks, Morse & Company and the Sanborn Electric Company, both of Indianapolis.

The Northern Electric Company, 542 St. Clair Street, Chicago, has installed additional equipment to provide for the increasing demand for its products.

The Adamson Manufacturing Company, East Palestine, Ohio, has added a new department to its works for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers and a large line of arc-welded products.

The Emerson Electric Manufacturing Company, St. Louis, has completed the third unit of its plant and it will be put into operation shortly. The new building is eight stories high and has approximately four acres of floor space. A feature of the new building is the 23,000-volt transformer room.

The Bluebird Division of the Davis Sewing Machine Company, Dayton, Ohio, is the name under which the Bluebird washing machine will hereafter be manufactured. Work has been resumed at the factory in St. Louis, Mo., and preparations are being made for manufacturing the Bluebird washing machine at the plant of the Davis Sewing Machine Company in Dayton. A complete unit of the plant has been set aside for the production of the washing machine.

Cameron Overbagh, 221 West Randolph Street, Chicago, manufacturer of steel boxes, connectors, clamps and fixture studs, is planning to extend the sale of his products to all sections of the country. Until now sales efforts have been confined to the Middle Western territory.

Albert Vestor Sons, Inc., Providence, R. I., announce that W. L. Patterson, sales manager, with headquarters at 1133 Broadway, New York City, will handle their line of fixture parts for the Metropolitan district.

Clemence Brothers, Irvington, N. J., have appointed B. W. Sandback, with headquarters at 5 East Thirteenth Street, New York City, direct factory representative for the distribution of their line of "Sterling Bi-Plex B-X" outlet boxes and "Meleady" loom boxes for the metropolitan district.

The New England Electric Appliance Company, 607 Main Street, Hartford, Conn., has recently been organized to represent the Air-Way Electric Appliance Corporation, Toledo, Ohio, in the New England States.

Foreign Trade Notes

EXTENSION TO NEW ZEALAND POWER STATIONS.—Tenders are invited by the Borough Council of Gisburne, New Zealand, according to the London *Mail*, until March 31 for work in connection with extension to the electric power stations, including two turbines of 3,600 hp. each, two 2,500-kva. alternators, two turbines each of 145 hp. and two 100-kw. exciters. Specifications may be consulted at Department of Overseas Trade, 35 Old Queen Street, Westminster, S. W. 2, London, England.

AUCKLANDS (N. Z.) INVITES TENDERS.—The city of Auckland, N. Z., according to the London *Electrician*, will receive tenders until Feb. 22 for furnishing and installing one 3,000-kw. and one 5,000-kw. turbo-alternator, one 1,500-kw. and one 500-kw. rotary converter, switch gear and transformers, water-tube boilers, conveyor pumps, pipe work and cables. Specifications may be obtained from Preece, Cardew & Rider, consulting engineer, 8 Queen Anne's Gate, S. W. 1, London, England.

SOUTH AFRICAN MARKET FOR AMERICAN ELECTRICAL GOODS.—The Bureau of Foreign and Domestic Commerce, Washington, has issued a 117-page Special Agents' Series No. 205, entitled "Electrical Goods in British South Africa." The publication describes methods of selling electrical goods, gives selling terms, discusses the market for specific classes of electrical goods, etc.

SOUTHLAND ELECTRIC POWER BOARD PLANS DEVELOPMENT IN NEW ZEALAND.—A. W. Rodger of Invercargill, N. Z., author of the Electric Power Boards act, which embraces both private and public ownership of utilities, who is now in the United States, has outlined to a representative of the ELECTRICAL WORLD the procedure being followed in connection with his plans for developing the water powers of New Zealand. His district was the first one to take advantage of the new law and, as chairman of the Southland Electric Power Board, he is on a trip to England and America to raise $7,500,000 to buy materials and appliances for a 50,000-hp hydroelectric development (two 3,000-kw. units initially), 150 miles of 66,000-volt line, 1,500 miles of 11,000-volt line, 600 miles of 400-volt line and wiring materials and appliances for 6,000 rural homes. The government has advanced money for the development work, which is now well under way. All poles have been bought, as have one-third of the insulators. Nine hundred tons of copper wire and 500 tons of galvanized-iron wire are among the items still to be purchased. Of the $7,500,000 required, $1,500,000 is for financing the wiring of homes and the sale of merchandise.

GEORGE C. ROUGH has, it is reported, resigned [illegible] to take charge of the Canadian branch, 455 King Street West, Toronto. The company is also in a position to manufacture special [illegible] such as pulley, [illegible] gears, bushings, washings, etc., at the Kings Street plant.

HYDRO-ELECTRIC DEVELOPMENT IN TASMANIA.—The Electrolytic Zinc Corporation of Australia is offering an issue of £1,100,000 8 per cent cumulative preferred stock, the proceeds of which will be used for the completion of its extensive works at Risdon, Tasmania. The corporation has a contract with the Tasmanian government by which it takes 30,000 hp. at $2 per year for twenty years, with an option at the end of that term for another twenty years. Extensions to the plant will increase the output of electrolytic zinc to 50 tons per day by the end of 1921, and to 100 tons a day by the end of 1922.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A wholesale dealer in electrotechnical lines in Switzerland (No. 34,306) wishes to get in touch with electrical lamp manufacturers with a view to purchasing these products.

A merchant in Ireland (No. 34,313) desires to obtain an agency for the sale of electrical appliances.

A firm of wholesale electrical dealers in India (No. 34,314) desires to receive quotations and information relating to resistance wire in sizes from No. 12 to 36 standard wire gage, and also similar information on ordinary fuse wire.

A merchant in the French West Indies (No. 34,319) desires to secure catalogs in French of articles which he plans to purchase, such as storage batteries, insulated wire, kerosene motors for electric lighting plants, etc.

An importing firm in India (No. 34,324) desires to be placed in touch with manufacturers and exporters for the purchase of electrical goods, etc.

A wholesale merchant firm in India (No. 34,327) desires to be placed in touch with a manufacturer of magneto telephones with a view to obtaining an agency for same.

A consulting engineer in Portugal (No. 34,329) desires to purchase electrical supplies for a municipal lighting plant and street-railway system.

New Apparatus and Publications

STORAGE-CELL TESTER.—The Metric Appliance Corporation, 133d Street and Willow Avenue, New York City, is distributing a circular describing its new "Mac" storage-cell tester.

TELEPHONE.—The portable telephone for communication from points along a transmission line is described in a new booklet of the Dobie Engineering Company, 40 Central Street, Boston.

LUBRICATION.—"Lubrication of Hydraulic Turbines" is the subject of the leading article in the December, 1920, issue of *Lubrication*, a monthly publication issued by the Texas Company, 17 Battery Place, New York City.

INDUCTION MOTORS.—The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has issued bulletin No. 1087-C, covering its polyphase induction motors.

INDUSTRIAL HAULAGE.—The General Electric Company, Schenectady, N. Y., has issued an illustrated bulletin, No. 44,251, describing its different types of electric locomotives for industrial haulage.

CALORIMETER.—Publication 876, Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is on the Thomas calorimeter, for recording graphically total heating values of gases.

RUBBER GLOVES.—The Seamless Rubber Company, Inc., New Haven, Conn., distributing a leaflet describing its "Maderite" brand of electric linemen's gloves, etc.

New Incorporations

THE ELECTRIC SIGN FLASHER CORPORATION, Los Angeles, Cal., has been incorporated with a capital stock of $50,000 to manufacture electric flashing devices and other electrical devices. The incorporators are Albert Andrews, G. T. Mahana and M. H. Mahana, Jr., of Los Angeles.

THE SCHOOL CREEK LIGHT COMPANY, Napoleon, Ohio, has been chartered with a capital stock of $10,000 to operate an electric light plant. The incorporators are S. P. Farison, C. V. Farison, W. J. Snyder and William Orthwein.

THE PECOS (TEX.) POWER & ICE COMPANY has been incorporated by J. W. Crowdus, M. E. Neiderkorn and M. E. Crowdus. The company is capitalized at $50,000.

THE SOUTH CENTRAL SERVICE COMPANY, Mitchell, Ind., has been incorporated by Murphy Owen of Mitchell, M. E. Black and Robert M. Cass of Indianapolis, and Clifford M. Hayworth and Winifred Jessup of Richmond. The company is capitalized at $300,000 and proposes to furnish light, heat and water power for Mitchell.

THE SPIELMAN ELECTRIC COMPANY, New York City, has been incorporated with a capital stock of $30,000 by B. M. Asch, S. and M. H. Spielman, 995 Alder Street, the Bronx.

THE ROCHESTER ELECTRIC CARBON BRUSH CORPORATION, Rochester, N. Y., has been incorporated by B. Ferris, J. P. Thompson, G. F. Hixson of Rochester. The company is capitalized at $10,000 and proposes to manufacture graphite products.

THE PHOENIX HYDRO-ELECTRIC CORPORATION, New York City, has been chartered with a capital stock of $350,000 to manufacture water turbines. The incorporators are O. A. Hack, C. E. Goehring and L. Schroeder, 1593 Lexington Avenue, New York City.

THE FOREST HILL WATER, LIGHT & FUEL COMPANY, Forest Hill, Tex., has been incorporated with a capital stock of $8,000 by Everett Cain, J. A. Todd and L. T. Jordan.

THE IMPERIAL ELEVATOR & ENGINEERING COMPANY, 403 South Caroline Street, Baltimore, Md., has been chartered with a capital stock of $25,000 to manufacture elevators, dumbwaiters, conveyors, etc.

THE FARMERS' LIGHT & POWER COMPANY, Delhi, N. Y., has been incorporated with a capital stock of $20,000 by F. W. Thomson, R. S. Marvin, R. Archibald and others. The company proposes to manufacture electrical machinery, etc.

THE NATIONAL ELECTRIC TOOL COMPANY, Pittsburgh, Pa., has been incorporated by John A. Metz, 707 B. F. Jones Law Building; Thomas D. Murray and S. E. Bentley, to manufacture electrical tools and other equipment.

THE UTILITY MANUFACTURING & SALES CORPORATION, Boston, Mass., has been incorporated by Arthur J. Driscoll, Jamaica Plains; George E. Williams and A. C. Drew, Boston. The company is capitalized at $300,000 and proposes to manufacture electrical equipment and do a general electrical engineering business.

THE ANCHOR LITE APPLIANCE COMPANY, Pittsburgh, has been incorporated by Jacob L. Simon, 1409 Park Building; A. S. Goldstein, E. J. Kelsky and others. The company proposes to manufacture electrical appliances and devices.

THE TIMES APPLIANCE COMPANY, New York City, has been incorporated by B. A. and E. A. Allen and E. B. Ingraham, 1475 Broadway. The company is capitalized at $60,000 and proposes to manufacture electrical appliances and devices.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 4, 1921)

1,364,495. WIRELESS-TELEGRAPH TRANSMITTER; Henry J. Round, London, England. App. filed Aug. 26, 1920.

1,364,517. FLASH-POINT-TESTING INSTRUMENT; William M. Pestel, Chicago, Ill. App. filed Sept. 10, 1917. For testing coils.

1,364,550. COIN-COLLECTING MEANS FOR TELEPHONE SERVICES; Frederick W. Hall, London, England. App. filed July 8, 1919. Slot receiver.

1,364,643. TELEPHONE-EXCHANGE SYSTEM; Winfred T. Powell, Rochester, N. Y. App. filed Feb. 6, 1919. Special character service.

1,364,672. TROLLEY; Frank Womack, Los Angeles, Cal. App. filed April 5, 1919. Will readily adjust itself to wire.

1,364,673. ART OF INDICATING SPEEDS OF ROTATION; Frank W. Wood, Montclair, N. J. App. filed Dec. 20, 1918. Synchroscope.

1,364,687. RHEOSTAT; Edward M. Bentley, Lawrence, N. Y. App. filed May 9, 1919. Compression.

1,364,688. RHEOSTAT; Edward M. Bentley, Lawrence, N. Y. App. filed July 17, 1919. Variable.

1,364,725. TELEGRAPH SYSTEM; Joao N. Correia, New York, N. Y. App. filed Aug. 14, 1918. For secret service.

1,364,751. ELECTRIC ARC LAMP; Horace B. Grylls, Weybridge, England. App. filed April 1, 1919. Searchlight.

1,364,760. BATTERY GRID; Walter E. Holland and James M. Skinner, Philadelphia, Pa. App. filed Jan. 9, 1919. Relatively thin.

1,364,811. TOASTER; Edwin A. Rutenber, Marion, Ind. App. filed March 20, 1917. Bread turner.

1,364,835. RHEOSTAT; John T. Daniels, Newark, N. J. App. filed Aug. 5, 1920. For low voltage but heavy current.

1,364,847. STOPPING APPARATUS FOR ALTERNATING-CURRENT MOTORS; Harry F. Stratton, Cleveland, Ohio. App. filed July 12, 1919. Quick-stopping.

1,364,852. SYSTEMS FOR GENERATING, STORING, DISTRIBUTING AND UTILIZING ELECTRICAL ENERGY; Edward V. Hartford, Deal, N. J. App. filed June 19, 1912. For automobiles.

1,364,853. ENGINE STARTER; Edward V. Hartford, Deal, N. J. App. filed June 19, 1912. For automobiles.

1,364,854. ELECTRICAL STARTER; Edward V. Hartford, Deal, N. J. App. filed June 28, 1913. For motor vehicles.

1,364,857. ALTERNATING-CURRENT ARC-WELDING SYSTEM; William A. Hall, Yonkers, N. Y. App. filed Sept. 23, 1918. Automatic regulation of voltage.

(Issued Jan. 11, 1921)

15,022 (reissue). HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed Jan. 20, 1914. Protected against accidental lighting.

15,025 (reissue). METHOD OF TESTING AND LOCATING DEFECTIVE MULTIPLE-PART PIN-TYPE INSULATORS; Tomlinson F. Johnson, Jr., Atlanta, Ga. App. filed May 6, 1919. Without interruption of service.

1,364,861. CONSTRUCTION OF ELECTRIC CONDUCTORS; William L. Bliss, Niagara Falls, N. Y. App. filed May 13, 1918. Prevents acid creeping out of battery.

1,364,879. FOOT FOR CONTACT SHOES; Winthrop K. Howe, Rochester, N. Y. App. filed July 13, 1916. Automatic train control.

1,364,909. TELEPHONE SYSTEM; Ray S. Wilbur, Lyndhurst, N. Y. App. filed Dec. 27, 1918. Toll trunk lines.

1,364,953. PROCESS OF PREPARING NEGATIVE PLATES FOR ELECTRIC BATTERIES; Adolfo Pouchain, Turin, Italy. App. filed Sept. 18, 1919. Negative plates of zinc.

1,364,961. MEANS FOR CONTROLLING REPEATERS; John F. Toomey, New York, N. Y. App. filed Oct. 19, 1918. Telephone.

1,364,965. TELEPHONE-CALL-TRANSFER SYSTEM; John F. Toomey, New York, N. Y. App. filed June 3, 1919. Long-distance transmission lines.

1,364,967. RHEOSTAT; Alexander F. Victor, Davenport, Iowa. App. filed July 17, 1919. Means for gradual variation.

1,364,969. SIGNALING SYSTEM; Ray S. Wilbur, Lyndhurst, N. J. App. filed Jan. 2, 1918. Responsive to currents of two different strengths.

1,365,004. TELEGRAPH-PRINTING APPARATUS; Andrew T. MacCoy, Dover, Mass. App. filed Aug. 11, 1917. Selective and synchronizing mechanism.

1,365,032. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed April 29, 1918. Electrolysis of impure copper solutions.

1,365,033. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed Feb. 10, 1919. Copper deposition.

1,365,034. ELECTROLYTIC APPARATUS; William E. Greenawalt, Denver, Col. App. filed June 13, 1914. Maintaining variable valent salts in impure electrolyte at their lowest valency.

1,365,053. PROCESS OF MAKING KETONE BODIES; Carleton Ellis and Alfred A. Wells, Montclair, N. J. App. filed March 18, 1918. From olefins or other unsaturated bodies.

1,365,066. MACHINE FOR WRAPPING AND UNWRAPPING TIRES; Elmer E. Shoopman, Cairo, Neb. App. filed May 13, 1920. With tape of fiber or paper.

1,365,085. MAGNETO-CONTACT-POINT PROTECTOR; Henry A. Bowers, Jamestown, N. Y. App. filed Dec. 8, 1919. To exclude dirt.

1,365,130. STARTING, GENERATING, AND BRAKING SYSTEM; William A. Turbayne, Niagara Falls, N. Y. App. filed Nov. 23, 1917. Automobile.

1,365,140. ELECTROLYSIS; Matthew A. Adam, John Stevenson, Alan T. Mabbit and John Fieldhouse, London, England. App. filed Aug. 31, 1920. Deposit of metals in loose crystalline form.

1,365,141. PREVENTION OF CORROSION; Matthew A. Adam, London, England. App. filed Aug. 31, 1920. For tanks, pipes, pumps, heaters.

1,365,152. ATTACHMENT-PLUG RECEPTACLE; Frank V. Burton, Bridgeport, Conn. App. filed Jan. 15, 1916. To receive jacks of different arrangement.

1,365,157. APPARATUS FOR USE IN TELEGRAPHY OR TELEPHONY; Lee de Forest, New York, N. Y. App. filed Feb. 3, 1916. Audion detector, amplifier or generator.

1,365,168. SPARK INTENSIFIER; Otto A. Gerdes and Emil Guth, Blue Island, Ill. App. filed May 26, 1920. For use upon old or worn spark plugs.

1,365,170. INDUCTANCE-COIL MOUNTING; Robert F. Gowen, New York, N. Y. App. filed Aug. 20, 1919. For coupling purposes.

1,365,186. ELECTRIC IRON; Jose A. Oca Balda, Bridgeport, Conn. App. filed May 16, 1919. Time-controlled switch and indicator.

1,365,193. ELECTRIC CUT-OUT BOX; Roscoe Ratcliffe, Plainville, Conn. App. filed Nov. 17, 1919. Detachable section.

1,365,198. METHOD OF AND APPARATUS FOR ELECTRICALLY WELDING TUBING; Frank L. Sessions, Lakewood, Ohio. App. filed March 24, 1919. Electrically welding lap-seam or close-butted-seam tubing.

1,365,199. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; Frank L. Sessions, Lakewood, Ohio. App. filed Sept. 27, 1919. For welding lap-seam or close-butted-seam tubing.

1,365,201. TROLLEY; Earl W. Sinnett, Grand Rapids, Mich. App. filed Oct. 27, 1920. Slide contact to replace trolley wheel.

1,365,224. ARMATURE CORE; John B. Bushnell, Berkeley, Cal. App. filed Nov. 23, 1918. Magneto.

1,365,225. MAGNETO; John B. Bushnell, Berkeley, Cal. App. filed May 24, 1919. Impulse starter.

1,365,231. PRINTING-TELEGRAPH SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Feb. 14, 1918. For keeping several stations in synchronism.

1,365,268. TELEPHONE-TRANSMITTER MOUTHPIECE; Clarence E. O. Olliffe, Leichhardt, New South Wales, Australia. App. filed Aug. 21, 1920. Germicidal disk.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received at the office of J. H. Delaney, commissioner of transit construction, 49 Lafayette Street, New York City, until Feb. 1 for installing an electric motor-driven drainage pump in the Fourteenth Street eastern district subway at Meserole Street and Bushwick Avenue.

BROOKLYN, N. Y.—The Nassau & Suffolk Lighting Company, 149 Broadway, New York City, has arranged for an issue of $436,000 in bonds for proposed extensions and general expansion.

NEW YORK, N. Y.—Bids will be received by J. W. Brannan, president of the Board of Trustees of Bellevue Hospital, at the office of the general medical superintendent, 415 East Twenty-sixth Street, until Feb. 4 for the installation of a complete fire-alarm system in the engineer's office, main office, old buildings and pavilions I, K, L and M.

SALEM, N. Y.—F. C. Lovejoy has applied to the Public Service Commission for permission to construct an electric plant at this place.

MILLVILLE, N. J.—The Millville Light & Power Company contemplates the erection of an addition to its power plant to cost about $500,000. S. J. Franklin, High Street, is engineer.

PERTH AMBOY, N. J.—Plans have been approved by the Board of Aldermen for the installation of a new ornamental street-lighting system on Madison Avenue from Market Street to New Brunswick Avenue. J. B. Franke is city electrician.

PHILADELPHIA, PA.—Bids will be received by W. S. Twining, director of the department of city transit, twelfth floor, 1211 Chestnut Street, until Feb. 8 for furnishing and installing electric lighting and power wiring for the car inspection shop and for lighting the yard at Bridge and Penn Streets, also an electric lighting system for Bridge Street Station and the trainmen's building at Frankford and Bustleton Avenues.

PETERSBURG, VA.—The Chesterfield Manufacturing Company contemplates the erection of an electric power plant to furnish light and power for present mill and for larger mill to be constructed later. J. F. Taylor is president.

North Central States

DETROIT, MICH.—The Public Lighting Commission, care of A. L. Jones, acting president, 138 East Atwater Street, contemplates the erection of a new power plant of 25,000 kw. to supply electric power for municipally owned street cars, fire department's high-pressure pumping station, and lighting streets and public buildings. The cost of the plant is estimated at about $500,000.

SPRINGFORT, MICH.—The city officials are considering entering contract with the Consumers' Power Company, Jackson, to supply energy for light and power. This plan would include the erection of a transmission line to Albion at a cost of about $22,000.

WAKEFIELD, MICH.—Improvements and additions to the street-lighting system, to cost about $5,504, are under consideration. W. Jacobson is city clerk.

CANTON, OHIO.—The municipal water commission is considering the erection of a central power plant for the operation of the pumping stations and to furnish light for city buildings and streets. The cost of the plant is estimated at $140,000. J. A. Buell is in charge.

MIDDLETOWN, OHIO.—Plans are under way for the installation of an ornamental street-lighting system. Mr. Morrison is city engineer.

MONROE, OHIO.—The County Commissioners at Eaton have granted permission

to D. Wolford to establish and maintain an electric transmission line in Monroe Township to provide for light and power.

ZANESVILLE, OHIO.—E. R. Meyer, electrical counsel of Zanesville, and R. E. McClure of the Ohio Electric Company, Springfield, are considering improvements, including a new power plant, extension to the street-lighting system, etc.

WAUKEEGAN, ILL.—The City Council has passed an ordinance providing for the installation of an ornamental street-lighting system at a cost of about $53,000.

ASHLAND, WIS.—The city officials contemplate the installation of an ornamental street-lighting system. W. C. Morris is city clerk.

MADISON, WIS.—Mayor L. M. Kittleson will have plans investigated for the erection of a municipal electric plant.

MANITOWOC, WIS.—The Oslo Power & Light Company, 526 South Eighth Street, plans to enlarge its plant, extend its wires, etc. H. Groth is in charge.

MERRILL, WIS.—The City Council has authorized the installation of an ornamental street-lighting system to cost about $30,000.

OCONOMOWOC, WIS.—The city officials contemplate the installation of a switchboard in the municipal light plant and in an outside substation. T. S. Johnson is city clerk.

IRWIN, MINN.—The village officials contemplate the installation of an electric lighting system. Energy will be obtained from the municipal plant at Litchfield. F. O. Holm is village clerk of Litchfield.

GRAND RAPIDS, MINN.—The city officials contemplate the erection of a municipal power plant at the government dam. F. A. McVicar is city clerk.

MINNEAPOLIS, MINN.—The Hennepin County Sanitorium Commission proposes to issue bonds to the amount of $1,500,000 for the erection of a sanitarium, including a power plant to cost about $210,000. E. C. Gale is a member of the commission.

ESTHERVILLE, IOWA.—The Emmet County Light & Power Company has petitioned the board of supervisors for permission to construct a transmission line along the public highways.

TROY MILLS, IOWA.—The Natural Research Development Company has plans under way for water-works improvements and a power house to cost about $50,000. Holland, Ackerman & Holland, 122 North Fourth Street, Ann Arbor, Mich., are engineers.

ST. LOUIS, MO.—It is reported that the Kansas City, Clay County & St. Joseph Railroad Company, 530 Railway Exchange, Kansas City, has plans under way for the construction of an electric railway line from [illegible] to Kansas City, a distance of about 250 miles.

VELVA, N. D.—The Dakota Engineering & Construction Company, Valley City, is considering the establishment of an electric generating plant near this place.

PHILIP, S. D.—C. H. Holcomb recently purchased a light and power plant and contemplates improvements.

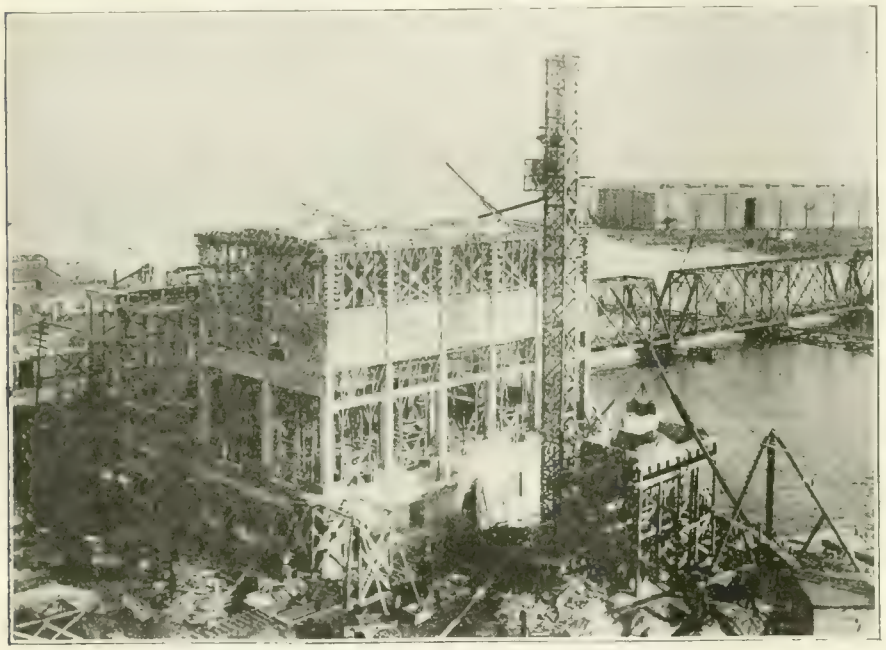
LEAVENWORTH, KAN.—Petitions have been circulated requesting the city officials to call an election for the purpose of submitting to the voters a proposition to issue bonds for the erection of a new electric light plant.

Southern States

CHARLOTTE, N. C.—The Southern Power Company, Church Street, contemplates the erection of a hydro-electric plant on the Catawba River to develop 35,000 hp. W. S. Lee is vice-president and engineer.

FAYETTEVILLE, N. C.—The Cumberland Railway & Power Company, Raleigh, plans to extend its street-railway lines in Fayetteville to Camp Bragg, a distance of 9 miles, at a cost of about $100,000. J. R. Baggett is receiver of the company.

FERNANDINA, FLA.—The city officials contemplate improvements to the municipal electric light and water plant.



POWER HOUSE CONSTRUCTED OF REINFORCED CONCRETE, OSHKOSH (WIS.) GAS LIGHT COMPANY

GERMANTOWN, TENN.—The town officials plan to issue bonds for the installation of an electric light and water plant. Gaines & Carlisle, 206 Falls Building, Memphis, are architects and engineers.

MEMPHIS, TENN.—The city and county officials of Memphis contemplate the erection of a municipal market and auditorium to cost about $2,000,000. Plans include the installation of an electric power plant. Bids will be received for construction work on March 1 by C. O. Pfeil and G. Awsumb, architects, 1403 Union and Planters' Building.

GADSDEN, ALA.—The Public Service Commission has granted permission to the Alabama Power Company, Birmingham, to erect a transmission line from this place to a point on the Georgia state line to connect with the line of the Georgia Railway & Power Company. T. W. Martin is president.

POTEAU, OKLA.—The Poteau Telephone Company plans to erect a two-story, 25-ft. x 80-ft. addition, install switchboard and replace wires with cables. The cost is estimated at about $200,000.

TISHOMINGO, OKLA.—The city officials contemplate the extension of transmission lines from this place to Milburn, a distance of 9 miles.

HARLINGTON, TEX.—Bonds to the amount of $60,000 have been voted for the installation of municipal light, water and sewer systems.

Pacific and Mountain States

CHELAN FALLS, WASH.—The Chelan Falls Power Company is planning to enlarge its facilities by installing a 12,500-hp. plant here. G. D. Brown is president.

PE ELL, WASH.—The Pe Ell Light & Power Company has been incorporated with a capital of $10,000 to generate electricity and handle electrical supplies.

ARROWHEADS SPRINGS, CAL.—Plans have been prepared for the erection of a power house and portable buildings to cost about $60,000, at the Public Health Hospital at this place.

CALEXICO, CAL.—The City Council is considering the installation of a municipal light plant. M. L. Parcels and A. C. Baskin were appointed to investigate the cost, etc.

LOS ANGELES, CAL.—The city engineer has been instructed to prepare ordinance providing for the installation of an ornamental street-lighting system on Ogden Street between Sunset and Hollywood Boulevards.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation plans to expend between $4,000,000 and $5,000,000 to enlarge production plants and extend its distribution system. The company has applied to the Railroad Commission for permission to issue $1,000,000 toward the development of this work. Estimates are now being prepared by engineers.

MONTAGUE, CAL.—R. E. Swigart, trustee of the Klamath-Shasta Valley Irrigation project at this place, has been granted permission to divert 1,600,000 acre-ft. of water from the Klamath River for storage purposes. Plans also include the development of 110,000 hp.

OLANCHA, CAL.—The Public Service Commission has authorized the erection of a transmission line from the municipal power plant at the Haiwee reservoir to the town of Darwin. The cost is estimated at between $75,000 and $80,000.

SANTA BARBARA, CAL.—An appropriation of $130,000 for a new lighthouse at this place has been recommended by the Rivers and Harbors Committee of Congress and indorsed by the Navy Department. Plans also include the erection of a wireless station and the installation of new island lights.

LEVAN, UTAH.—The Town Council contemplates an election soon for the purpose of submitting to the voters a proposition to issue bonds for the erection of a municipal light plant.

IDAHO FALLS, IDAHO.—The City Council will be petitioned to take steps in securing a lighting system for C Street.

ST. MARIES, IDAHO.—The Washington Water Power Company, Spokane, Wash., has applied to the Public Utilities Commission for permission to construct a transmission line from the Kootenai-Benewah county line along the St. Joe River to the limits of this city.

SELIGMAN, ARIZ.—E. L. Beyard of this place has applied to the Federal Power Commission for permission to develop 480,000 hp. on the Colorado River, Mojave County. This project will include the electrification of 500 miles of the Atchison, Topeka & Sante Fé Railway system and the irrigation of 500,000 acres of desert land.

LARAMIE, WYO.—The Midwest Refining Company contemplates the installation of one 500-kva., 2,300-volt, 60-cycle, steam-driven turbine, three 125-hp. motors for water pumping and one 100-hp. motor for boiler feed. J. F. Cullen is superintendent.

Canada

HALIFAX, N. S.—The Nova Scotia Power Commission plans to take over the power plant in operation at the Musha-mush River, which supplies Lunenburg, and contemplates increasing its capacity in order to supply several adjoining towns. The commission also proposes to improve some power plants now in operation. A power project on the East River, Sheet Harbor, allowing a development of 25,000 hp., is under consideration.

LONDON, ONT.—Bids will be received by E. V. Buchanan, general manager of the Utilities Board, about March 1 for the erection of a substation on Cabell Street to cost about $50,000.

MONTREAL, QUE.—The Shipman Electric Engineering Company, 26 St. George Street, plans to purchase one 7½-hp., 110-volt Wagner or Century single-phase motor; one 350-kva. three-phase, 60-cycle, 600-volt synchronous motor, and one 150-kw., 220-volt to 110-volt, three-wire, direct-current generator.

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Stepping Stones to Good Will

FORTUNATELY there are no secrets in the electric light and power business. The element of competition being absent, every manager, engineer and commercial agent is free to divulge to his fellows in the business just how he has floated a successful loan, improved the station efficiency or increased the sale of energy or appliances. This is real co-operation, valuable alike to the company and its patrons, both of whom gain through this free and frank interchange of information. Thus a spirit of good will is fostered between leading central-station men and organizations all over the country. Excellent as it is, however, it is not enough. The intimacy must embrace in a way the general public, but with so much privacy and so many inner offices separating the executives of the company from its patrons how is this possible? If proper public relations are to be maintained, the barrier must be removed and every manager of a public utility made "get-at-able." In fact, the whole business should be conducted, as it were, in glass houses so that every one can see all that there is to be seen about its operation. That is the best basis for inspiring confidence and for establishing good will. It has the advantage of simplicity and is, moreover, effective.

Middle West Transmission Growing

AN INDICATION of the growth of power transmission in the Middle West is the recent operation for several weeks of interurban cars between Rockford, Ill., and Janesville, Wis., by energy transmitted 135 miles from the Prairie du Sac plant of the Wisconsin River Power Company. While operation in this way is not new even under Middle Western conditions, there are comparatively few Middle Western systems on which such a length of transmission can be found. While the West Coast and Southeastern sections of the country hold the record for interconnected systems and long-distance transmission, Middle Western progress is such that the general development in that section of long-distance transmission and large interconnected systems that will approach in size the developments of the other two sections seems to be a matter of a few years only.

The Colorado River Project

THE proposed development by the Southern California Edison Company of more than two and one-half million horsepower of hydro-electricity on the Colorado River is a plan to stagger the imagination. Immense as it is, however, the project cannot be viewed as an idle dream. Its realization will ultimately be forced by the necessity for new sources of energy to supplement the large developments now under way in the High Sierras on the San Joaquin River and its tributaries. These latter developments will eventually produce approximately 650,000 kw., and it is estimated that this entire output will be consumed within fifteen years. It is worthy of note also that the Colorado River project is proposed at a time when other utilities in many sections of the country find that their load is not increasing at a very rapid rate. In central and southern California, however, the utilization of electrical energy continues by leaps and bounds, and in reaching out for other sources of supply long before they are required the Southern California Edison Company is following its usual far-sighted policy.

A Crutch for the Pessimist

TO THOSE who have allowed themselves to become depressed by the business conditions of the past few months our monthly report on central-station operating statistics should come as a tonic. While industrial-plant energy requirements varied from 10 to 66 per cent below normal during November, the increased lighting and heating load was sufficient to carry the average daily output beyond any previous high mark. The revenue for November was also 3.1 per cent greater than ever before. Compared with a similar period during 1919, the kilowatt-hour output for November, 1920, showed an increase of 11.5 per cent. Of those central-station companies in the class that generate more than 100,000,000 kw.-hr. per year, no more than ten have reported a lower total output for 1920 than for 1919. It is apparent that electric central stations are not experiencing the depression so prevalent in other lines of industry.

The Status of the Electric Vehicle

NOTWITHSTANDING their many and great advantages, numerous electrical devices fail to awaken the imagination of the average man. Our large steam turbo-generator sets, inclosed as they are, give but little indication of their power, and the electric locomotive, lacking the noise and the attractive reciprocating motion of its steam competitor, disappoints the eye and deceives the mind. Approaching within 1 or 2 per cent of actual perfection, the electrical transformer is nevertheless the most unobtrusive thing imaginable to the layman, and even the sturdy motor, diminutive beside the machine it drives or the engine it displaces, is rarely accepted at its face value. People invariably associate power with bulk and noise, and it is because of this that the electric vehicle does not get its just due when compared with the gasoline-driven

machine. The electric car is too prosaic and quiet. If it could snort and chug outlandishly and if it were of hideous aspect, it might give a truer impression of its prowess. As it is, proof of its possibilities must be made, and even then the prospective buyer accepts it with reservations. To the electrical man this phase of human psychology is baffling. Nevertheless, it exists and allowance must be made for it. That the electric vehicle for city traffic is superior in the long run to its competitors is demonstrable, and there are still tremendous opportunities to conserve time, labor and money and to promote efficiency in the handling of materials through its agency. The greatest problem concerns the marketing of the product, and its proper solution involves many complex and perplexing questions.

Each manufacturer may have very definite and pronounced views in regard to the ways and means to be employed, but unless the various ideas are thoroughly co-ordinated and a comprehensive plan agreed on a complete and satisfactory solution cannot be attained. One thing is certain, the problem is not technical, but is primarily and essentially a business one. If attacked in a spirit of tolerance, forbearance and helpfulness, rapid progress will be made. It is encouraging to note that the number of electrically propelled vehicles is increasing year by year, and the rapidity with which industrial trucks are establishing themselves in warehouses and factories is surprising. Eventually the electric vehicle will fill its proper place in the transportation world. Of that there can be no doubt. Its inherent advantages cannot be forever obscured by the glamor surrounding the gasoline machine. Meanwhile if the electrical industry will accept it as it is and apply it, needed encouragement will be given. Confidence is the basis and measure of development, not idealistic conceptions of the millennium.

Improvement of Industrial Illumination

AS A RULE the advent of improved material is the result of demand for more effective application in obtaining results. Oddly enough, industrial illumination furnishes an instance to the contrary, for electric lamps and their equipment are awaiting proper utilization. When it is considered that the last decade has brought down the cost of light as a raw material to one-tenth its initial value it seems strange indeed that its liberal and skillful use should have fallen behind. Progress is under way, to be sure, but it is slow, and innumerable manufacturing establishments, to their own serious loss, are still working with illumination fully ten years behind. There is no excuse for poor lighting on the ground of expense, for if, using his own cost per kilowatt-hour, one figures out the expense of energy per foot-candle-hour per acre, let us say, the false economy of current practice becomes self-evident.

One of the most striking recent investigations on the subject bears directly on the relation of output to illumination, and the results plainly show that better lighting implies not only better work, with the ability to see easily, but more work, owing to the fact that poor lighting slows down efficient vision. The workman with plenty of light well distributed and free from glare can work, and instinctively does work, at a better pace than the man who is struggling along with just light enough to perform his task after a fashion. How far increase in illumination can be carried with advantage from the standpoint of quantity and quality of output has not yet been determined, although it is certain that the limit lies far beyond ordinary practice. If industrial illumination should actually keep up with its opportunities, we should anticipate an increase in the use of light even more rapid than the increase in motor service.

Water Power as an Asset in Austria's Regeneration

FEW Americans actually realize the changes the war has wrought in the old Austro-Hungarian Empire, and fewer still will lack some measure of active sympathy in the troubles of the Austrian Republic, which is the sole territorial remnant of the widespread domain of the luckless Hapsburgs. A striking article from the editors of the chief electrotechnical journal of Austria in this issue gives a vivid idea of what has happened. After the partition of the empire had cut off Czechoslovakia, Poland and Jugoslavia and assigned territory to Rumania and Italy the Austrian Republic was cut down into an area less than that of the State of Maine with a population of six and a half millions. Thus reduced to about one-eighth of the imperial territory, the republic is doubly unfortunate in lack of raw material, especially coal and iron. Most of the material used in the electrical manufactures for which Austria has been famous was obtained from what is now Poland or Czechoslovakia. As a result the electrical, and indeed all, manufactures have suffered, and industry is singularly slow in recovery. The number of workmen is cut in two, and although the wages per man have doubled in the last two years, they have not kept pace with the cost of necessities, so that a large proportion of the working people are undernourished and in poor physical condition. Credit is stopped, and the only terms on which manufacture can be undertaken are cash on placing the order. Prices are therefore uncertain, for the fluctuation is continuous and cannot be predicted.

With all this in the way of discouragement, it is gratifying to note that the manufacturers of the Austrian Republic are exerting every effort to get once more upon a sound basis. They are preparing for work when more normal times are reached, and the electrical industry is perhaps more hopeful than the most. There are large resources in water power as yet undeveloped, and with the totally insufficient supply of coal and crude oil the development of these powers and the supply of transmitted energy is a certainty. The electrification of the railroads is one of the important steps under contemplation to free the republic from dependence on imported fuel. Austrian electric lamps, one of the most important features of export in the past, are still making their way into foreign countries, and with the excellent reputation which they have always had they are likely to continue as an important article of manufacture.

The Electrotechnical Society of Vienna, which has played a valuable part in the upbuilding of industry, is turning its energies to getting back something of the old trade. It is to the possibilities in developing power, however, that attention should chiefly be directed in the effort to regain for the republic something of the industrial capacity which the loss of the main coal supply has so seriously diminished.

Industrial Heating to Improve Power Factor and Load Factor

TWO big problems before the central-station industry are those of improvement of power factor and of increase of load factor. Industrial heating promises to assist materially in both endeavors. Whereas it will take time to get results by discouraging low-power-factor loads, it is possible to improve immediately the system conditions as a whole by adding large blocks of high-power-factor industrial heating load. In most instances industrial heating promises a continuous process; therefore, though it will increase the peak, it will also increase the load at the low-load period and the net gain will be high load factor. Filling the low places in the load curve presents great difficulties that it will take many years to overcome, but it is possible to obtain some improvements now by the connection of industrial heating loads. Besides its other benefits, industrial heating offers an excellent source of revenue. The progressive central-station companies can be expected to take full advantage of these opportunities.

It Is Time to Be More Specific

WE HAVE already noted the report of the National Board of Fire Underwriters and the rejoinder of the Society for Electrical Development regarding fires from electrical causes. The facts presented by the underwriters are less important than the somewhat sensational way in which they were put. It is one thing to headline electricity as the chief source of fires and quite another to report that it was the source of about 6 per cent of the total fire damage of the last five years. The rejoinder of the Society for Electrical Development showed that of all fires investigated and reported to it about 2½ per cent were of electrical origin. The statistics put forward by the Board of Fire Underwriters deserve more than casual study, and the time is ripe for a complete exposition of the relations derivable from the data. If even 6 per cent of the fire damage in the country is due to electrical causes, it is of high importance, considering the aggregate amount of damage done, to know just how and why electrical causes were responsible. Incidentally it would be interesting to know the nature of the correlation between fires reputed to be electrical and those charged to other causes. For instance, what was the proportion of fires charged to spontaneous combustion and our old friends rats and matches in wired and unwired buildings respectively? In what proportion of the reputed causes of electrical fires was the actual nature of the electrical failure responsible for the fire determined? Of such instances what were chargeable to modern installations made under the rules of fire underwriters and what to installations of an earlier date made without suitable inspection? In other words, there is direct need for finding out, in so far as can be ascertained from statistics, what is the exact character of the risks fairly attributable to electrical causes and what is the relation of these causes to the actual circumstances of electrical distribution.

Our memory runs back over a good many years to the time when a wire in the next street was sufficient whenever an alarm was sounded to cause an outcry against the fire risks due to electricity. That day has happily gone by, but pointing to electricity as the chief classified cause of the huge fire loss of the country, even when the actual percentage of loss is small, is an accusation which demands prompt attention. The Society for Electrical Development is to be commended for its work in investigating the statistics of the fire underwriters and running down with punctilious care the various correlations disclosed.

Circular Versus Rectangular Coils for 220-Kv. Transformers

THE advance to 220 kv. for power transmission, long foreshadowed, is apparently definitely realized in the construction of four 8,333-kva. transformers for the Southern California Edison Company. These transformers, while having for their immediate purpose the relief of the overloaded 165-kv. lines of the Southern California Power Company, will eventually form a permanent link in the proposed 220-kv. California power bus. The Pacific Coast therefore will probably be the first to produce a superpower transmission system.

The construction of the transformers mentioned is described in a paper by Clinton Jones in this issue. Aside from the interest attaching to the figure of the high-tension voltage, noteworthy features are the circular type of coil with its bracing against short circuits, the oil conservator, whereby the main case of the transformer is completely filled with oil, thus eliminating air, and the 220-kv. terminal bushing. Particular stress is laid upon the advantages of the circular coil over the familiar rectangular-shaped coil of the shell-type transformer. The advantages claimed are superior mechanical characteristics as against the stress from concentrated leakage flux under short circuit, the practicability of assembling with frequent cross-bracing in the direction of oil flow, the protection of turn insulation from mechanical injury, and increased reliability in the major insulation between the primary and the secondary. It is further claimed that there is increased cooling efficiency of the oil ducts.

The original reasons for the adoption of the rectangular-shaped coils were probably the reduction of the voltage between layers and the intermingling in assembly of primary and secondary coils, reducing the leakage flux and internal reactance. With increasing sizes and vertical types the advantage of longitudinal conduction of heat to the upper exposed ends of the coils is also recognized. Considering these things from the standpoint of the circular coil, it is possible to reduce the voltage between layers to the same extent, although generally a greater number of coils will be necessary. In the matter of leakage reactance it is probable that neither type has the advantage, particularly as reactance has lost most of its early terrors and, in fact, in many instances is desirable nowadays. Neither in the matter of efficiency of oil cooling is a superior position certain for either type; the considerations set forth in the article referred to show some advantages for the circular coil, although it is not apparent that these offset the salient feature of the vertical rectangular coil, of straight conduction to the exposed ends and the direction of this conduction being paralleled by the upward flow of oil. It does not appear that the advantages claimed for either type are sufficiently definite to eliminate the other, and it is probable that transformers of both types and of about the same degree of reliability will continue to appear.



William Slocum Barstow

A pioneer and recognized leader in electric light and power utility management who by insisting on a proper balance between physical and financial operation has been able to rescue many properties that were apparently in a hopeless state

SOUND financing methods and ideals in management have always been of paramount interest to electric light and power utilities, but at no time have they been more absorbing than today. Bankers and managers are beginning to call for some permanent financial plan sufficiently flexible to accommodate itself easily to current rates for money and investment demand. One who has advocated this principle for years and who is recognized as an authority on public utility finance and a rebuilder of electric light and power properties that through mismanagement and poor financing have been allowed to run down is W. S. Barstow, electrical engineer, operator, manager, financier and president of the General Gas & Electric Company, with properties in Pennsylvania, Ohio, New Jersey, New York and Vermont. Included in these properties are those once controlled by the Atlantic Gas & Electric Company, a holding company which went on the financial rocks a few years ago.

Mr. Barstow's connection with the industry dates back to the old Edison Machine Works at Schenectady, where he started work in 1887. He had charge of construction of new plants for that organization. Upon completing the installation of the Brooklyn Edison system in 1889 he remained as electrical engineer and general superintendent and later became general manager. In 1901 he resigned to engage in the practice of consulting electrical engineering, and in 1906 he organized the engineering and management corporation of W. S. Barstow & Company. During the time he was with the Brooklyn Edison Company he acted in an advisory capacity for other electric light and power companies and as such effected the consolidation of the Edison companies in Cleveland. Under his management the Brooklyn Edison Company was one of the first to install multiphase transmission and substation distribution, low-tension arc lamps, storage batteries, the "booster" system and other devices then new.

As the result of this operating and management experience Mr. Barstow has come to believe that the electric light and power utility must be operated from both the physical and the financial viewpoint. While these points of view are apparently entirely different, they must be kept parallel or the company will come to grief. He has, accordingly, always advocated the maintenance of a well-defined balance between these two phases of utility operation. A week from next Tuesday Mr. Barstow will celebrate his fifty-fifth birthday. Mr. Barstow was born in Brooklyn, where he spent so much of his commercial life. In 1887 he was graduated from Columbia College. He is a fellow and life member of the A. I. E. E., of which he has been a vice-president. In numerous other electrical societies he has had an active part.

Elsewhere in this issue will be found a contribution from Mr. Barstow to the current discussion on financial structures. In this paper common stock is held to be fundamental.

Building First 220,000-Volt Transformers

Four 8,333-Kva., Single-Phase Units Are Being Manufactured for the Southern California Edison Company—Advantages of Circular Coils Are Set Forth—Standard Bushings for 220 Kv.

By CLINTON JONES
Transformer Department, General Electric Company, Pittsfield, Mass.

POPULAR interest in the so-called "super-power" system has been intensified by the coal and oil situation, by war conditions, the recently crippled condition of our transportation facilities and the probability of further railway electrification. Fortunately, electrical interests have long foreseen the ultimate necessity of higher voltage and larger power transmission systems—such transmission systems as would not only decrease the present waste in undeveloped power but also steadily increase the efficiency of all power in use and relieve the railroads of a vast amount of their present coal-carrying burden.

The movement toward this very vital national economy is being furthered by the enterprise and foresight of individual operators who are so planning and building their systems as greatly to simplify the eventual linking up of what may be termed the "key transmissions" of the various industrial and agricultural areas. The line voltage of 220,000, which has been tacitly agreed upon as being the approximate economic potential for these extensions and interconnections, constitutes a very abrupt step in the curve of maximum transformer voltages, as indicated in Fig. 1. Nevertheless, there is every indication that the use of 220,000 volts will be attended with just as much success as that which characterized the first operation of 150,000-volt apparatus by the Southern California Edison Company. The circular coil concentric winding design is being used for the first transformers and this construction has already proved of great value in the development toward a safer apparatus for very large powers and high voltages. The elimination of the air space in the main containing tank is another noteworthy advance, also the completion and standardization of an oil-filled 220,000-volt bushing to be interchangeable for all apparatus and services with the exception of the line itself.

The last step in potential—namely, to 220,000 volts—had been discussed for some time prior to 1920, but no actual moves were made by the operators until last summer, when the Southern California Edison Company placed an order with the General Electric Company for four water-cooled 50-cycle, 8,333-kva. transformers, arranged for operation at 220,000 volts, stepping from a generated voltage of 11,000. These will be used in the company's new hydro-electric station, to be known as "Big Creek No. 8," which will be a part of an ultimate development for the transmission of 750,000 hp. at 220,000 volts, over a distance of 240 miles (385 km.). One of these units is shown in the illustration. No definite time has yet been set for operation at 220,000 volts, but it must be in the near future, as the present lines of the Southern California Company will soon be loaded to their full capacity and it is imperative that more power be delivered to Los Angeles County at an early date. This transmission is interesting in that it will be available as a permanent link in the 220,000-volt California bus* by which it is proposed to interconnect all the large natural powers throughout the state.

There is now no doubt as to the commercial practicability of transmission potentials in the order of 200,000 volts. In fact, as far as transformers are concerned, it may be said that the transition from 150 to 220 kva. involves far less uncertainty than did the transition from 66 to 100 kva. The recent natural tendency toward the use of the grounded system, with its attendant stabilization of line potential, has been of great importance in this extension of voltage.

The turning point in coil construction in high-voltage transformer design came after the first experience in potentials of from 70 kv. to 100 kv. In order to understand better the needs of the situation, the General Electric Company early in 1910 began extensive investigation of all problems encountered in the operation of several of the early 100-kv. systems. These investigations included the systems of the Colorado Power and Great Western Power companies and were very complete and made at great expense. Furthermore, extensive laboratory apparatus was built for experimental purposes, making possible the duplication of phenomena existing in field service and thus permitting more careful and extended investigations. The results obtained were, as is quite usual in such cases, explained without much difficulty by theoretical and practical considerations, and it can be said in all confidence that all of the phenomena inimical to the safety and operation of high-voltage lines and apparatus are quite well known.

ADVANTAGES OF CIRCULAR COIL FOR HIGH-VOLTAGE TRANSFORMERS

Much has been said in regard to the merits of different typical transformer constructions for high-voltage work, so that it will not be amiss to examine the design of this pioneer 220,000-volt unit. It should be said here that the General Electric Company early committed itself to the use of the circular coil in small form-wound sections for all power transformers. The accumulated experience of the company, both in the early stages of the development of large power units, when the "shell" form with rectangular coils was used almost universally, and in these later years that have seen such remarkable strides in capacity and voltage, all points unmistakably to the circular coil as the keynote to permanent practice, and every danger that still threatens from the use of longer lines with higher voltage and larger powers is closely associated with some important characteristic of design dependent directly upon the form of the coil.

The superior mechanical characteristics of the small circular coil have already proved invaluable in constructing power units which will withstand the destruc-

*Paper by Sorensen, Cox and Armstrong, *A. I. E. E.*, 1919.

tive efforts of short circuit as demonstrated by actual tests with large powers at the company's Schenectady factory. These mechanical characteristics may be summed up in their larger sense as resulting:

First—From the fact that a transformer coil under magnetic stress from concentrated leakage flux—*i.e.*, under short circuit—tends to assume a circular form.

Second—From the practicability of assembling such coils with frequent cross-bracing in the direction of the oil flow, thus giving positive support to all conductors at short intervals without interfering with the cooling action of the coil.

The important advance in thermal characteristics made possible by this construction may also be summarized under two general heads—namely, the reduction in heat-blanketing effect of the intercoil bracing structure and the increased cooling efficiency of the oil ducts.

The first advantage accrues from the use of narrow coil and group-spacing braces at right angles to the conductors, thus reducing to a fraction of an inch the length of the heat-conducting path from center of brace to the oil. The second is the result of the very short oil duct in the circular coil assembly, where the oil flow is across instead of along the conductor and the length of

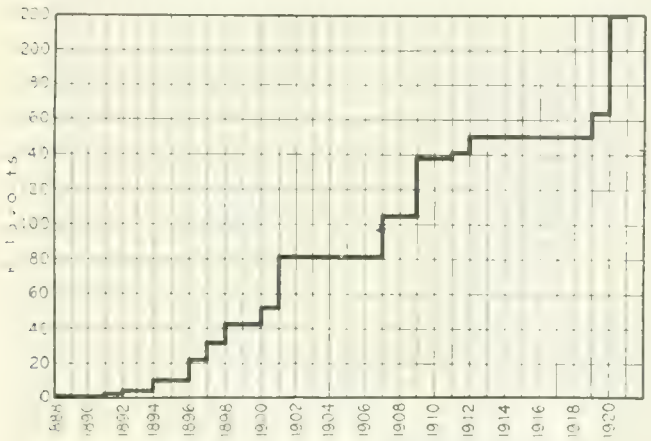


FIG. 1—INCREASE IN MAXIMUM POTENTIAL IN POWER TRANSFORMERS BY YEARS

the duct is determined by the width of the coil rather than its length. These combined advantages have made it possible to construct large power units in which the "hot-spot" temperature is mainly due to the difference in oil temperature as between the top and bottom coil levels, and this, in turn, can be controlled to a large extent in the design of the particular transformer and its cooling system.

PROTECTION OF COIL INSULATION FROM INJURY

The protection of turn insulation from mechanical injury both in manufacture and operation is also a noteworthy improvement characteristic of the small circular coil. As this is a very vital detail of any design, it will bear brief examination. Such insulation naturally occupies a very restricted space and must stand a high puncture voltage per mil. Uniformity is obviously necessary, and a plurality of thin layers is therefore advisable. To protect this fibrous insulation in the winding and treating process and to preserve it in operation has been made much more certain by the use of the small circular coil, which is wound with uniform tension, has no sharp corners and expands and contracts uniformly over the necessary wide range of operating temperatures.

It would be impracticable and out of place here to go into any great detail as to the merits of the circular coil construction and its adaptability within the commercial range of power transformers. Enough has been said, however, to indicate the basic reasons for the emphasis that the manufacturer has placed on the form of the coil. As the importance of insulation increases the importance of protecting it from mechanical damage or overheating also increases. Thus the natural ruggedness and uniform thermal qualities of the circular coil come into play with increased force. If the oil duct of a low-voltage transformer becomes partially clogged by oil deposit or the distortion of a coil due to magnetic stress, the only immediate effect may be an increase in local heating. If one of these things happens in an extra-high-voltage unit, it may easily cause a breakdown between coils at the next line disturbance.

Again, the circular-coil design admits of the concentric arrangement of windings as between high-voltage and low-voltage components. The General Electric Company has made this a requisite in high-voltage designs. In such construction the windings are more surely braced where there must be considerable striking distance between active parts and ground, since the principal magnetic forces are exerted radially between the windings, rather than vertically as in the "interleaved" designs where the resultant force must be taken by the core-clamp structure through insulating supports. The form of assembly also allows of a simplification and increased reliability in the major insulation. This consists of a number of concentric cylinders so installed between the windings with longitudinal spacers as to preclude any movement and closing of oil ducts.

The particular transformer under discussion is of the "core" type with two groups of windings on separate core legs for each phase. As far as the general arrangement of core and coils is concerned, it is similar to the Great Western Power unit shown in Fig. 2. It was designed for operation with neutral point permanently grounded, and this again lends additional interest to the concentric form on account of its exceptional adaptability to grounding.

The line end of the high-voltage winding is brought out through a new standard oil-filled 250,000-volt bushing which is interchangeable as between the transformers and high-tension oil circuit breakers. It will be interchangeable with any other bushings for 220,000-volt apparatus which may be furnished later. The external shell of this bushing consists of two porcelain pieces above the transformer cover, one porcelain piece below the cover and an intermediate metal cylinder which is flanged at the upper end to support the bushing. This metal portion always extends below the transformer oil level to avoid any possibility of corona in transformers having an air space between the oil level and cover. A metal tube extends from top to bottom through the center of the bushing, and the intervening space between this tube and the porcelain shell is filled with transil oil and concentric cylindrical insulating barriers. The glass chamber at the top provides space for expansion of the oil and indicates its level. The joints between the shell sections are made with treated cork gaskets compressed locally by numerous bolts engaging metal clamping rings. The central tube serves as the conductor when used in a breaker and as a conduit for a cable conductor in a transformer.

The bushing has a dry flash-over voltage of 660,000. The lightning flash-over is estimated at more than twice the normal frequency figure and is equal for wet or dry conditions. In the event of any high impressed voltages the bushing will not puncture but will arc from the terminal to ground without damage. The general design of the bushing is such that an essentially uniform surface distribution of potential is obtained, thus preventing corona on the surfaces.

The containing tank is of the "oil conservator" type, having a separate chamber for oil expansion (see Fig. 2A). The principles involved in this construction are to some extent in all transformers open to the air and is easily accelerated to the danger point during emergency overloads. It preserves the transformer insulations to a remarkable extent, as shown by actual time tests at various operating temperatures. While final conclusions cannot be drawn at present, owing to the protracted nature of such investigation, it can be said that the rate of deterioration of the usual organic transformer insulations is greatly reduced by the use of a conservator. Obviously, this is a very important step in advance and can be used to great advantage in high-voltage work.

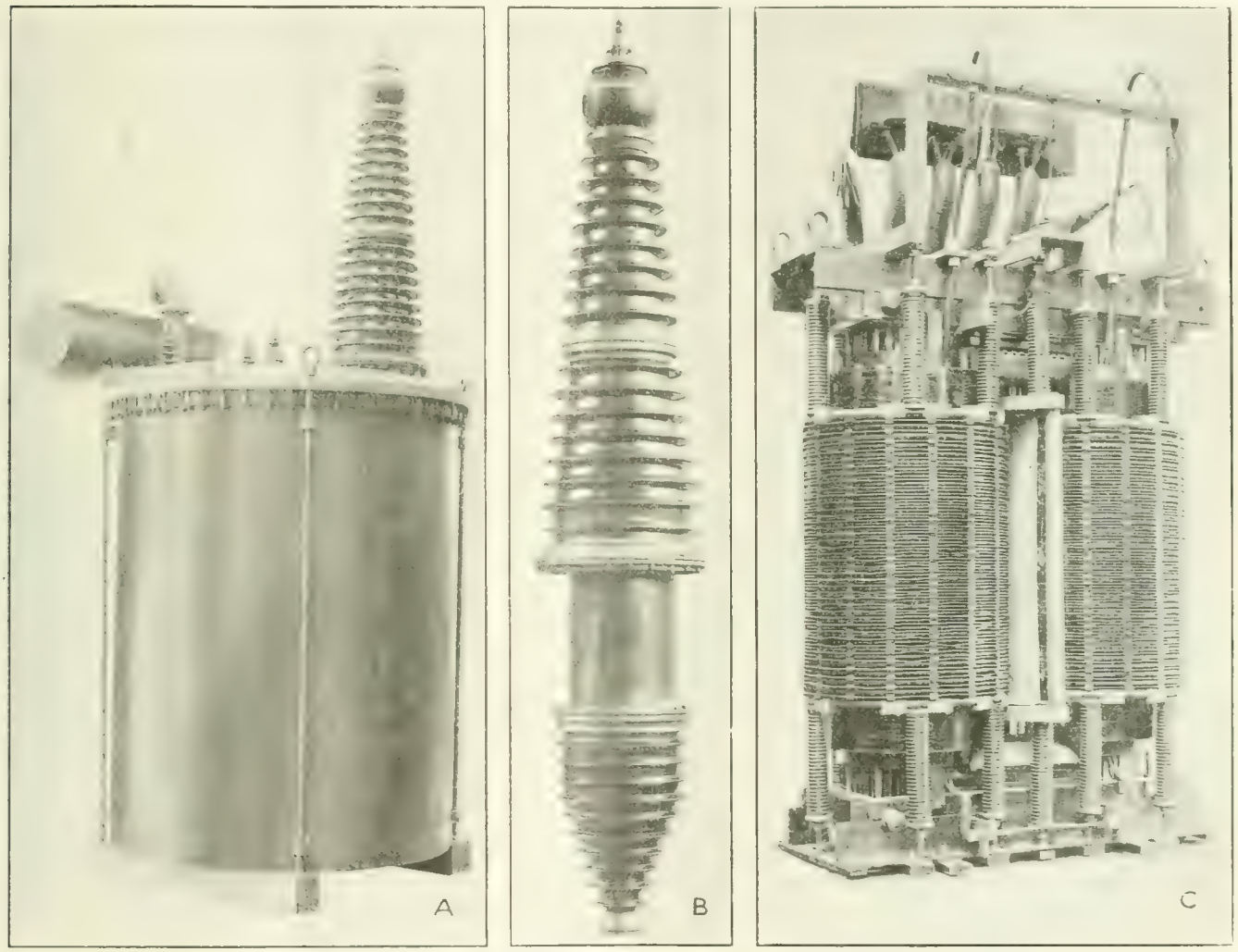


FIG. 2—WORLD'S FIRST 220,000-VOLT POWER TRANSFORMER

A—External view of the 220-kva., 8,333-kva. transformer, of conservator type. Four of these units are being built for the Southern California Edison Company and will be star connected in service.

B—This bushing, rated at 250 kv., maximum potential, will be used on 220-kv. lines for either transformers, oil circuit breakers or lightning arresters. It is said that the new 220-kv. transformer construction follows the general design of that shown in C, which is one of the 7,500-kva., 165-kv. transformers recently obtained by the Great Western Power Company.

the elimination of the usual air space above the oil in the main tank and the isolation of the hot oil and transformer insulation from the surrounding air. The main tank is always completely filled with oil, and pressure is prevented by opening the auxiliary tank to the outside air through a breathing device. Any accumulation of moisture in the auxiliary tank due to condensation is caught in a sump and may be drawn off through a pet cock at the bottom. This construction eliminates "breathing" in the main tank and keeps the oil absolutely dry. It avoids explosions due to a possible mixture of air and gas formed from hot or decomposed oil. It protects the oil from "sludging," which occurs

The total weight of this transformer is 50 tons, including oil. The height from rail to top of bushing is 24 ft. (7.3 m.), and the diameter is 10½ ft. (3.2 m.).

A current transformer is mounted on the cover and connected into the neutral circuit before the ground is made on the tank. The current transformers of three units (one three-phase bank) have their secondaries connected in parallel so that any unbalanced current (ground current) can be read.

It is an interesting fact that the manufacturer had actually designed this 220-kv. transformer long before any definite plans had been made by power interests for operation at this voltage.

Review of Electrical Business in 1920

Analysis of Conditions Gives Rise to Estimate of $4,200,000,000 Spent Last Year for Goods and Service—Prospects for Future Brighter Still

By T. Commerford Martin

THROUGHOUT the year just closed electrical development maintained to a degree even beyond reasonable expectation the rate of progress that had characterized it during the periods alike of the great war and of the post-armistice resumption of pacific relationships. For many industries 1920 was a time of distress and the beginning of the era of deflation, but electricity, broadly considered, had known little of abnormally high prices and has very few steps to retrace painfully. For the great group of public utilities, with the return to national sanity in trade and commerce and in industrial affairs, the new hope is seen in fairer quotations, fairer rates and a fairer income on the investment. The industry is really starting from the bottom upward, because others are starting from the top downward. The electrical note for 1921 can only be one of hopefulness. Raw materials and labor are in readjustment, with universal benefit, and capital itself, the world's savings, is becoming cheaper, because the savings are once more accumulating.

It has been the privilege of the writer for some twenty-five years past to submit to the readers of the Electrical World a review of the year past as regards the expenditures of the American nation for electrical goods and service. Being based on the latest available census data, Electrical World monthly statistics and the reports when obtainable of the great manufacturing companies and the public utilities in general, such figures have subsequently been found to "make good" in a very encouraging manner. An estimate of production and income in 1920 is made in the accompanying table.

ELECTRICAL PRODUCTION AND INCOME IN 1920

Central stations	$900,000,000
Electric traction	800,000,000
Telegraphy	250,000,000
Telephony	550,000,000
Electric manufacturing	1,250,000,000
Isolated plants	200,000,000
Miscellaneous	250,000,000
Total	$4,200,000,000

Central Stations

The figures of the United States Census Bureau for 1917 showed the central-station revenues of that year to be $526,886,408. Since that time the revenues of the industry have grown rapidly—roughly, as shown by the Electrical World's monthly statistics, 20 per cent annually. From these bases it was thought quite reasonable to estimate central-station earnings for 1920 at $900,000,000. The past year has seen central stations enjoying better rates in many instances. Some of the 1,250,000 new homes needed are already being built and occupied and industrials up to the late fall were using all the power available.

Electric Traction

Estimates of revenues of the street railways in 1919 from transportation are given by the American Electric Railway Association at $750,000,000. It is doubtful whether there has been very much advance over this figure in the intervening twelve months. It is true that fares have been raised, but it is also true that riding has decreased as a direct result. Morever, the "jitney" has taken from the electric railway a very handsome slice of its business. For these reasons it is not thought advisable to place the electric railway revenues from transportation at more than $800,000,000.

The Arts of Communication

It has been a hard job for the telegraph and telephone systems to recover from the injuries inflicted by a term of governmental management. But fortunately the damage done, though deep, was not vital. Service was reduced to its lowest form of efficiency, but is "coming back." The earnings of the telephone, set down in 1919 as about $475,000,000—Bell co-operative and "independent"—are now for 1920 taken at only $550,000,000, an increase of approximately 15 per cent.

The telegraph income, which was set at $200,000,000 for 1919, is now estimated for 1920 at $250,000,000. This includes a great variety and miscellaneousness of function and service—land lines, ocean cables, railway systems, "wireless," district systems, burglar alarms, police and fire systems. The "wireless" advances of 1919 are of splendid scope and magnitude, with infinite promise for the near future.

Electrical Manufacturing

It was shown that in 1918 only three of about nine hundred producers of supplies and apparatus had reached an audited total of $522,421,000, which of course was not the figure at which the goods were put in the hands of the customer and consumer. In 1919 the output of one electrical manufacturer was represented by orders of $237,000,000 and sales at first hand only $3,000,000 less. During the last year there was a ceaseless call for electrical goods. When one department of electrical manufacture lets up a bulge is seen immediately in some other direction, while demands heretofore unheard and unsuspected bring new producers into a field whose bounds will not be set by us or in our time. For the year 1920 the writer is very much tempted to rate the high-water mark at $1,250,000,000, the first time that any branch of electrical production and service has passed the billion mark.

Isolated Plants and Miscellaneous

It may be very much doubted whether there is any notable increase in the number of isolated plants in office buildings and factories. The great war has put an appreciable drag on that kind of development, as it has on the sinking of taxes in unprofitable municipal plants. But, per contra, there is a most interesting development in such isolated plants as the new battleships and the new lines of steamers, as well as in farm plants, for which the call is being met with feverish activity. The farmer has been educated by his "flivver" up to a desire for putting away his oil lamps with other back-number gear, and electricity has a strong growing appeal to him in 1920-21.

With an undeniable aggregate of more than four billions of electrical goods and service needed by our fellow-citizens in the year just ended, are we not called upon by the opportunities of 1921 to put forth energies not yet by any means fully extended in what has been done thus far? "The greater lies before."

Common Stock the Basis of Financing

The Physical and the Financial Structure of Utilities Are Equal Components, Although the Latter Has Not Been Receiving Equal Consideration from Regulating Bodies, with the Result that It Has Become Top-heavy Because of Too Much Borrowing and Too Little Investment

By W. S. BARSTOW
President W. S. Barstow & Company, New York

ALL corporate enterprises are made up of what might be termed two structures—physical and financial—and these function only when and as long as both are present. In an electric light and power company the physical structure is the power house and distributing system by means of which is generated, distributed and sold to the public the service of lighting and power. The financial structure is made up of the securities which are sold to the investor (stockholder) or lender (bond or note holder).

From these two sources—service and securities—money is obtained to operate, maintain and extend the property. As the physical structure makes use of public property which is necessarily confined as to its limits, the service rendered thereby is economically a monopoly, and to protect the public using the service regulations are made.

As the financial structure is made up of securities distributed over an unlimited territory throughout the world, its operations are competitive and automatically subject to regulation by the law of supply and demand. When, therefore, public service commissions attempt to regulate the financial structure which already has been regulated by the law of supply and demand, they may render it inoperative, in which case all money necessary to extend the physical structure must be derived from the returns for service. Under such a condition these returns would have to be so high that service could not be sold and expansion would be blocked.

Earnings Not Return on Investment

Regulating bodies have as yet only a general knowledge of the financial structure. On the other hand, their efficient engineering staffs have kept them fully informed on the physical property and its operation. One of the results has been the confused conception of earnings and return on investment. That these two are related to one another is of course unquestioned, but that relation should be clearly understood.

The state of the art today provides recognized means of fulfilling the requirements of the public for service, but no means are provided for fulfilling the requirements of the investor. The former relates to the proper operating, maintenance and extension of the property. The latter means the safeguarding of both the principal and the return on the investment. If the state and commission laws protect the public in the service but do not protect the investor, or vice versa, the enterprise fails.

The investor or stockholder in any enterprise should not be confused with the lender or bondholder, whom the enterprise must at some time pay back and who, when this is done, is no longer a factor in the financial structure. The investor's interest remains permanently in the property, although this interest may be passed from individual to individual. The majority of state laws and commission rulings make it difficult in many ways to interest the investor but easy to interest the lender. As a result, the financial structure of the public service enterprise has become top-heavy and in danger of falling owing to the heavy debts, which have gradually grown to a point where the foundation established by the investor becomes too weak. The solidity of the structure can only be restored by increasing the investment and decreasing the debt to a safe point. If we cease to maintain the power plant by interrupting the coal supply, the plant will soon stop its operations. If we cease to maintain the financial structure by stopping the returns to the investor, this will ultimately cease to function, and in turn the power plant will cease its operation. In either case the enterprise fails sooner or later and the public suffers.

Should Provide Stabilization Fund

The investor today is appreciating through lessons learned in the past that there is on hand no contingency or stabilization fund which will act as a reserve to provide for a return on the investment during periods of depression. Such a condition did not always exist. In the early days of the public service enterprise when the growth was comparatively slow owing to the newness of the art and rates for service were high and expenses low, many successful companies established a contingency or stabilization fund. In the later days of the exploiter this fund was used to furnish a return on securities issued but not represented by cash or services in the physical structure.

When the price fixing of service was put into effect, the importance of the contingency fund was not appreciated and its establishment was not permitted, and as a result, the value of common stock as a means of permanent financing, which is the foundation in any enterprise, was lost sight of. In an effort to continue to meet the demands of the public for extensions and additions to the physical structure, a stock was created which took a preference over this common stock, and on this the returns on the common stock acted as a contingency or stabilization fund. As the amount of preferred stock grew, such fund became inadequate to protect the preferred stock investor. At this point both classes of investors ceased further investment in the enterprise, which was then forced to borrow. All returns to the investor in common and preferred stocks now become the contingency or stabilization fund of the lender or bondholder. The point has now been reached, however, where in many cases even the requirements of the lender cannot be met and the financial structure as it now exists is once more in trouble.

Return on investment is not permanently fixed, but varies from time to time, depending upon money market conditions and investment risk. The basis upon which a stock sells may vary at time from 6 to 10 per cent or more, depending upon the market price of money and whether or not a loan is placed ahead and secured by the investment. The investor is compelled to assume the risk of a loan ahead of the investment in order to meet the demands of the public for extensions to the physical property at a time when, owing to money market conditions, the investment cannot be increased because the rate of return permitted has been fixed below market requirements. In this connection the public and the commissions compare the rate of return to the lender with that to the investor, without giving due importance to risk to the investor. The lender is secured in the loan not only by property represented by such loan but by all the property owned by the investor, while the investor has remaining only a conditional claim on the investment.

Then again the lender (bond or note holder) must ultimately be paid back, and there are only three ways in which the investor can accomplish this—first, by earnings or returns from service, which the public must pay; second, by the investor increasing his investment so that the lender can be paid off, an object that can be accomplished only when the investor receives a rate of return which will encourage such additional investment, this being the only plan, moreover, which will finally restore the financial structure to a permanent basis; third, by again borrowing to pay off the loan, which is the method adopted generally, but which involves a continual refinancing through loans either for short or long periods the expense of which must be recognized in the rate for service.

Relative Returns to Lender and Investor

The relative positions occupied by the lender and the investor in the financial structure are important in determining return. If the lender, or bondholder, demands a return of 5 per cent, then the preferred stockholder, or investor, should be entitled to a return of 7 per cent, the increase being commensurate with the risk, and the common stockholder, who assumes the greatest risk, should be entitled to a return of 10 per cent. These figures, however, are based on a loan extending over a long period during which the stockholders have an opportunity to take advantage of cheaper money to pay off the lender. If the loan is for a short period, the chance of protecting the investment is materially reduced, the investment becomes more speculative and therefore is entitled to more return.

Ratio of Bonds, Preferred and Common Stock

In a case where the financial structure is made up of 50 per cent in 5 per cent bonds, 25 per cent in 7 per cent preferred stock and 25 per cent in 10 per cent common stock, the return on the total capital would be somewhat less than 7 per cent, but if market conditions require a 6 per cent bond, 8 per cent preferred stock and 12 per cent common stock, the return on the total capital becomes 7½ per cent. This rate of return, however, is not the cost of money to the enterprise, and in this connection regulating bodies often err. To arrive at the cost of money to the enterprise there must be added to any return to the lender or investor all expense necessary to transfer the money to the enterprise, corresponding in a way to transportation of coal to the power plant. In addition to the cost of distribution of securities, which may vary over a wide range, financial expenses include cost of legal, accounting and engineering services, disbursements in connection with proceedings before regulating bodies, taxes on securities, printing or engraving of certificates and numerous other items which always accompany new financing. In the case of short-term bonds or notes where the loan is for a small amount the cost has in many cases exceeded materially the amount paid for interest. There are many instances on record where short-term financing has cost from 14 to 16 per cent and more, although the interest rate has been but 7 per cent.

Then again the cost of money depends to an extent upon the action of regulating bodies. The securities are created and marketed as money is required, under money-market conditions which are subject to change during the deliberation of the regulating bodies. In many cases in the past owing to the vast amount of detail work in the hands of the regulating bodies there have been delays in securing prompt approvals, during which time the cost of money has increased from 30 to 50 per cent.

Must Increase Sale of Common Stock

For the past five years public service enterprises have had all they could do to meet the constantly increasing cost of labor, coal and material by getting rate increases that enabled them merely to exist and continue as solvent concerns. It has not been possible, therefore, for the enterprises themselves, the commissions or the public to give full consideration to some of the broad questions which must now be fairly passed upon and settled if these enterprises are to continue to serve and satisfy the demands as to extensions. To return to a proper basis means not only that enough money must be earned to pay a cash return on the common stock which would make additional stock of this class salable in competition with other securities, but that common stock should be permitted some of the cash return which it has had to forego during the past five years. Otherwise investors will not be attracted to the enterprise, because it will be apparent that in another period of similar financial stress they will again be without any return on their investment. But, more than this, a contingency or stabilization fund must be built up to safeguard return.

Regulation Should Draw Investors to Utilities

There has been a widespread belief in many communities that recent rate increases are satisfactorily meeting all problems. This is not the fact. Such increases have barely been sufficient to provide for the increased cost of coal, labor and materials. The final problem to be solved is the renewed interest of the investor or stockholder and the gradual elimination of the lender or bondholder, and no enterprise can find this solution unless the investment of common stock is paying in cash a proper rate of return after provision for all reserves and contingencies.

If such a market is created, it will of itself create the best regulation. An enterprise whose common stock has been selling at premium for a substantial period can obtain capital for extensions so that all increased economies can be passed down to the public. It will then be the duty of the public service commission to see that all further economies are shared by the public and by the investor.

Unusual Industrial Heating Developments

Possibilities of Electrical Service of This Kind Shown by Variety of New Applications—Central Stations and Manufacturers Should Combine Efforts in Developing a Field Which Eventually Should Be as Large as Motor Load

By WIRT S. SCOTT
Manager Industrial Heating Section Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE electrical manufacturers apparently appreciate more fully than central stations the tremendous possibilities in the development of the industrial heating load, but they alone cannot develop this field. So far the electrical manufacturers have done the major part in the investigation and application work, at a considerable expense and with comparatively little help from the central-station companies, which in the long run will be the greatest beneficiaries, since the purchase of power goes on continually. The leading electrical manufacturers have organized separate departments for industrial heating work, are developing apparatus to meet the requirements just as rapidly as possible, and are training a corps of specialists for the development and handling of this comparatively new field of business.

It is only a matter of time until every central station throughout the country will have as many power salesmen engaged in industrial heating work as it now has on industrial motor work. The available business is there for the going after, and the character of load is almost ideal. If the electrical manufacturers, with their limited number of experts, can accomplish in one year the work that was accomplished during 1920, what could be accomplished in 1921 if each central station would put on specialists for the development of a field larger than the motor load—that of industrial heating?

Development of Electric Air Heating for Textile Mills

One of the most interesting and progressive steps made up to the present is the heating of a large textile mill electrically. It has been an accepted fundamental principle that electricity could not compete with coal for the heating of buildings. Recent investigations have been made, however, which show that electricity can compete with coal, taking all the facts into consideration, when energy is obtainable at 1 cent a kilowatt-hour and coal is $8 a ton.

The Canadian Cotton Company of Canada, after a thorough investigation and examination, has entered into a contract for the electrical heating of one of the new mills it is building at Milltown, New Brunswick. The building is 184 ft. (57 m.) wide by 410 ft. (134 m.) long, two stories high, and has an installed capacity of 2,200 kw. for maintaining a temperature of 65 deg. Fahr. within the building when the outside temperature is 20 deg. below zero.

A hot-air system of heating is employed, this being recognized as the most effective manner of heating the building, besides providing good ventilation at all times. During the summer the system may be operated as a strictly ventilating system without the heat being on. This does not interfere with the humidifying system usually employed in textile mills, and as a matter of fact it should result in a more uniform humidity being maintained.

The heaters are concentrated into two centralized systems, one for each half of the building, and are placed in housings similar to those used with steam coils, the air being drawn through the heaters by a suction fan and distributed through the building by means of vent pipes.

Electric contact-making thermostats are used for maintaining the temperature constant within narrow limits. These, in connection with magnetic contactors, hold the temperature constant, continually and entirely automatically, at 65 deg. Fahr. throughout the entire twenty-four hours, irrespective of the outside temperature. The installation is thoroughly safeguarded, so that in the event of the power going off the motor driving the exhaust fans the current is automatically cut off from the heaters. It is further safeguarded to the extent that if the temperature within the heater housing goes beyond a predetermined limit the heaters are automatically disconnected from the line. In the event that the temperature within the room should go beyond a given point owing to the possible failure of the controlling thermostats a separately operated thermostat will cause the sounding of a loud gong, which will be sufficient to attract the attention of the watchman day or night.

By the electric heating of mills, particularly where water power is available, an enormous opportunity is provided for conserving natural resources, especially coal. It is to be hoped that steps will be taken at once by those companies fortunate enough to operate plants deriving their power from waterfalls, or those that purchase power from water-power plants, to investigate the advantages offered by means of electric heating.

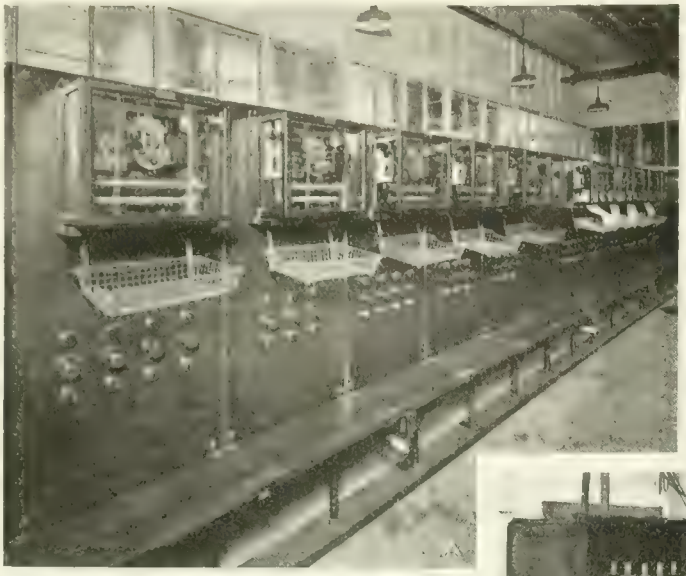
Electric Core Baking Showing Progress

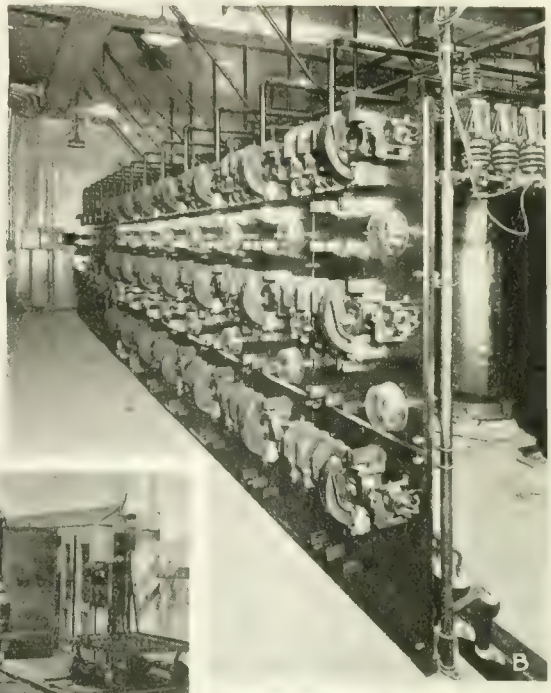
Scientific baking of cores has been almost an unknown subject in this country and through ignorance has resulted in a waste in labor, material and fuel. A visit to the foundries will demonstrate that not one-half of the core-baking ovens have thermometers on the ovens to indicate the temperature. Furthermore, very little attention is given as to the amount of ventilation required, and those who make a pretence of controlling it do so on a hit-and-miss basis.

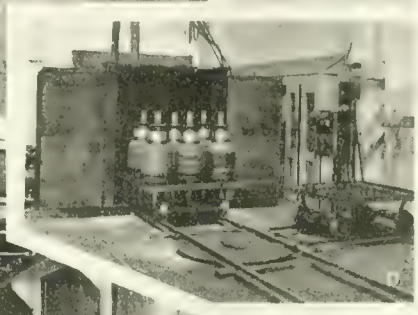
On the basis that there is one best operating temperature in any heating process, and that there is a definite best rate for heating up any piece of work to that temperature, attention has been turned to the core-baking field as virgin territory.

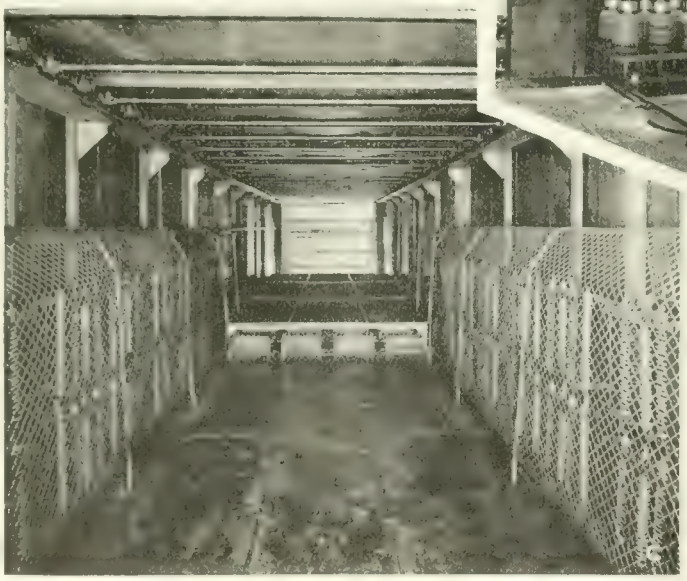
There has been comparatively little done in electrifying core-baking ovens in the past, owing primarily to the lack of specific data as to the advantages to be gained by heating core ovens electrically. There was

Electric Heating Is Becoming Very Important in Industrial Production Processes

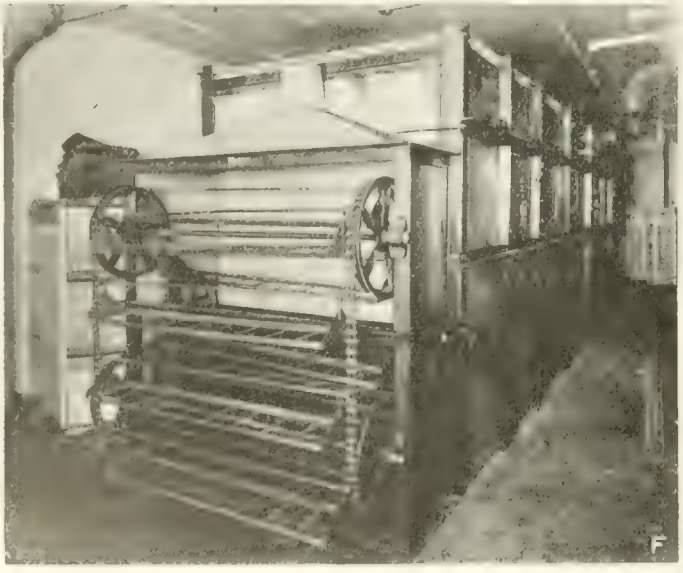












In *A*, *B*, *C* and *E* are shown some details of interesting installations in the new plant of the Cadillac Motor Company. The instrument board *A* is for controlling and recording the temperature of the electric ovens, while *B* shows the circuit-control panel for the heating equipment, totaling 2,000 kw., in the enameling ovens. In *C* and *E* are shown inside and outside views of one of the continuous conveyor ovens. The oven is 12 ft. wide, 145 ft. long and 8 ft. high. The heater capacity is 450 kw. Parts to be enameled are hung from the conveyor bars at the top (*C*) and move through the oven after having been dipped in the enamel tank shown in the foreground of *E*.

The armature baking oven, shown in *D*, holds eighteen armatures, six being placed on each of three trucks. The continuous bread-baking oven shown at *E* is used by Fisher Brothers, Cleveland, Ohio. The bread moves through the oven continuously with a baking time of thirty-five minutes.

no questioning that it could be done, but there were almost no data showing the effect of baking cores electrically and scientifically.

The Westinghouse Electric & Manufacturing Company undertook the work of investigating the baking of cores electrically, carrying out this research work along lines of investigation made in connection with other baking processes which now have become standards for many industrial plants.*

The research department was placed in charge of the investigation work and a core-baking oven was purchased and installed in the brass foundry. Tests were run, extending over a period of six months, during which time cores of various mixtures were baked, with varying amounts of ventilation and at different temperatures.

The conclusion of these tests resulted in very strong recommendations being made by the process and materials department of the Westinghouse company for the adoption of electric heating in its brass foundry, with the result that the electric oven, which was purchased on an experimental order, has been taken over by the works and is now in daily operation.

Typical Uses to Which Electric Heat Can Be Applied

Tests show that the bread baked in an electric oven is much more uniformly baked than when a gas oven of similar design is used. The conveyor type of oven has found favor among commercial bakeries, Fisher Brothers, Cleveland, having an installation rated at 900 1.5-lb. or 1,350 1-lb. loaves per hour. The oven is equipped with fifty-six heaters rated at 140 kw. and 220 volts and has automatic temperature control.

Armature-baking ovens have been made for the purpose of determining the advantages in baking railway motor armatures electrically, with the result that process specifications have been prepared covering the complete method of handling armatures and field coils in order to insure the fullest benefit from electric heat. It was found that three sizes of ovens fill nearly all the requirements of the field. Beyond a certain size it is better to install more than one oven.

Many of these ovens have been installed during the past year, with the result that this method of baking is becoming quite extensively used. Tests have shown conclusively that a dipped and baked armature has a much longer life and that trips to the repair shop are greatly reduced in number. An electrically heated oven materially shortens the time a motor is out of service. Owing to the automatic temperature control there is no danger of overbaking.

An electrically heated oven does not require expert supervision in its installation or operation, as is shown by the fact that several have been installed by men who had never seen this equipment except in catalogs but are now operating the ovens with complete success in the baking of railway armatures, field coils and other apparatus.

Three noteworthy installations have just been completed for the baking of enamel on automobile fenders, hoods and other accessories at the plants of the Cadillac Motor Car Company, Detroit; the Packard Motor Car Company, Detroit, and the Buick Motor Car Company, St. Louis. The ovens at the Cadillac and Buick plants are of the continuous-conveyor type, the work being hung on an overhead moving conveyor which automatically carries the parts down into the dip tank of enamel, up the drain board, into and through the ovens, progressing through three ovens continuously for three-coat baking, without removing the work from the conveyor. In the Cadillac ovens there is an installation of 2,000 kw., and in the Buick ovens one of 1,600 kw. These ovens are maintained at 450 deg. Fahr. by means of automatic temperature-control equipment.

The Packard Motor Car Company installed an equipment which consisted of twenty-two semi-continuous conveyor-oven equipments, requiring a capacity of 3,120 kw. The temperature of each oven is automatically controlled. The Packard company previously had some twelve or fifteen electrically heated ovens in operation.

During the past year considerable experimenting has been done and much progress made in the development of reliable and satisfactory high-temperature heat-treating furnaces, with the result that there are now available electric furnaces for working temperatures up to 2,000 deg. Fahr. A 120-kw. furnace has been in operation for more than a year heat-treating automobile springs. It is operated at 1,560 deg. Fahr. Two tests made at different intervals show consumptions of 1,520 kw.-hr. for 15,000 lb. (6,800 kg.) of springs and 1,550 kw.-hr. for 16,330 lb. (7,400 kg.) of springs treated. Initial temperature of steel, 70 deg. Fahr. Weight of charge, 675 lb. (306 kg.).

One of the interesting applications has been the annealing of hotel glassware in a 72-kw. furnace at a temperature of 1,200 deg. Fahr. This furnace is 22 in. wide, 10 ft. long and 5 ft. high (56 cm. x 3 m. x 1.5 m.), of the overhead-conveyor type. Several thousand goblets were annealed, the goblets being placed in metal containers consisting of nine trays, each tray holding twenty-five goblets, five in each row and five rows deep.

Special Heat-Treating Applications

During the war period 3,500,000 safety springs for shrapnel fuses were heat-treated in an electric furnace at a temperature of 1,200 deg. Fahr. without a single rejection and without reheating any batch. The shrapnel-fuse springs were heat-treated in brass tubes into which was poured approximately one teaspoonful of water. Conversion of the water into steam prevented oxidation. Approximately 550 lb. of brass, including container tubes, was heat-treated every twenty minutes. Hand control was used, consisting of a transformer having a large number of taps, with radial knife switches. The temperature and time of heating were announced by a specially built alarm clock ringing at irregular predetermined periods, such as one minute, three minutes, two minutes, at which times the operator placed the radial switches in certain predetermined contact positions. With a fuel-fired furnace an exact, predetermined, step-by-step temperature control is impossible, and it was only by the use of the electric furnace, in which the heating was done on all four sides, bottom, top and sides, that the results as above outlined could be obtained.

An electric furnace is in operation heat-treating approximately 4,000 lb. of brass per week for the United States government. This is the only type of furnace which can uniformly control the crystallization of brass according to rigid specifications of the United States.

Fusing bifocal lenses must be done at a critical temperature, requiring a uniform temperature to pre-

*The results of these tests are shown in an article, "Electrifying the Foundry Core Room," by J. L. Jones, in the Dec. 18, 1920, issue of the ELECTRICAL WORLD.

vent resulting strains and a clean atmosphere to prevent spoiling the polished faces of the lenses being fused. The lenses are placed on small plaques, four per plaque, and each plaque is covered with a vitreous enameled-steel square cup, fed automatically through the furnace chamber and discharged into an annealing lehr. The furnace chamber is in four sections, two sections 18 in. (45 cm.) long, each maintained at a different temperature. The annealing lehr is 60 ft. (18 m.) long.

When the work was carried on originally through gas-fired furnaces the loss was approximately 20 per cent, whereas the average loss now is 3 to 4 per cent electrically treated.

Tests were made to determine the practicability of using an electric furnace for vitreous enamel kitchenware. Thirty-six miscellaneous pieces were fired in the furnace, and a most careful inspection showed that the results were perfect as to polish, absence of pitting and general smoothness. Owing to the ease with which a definite temperature could be maintained it was a very easy matter to secure results of the highest order, with almost no attention.

Among the numerous reasons advanced for the phenomenal development of electric heating are the following: No combustible gases are generated in the electric furnace; no stacks are required, therefore the efficiency is much higher than in furnaces of the combustion type; there is no escaping gas, no odor and no smoke from the electric furnace.

Power Possibilities of Austria*

Total Water Power Capable of Development in That Country Is Estimated at 1,500,000 Hp.—New Republic Has 460 Stations

By J. Seidener and A. Gruenhut
Editors *Elektrotechnik und Maschinenbau*, Vienna

In a previous article (Electrical World, Nov. 27, 1920) the effect of the war on the electrical industry of Austria was shown, and the statement was made that the markets of east Europe could be reached more cheaply from Austria than from the United States. As a result it was maintained that the opportunities for American capital are promising.

While the new Austrian Republic is lacking in minerals, and particularly coal, there is an abundance of undeveloped water power. Excluding western Hungary and the district of Kärnten, there is available 1,500,000 hp., not including sources rated under 1,000 hp. Estimated total water power may be put at 3,000,000 hp. Of the 1,500,000 hp. available only about 150,000 hp., or 10 per cent, is being utilized at present.

Other sources of energy are only available in the form of small amounts of inferior coal. These deposits are so small that they will be consumed in fifty to sixty years at the present rate of demand. There are no petroleum or natural-gas resources.

For the determination of the power requirements the consumption of coal will be considered first. A total of 1,156,000 tons of coal and 110,000 tons of coke is needed per month, which equals 15,500,000 tons of coal per year. The yearly output of Austrian coal being about 2,200,000 tons, 85 per cent of the coal needed must be imported. An investigation of the main power consumers—first, the power houses of Vienna; second, the combined industries, and, third, the main railway lines of the republic—shows a possible replacement of caloric power by hydro-electric power of respectively 450,000 tons, 3,000,000 tons and 1,200,000 tons, or a total of about 4,500,000 tons.

If it be assumed that this replaced coal consists of 50 per cent anthracite and 50 per cent low-grade coal, 3.3 lb. (1½ kg.) of this mixture will be required per horsepower-hour, or, calculated on a basis of 3,000 operating hours, a total of about 900,000 hp. If it be assumed that the coal to be replaced by hydro-electric energy is full-grade anthracite with a heating value of 11,400 B.t.u. per pound (6,000 calories per kg.), giving 1 hp.-hr. per 2.2 lb. (1 kg.), a similar calculation would result in a total of 1,350,000 hp. To these figures a total of about 100,000 hp. would have to be added to take account of power generated by gasoline and crude-oil motors in small industries. This all sums up in a grand total of about 1,000,000 hp. of hydro-electric energy required for the republic.

DEVELOPABLE WATER POWERS OF THE AUSTRIAN REPUBLIC

This tabulation shows a rather high average per square mile and also a decided decrease toward the east.

	Hp.	Area in Sq. Miles	Hp. per Sq. Mile
*Lower Austria	231,800	7,150	32 4
*Upper Austria	314,700	4,630	67 8
Salzburg	111,450	2,760	40 3
Steiermark	294,850	6,220	47 4
Kärnten	146,200	2,900	50 4
Tirol	302,600	4,940	61 2
Vorarlberg	85,000	1,000	85 0
Total	1,486,000		Avg. 55 0

*Including the Danube

Status of the General Electrification

The amount of 5,000,000,000 crowns has been appropriated by the government as an investment for five years for railway electrification. The salient points of the railway program are a single-phase system with 15,000-volt trolley line at 16⅔ cycles, such as is used successfully in Germany, Switzerland and Sweden; express locomotives of 3,000 hp. and 116 tons weight with 37 miles (70 km.) per hour maximum speed, and local passenger-train locomotives of 1,000 hp., 68 tons and 35 miles (65 km.) per hour maximum speed. A stretch of line in the Alps covering 404 miles (651 km.) will be electrified first, saving about 350,000 tons of coal per year. Later the 1,110 miles (1,788 km.) of main line will be electrified, a development which will require twelve to fifteen years to complete.

POSSIBLE SAVING IN COAL BY ELECTRIFICATION OF RAILWAYS AND INDUSTRIES

	Tons
Roads	1,200,000
Industries	2,700,000
Vienna	500,000
Total	4,400,000

A number of hydraulic power stations are to be erected near Vienna with the financial help of the city, the state of Lower Austria and possibly the State Railways and Danube Commission. To assist this action three new companies have been already formed, each holding franchise rights on water powers south of Vienna. Obstacles to the rapid progress of this large

*This article was contributed by the authors exclusively for the Electrical World.

program are the present lack of raw materials and coal, the difficulty of financing and a desire on the part of certain states to separate from the republic.

The ultimate realization of complete electrification of the roads and industries of Austria would mean in round figures the saving shown in the table.

Under the most favorable conditions three-tenths of the total requirement of coal will, therefore, be replaced by hydro-electric power.

Central-Station Development

Before the war the Austrian monarchy had 931 electric generating stations with a total rating of 540,000 kw. The republic has 460 stations with a total rating of 298,000 kw. Twenty new stations are under construction or will soon start operation. Of the total number 168 are operated by the communities in which they are situated, while 292 are in private possession. Service is supplied to 1,300 towns with a total population of 4,200,000. It may be assumed, therefore, that about one-third of Austria's population has no access to electric lines. These stations give occupation to 3,500 persons and represent an investment of 400,000,000 crowns. The number of small plants of less than 100 kw. and mostly operated with direct current is 300, or 70 per cent of the total number, but their output is only 4 per cent of the total. About 85 per cent of the energy is generated in 200 plants of more than 1,000 kw. capacity each, using exclusively three-phase, 50-cycle alternating current. Owing to the copper shortage during the war a great number of direct-current plants changed over to alternating-current, so that at present the direct-current plants represent barely 3 per cent of the total capacity.

Voltages Used in Austria

Approximately 70 per cent of the total output is generated in seventy plants at 5,000 volts and 7 per cent in fifty-nine plants at 3,000 volts, while 6,000 volts is used in a few plants. Transmission tensions used as standards are 10,000, 15,000, 25,000 and 35,000 volts. Stations using 100,000 volts are now under construction. Service voltage is two-wire, 220 volts, on direct-current networks and 380/220 volts on alternating-current lines with grounded neutral. The use of direct current at 110 volts is rapidly decreasing. About 85 per cent of all the plants are water-driven, and only one-third of these have a steam reserve. About 15,000 hp. is generated by gas or Diesel motors.

Municipal Power Station of Vienna

The municipal power station of Vienna is the most important and largest central electric station in Austria. Shortly before the war the last private plant had been taken over by the city, so that since that time not only all the power for the street railways but also 90 per cent of the light and power of Vienna has been furnished by the municipal plant. There were three generating stations in Vienna at that time, with machines totaling 172,000 hp. They served 450,000 consumers with a connected load of 280,000 kw. During the year 1914-1915 a total energy of 220,000,000 kw.-hr. was generated.

To utilize the low-grade coal mined 23 miles (38 km.) south of Vienna at Ebenfurt a power house was erected at the mouth of this mine and designed originally for 16,000 hp.

During the first months of the war the use of energy decreased. Soon, however, owing to the intense operations of war industries, the output increased rapidly, reaching a maximum of 280,000,000 kw.-hr. during 1917-1918. An increase in power of 20 per cent and a decrease in lighting of 11 per cent were noticed. The decrease in lighting was caused by the daylight-saving system and by ordinances imposing economy.

After the collapse of the monarchy conditions rapidly became worse, and during the year of 1918-1919 practically no coal reached the Viennese plants, the plants being, in consequence, thrown entirely upon their reserves.

Because of lack of workmen the plant at Ebenfurt had to be stopped almost entirely, and more drastic regulations for the use of light, and even of power, had to be imposed upon the consumers. While it has been possible to bring the Ebenfurt plant back to normal, and even to increased, output, foreign coal deliveries to Vienna have improved very slowly, and owing to their irregularity all ordinances in the interest of economy were left unchanged.

During the year 1919-1920 a marked increase of the connected load was made, and to meet all the demands would have required a total generation of 320,000,000 kw.-hr. Owing to the many and rigorous restrictions only 210,000,000 kw.-hr. could be delivered, or 35 per cent less than needed.

Methods Used to Solve Power Shortage

Several measures have been put in force to relieve the serious power shortage at Vienna. The first of these was an increase in the output of the Ebenfurt plant. New coal beds were opened up, a double shaft was sunk, and the total machine output was increased to 28,000 hp. The transmission voltage between this plant and Vienna will soon be raised from 35,000 to 70,000.

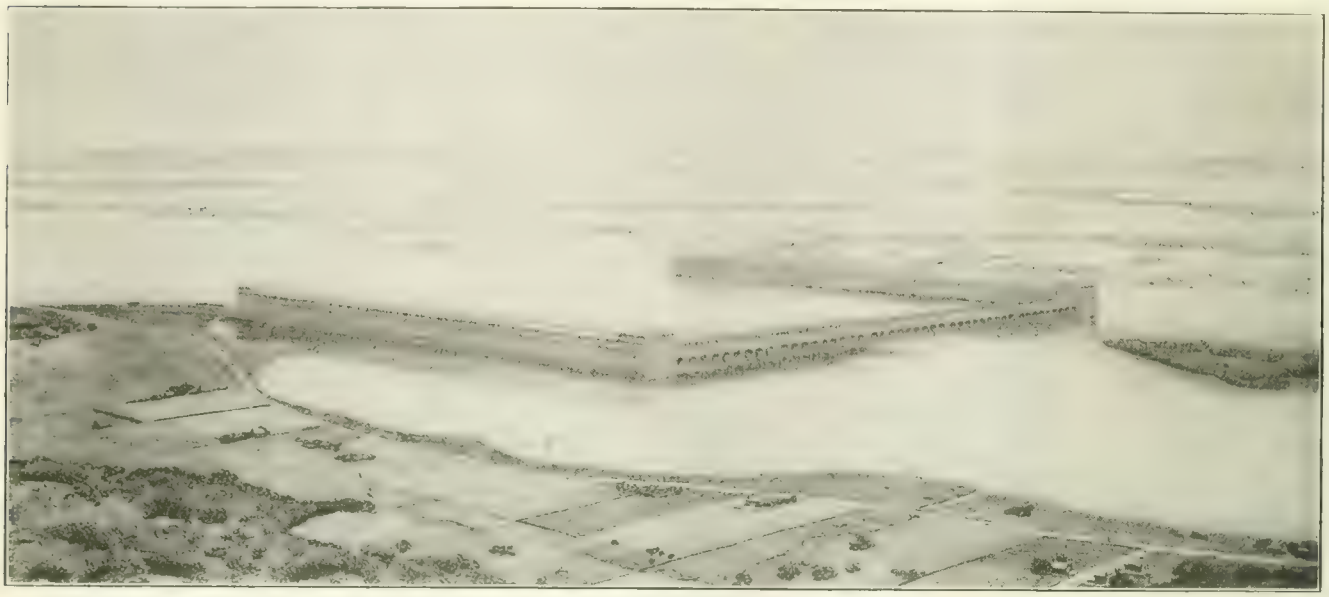
The grates of the boilers at Vienna will be changed over to use the low-grade coal from the Ebenfurt mines. Four modern steam turbines of 12,000 hp. to 16,000 hp. each will replace old reciprocating engines. The first of these is already in operation; the second should be in operation soon. Twelve boilers of the power house were changed over to oil firing. Several small hydro-electric plants near Vienna were tied in to the main 70,000-volt transmission line.

All these measures will soon make it possible to reduce the need for foreign coal to the small quantity at present available. The ultimate idea is to make Vienna totally independent of imported coal by increased production of Austrian coal and the addition of all available water power. Every possible means is being used to make this relief an actuality and thus render the repeal of the restrictive ordinances possible.

THE *commission in fixing a rate of return must be liberal, lest too strict a policy result in turning capital to other fields of enterprise. The commission's policy should be a broad and liberal one, so as to encourage capital to develop the state by legitimate public utility enterprises where needed. The commission should be careful not to permit an inflation of prices in ascertaining the value of the property of a public utility used and useful for the public purpose, but should be liberal in establishing the rate of return on that value.*—From decision of California Railroad Commission.

5,000,000 Hp. Available from St. Lawrence*

Joint Development of This Power and Locks Around the Dams Will Create 30-Ft. Channel from Great Lakes to Sea at 27 per Cent of Expenditure Required for Improving Navigation Alone—Methods of Conducting, Time Required and Market for Power



ARRANGEMENT OF DAM AND POWER HOUSES PROPOSED FOR DEVELOPMENT AT CROIL ISLAND

MOST suggestions for utilizing the power of the St. Lawrence River have made no provision for improving navigation of the river as a whole, despite the fact that nothing helps to develop a market for electrical energy more than good transportation facilities. However, a plan is now suggested whereby 5,000,000 hp. may be developed and a 30-ft. (9-m.) waterway provided at the same time for freight that must be transported between the Great Lakes and the Atlantic Ocean. By this joint development plan, and by this plan only, it is claimed that the navigation facilities can be provided for $150,000,000, or only 27 per cent of the expenditure that would be required if improvement of navigation were undertaken alone.

The proposed development involves the construction of five dams with a generating station at each end of each dam (an arrangement essential to the handling of the great ice flows of the St. Lawrence), the provision of a lock at each dam, and the deepening of the channel at the head of the Golops Rapids at the Long Sault and at Farran's Point. The dam which it would be most logical to construct first would be located near Croil Island, about 33 miles (53 km.) below Lake Ontario; the second would be installed near Massena Point, N. Y., about 15 miles (24 km.) farther downstream; the third would be about 44 miles (70 km.) farther along, near Cedars, Quebec; the fourth about 4½ miles (7.2 km.) below, near Cascades Point, Quebec, and the fifth about 20 miles (32 km.) downstream, near Côte St. Paul, Quebec. Approximately 40 ft. (64 km.) of head would be developed at each plant, the aggregate head being 196 ft. (315 km.). Locks would be provided at each dam to the total of six and would involve 3½ miles (5.6 km.) of canal.

The entire development, it is estimated, will cost approximately $1,300,000,000. The initial installation, 400,000 hp. of the Croil Island development, can be completed within five years. The remaining 600,000 hp. from this site can be installed in blocks of 50,000 hp. upon twenty months' notice as and when the demand for power requires it. Plants at the other four water-power sites can be constructed by the electric service companies now operating in the vicinity of them or can be installed by others. To recompense the existing operating companies which would be deprived of water they now use, they might be provided gratis with an amount of power equal to what they are now developing by the company, which would operate a new plant at the site. Development of plants Nos. 3 and 4 would provide 2,000,000 hp. for public consumption, compared with the 160,000 hp. now developed in the vicinity of these sites.

According to careful estimates, power can be made available to consumers from the proposed Croil Island development at $17 per horsepower-year. To judge whether there will be any difficulty in securing a market for the power made available, it is only necessary to compare the parallel development of industry and electric service facilities during the past few years. In general it can be said that industries will locate where price or reliability of power, availability of labor, railroad facilities and proximity to their market are most favorable. All of these requirements, especially those relating to power and transportation, will be met if the proposed joint development is completed.

The actual undertaking of this development cannot

*Statements extracted from a report which has been recently submitted to the International Joint Commission on navigation and power development of the St. Lawrence River between Lake Ontario and Montreal by Hugh L. Cooper & Company.

be expected to become an immediate reality, however, unless the governments of Canada and the United States, which have jurisdiction over boundary water-power development, will recognize the relative benefits of the proposed plan, will wave duties on construction materials and restrictions on labor, will consent to free interchange of power, and will allow rates for power which will be commensurate with the unusual financial and engineering factors involved. Furthermore, each government must provide, operate and maintain all navigation facilities and adjust all damages resulting from changes in water elevations.

Collectively, the Great Lakes, Niagara River and the St. Lawrence River are the largest undeveloped resources of their kind in the world, yet the ratio of present power development on these boundary waters to the ultimate possible is negligible. At present only about 850,000 hp. is developed at Niagara Falls, whereas at least 2,305,000 hp. can be developed without marring the beauty of the Falls. This additional available power plus the 5,000,000 hp. which can be developed as proposed on the St. Lawrence would provide a total additional 6,625,000 hp., or 66 per cent of the total water-power horsepower installed in the United States. Owing to the more constant flow of the Niagara and St. Lawrence Rivers, this power could be developed at 25 per cent higher load factor than the average in the United States and thus produce the equivalent of 82 per cent of the energy now generated by water power in this country.

Considering this enormous amount of available hydro-electric energy, increased importance should be attached to the following advantages of water-power development:

(a) Every 35 hydro horsepower which is developed releases one laboring man's efforts for one year for more profitable engagement. This means that 190,000 men would be made available by the proposed development for other business, say agriculture and industrial.

(b) Seventy times more labor is required to produce a given quantity of steam-electric power than to give the same quantity of hydro-electric power. This takes into consideration labor required in the mining of coal used as well as generating-plant personnel.

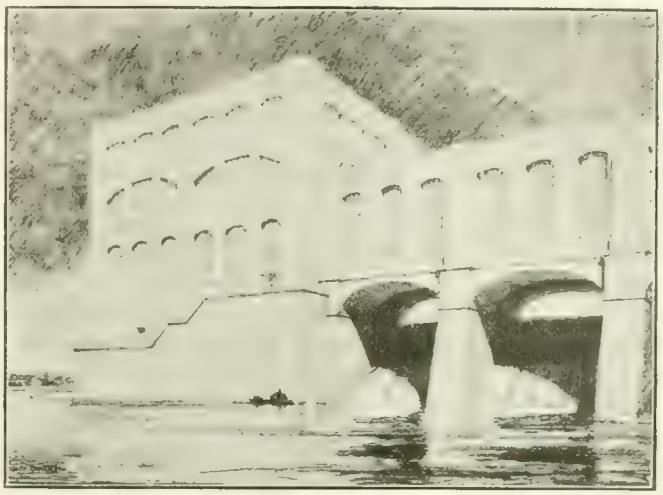
(c) Every hydro horsepower saves on the average more than 10 tons of coal per annum, or 66,250,000 tons in this case.

(d) Hydro-electric energy saves every consumer $35 per horsepower-year on the average, or $231,875,000 based on the proposed developments. This alone would justify an expenditure of $1,932,000,000 if capitalized at 12 per cent, the average return on industry before the war, or more than the proposed canalization and power development of the St. Lawrence River would cost.

(e) Water power reduces freight rates on general commodities through saving of coal and releasing railroad property and equipment for more productive uses. More specifically, 36,000 freight cars and 600 locomotives, valued at $141,000,000, would be released by this development, to say nothing of other railway property used solely in connection with this coal equipment and amounting to an additional $530,400,000.

Aside from the foregoing advantages would be the increased speed of traffic in the St. Lawrence River and the reduced rate per ton, the development of new industries, the reduction of coal exports to Canada and hence its greater availability at a lower ton cost in the United States and the increased business on the Erie Canal which would result from new industries.

According to records of recent traffic on the St. Lawrence River, it would require a tax of $6.66 per ton to cover the annual charges on the investment which would be required for an independent development of the navigation facilities. If this traffic could be quintupled by the improved facilities, which is possible, the tax would be $1.32 per ton; but this is prohibitive. The same traffic would have to be taxed only 36 cents per ton



DOWNSTREAM SIDE OF DAM WITH END OF POWER HOUSE ON LEFT

(about one-quarter as much) if the improvement of navigation should be accomplished jointly with power development as proposed.

The creation of a vast water-power zone, with the transportation facilities proposed, coupled with the existing excellent railroad facilities, nearness to large centers of population, sources of labor, supplies and so forth, would attract great chemical and fertilizer plants and other industries to which cheap reliable electric service is of paramount importance. The employment of labor and the circulation of wealth created by the production of these new industries would benefit not only the ten million industrial and agricultural people between the fortieth and fiftieth parallels but all North America. Based on the past relation between industrial growth and power development, the installation of 6,625,000 hp. could be expected to carry along with it the investment of at least $2,000,000,000 in new taxable industries. Including the investment in the hydro-electric plants, an outlay of $3,300,000,000 would be caused.

In some persons' minds, the report states, the question may arise, "Should the proposed development be financed, constructed and operated by private or by public capital?" The answer is emphatically that nothing should be undertaken by a government agency which can be accomplished by an intelligently regulated private agency. Despite the fact that there are some very able men in government service, they are in the minority, and energy and initiative are usually wanting or dormant in government undertakings. More zeal is usually devoted to holding jobs than to the execution of the work. Besides, there are some unusual financial and engineering problems involved in this proposed development which require unity of direction by men whose past achievements prove them amply capable of handling this undertaking. The best results can be obtained through competitive plans submitted by private capitalists and engineers.

Among the major engineering problems are the diversion of the St. Lawrence River by cofferdams, which

must be substantial enough to serve five years (the period of construction), preventing ice trouble and regulating the flow of the river. Four and one-half times the maximum amount of water ever diverted before—180,000 cu.ft. (5,000 cu.m.) per second—will have to be handled by cofferdams. To prevent ice troubles two principal methods are proposed: (1) By storing water for flushing the ice during the winter and early spring, and (2) by special construction and arrangement of each plant. The storage will be provided by regulating the level of Lake Ontario from the Croil Island dam so that 100,000 cu.ft. (2,800 cu.m.) per second extra is available continuously for 265 hours or in greater quantities for shorter periods if desired. Ice trouble will also be reduced or even eliminated by the construction shown, in which the power houses are arranged parallel to the stream flow so that water will enter the wheels at right angles to the river. Rugged, substantial piers extending upstream from the dam would serve to break any ice which approaches the dam. Provisions would also be made for heating the gates, gate seats, etc., to prevent attachment of ice.

Without stored water for flushing ice, the low unregulated flow of the St. Lawrence River—160,000 cu.ft. (4,500 cu.m.) per second—might be reduced to 60,000 cu.ft. (1,600 cu.m.) by ice as compared with the 224,000 cu.ft. (6,200 cu.m.) which may be obtained continuously with Lake Erie and Lake Ontario regulated or 217,000 cu.ft. (6,000 cu.m.) with only Lake Ontario regulated.

Water for regulating the flow of the St. Lawrence River would be obtained by controlling the level of Lake Ontario from Croil Island dam. The storage would permit momentary withdrawals of 280,000 cu.ft. (7,800 cu.m.) per second to carry peaks. All the plants might be expected to operate at approximately 80 per cent load factor. Thirty-six 17,000-hp. units would be installed in each station, the extra capacity above 50,000 hp. being provided to meet demands during reduced heads.

Correcting Wattmeter Readings for Phase-Angle Errors

Calculations Are Greatly Shortened by Use of a Chart—Method Is Particularly Good for Low-Power-Factor Measurements

By E. D. Doyle
Electrical Testing Laboratories, New York City

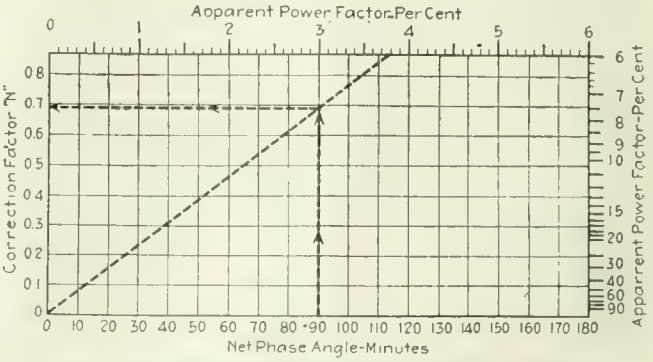
That wattmeters read incorrectly on low-power-factor circuits because of the phase angles of the wattmeter and the instrument transformers is generally recognized, and several methods of correction have been proposed.* These methods, however, are unsuitable for such low-power-factor measurements as are encountered in measuring losses in current-limiting reactors, high-voltage cables, and similar apparatus. The accompanying chart, devised by the writer in connection with some work at the Electrical Testing Laboratories, has proved very satisfactory in practice. The method is readily understood by reference to the chart and accompanying examples.

To make wattmeter corrections proceed as follows:

(1) Determine the net phase angle due to the reactance in the potential circuit of the wattmeter, the voltage transformer and the current transformer by reference to data from actual tests. Consider the wattmeter potential circuit phase angle as positive if inductance predominates and negative if capacitance predominates. Likewise the potential transformer phase angle is considered positive if it is an angle of lag and negative if an angle of lead. For the current transformer phase angles, however, an angle of lead is to be considered positive.

(2) Add the three angles and call their sum the net phase angle; express the result in minutes.

(3) Lay a straight edge on the curve from the point *O* to the apparent power factor; that is, the power factor



USEFUL CHART FOR CORRECTING WATTMETER READINGS

Examples:

(1) Apparent power factor, 3.78 per cent.
Net phase angle, 1 deg. 30 min. = 90 min.
Correction factor = 0.69. Multiplying factor = 0.31.

(2) Apparent power factor, 3.78 per cent.
Net phase angle, 0 deg. 9 min.
(Multiply by 10, work the same as first example and divide by 10.)
Correction factor = 0.069. Multiplying factor = 0.931.

as determined from the instruments in the secondary circuits of the instrument transformers.

(4) Follow up the required net phase-angle line to its intersection with the straight edge and then follow horizontally to the correction-factor scale. The correction factor is to be considered positive if the net phase angle is negative and the power factor is lagging, or if the net phase angle is positive and the power factor is leading. It is negative if the net phase angle is positive and the power factor is lagging, or if the net phase angle is negative and the power factor is leading.

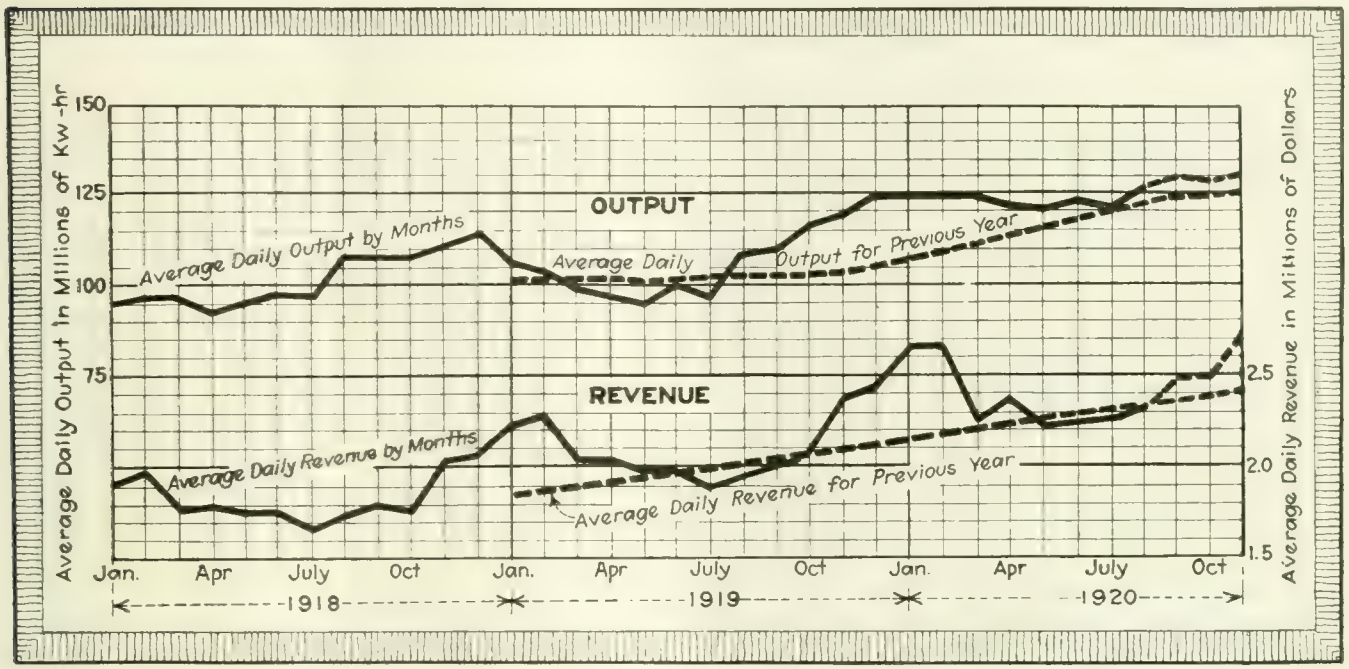
(5) Add or subtract the correction factor from 1, depending on its sign, and multiply the observed wattmeter reading, corrected for scale error, by this factor. Where the net phase angles are small and it is desired to read the correction factor with a higher degree of accuracy, multiply the phase angle by some factor, preferably 10 or 20, obtain a correction factor and divide by the same factor as was used as a multiplier before adding or subtracting from 1.

It will be noted that the chart goes up to 180 minutes—that is, 3 deg. An analysis of a large number of tests of current and voltage transformers shows that this range is more than ample. The only phase angles larger than 3 deg. which have been encountered were at 10 per cent load on current transformers, and they constituted less than 1 per cent of all that had been tested. In addition, both voltage and current transformers usually have leading angles which partially compensate each other. The largest phase angle which has been encountered in wattmeters has been less than 5 minutes at 60 cycles.

This chart may readily be copied, but the proof of its construction is beyond the scope of this article.

*Additive method of Dr. C. V. Drysdale (*Electrician*, London, Vol. 46, pages 774 to 778, 1901, and Vol. 76, pages 523 to 525, 1916), and the multiplying method given in the American "Handbook for Electrical Engineers," first edition, pages 1819 to 1822.

Record Output and Revenue in Spite of Industrial Depression



CENTRAL STATION INDUSTRY AS A WHOLE REPORTS RECORD OUTPUT AND REVENUE DURING NOVEMBER

THAT the central-station industry in general is riding the storm of industrial depression in a most gratifying manner is indicated by returns of central-station operations received by the ELECTRICAL WORLD for the month of November. A national record of 129,000,000 kw.-hr. average daily output was hung up in November, which is 700,000 kw.-hr. greater than the former high mark, established during the previous September. The total output was also 11.5 per cent greater than that reported in November, 1919.

Perhaps the most remarkable and gratifying fact, however, is that during a period when practically all other industries were curtailing operations on account of decreased income the central-station industry actually established a record for gross revenue. The figure of $2,710,000 average daily revenue recorded during November is 3.1 per cent greater than the previous record figure of $2,630,000, reported in January, 1920.

The demand for electrical energy for power purposes decreased on the average about 20 per cent below normal, but some industrial centers reported that energy sold to power customers during November was curtailed as much as 66⅔ per cent. Industrial curtailment was not, however, the only source of decreased energy requirement. In virtually all the Northern States a large number of office buildings and department stores run their own plants between October and April, during which period the demand for exhaust steam for heating enables them to operate their generating equipment economically. Notwithstanding these large deficiencies in energy requirements, seasonal increases in the lighting and heating load were sufficient to overcome the largely decreased industrial load except in a few highly industrial centers and in the Mountain and Pacific sections.

In New England large industrial curtailments were general throughout almost all industries. In the textile industry more than 2,680,000 fewer spindles were operating during November than during a similar period in 1919, and other large industries, such as the shoe industry, reported even more extensive cuts in factory operations. Yet the increased lighting and heating load was such that only a few central stations reported a decreased output for the month, and the average daily output of the section as a whole was slightly greater than that of October.

Notwithstanding the fact that in New York State

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Revenue from the Sale of Energy				Kw.-Hr. Output			
	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase
Dec.	59	$44,125 1920	$37,978 1919	16.0	65	2,509,571 1920	2,270,833 1919	10 0
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18.0
Feb.	63	45,881	37,502	22.1	69	2,494,764	1,986,493	25.3
Mar	65	46,155	36,840	25.0	70	2,698,890	2,103,587	28.0
April	65	45,547	36,541	24.5	70	2,603,692	2,098,559	24.1
May	65	43,888	35,512	23 4	70	2,631,560	2,179,916	21.2
June	66	44,434	35,528	24.5	71	2,630,831	2,175,645	20.2
July	66	46,608	36,265	28.5	71	2,677,131	2,234,215	20.0
Aug.	66	47,410	36,713	29 1	71	2,769,175	2,303,099	20.1
Sept.*	66	49,224	38,209	28 5	71	2,734,179	2,327,460	17.4
Oct.†	66	51,299	41,026	25.3	71	2,800,515	2,500,166	12.0
Nov.‡	66	53,844	44,278	21.5	71	2,748,311	2,469,738	11.5

* Includes estimates for twenty-six companies, representing 6 per cent of the total installed rating of all central stations.

† Includes estimates for thirty-five companies, representing 7.9 per cent of the total installed rating of all central stations.

‡ Includes estimates for seventy companies, representing 14.7 per cent of the total installed rating of all central stations.

alone more than 150,000 out of 359,000 persons employed in factories in a selected list of industries were idle, and that iron and steel operations in Pennsylvania were decreased, yet with but few exceptions every central station in the Middle Atlantic States reported increased output over October, and in many cases a record output. In the cotton states there were 165,395 fewer active spindles than during November, 1919, and ore mining was considerably curtailed. Increased lighting and heating requirements in the Atlantic States as a whole were sufficient, however, to record a central-station average daily output greater by almost a million kilowatt-hours than was reported for October.

The North Central section reported the largest aggregate gain of any section. Even the most intensely industrial centers showed only a small drop in output under October, and some large industrial cities showed a large increase. The central stations supplying mainly the country districts reported a largely increased output, and the average daily output for the section as a whole exceeded any previous record for that section.

The growing importance of the industrial load in the South Central States is evidenced by the fact that notwithstanding large increase in the lighting load, the average daily output of 8,500,000 kw.-hr. was less than that reported for October by 200,000 kw.-hr.

Industrial curtailments in the Pacific States, a slackening in mining operations throughout the Mountain States, greatly decreased operations in the lumber industry of both sections, and decreased irrigation pumping load by reason of heavy rains, account in a large degree for the decreased average daily output of the central stations in the Mountain and Pacific States during November. Some large industrial centers in this section reported increased output over October, but this was overcome by largely decreased output in other centers and in the mining regions.

Readers' Views and Comments

Efficiencies of Low-Head Plants

To the Editor of the ELECTRICAL WORLD:

SIR: In the Dec. 25 issue of the ELECTRICAL WORLD, page 1260, appeared an article by L. E. Ayres on developing low-head plants. This is a very interesting article, but I question some of the statements. Mr. Ayres points out that turbine efficiencies have been increased about 10 per cent during the past twenty-five years and that where an increase of 10 per cent is possible by replacing old with new turbines at least an additional 15 per cent may be expected from a well-designed modern setting.

In his illustration marked Fig. 1 he shows the old horizontal quadruplex units in comparison with a single-runner installation and states that at least 20 to 30 per cent is expected as a gain in efficiency. I would like to ask if it is not a fact that the quadruplex setting was for wheels that had already been in use over twenty years and had thus seen their best days and were worn out and ready for the scrap pile.

Mr. Ayres makes a point of the saving in length of penstock, but says nothing of the greater width and depth necessary. It is generally known that water to be efficiently handled must be within certain velocities, and this dictates the capacity of waterways. Thus if you save in one direction by length, as noted in his article, it must be made up for by greater width and depth. From his illustration, Fig. 1, again, the elevation of bottom

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States			
		Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1919 Thousands	1918 Thousands	Per Cent Increase
REVENUE	Dec.	73	$4,908	$4,254	15.1	57	$15,926	$13,806	15 8	49	$11,660	$9,833	18 3	44	$2,496	$2,070	20.0	77	$9,135	$8,015	14 2
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	5,635	4,718	19 8	59	17,659	14,625	20.9	51	12,885	10,799	19.6	53	3,047	2,538	19.9	75	7,388	6,322	16.1
	Feb	82	5,354	4,368	22 1	61	17,245	14,343	20 4	55	13,191	10,403	26.0	53	2,949	2,360	24.7	79	7,142	6,028	18.3
	Mar	82	5,136	4,044	27 0	63	17,696	14,299	23.7	57	13,270	10,469	26.5	54	2,910	2,287	27 8	79	7,148	5,741	24.2
	April	82	5,087	3,943	29.0	64	17,700	14,383	23.5	57	12,690	10,042	26.9	54	2,952	2,181	35.2	79	7,118	5,992	19.2
	May	82	4,897	3,741	30 1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32.0	79	7,067	6,147	15.1
	June	82	4,948	3,778	30 5	65	16,525	13,449	22 1	57	12,412	9,776	26.9	54	2,849	2,127	33.9	79	7,700	6,398	20.5
	July	82	5,009	3,802	28 5	65	16,899	13,438	25 5	57	12,822	9,793	30.9	54	2,747	2,194	35.0	79	9,131	6,948	31.5
	Aug	82	5,075	4,093	24.0	65	17,210	13,731	25.9	57	13,497	10,151	32.9	54	3,168	2,281	38.1	79	8,460	6,457	31 1
	Sept	82	5,409	4,296	25.9	65	18,081	14,456	24.5	57	13,834	10,522	31.5	54	3,262	2,386	36.5	79	8,638	6,549	32.0
	Oct	82	5,689	4,623	22.9	65	19,205	15,724	22 0	57	14,458	11,667	23.9	54	3,504	2,551	36.9	79	8,443	6,461	31.0
	Nov.	82	5,917	5,014	15.5	65	20,876	17,080	22.2	57	14,795	12,497	18.1	54	3,793	2,905	30.2	79	8,463	6,782	24 5
KW.-HR. OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918			1919	1918	
	Dec.	73	180,493	152,304	18.0	58	803,165	733,222	8.9	67	825,313	713,959	15.8	44	88,658	73,728	20.1	77	611,942	597,620	2.5
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan	78	207,158	159,773	29.8	60	853,057	717,303	19.2	69	841,841	731,758	15.2	56	140,736	117,677	19.9	75	538,304	460,221	16.2
	Feb.	82	187,264	148,103	26.2	62	809,865	672,836	20.1	73	858,939	663,523	29.4	56	130,473	98,098	33.0	79	508,223	403,933	26.1
	Mar.	82	198,603	148,512	33.7	64	897,327	711,828	26.0	74	913,659	711,761	28.1	56	137,306	102,545	33.6	79	551,995	428,941	28.6
	April.	82	187,174	144,922	29.1	65	883,264	701,778	25.9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May	82	188,566	148,186	27.5	65	854,631	711,276	20.0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June.	82	189,934	149,607	26.5	66	865,714	721,688	19.9	74	855,013	681,780	25.5	56	132,733	99,660	33.2	79	587,437	522,901	12.2
	July	82	190,668	159,000	20.0	66	881,241	714,485	23.5	74	841,351	702,302	19.7	56	138,937	106,460	30 1	79	614,934	551,959	13.4
	Aug.	82	194,028	171,002	13.5	66	905,170	728,097	24.2	74	891,712	750,787	18.6	56	147,082	111,573	32.0	79	631,183	541,640	16.5
	Sept.	82	194,730	170,593	14.1	66	905 872	758,737	19.5	74	878,237	758,017	15.9	56	147,524	113,649	30 0	79	607,816	526,464	15.5
	Oct.	82	196,512	190,727	3.1	66	964,550	842,535	14.1	74	896,241	817,757	9.5	56	157,267	126,769	24 0	79	585,945	522,378	12.0
	Nov.	82	193,567	183,151	5.9	66	953,196	825,452	15.9	74	896,944	829,452	8.1	56	143,468	124,280	15.0	79	561,136	507,403	11.0

of intake was originally 100, which in the new plant was made 96, thus showing that my contention is correct. I would further ask whether the saving in cost made possible by the decreased length, assuming there is no greater width required, is not more than eaten up in cost of this special draft tube.

Mr. Ayers gives the efficiencies of the Nagler wheel as 85 per cent and 86.7 per cent, saying they are only about 2½ per cent lower than the best standard-type runners. This is not in accordance with recorded facts, for there are many official tests of standard wheels, and one especially, the "Leffel runner test (Holyoke), No. 2,359," which gave as high as 93.07 per cent. This is 6.37 per cent higher than any test he shows for the Nagler wheel.

Mr. Ayres states further than this deficiency in the Nagler wheel is compensated for by the increased efficiency in the generator due to the higher speed of the Nagler wheel. Again this is incorrect, for there could not be that much difference in generator efficiencies for the difference in the speeds possible. I make this claim

EFFICIENCY (IN PERCENTAGE) OF 500-KVA. ALTERNATORS, THREE-PHASE, 60 CYCLES, 2,300 VOLTS

Load	200 R.p.m.	150 R.p.m.	138 R.p.m.
Full	91.6	90.7	90.6
Three-quarters	91.4	90.5	90.5
One-half	90.1	89.7	89.7

on the basis of guaranteed certified tests from one of the big electrical firms for a project I am now handling where the sizes are almost duplicates of those he discusses. I show in the accompanying table the efficiencies obtained.

There is, therefore, according to Mr. Ayres' statements, a loss of 2½ per cent between the Nagler wheel and a standard modern make of wheel. The generator efficiencies of my table show only 1 per cent maximum loss, leaving the Nagler wheel still a loser of efficiency by 1½ per cent.

I would finally ask Mr. Ayres if it is not a fact that all engineers and most buyers are capitalizing on high efficiencies, and if this be true, why the standard makes of wheels are not a better purchase.

H. H. WHITE,
District Engineer.

The James Leffel & Company,
Atlanta, Ga.

Safety Code Administration

To the Editor of the ELECTRICAL WORLD:

SIR: In answer to inquiries addressed to me for further information in connection with my statement regarding California's Electrical Safety Code, as published in the ELECTRICAL WORLD for Dec. 25, 1920, page 1275, the following is submitted:

Many theories have been advanced from time to time concerning the practicability of administering codes for the prevention of fires and accidents arising in both cases from electrical causes by the same administrative authority. A fire code is designed to reduce property loss directly traceable to fires of electrical origin by incorporating certain specific requirements dealing with electrical materials and installation methods adherence to which should reduce that possibility to a minimum. The California "Electrical Utilization Safety Orders," on the other hand, have for their object reduction of electrical accidents from shock, flash, burn or otherwise. Both of these codes have a distinct value, the extent of this benefit to the people depending largely upon the reasonableness of the rules, the amount of intelligence used in their enforcement and the degree of compliance.

In order that the rules themselves should be just and reasonable, they should be drawn by those who will afterward be called upon to obey them. That they should be intelligently enforced required the services of competent inspectors and the adoption of a plan of rigid inspection, together with an impartial report system by the inspection department. The chief requisites of an efficient inspector are a clear understanding of the rules he is called upon to administer and a marked familiarity with modern electrical devices and practices, together with a knowledge of industrial and commercial applications of electricity.

A close study forces the conclusion that it is difficult indeed to draw a hard and fast line distinguishing between a fire hazard on the one hand and an accident hazard on the other as a given defect may under certain circumstances conduce to either one or even to both. The enforcement of an electrical fire code, therefore, does not call for specialized training of inspectors, and our experience in actual practice has been that a qualified inspector is able to handle both fire and accident inspection work.

The need of uniformity of regulations in the installation of electrical equipment and devices is very real. In California there are at present about thirty-eight municipal ordinances, each differing more or less widely, and therefore no small amount of dissatisfaction and confusion is caused. Our contention has always been that under the same conditions of equipment and construction a hazard would be just the same regardless of the geographical location, and for that reason a requirement inside or outside of fixed fire limits should be the same in Los Angeles, for example, as in San Francisco or any other city of the first class, and the same should hold true for other municipalities of a given classification.

The hope then, of uniformity lies in a state-wide code for prevention of both fire and accidents arising from electrical causes. In the event that this single code combines all the essential requirements of the National Electrical Code and other rules for fire prevention equally valuable, together with reasonable rules formulated for accident prevention, will not the interests of the people be conserved and will not the principal object sought be fully realized?

After three years' experience in administering the provisions of the National Electrical Code, as published by the National Fire Protection Association, and the "Electrical Utilization Safety Orders" of our California Industrial Accident Commission, we are convinced of the practicability of and the necessity for a complete electrical code. Tentative copies of this enlarged code may be available about the early part of March.

ROBERT L. ELTRINGHAM,
Electrical Engineer.

California Industrial Accident Commission,
San Francisco, Cal.

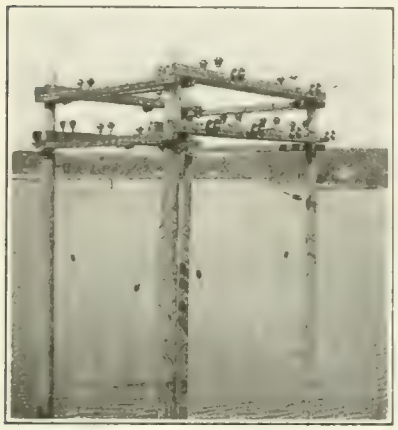
REWARD *as an incentive is closely allied to pain. It spells security for one's self and family. It is one of the things which must be attended to if effective action is to be maintained. There is also a definite relation between reward and the instinct to achieve, but concentration upon the thought of the reward short-circuits the whole creative process.*—CHARLES P. STEINMETZ.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Four-Pole Rack for River Span

A FOUR-POLE rack with concrete base supports the 500-ft. span across the St. Joseph River at Berrien Springs, Mich. The rack, which was built by the Indiana & Michigan Electric Company, has four poles 55 ft. long and set in concrete to a depth of approximately 7½ ft. The poles are 12 ft. apart and the cross-members are sixteen 6-in. x 12-ft. timbers.



FOUR-POLE TOWER SUPPORTING SIX NO. 2/0 CONDUCTORS ON 500-FT. SPAN

There are two circuits (six conductors) of No. 2/0 solid bare copper leading to the rack and No. 2/0 stranded bare copper strung across the river. The lines are on two suspension insulators with a hole bored through the arm and an eye bolt and ½-in. messenger leading across to the opposite insulators. The conductors are carried over the cross-members on pin-type insulators.

R. F. MUNDORFF.
Kansas City, Mo.

Instructions for Inspecting and Cleaning Boilers

BOILERS should be carefully inspected and systematically cleaned. When a boiler is to be taken off the line for washing stop delivering coal to the boiler furnaces. Burn out the fire in the furnace as soon as possible, and when the fire is out close the damper. Shut off the boiler stop valves and notice if the automatic valve is holding. Blow all water out of the boiler when the steam is down to about 15 lb. or 20 lb. per square inch. Blow off all soot from tubes and superheaters and wash down with water spray.

For the purpose of inspection take off all hand-hole plates on the front header and manhole plates on the back of the steam drums. Look carefully for leaky hand-hole plates on the back header, and if any are found remove them and replace the gaskets. Inspect the tubes inside the furnace for bags and blisters. Cut out defective tubes and replace with new ones. Inspect all tubes internally for mud and scale. After the workmen have finished cleaning, inspect the steam drums and water columns. If scale or mud is found, wash and scrape clean.

Inspect the superheaters and their connections to the steam drums. After the scale is removed from the steam drums, inspect the rivets and seams for corrosion, pitting or grooving of the steam-drum plates. Inspect the furnace and clean the side walls, back walls, arches and water-back. If any defective bricks are found, have them repaired or renewed. Inspect the stoker and grate and repair any parts that may be found defective. See that the steam gage is registering correctly.

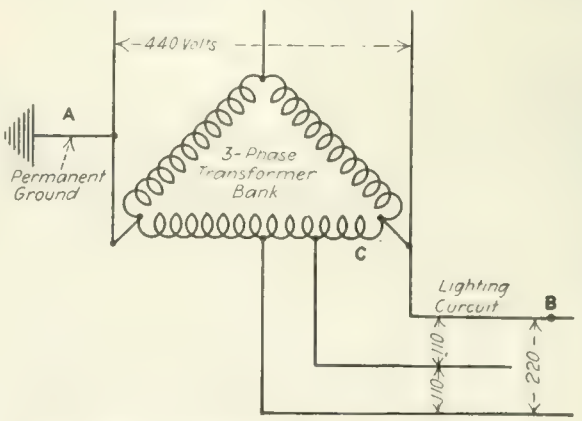
When filling a boiler with water preparatory to putting it back in service, notice any leaks that develop and mark them. If a leak cannot be stopped while the water is in the boiler, draw the water off, repair the leaks and refill the boiler. If the boiler is found tight, start the fire, but do not crowd the boiler too hard at first. A cold boiler should not be fired up to 200 lb. of steam in less than two and one-half to three hours. After the steam is up to 100 lb. or 150 lb. blow out the superheater. When the pressure is within 5 lb. of the other boilers on the line, open the header valve very slowly and let the boiler carry its share of the load.

Iowa Railway & Light Company, JOHN M. MAY,
Marshalltown, Iowa. Traveling Engineer.

Method of Grounding Deserves Serious Consideration

SINCE improper grounding of a distribution circuit, as shown in the accompanying diagram, recently caused the death of a man who accidentally came in contact with the wire marked *B*, it is advisable to avoid any practice which will establish the conditions which led to this fatality. The drawing shows an arrangement resorted to for securing lighting service for 440-volt transformers.

It is sometimes not advisable to ground any point of a secondary circuit if the voltage between any other point and ground will be dangerous. If a circuit is



GROUNDING ARRANGEMENT THAT IS DANGEROUS

not grounded, it should be mounted where it cannot be reached—at least 8 ft. above the floor—or protected by barriers. General practice seems to place the limit for grounded circuits at 150 volts to ground, which

means that 300-volt, three-wire circuits are the highest that should be grounded. This would bar grounding on 220-volt, three-phase circuits or any other circuit of this type. On some three-phase, 220-volt delta-connected transformer banks one transformer neutral is often run out to serve three-wire lighting circuits. When this neutral is grounded it should be remembered that approximately 190 volts can be secured between the third 220-volt wire and the neutral. Shifting of transformers from one combination to another to secure desired results is so easy that the effect of a neutral ground is often overlooked.

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

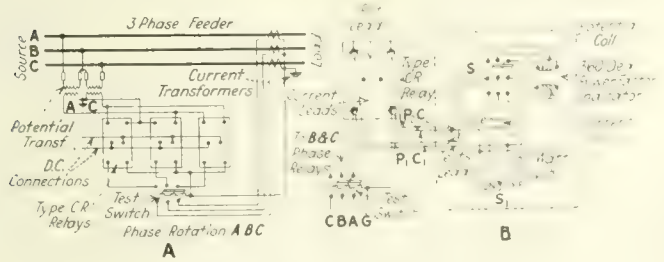
Improvised Forced Lubrication Prevents Blower Breakdowns

BY APPLYING forced lubrication to draft fans repeated burning out of bearings was stopped in one of the stations of the Philadelphia (Pa.) Electric Company. In this station serious loss of blower capacity due to the burning out of bearings on turbine-driven fans was formerly a frequent occurrence. These bearings are ring-oiled, and the rings would not carry sufficient oil. After a considerable amount of experimenting with various oils and different schemes for getting the rings to carry more oil, the trouble was practically eliminated by running a pipe to the bearing from the oil pump provided for forced circulation to the turbine reduction gear. Through this pipe a positive and greatly increased flow of oil to the bearing was obtained. This has resulted in eliminating the trouble and the bearings now have a normal life.

Philadelphia (Pa.) Electric Co. F. C. RALSTON, Operating Division.

Testing Reverse-Power Relays Without Removing Leads

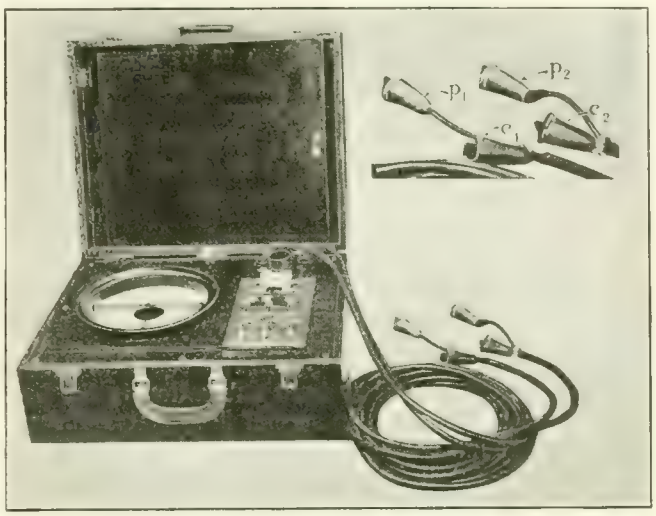
FOR readily testing Westinghouse type "CR" reverse-power (directional) relays to make sure that all connections, etc., are correct the device described in the following paragraphs was developed by the Philadelphia Electric Company. All equipment is compactly mounted in one box and no relay connections are removed while making the test. These relays must be connected so that the current in each relay leads the voltage by 30 deg. at unity power factor. The testing device, in addition to checking the 30-deg. angle of lead, checks the operation of the wattmeter element of the relay to make sure that its contacts close on reverse direction of power. Furthermore, the test is made without disconnecting any wires in the relay circuit which might result in their being reconnected incorrectly. The adjustment of the excess current element of the relay for operating current and time is made before the test outlined.



CONNECTIONS FOR TESTING REVERSE-POWER RELAYS, WESTINGHOUSE TYPE CR

A—Westinghouse type CR reverse-power relays connected to a three-phase feeder. B—Internal connections of test device and connections of test leads to relay terminals.

The testing device consists essentially of a 360-deg. power-factor indicator and a small transformer connected as shown at *B*. The leads P_1, P_2, C_1 and C_2 of the test set are arranged in pairs as shown in the illustration, so that it is almost impossible to connect them to the relay terminals in an improper manner.



OUTFIT FOR TESTING REVERSE-POWER RELAYS IN CONVENIENT CARRYING CASE

The inserted view shows how the leads are constructed to prevent improper connection to the relay.

To determine if the connections give a lead of 30 deg. at unity power factor the leads are connected as shown to the potential *(p)* and the current *(c)* terminals of the relay. The feeder on which the relay is installed should carry not less than one-quarter of rated current in the normal direction. The relay test switch is closed, switch *S* is closed in the upper position and switch S_1 is turned to the "on" position, after which the current circuit in the relay is opened by turning out the screw used to make the adjustment for minimum operating current. The pointer of the power-factor indicator will take a position depending upon the calibration of the test device. The power factor of the load carried by the feeder must be taken into consideration when observing the instrument pointer in order to determine the correctness of the relay connections. Therefore the dial of the power-factor indicator is marked so that when its indication corresponds to the feeder power factor it is known that the connections to the relay are correct.

In testing the operation of the reverse-power element the feeder should be alive, but if it is carrying load the direct-current circuit to the trip coils should be opened. The test is made by opening the relay test switch, closing switch *S* in the down position, and turning switch S_1 to the "on" position. Then the 50-watt, 110/8-volt transformer excited from the feeder potential transformer sends current through the current coil of the relay. If the relay is in good shape the contact of the element under test will close. If desired, the transformer might be so connected that on making these connections the contacts would open, but in the device as made the contacts close when the relay wiring is correct.

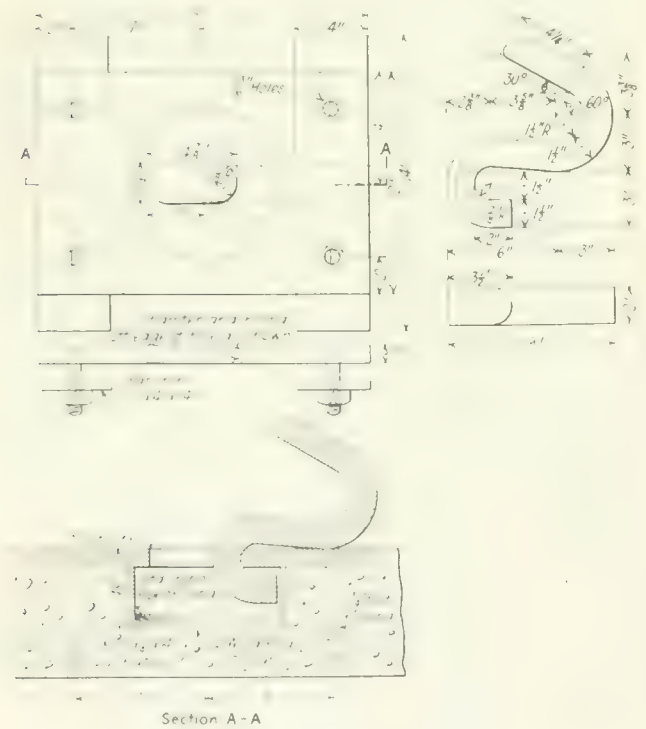
The equipment comprising the test device is mounted in a convenient carrying case. The flexible leads used for connecting to the relay under test are permanently connected to the test equipment to prevent the possibility of their being connected incorrectly for any test There is room for the leads in the hinged cover of the case. Switch S_1 is not necessary, but is sometimes useful. When in the "off" position it short circuits the current terminals of the relay, so that Switch S may be opened without opening the current transformer.

Relays which have been shown to be connected correctly by the tests outlined should also be carefully inspected and have the time settings accurately made so as to obtain selective action.

RAYMOND BAILEY,
Assistant Chief Electrical Designer.
Philadelphia (Pa.) Electric Company.

Floor Hooks Facilitate Movement of Apparatus

TO FACILITATE moving heavy equipment about the floor of a recently built substation in St. Louis steel hooks are inserted in special floor plates and rope is passed around the hooks. One of the floor plates, as shown in the detail drawing, is inserted in the concrete floor in front of each vault containing transformers or other heavy apparatus, and the hooks are kept on hand in convenient places. The possible routes of each piece of apparatus that might have to be moved have been carefully considered, and floor plates have been inserted at every turn or point where they may be of assistance



DETAILS OF HOOK AND FLOOR PLATE USED TO HELP MOVE SUBSTATION APPARATUS

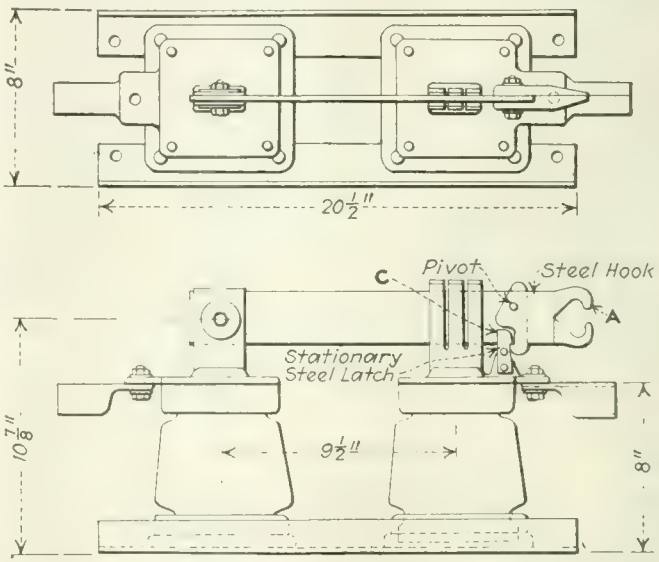
in an emergency. The same scheme is used for moving a transfer car which runs on a track in front of the transformers for the purpose of shifting in a spare transformer for one that is being taken out of service for repair or overhauling.

The hook and floor plate shown in the illustration are designed to withstand a pull of about 20,000 lb. The hook is made from a piece of 1.5-in. x 2-in. x 20-in. bar iron. The material in one pull box consists of one steel plate 1 in. x 12 in. x 18 in., two pieces of 0.5-in. x 4-in. x 1.25-in. bar iron, four 0.75-in. x 6-in. flat-head machine screws and nuts, one piece of 8-in. standard iron pipe 3.5 in. long, and one wooden plug 8 in. in diameter by 0.875 in. thick.

WALTER H. MILLAN,
Superintendent of Substations.
Union Electric Light & Power Company,
St. Louis, Mo.

Disconnecting Switch Opened Without Strain on Supports

AN 11,000-VOLT disconnecting switch which cannot be opened unintentionally but is easily opened by an operator has been developed for the Springdale plant of the West Penn Power Company, Pittsburgh,



LOCKING DISCONNECTING SWITCH WHICH IS OPENED WITHOUT STRAIN ON SUPPORTS

Pa. A lever action starts the switch to open without the use of much force. This switch has a steel hook pivoted to the end of the blade, and when closed the hook engages with a steel latch on the stationary insulator cap.

To open the switch the operator pulls on the hook at point A, which unlatches the switch, the lug on the hook casting pushing against the top of the stationary steel latch at C, which moves the switch blade in its contacts about ¼ in., thus breaking the set and making it very easy to pull the blade the rest of the way out of the contacts. If this lug were not provided to pry the blade loose by acting on the stationary steel latch, the operator would have to pull quite hard on the blade, which would put a heavy stress on the supporting insulator and might break it, in addition to causing a possible troublesome delay in getting the blade to start. The lever action provided does not put any excess strain on the insulator, and as the operator pulls on a lever considerably longer than the one which loosens the blade, it is quite easy for him to get the switch to start.

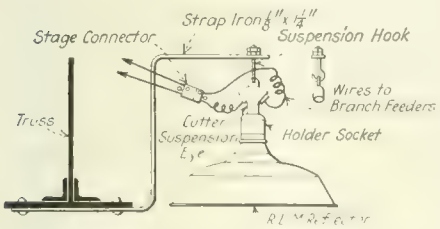
GEORGE S. HUMPHREY,
West Penn Power Company, Electrical Engineer.
Pittsburgh, Pa.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Mounting a Lighting Reflector Out of the Way of Cranes

IN ORDER to avoid a traveling crane, the lighting unit shown in the accompanying drawing was mounted on a piece of strap iron so that the bottom of the reflector came just level with the ceiling truss. In this position the reflector will not be struck by the crane as it travels, but at the same time it will be accessible from the crane. For a support a piece of ⅛-in. x 1¼-in. (3.2-mm. x 32-mm.) strap iron, bent in two right angles, is fastened to the lower edge of the steel beam. The unit is hung on a suspension hook passing through the outer end of the strap-iron support by means of a Cutter suspension eye, No. 30,196. An R. L. M. reflector is employed to throw the light downward. The connection is made to the branch feeder through a stage connector. This allows the entire unit to be disconnected and removed to a safer place for cleaning. When the unit is disconnected it is replaced immediately with a clean unit so that it is not necessary to bring back the original unit after it is cleaned.



MOUNTING FOR LIGHT UNIT WHERE THERE IS INSUFFICIENT CLEARANCE UNDER THE TRUSSES

SAMUEL G. HIBBEN,
Consulting Illuminating Engineer.
Westinghouse Lamp Company,
Bloomfield, N. J.

Correct Filing of Motor Inspection Records

MAINTENANCE and inspection records are valuable only when intelligently filed and analyzed. After a maintenance department has located and remedied trouble a report should be filed under a head which refers to the machine or service. It is also usually filed under the motor number, but for purposes of analysis it is useless to keep a record of the breakdowns of a certain motor, as this machine might after repair be installed in some other location. The classification heads should be something like these: (1) Hot-metal crane; (2) main hoist controller; (3) yard crane; (4) cross-trolley motor.

Under these heads should be filed the inspectors' reports, with date of breakdowns, cost of repairs and reason for failure. Such a record is not expensive to keep up and is not a useless luxury but a stern necessity.

An immediate result is to direct attention to any location where trouble is more frequent than it should be. Perhaps the motor at this place is not big enough, is not properly connected to its work, is badly handled, or there is some other reason for the frequent failures, but the reason will not be discovered unless the fact is known that the machines used for that particular job give too much trouble.

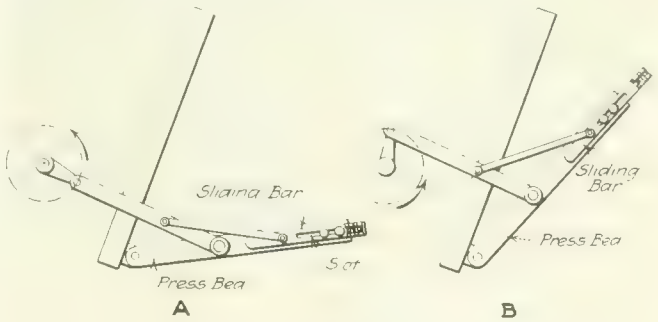
A maintenance record is useful in deciding the number and kind of repair parts that must be kept on hand and in keeping watch on the quality of the work turned out by the repair shop. Finally, such a record to be of any value must be consulted and its evidence weighed from time to time. Too often careful records are kept and never used to better conditions.

JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Device to Prevent Operators' Hands Being Caught in Presses

A HOME-MADE device used for some years by the writer for preventing presses from closing on the hands of operators was brought to mind by the description of the method of controlling toggle presses in the ELECTRICAL WORLD for Nov. 13, page 681. The device designed by the writer consisted of a rod across the front of the press which the operator's hand would strike, thus opening a switch which stopped the motor. In the accompanying drawing the principle of its operation is shown as applied to a job printing press. With suitable modifications it can be used on any other type of press.

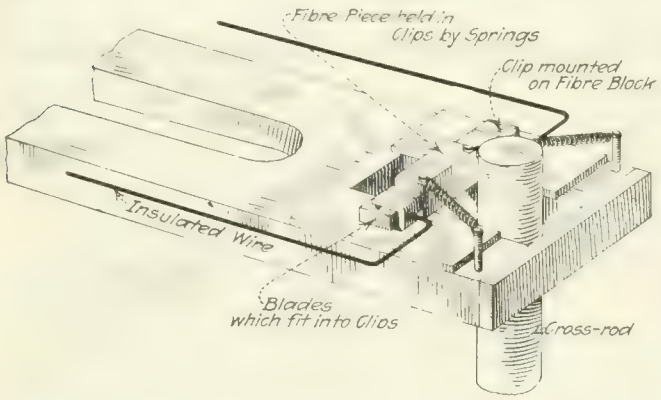
Details of the circuit-breaking switch are shown on the following page. This switch consists of two small bronze clips mounted on fiber strips on each side of a slot cut in an iron bar. Two bronze blades mounted on a fiber block are normally held in these clips by two springs fastened to the fiber block and to the ends of the bar. A cross rod extending across the front end of the press fits in the slots in the bars on each side of the press. Pressure on this rod forces the blades out of the contact clips, thus breaking an electrical circuit. This breaking of the electrical circuit serves to operate



IF OPERATOR PUTS HAND INSIDE PRESS WHEN IT IS CLOSING MOTOR CIRCUIT WILL BE OPENED

the no-voltage release on the motor switch, and if necessary, a brake may be connected to operate when this circuit is open.

With some types of presses this bar might be mounted securely on the side of the moving bed of the press. In this case the cross rod would stick out considerably



SPRING CONTACT PLACED ON EDGE OF PRESS TO OPEN CIRCUIT IF OPERATOR'S HAND IS CAUGHT

beyond the end of the press bed. In the mounting used on the job presses, however, it was objectionable to have the cross rod sticking out any considerable distance beyond the end of the press bed and, therefore, the bar was slotted and mounted so that it would slide on the side of the bed as shown at *A* and *B*. With this arrangement, when the press is open, the cross rod is drawn down close to the edge of the plate. When the press starts to close, however, as shown at *B*, the bar is raised so that it projects some distance beyond the end of the bed, and the rod will be sure to strike the operator's hand if it is left in the space between the two plates.

W. A. HARRIS.

New York, N. Y.

Accurate Electromagnetic Control in Heat Treatment of Steel

IN THE preparation of high-carbon steel for cutting tools it is often desirable to heat the metal to a temperature just above the point of loss of magnetic susceptibility before quenching. If heated much above this point, the metal is apt to become brittle. This change in magnetic susceptibility of steel affords an excellent method of controlling the temperature of electric furnaces. The point at which magnetic susceptibility falls away can be readily detected by means of an exploring coil over the furnace chamber.

In a recent number of the London *Electrician* an article on this subject by Lancelot W. Wild appears. It describes the use of an exploring-coil secondary winding over the furnace, within which is an alternating-current primary heating coil. Another and separate transformer, with its primary winding in the heating circuit, enables a differential balance to be kept on the furnace in such a manner that a galvanometer in the secondary circuit shows no current when the furnace charge becomes non-magnetic.

It might be supposed that this magnetic detector of non-magnetic temperature could only be applied to alternating-current furnaces, but the article shows that a modification of the method is also applicable to direct-current furnaces. FIELD EDITOR ELECTRICAL WORLD.

New York, N. Y.

Repairing a Grounded and Poorly Soldered Armature

A GROUNDED and poorly soldered commutator was recently sent to an Eastern shop to have the trouble determined and remedied. The armature had partly closed slots. After locating the coil in which the ground occurred the leads of the grounded coil were removed from the commutator and the top lead was lifted out of the slot. The ground was found at the rear end of the slot. At this point the wire was taped with thin silk tape and laid back in the slot in a new trough of 0.010-in. varnished cloth. Thin air-drying paint was put in the slot and a slot stick inserted while the paint was soft.

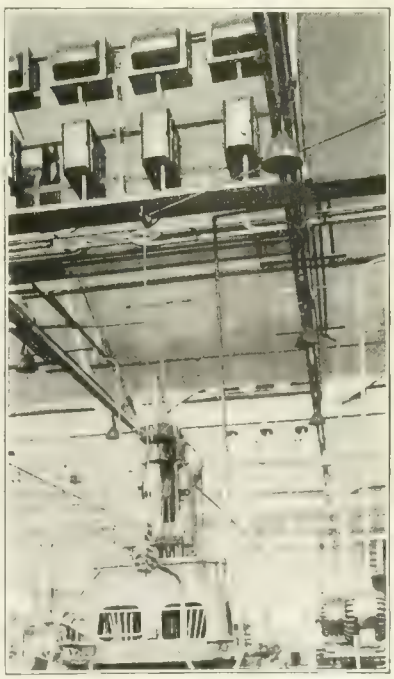
After reconnecting, however, a voltmeter test from bar to bar of the commutator showed a very uneven reading, a number of readings being quite high. The leads at which the readings were high were removed for inspection, which showed the bottom leads to be quite short and not soldered to the commutator. To correct this condition all of the leads were removed from the commutator and cleaned. They were then replaced and soldered with soft solder and a rosin flux. On the second voltmeter test a uniform reading was obtained, indicating freedom from short circuit and loose connections.

A. HERVEY.

New York, N. Y.

Automatic Switches Mounted Overhead

TO SAVE working space the automatic control apparatus of a number of machines is mounted between the roof trusses in the shops of the Canadian Products Division of the General Motors Company. In the accompanying photograph the four sets of control devices shown in the upper foreground consist of standard inclosed externally operated switches, shown above, and iron boxes, lower down, containing relays for stopping and starting 3-hp. motors. A push-button station, for starting and stopping the machine in the foreground, is mounted on the front of the machine, and the automatic compensator which this push-button operates can be seen to the left and somewhat to the rear of the front line of automatic-control devices overhead. The machine is a National Automatic Tool Company's No. 30 multiple-spindle drill driven by a 15-hp., 1,500-r.p.m. squirrel-cage motor mounted on the rear of the machine.



WORKING SPACE SAVED BY MOUNTING AUTOMATIC SWITCHES OVERHEAD

Canadian Products Division
of General Motors Co.,
Walkerville, Ont.

ALEX. H. MAY,
Works Engineer.

Motor Selection for Oil-Well Pumping

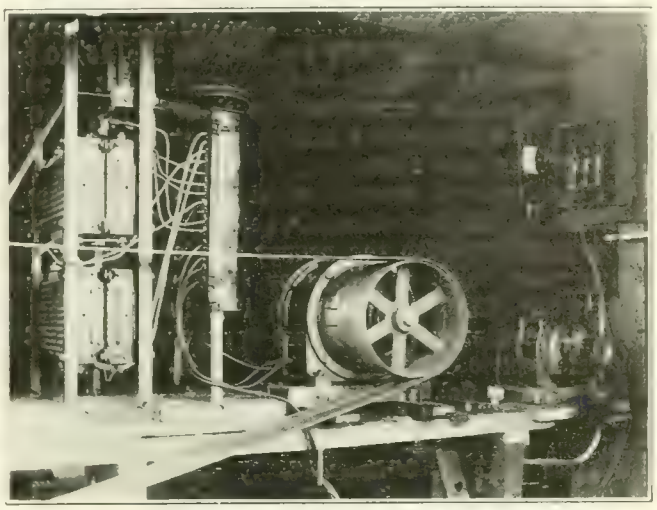
SO MANY factors affect the amount of power required to pump a well that the most careful calculations will not check with the results of actual tests. A large amount of sand will considerably increase the power required, while the presence of gas will act as a lifting agent and considerably decrease the power input. Furthermore, proper counterbalancing to offset the weight of the rods operates to effect a considerable saving in power. Other conditions being equal, the power required to pump a well will depend on the length of stroke, the number of strokes per minute and the size of tubing.

Motors for pumping, pulling and cleaning, although of the same general type as those employed for drilling, are of considerably smaller horsepower. Wells can be pumped electrically by any one of three methods —from a power jack—by a small motor suitable for pumping duty only, or by a special motor designed to take care of all of the necessary operations around a pumping well.

In shallow territories, where the wells are small producers, where pulling and cleaning have to be done very infrequently, and where the location of the different wells makes such a method practicable, a number of wells can be operated from a central power head or jack at a comparatively low cost per well. A standard constant-speed, squirrel-cage induction motor is suitable for practically all conditions. The motor is belted to a countershaft, which is in turn belted to the power head through a quarter-turn belt. The power required for pumping wells by this method depends upon how well they are balanced against one another.

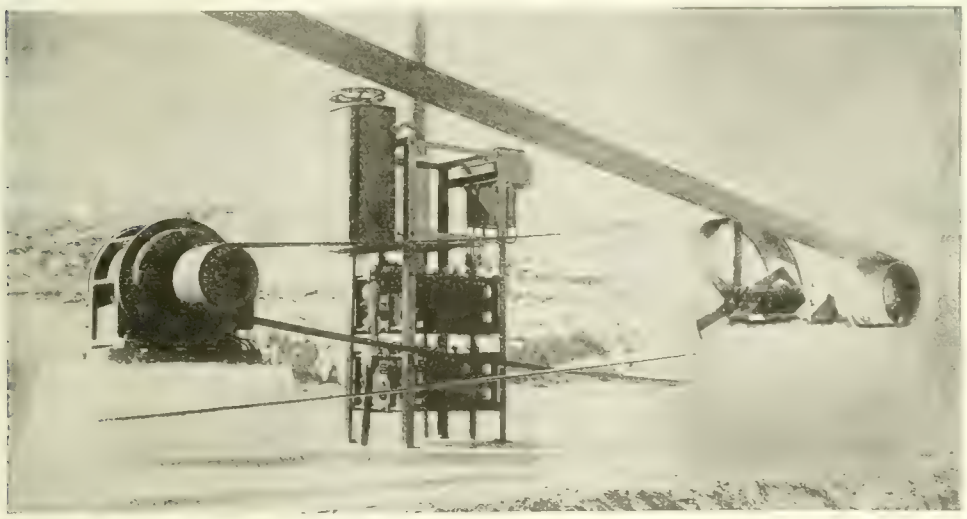
Wells on the beam which have settled down so that a given constant speed of pumping is satisfactory, but which by reason of their production cannot be satisfactorily operated from a power jack, can be individually operated by small-horsepower, squirrel-cage induction motors. Should it be advisable to vary the speed of the well from time to time, a single variable-speed motor can be employed instead of a constant-speed squirrel-cage motor. In either of the last two mentioned applications some external means must be employed for the shaking up and pulling or cleaning operations.

On the majority of wells pumped by individual motors it is preferable that all operations of pumping, cleaning and pulling shall be performed by one motor, just as with steam-engine drive. To meet the wide range of duty thus imposed motor equipments of double rating have been designed. They are of the two-speed, variable-speed type, and by means of a pole-changing switch on the motor frame the capacity and speed of the motor can be instantly changed from, for example, 15 hp. at 600 r.p.m. to a normal rating of 30 hp. at 1,200 r.p.m. Nothing is necessary to effect this change except throwing the pole-changing switch. This method appeals to the operator on account of its simplicity and flexibility. Three standard equipments have been developed with ratings of 10/25 hp., 15/30 hp. and 20/50 hp. with corresponding speeds of 600/1,200 r.p.m. at 60 cycles. The motor is designed with a six-phase rotor and a stator winding capable of being connected either six poles or twelve poles at the option of the operator. The object of this design was to provide a motor of small horsepower, low speed and good efficiency for pumping operations and at the same time make provision for the necessary capacity at a higher speed for pulling and cleaning. The pole-changing switch doubles both the capacity and speed of the motor for this latter duty. Regardless of the size of the motor, an equipment consists of the motor with its base and pulley, a controller operated by a telegraph cord from the headache post, a speed-regulating resistor, and an oil circuit breaker for protection against under-voltage and excessive overload. A



RECENT IMPROVEMENTS IN MOTOR DRIVE HAVE TENDED TO ELIMINATE THIS TYPE OF INSTALLATION

The small squirrel-cage type motor is used for pumping on the beam, while the larger slip-ring motor is used for pulling and cleaning.



AN INSTALLATION USING A DOUBLE-RATED 15/30-HP. PUMPING, PULLING AND CLEANING MOTOR

speed-reducing countershaft is also necessary, and in instances where the motor equipment is to replace a worn-out steam or gas engine the crankshaft of the engine is often used as a countershaft after replacing the heavy flywheels with pulleys of proper size.

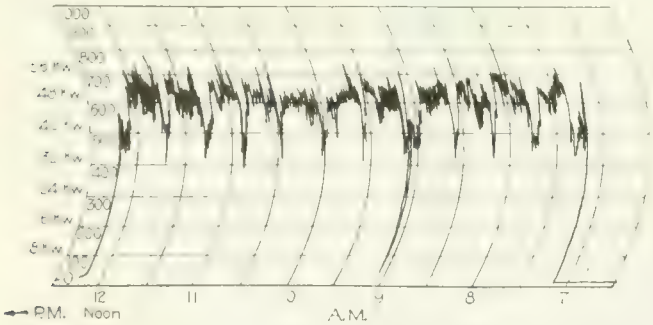
Although there are some wells which could be satisfactorily handled by the pumping motor rated at 10/25 hp., the conservative tendency of the oil operators to provide more power than necessary rather than "take a chance" has resulted in the 15/30-hp. equipment being accepted as the standard. It is only in cases of wells of exceptional depth or of very heavy gravity and with oversize tubing that the motor rated 25/50 hp. has been used.

On the basis of present prices, a 15/30-hp. equipment can be installed complete, ready to run, inclusive of countershaft with the proper size of pulleys, but exclusive of belts, buildings or foundations, for approximately $2,000. The same installation using a 20/50-hp. equipment would cost approximately $2,500.

General Electric Company, W. G. Lane,
Los Angeles, Cal. Engineer.

Cotton Gin Shows Energy Consumption of 16.5 Kw.-Hr. per Bale

THE load characteristics of a typical cotton gin are brought out in the accompanying graphic meter record of a forenoon's operation of a ginnery connected to the lines of the Georgia Railway & Power Company. The chart has been furnished to the ELECTRICAL WORLD by Charles A. Collier of that company. The ginnery whose operation is recorded has four stands, each gin having seventy 10-in. (25-cm.) saws. The tramper is operated by compressed air. A 50-hp., squirrel-cage-type, 2,200-volt motor, operating at 900 r.p.m., is installed. During the particular day shown the ginnery was in operation nine hours and fifty-five minutes, in which time thirty-four bales were ginned, an average of seventeen and one-half minutes per bale. The energy consumed was 462 kw.-hr., or 13.5 kw.-hr. per bale. The maximum demand for a thirty-minute interval was 53 kw. The accompanying table, also furnished by Mr.



TYPICAL LOAD CURVE FOR A FOUR-STAND SEVENTY-SAW COTTON GIN DRIVEN BY A 50-HP. MOTOR

Collier, was obtained by taking the average of twelve cotton-gin installations.

As the cotton leaves the farm it consists of a mass of seeds with the attached fibers, mixed with impurities such as dirt, trash and fragments of bolls. The first step in its manufacture is necessarily the separation of the cotton fibers from the seeds, the well-known process of ginning. This separation is accomplished by the cotton gin, and the plant at which gins are installed is termed a ginnery. It is in this process that mechanical energy is first required in the treatment of the cotton.

A standard modern cotton gin consists of an elevator operated by an exhaust fan for removing the cotton from the wagon or storehouse and conveying it to the feeders; several sets of feeders and gins; a flue through

AVERAGE REQUIREMENTS FOR TWELVE INSTALLATIONS

Number of stands per gin	4
Number of saws per stand	71
Size of saws in inches	10.5
Saws per horsepower of motor capacity	4.77
Horsepower of motor	60
Number of bales ginned per season	1,271
Energy consumption per season, kw.-hr.	19,733
Kw.-hr. per bale	16.51

which the lint cotton is conveyed to the condensers, by which it is formed into a bat, and a press for forming the cotton into bales and wrapping it for shipment. All of these operations may be regarded as auxiliary to the principal process of ginning, and the size and number of gins determine the capacity of the plant. A cotton gin consists essentially of a series of circular saws from 10 in. to 14 in. (25 cm. to 35 cm.) in diameter, mounted side by side on a shaft. The teeth of the saws project through a grid into a hopper, and their rapid rotation collects the cotton fibers on the teeth, drawing it through the grid and leaving the seeds behind. The separated fibers, called lint cotton, are removed from the saw either by a rapidly revolving brush or by an air blast. A standard gin has seventy or eighty saws, and most plants have four gins, although there are many two-gin or three-gin outfits in operation.

Auxiliary to each gin are feeders, which clean and prepare the cotton or ginning and supply it uniformly to the machines. The feeders are usually driven by pulleys and belts from the line shaft. The conveyors both to and from the gins are operated either by belt conveyors or, preferably, by fans. The baling of the cotton requires a powerful press, either screw or hydraulically operated. A gin of the standard type has a capacity of from 60 lb. to 150 lb. of cotton per hour, depending on the condition of the cotton, which means that the ginning of a standard 500-lb. bale requires for a four-standard ginnery from fifteen to thirty minutes.

A cotton ginnery may be operated as well by electricity as by mechanical power, since no heat energy is used in the process.

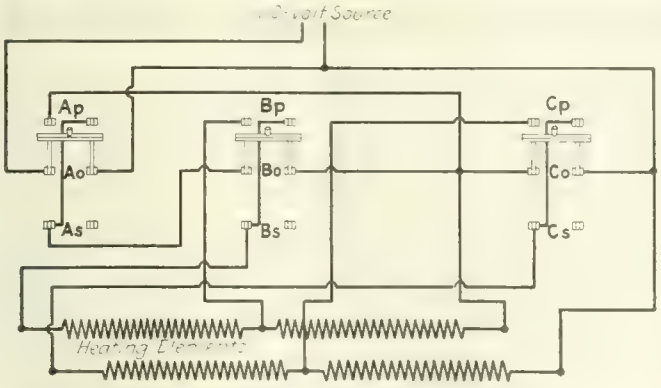
The power requirement of each type of machine in a standard gin is approximately as given in the following table:

	Hp.
Conveyor	2.0
Cotton cleaner (if used)	5.0
Four seventy-saw feeders	3.0
Four seventy-saw gins	25.0
Fans	25.0
40-in. condenser	1.0
Tramper	4.0
Press	15.0
Total	80.0

However, there is a certain amount of diversity in the demand of this equipment which makes the total power requirement somewhat less than that indicated, and a 75-hp. motor is generally considered ample for a four-stand ginnery.

Wide Variations of Resistance Obtained with Three Switches

IN ORDER to change the current of an electric oven over wide ranges it was connected up to three double-pole switches as shown in the accompanying drawing. With this connection six different current values may be



ARRANGEMENT OF SWITCHES AND RESISTORS WHICH GIVES WIDE RANGE OF CURRENT

secured, ranging from 3.75 amp. to 60 amp. The accompanying table shows in what direction the switches must be thrown for the different values of current.

This combination of switches was employed to vary

Position of Switches	Total Amp	Position of Switches	Total Amp
As—Bs—Cs	3.75	Ap—Bp—Co	30
As—Bp—Cs	6	Ap—Bp—Cs	37.5
Ap—Bs—Co	7.5	Ap—Bp—Cp	60
As—Bp—Cp	15		

the temperature of a baking oven installed in Lima, Peru.

As the heating elements were quite small and closely spaced, the suppression of every other element in some of the switch combinations did not materially alter the uniformity of the heat distribution.

Lima, Peru. VICTOR M. ARANA,
Consulting Electrical Engineer.

Speed Variation of Slip-Ring Motor Due to Faulty Secondary Fuse

WIDE variation in speed of a slip-ring motor in a large pipe mill was found after some investigation to be due to a defective fuse in the secondary leads. The motor was a three-phase motor of the slip-ring type with a drum controller and grid resistors. The circuit leading from the slip rings was carried through conduit to the controller and resistors. Near the motor the circuit passed through a three-pole fuse extension switch so that the starting equipment could be entirely disconnected from the motor. It was suggested that an open circuit in one phase of the secondary circuit might cause the peculiar action of the motor. However, a test of the circuit with a magneto disclosed no sign of trouble.

It was then decided to examine the circuit piece by piece, but nothing was found until the three-pole switch in the secondary controller circuit was examined. Here it was discovered that one of the link fuses had become unsoldered from the terminal clip, but when the motor was not operating it still made contact. For this reason the magneto did not reveal the trouble. When the machine was in operation the vibration occasionally caused the contact to be broken, resulting in variations in the motor speed. HARRY RUSH,

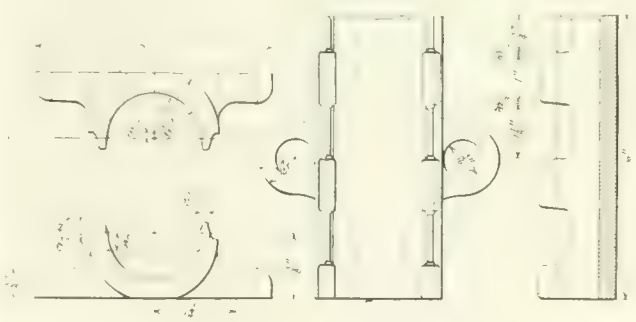
Assistant Professor of Mechanical Engineering.
North Dakota Agricultural College,
Fargo, N. D.

Selection and Installation of Mine Cables

WHEN ordering three-conductor cables to carry 2,200-volt, three-phase service down mine shafts one of the large companies in the Lake Superior iron-mining district specifies that each conductor be insulated with approximately $\frac{5}{32}$-in. (4-mm.) 30 per cent Para rubber compound and that the conductors be laid up with saturated jute fillers, taped with jute and armored with galvanized steel wires of sufficient number and size to support the entire length of cable when hung in shaft from one end. The cables are ordered in one piece, and those now in use on the company's properties include such lengths as 1,520 ft. (456 m.) of 300,000-circ.mil (151.8-sq.mm.) and 2,800 ft. (840 m.) of No. 2/0 (57.5-sq.mm.) cables.

It will be noted that lead covering is not included in the specifications. Earlier cables were installed with the lead sheath in addition to the armor, but later practice has been to build these cables with a heavier serving of saturated jute and without the lead casing. This gives a cable which is less expensive to build, of lighter weight and easier to handle because of its greater flexibility.

In the ELECTRICAL WORLD of June 5, 1920, a method was described of installing cables in mine shafts by first lowering the cable to the bottom of the mine and then hoisting the cable into position by fastening one end to the cage. This cannot be done with the long lengths of cable which have been referred to above because the reels required to hold them are too large to enter the shaft opening. It is therefore the practice of this company to wind the cable from the cable drum onto the hoist drum and then unwind the cable from the hoist drum into the shaft. The cable is then secured in place every 12 ft. to 18 ft. (3.6 m. to 5.4 m.) by the



CABLE CLAMP FOR MINE SHAFTS

The dimensions shown are for a No. 2 gage three-conductor, 5,000-volt, cable wrapped with jute and armored with galvanized-steel wire.

clamps shown in the illustration. In shafts with concrete sets and dividers the clamps are bolted to cast-iron inserts poured in concrete. In shafts with steel dividers and sets, concrete-lined, the steel is drilled to hold the clamps. It will be noticed that the sides of the top and bottom half of the cable clamp intermesh, so that an even pressure can be applied all around cable without squeezing out the rubber insulation.

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

How Utilities Can Hasten Better Public Relations

SOME very important statements on a utility's public policy were made by E. K. Hall, vice-president of the American Telephone & Telegraph Company, in the course of a recent address before the Indiana Public Utilities Association. Mr. Hall pointed out that public bitterness against profiteers had caused much of the opposition to higher public utility rates, although the utilities were far from being profiteers.

"What is the trouble?" asked Mr. Hall. "The utilities have the knowledge and the information and have been trying to tell their story to the public for some time, but the public does not understand because it does not believe. The utility business is very young, no one had visualized the field very clearly, and through the development of the art mistakes have been made. In the early days some companies were guilty of questionable transactions and got themselves and the honest utilities into bad repute. Since then the utilities have been paying the bills resulting from these mistakes, and when regulation appeared it started with a hostile attitude.

"The public believed that virtually all rates were excessive, and the utilities were not sufficiently forehanded to tell it otherwise in terms that were convincing and which could be understood by the average customer of an electric light and power company.

"It takes a long time to change a lifetime of opinion, and the utilities must patiently, intelligently and tactfully lay their facts before the people during the next five years and then forever keep the information before them. It must be brought home to the public that it has finished its job of 'spanking the utilities.' The punitive era of teaching utilities to be good has passed and few companies find any profit in shady practices today. If there is any utility company which is not now ready to play fair and square with the public, it should be the duty of the honest utilities summarily to bring the erring one into line. If the utilities don't perform this service, the public will, and if the public takes hold it will punish the good with the bad.

An Era of Co-operation

"The second era of making and keeping utility companies strong enough to do their several jobs has arrived. This must be an era of co-operation and better understanding between the companies and the public, and all distrust must be removed. The new attitude of the public toward the public utilities can be seen, and its complete arrival will be hastened by giving the proper consideration and prominence to the fundamentals of the business.

"For instance, the interest of the public and the utility companies is identical, there is no such thing as profit in the ordinary sense of the word in the utility business, and as to rates the only possible danger to the public is that rates may be too low. It can easily be seen when rates are too high, but if they are too low it takes the heart and flesh out of the business and reacts against the public interests.

"The public thinks that the rates for utility service are too high because as individuals they think that they would charge the highest possible rates if they were running the business. A difference of opinion also arises because the public thinks only in terms of today, while utility operators must consider the future. Furthermore, the public has no conception of the magnitude and intricacy of the task involved in providing the service it demands.

Apologizing for Poor Service Is Bad Policy

"All these points and many others should be taken into account by those responsible for a utility's public policy, but no one man in any company can alone accomplish much in trying to inform the public. Every officer and employee must do his part. No help or sympathy is to be obtained by sobbing and apologizing to the public. Such a policy usually breeds suspicion and distrust. The utilities are performing good service and have a real story to tell the public, but every company should make sure it deserves public confidence before attempting to get public support."

Careless Purchasing Lessens Profit on Merchandising

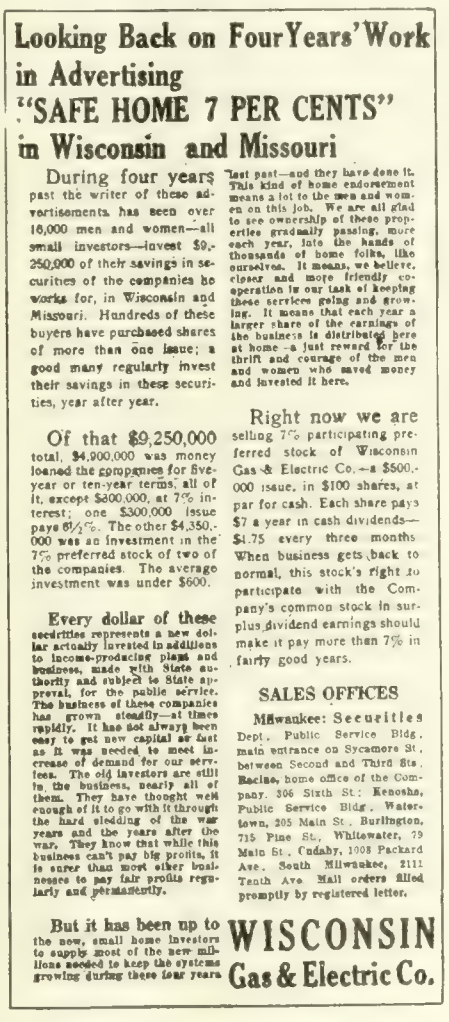
THAT central stations can make a fair profit on the sale of electrical appliances was shown by a recent survey of merchandising conditions in the Southeastern States. It was found, however, that a number of companies had tied up an unnecessarily large amount of capital in excessive stocks because of inaccurate purchasing records and failure to keep careful account of the stock on hand. The margin of profit between the manufacturer's price and the resale price was found in most instances to be sufficient, although some companies have lost a part of their profit through failure to take advantage of all discounts to which they are entitled. This is due partly to purchasing in quantities less than standard-package lots, thus losing an additional 5 or 10 per cent discount.

In view of these conditions the merchandising committee of the Southeastern Section, N. E. L. A., which made the survey, recommended in its report at the annual convention at Miami, Fla., that wherever possible all companies have a purchasing agent and cost accountant whose duties would be to obtain the best discounts, take advantage of cash discounts and keep accurate purchase and inventory records in order that stocks may be kept at proper levels and at the best prices obtainable.

Cost of Selling $9,250,000 of Utility Securities to 16,000 Investors

A CONVINCING message to small investors is presented in the accompanying advertisement, which appeared in the Wisconsin newspapers during the week of Jan. 17 to 22, 1921.

The companies alluded to in the advertisement are the Milwaukee Electric Railway & Light Company, the Wisconsin Gas & Electric Company (main office, Racine, Wis.), and the Union Electric Light & Power Company of St. Louis — frequently referred to as the North American group. The average over-all cost of selling these securities at par—a total of $9,250,000 — in three years and four months ended Dec. 31, 1920, was well under 3 per cent. Four-fifths of this expenditure was for newspaper display advertising space. The remainder was expended for printing, postage and salaries and commissions to salesmen. High state and federal taxes on large incomes during the years indicated restricted the sale of these taxable securities almost wholly to small investors. It was therefore impracticable to employ field salesmen to canvass for buyers. Advertising had to attract nearly all of the purchasers to the companies' counters. In St. Louis during 1920 some seventy Union Electric employees, organized in departmental teams, did excellent work in pulling the third million of that company's 7 per cent preferred across the mark, earned substantial commissions and in several cases disclosed unsuspected sales talent. In each of the main sales offices one or two office salesmen received customers and two or three others followed up inquiries on the outside.



Looking Back on Four Years' Work in Advertising

"SAFE HOME 7 PER CENTS" in Wisconsin and Missouri

During four years past the writer of these advertisements has seen over 16,000 men and women—all small investors—invest $9,250,000 of their savings in securities of the companies he works for, in Wisconsin and Missouri. Hundreds of these buyers have purchased shares of more than one issue; a good many regularly invest their savings in these securities, year after year.

Of that $9,250,000 total, $4,900,000 was money loaned the companies for five-year or ten-year terms, all of it, except $400,000, at 7% interest; one $300,000 issue pays 6½%. The other $4,350,000 was an investment in the 7% preferred stock of two of the companies. The average investment was under $600.

Every dollar of these securities represents a new dollar actually invested in additions to income-producing plant and business, made with State authority and subject to State approval, for the public service. The business of these companies has grown steadily—at times rapidly. It has not always been easy to get new capital as fast as it was needed to meet increase of demand for our services. The old investors are still in the business, nearly all of them. They have thought well enough of it to go with it through the hard sledding of the war years and the years after the war. They know that while this business can't pay big profits, it is surer than most other businesses to pay fair profits regularly and permanently.

But it has been up to the new, small home investors to supply most of the new millions needed to keep the systems growing during these four years past—and they have done it. This kind of home endorsement means a lot to the men and women on this job. We are all glad to see ownership of these properties gradually passing, more each year, into the hands of thousands of home folks, like ourselves. It means, we believe, closer and more friendly co-operation in our task of keeping these services going and growing. It means that each year a larger share of the earnings of the business is distributed here at home—a just reward for the thrift and courage of the men and women who saved money and invested it here.

Right now we are selling 7% participating preferred stock of Wisconsin Gas & Electric Co.—a $500,000 issue, in $100 shares, at par for cash. Each share pays $7 a year in cash dividends—$1.75 every three months. When business gets back to normal, this stock's right to participate with the Company's common stock in surplus dividend earnings should make it pay more than 7% in fairly good years.

SALES OFFICES

Milwaukee: Securities Dept., Public Service Bldg., main entrance on Sycamore St., between Second and Third Sts. Racine, home office of the Company, 306 Sixth St.; Kenosha, Public Service Bldg., Watertown, 205 Main St., Burlington, 715 Pine St., Whitewater, 79 Main St., Cudahy, 1008 Packard Ave., South Milwaukee, 2111 Tenth Ave. Mail orders filled promptly by registered letter.

WISCONSIN Gas & Electric Co.

AN EFFECTIVE ADVERTISEMENT USED BY NORTH AMERICAN GROUP OF UTILITIES IN WISCONSIN NEWSPAPERS

A par cash market was maintained by the Union Electric Light & Power Company for its $1,000,000 of 7 per cent preferred sold between Nov. 15, 1919, and Nov. 13, 1920, by reselling more than $650,000 of its earlier issues of preferred for small shareholders who needed money. All of these resales were made at par for cash and without charge by the company for its service. This made the total cost of Union Electric's third million 10 per cent, as compared with 1.123 per cent, the cost of selling its first million in 1917, and a trifle over 2 per cent for its second million in 1918. Incidentally, maintaining a par cash market for the stock in this way, the Union Electric 7 per cent preferred has been established as St. Louis' premier savings investment. For example, the 424 shares of the fourth million sold from Jan. 13 to Jan. 22 inclusive—just ten days—were bought by 112 persons, or at the rate of less than four shares to an individual.

During the last nine and one-half months of 1920 the Wisconsin Gas & Electric Company sold $1,000,000 of five-year and ten-year 7 per cent notes and $570,000 of 7 per cent preferred stock at par for cash, at an over-all selling cost of 4½ per cent.

Portland Company Adopts Bimonthly Billing

NOTICE has been sent to the 40,000 residential customers of the Portland (Ore.) Railway, Light & Power Company that, effective Jan. 1, bills for electric service used will be rendered only once in every two months instead of once a month. It is believed that this will be an acceptable plan to a great majority of the customers, as it will cut in half whatever inconvenience may be attached to allowing meter readers to enter premises and to paying these small bills before the delinquent date.

It is expected that there will be an annual saving of $14,000 effected by the reduction of the meter-reading, billing and distributing force. The various steps on the rate will be doubled and a discount of 10 per cent instead of 5 per cent for prompt payment will be allowed.

The Portland Railway, Light & Power Company is the only large company on the Pacific Coast and one of the few large companies in the country to adopt the bimonthly billing system.

Fractional Shares Recommended for Customer Ownership

IN ADDITION to an appreciation of the public utility situation, the American people will have to be educated to habits of thrift, and to encourage thrift securities may have to be issued in smaller denominations, in the opinion of Fred H. Sheel, manager of the security department of the Insull interests in Chicago, who spoke recently before the Illinois State Electrical Association. Something might be learned, according to Mr. Sheel, from the experiences of the most thrifty people in the world, the French who are retailers of securities first and wholesalers only on occasion. French securities are made for the very small investor, who measures the attractiveness of the security by its safety, simplicity and availability. The sale of securities in France is a regular over-the-counter merchandising transaction, and the national habit of investment has been largely developed by the small denominations and ready availability of the securities.

The minimum size of bonds has been reduced from a thousand dollars to fifty dollars, with very gratifying results to those requiring money, and Mr. Sheel said that it would seem as if the utilities could make their financing much easier if fractional shares were issued or the par value of stocks reduced to a very low sum.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Voltage Relations in Direct-Current Machines.—R. E. FERRIS.—With the increasing voltage now being used in direct-current machinery, it is very important to look into the potential difference more carefully than simply to investigate voltage between ground and single coils. The author analyzes voltage conditions in the common types of direct-current winding.—*Electric Journal,* January, 1921.

Short-Circuit Current of Induction Motors and Generators.—R. E. DOHERTY and E. T. WILLIAMSON.—The authors state that there has been a prevalent opinion that a sudden short circuit of an induction generator would not cause a serious initial rise in current such as occurs in synchronous generators. This has led to the proposal to use such machines as a partial solution of the short-circuit problem on alternating-current systems. Theoretical considerations and experimental data given in the paper show that, on the contrary, there is in the induction generator, just as in the synchronous machine, a serious initial rush of current, which is limited only by the leakage reactance of the machine. The only difference is that the transient is shorter in the induction machine and that the current dies down, of course, to zero instead of to the sustained value which occurs in an excited synchronous generator.—*Journal A. I. E. E.,* January, 1921.

Lamps and Lighting

Manufacture of the Edison Incandescent Lamp.—HENRY SCHROEDER.—A detailed description of the mounting and preparation of the bulb, assembly of mount and bulb, exhausting, basing and packing of both vacuum and gas-filled lamps.—*Bulletin L. D. 119, Edison Lamp Works,* October, 1920.

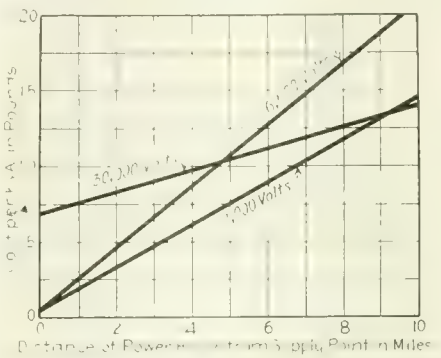
The Gas-Filled Lamp for Stereopticon Service.—H. F. BARNES.—After a review of the conditions which have to be met in this service, some description is given of lamp construction, including an account of how spiral filaments are crowded together for the purpose of producing the high intrinsic brilliancy required.—*Bulletin L. D. 116, Edison Lamp Works,* Harrison, N. J.

Generation, Transmission and Distribution

Central-Station Boiler Practice.—M. K. HABERSHON.—A general treatment of British practice in steam-boiler design for central-station use.—*Beama,* December, 1920.

On the Equilibrium of Suspended Wires.—W. FETTER.—On the basis of a monographic method, earlier described by Seefehlner, the author studies the conditions of equilibrium of a conductor hanging in freely moving suspension insulators, the conductor at certain points being kept rigidly in place by strain insulators. By a special device the equation for one single span is made to apply also to the above-stated case, where the horizontal component of pull will equalize over a number of spans. The author shows by numerical examples that if spans of widely different length are used between two anchoring towers the longitudinal displacements of the wire will cause the actual tension and the actual distance to ground to deviate considerably from the values which would be obtained with fixed suspension points.—*Elektrotechnik und Maschinenbau,* Nov. 21, 1920.

Economic Aspects of Extra-High-Tension Distribution by Underground Cable.—R. O. KAPP.—In this paper the chief points considered are (1) the choice of the most economical position for the power and transformer houses; (2) the choice of the most economical voltage; (3) various types of cable lay-out; (4) means of insuring that all radial feeders shall be fully loaded; (5) methods of making fullest use of the current-carrying capacity of cables; (6) the adoption of tariffs for obtaining the best use of the distribution system. An interesting diagram shows the cost of transmission line equipment for the three main voltages in use.—London *Electrician,* Dec. 3, 1920.



COST COMPARISON OF UNDERGROUND TRANSMISSION-LINE VOLTAGES

Traction

Changes in Electric Locomotives to Meet Demands for Heavier Duty.—GRAHAM BRIGHT.—The locomotives, the author says, are built more rigidly than formerly and offer greater protection for the motors. The largest mine locomotive is described as weighing 35 tons and having three 85-hp. commutating-pole ball-bearing motors cooled by ventilating fans. This locomotive is said to be capable of hauling 100 cars up a grade exceeding 3 per cent where otherwise seventy cars would be the limit. Storage-battery locomotives are also described.—*Coal Age,* Jan. 13, 1921.

Electric Railway Contact Systems.—PHILIP DAWSON.—A comprehensive discussion of the relative merits of contact systems, including both direct-current voltages up to 3,000 and alternating voltages from 6,000 to 16,000, also 3,000 volts to 5,000 volts three-phase. Experience with third-rail and overhead conductors both in the United States and in Germany is reviewed, with some comparison of the cost of maintenance in each system.—*Journal Institution of Electrical Engineering,* London, September, 1920.

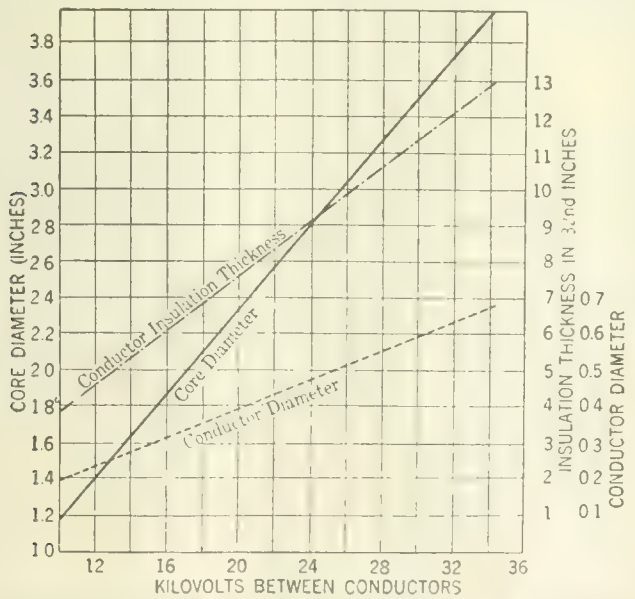
Installations, Systems and Appliances

Three-Phase Current-Limiting Reactors. — M. E. SKINNER.—The author tells what connections are necessary in three-phase reactors to obtain balanced voltage, since the mutual inductive effects are different in different positions of coils. A satisfactory arrangement is to mount the coils one above another, but to split one coil, mounting one-half below and one-half above the other coils.—*Electric Journal*, January, 1921.

Magneto Testing and the Choice of a Spark Gap.—A. P. YOUNG.—The writer considers the commercial testing of magnetos, which may be divided into two parts—(1) a determination of low-speed sparking characteristics of the machine; (2) an endurance test of many hours' duration at a speed well above the normal working speed to thoroughly test the mechanical and electrical components. The impulse ratio of spark gaps is considered and data for pointed and sphere gaps are shown. The other factors to be taken into account are (1) the shape and disposition of the electrode; (2) the material of which they are made (in slight degree); (3) the nature of the gaseous medium surrounding the electrode; (4) the density of the gaseous medium; (5) the degree of turbulence existing in the gaseous medium, and (6) the direction of the current in the gap.—London *Engineering*, Dec. 3, 1920.

Wires, Wiring and Conduit

Maximum Allowable Working Voltages in Cables.—CHARLES W. DAVIS and DONALD M. SIMONS.—The authors state that it may be reasonably concluded that for high-voltage cables of the future the ordinary three-core form will be used as heretofore up to 30,000 volts, except where it is replaced by cables of higher efficiency. The Hochstadter cable, in which each single-conductor insulation is wrapped with copper foil and the three



SMALLEST POSSIBLE TRIPLEX CABLES WHEN THE MAXIMUM STRESS IN THE INSULATION IS LIMITED TO 25 KV. PER CM.

cabled together without belt, on account of its carrying capacity and high permissible working stress, can be used from a few kilovolts up to 50,000 volts. Three single-conductor cables could be used at wider ranges than this, but, owing to the difficulties of induced sheath currents and voltages and their higher cost, their use would, according to the authors, probably not be good economy until the higher voltage limit is reached, unless such large amounts of power are involved as would require more than three triplex cables of the maximum size considered practical. Extensive data are given concerning the installation of cables of various sizes and designs. The curves shown are calculated for cables in which the belt insulation thickness is equal to the conductor insulation thickness. Additional curves give for each voltage the size of conductor and insulation thickness which will produce the cable of minimum diameter.—*Journal A. I. E. E.*, January, 1921.

Electrophysics and Magnetism

Electricity and Gravitation.—H. BATEMAN.—It is suggested that gravitation may be an effect arising from fluctuations of the electric charges associated with the electrons and positive nuclei of atoms. It is assumed (1) that the ether contains an enormous number of electric doublets moving in all directions with the speed of light, (2) that each charged particle is continually both absorbing and emitting doublets at a rate proportional to its mass, and (3) that during the absorption and emission of each doublet the charge on the particle fluctuates. If these fluctuations exist, it is shown that the mean value of the force exerted by one charged particle on another includes, in addition to the ordinary electrostatic force, an attraction proportional to the product of the masses. If it be supposed that the doublets emitted by a particle possess available energy only when the energy of the particle changes, and that the effect of changing the energy is to produce periodic gaps in the emission of doublets with a frequency proportional to the amount of energy lost, there results a theory said to be compatible with the theories of Bohr, Planck and Einstein.—*Physical Review*, January, 1921.

Spark-Over Voltages Through Air.—W. S. FLIGHT.—In this series of articles, which was begun in the October number, the writer considers voltage distribution over suspension or strain insulator strings and important considerations in the testing of porcelain insulators.—*Beama*, December, 1920.

Nature and Explanation of the "Motor Effect" in the Ajax-Wyatt Furnace.—E. F. NORTHRUP.—It is stated that whenever a high-density current, direct or alternating, flows in a liquid conductor motions of the liquid of considerable magnitude are always produced. This phenomenon is called motor effect. The analysis given considers the nature and cause of the fluid motion which occurs in the apex of a fluid triangular conductor, such as is employed in the secondary of the Ajax-Wyatt furnace.—*Journal of Franklin Institute*, December, 1920.

Telegraphy, Telephony and Signals

Telephoning Over the Lighting Mains.—BELLEVILLE.—In a brief note communicated by the technical commission of the French Syndicate of Producers and Distributers of Electrical Energy a device is described by the aid of which a line between a generating station and a substation may be utilized both for telephone communication between the two stations and for lighting, heating or storage-battery-charging purposes. The line is normally connected for power service, but as soon as the receiver is lifted off the hook on any telephone apparatus on the system the line is disconnected from the power supply by means of relay-operated breakers and is instead connected to the telephone system.—*Revue Générale de l'Electricité*, Nov. 27, 1920.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Hoover Expected to Outline Federation's Industrial Relations Plan Feb. 14

ON FEB. 14 the executive board of the American Engineering Council of the Federated American Engineering Societies will hold sessions at Syracuse, N. Y., culminating in the evening in an address by Chairman Herbert Hoover, who it is expected will outline the new council's plans for dealing with industrial relations and particularly with human waste as it affects the present army of unemployed.

The Syracuse meeting will mark the beginning of a movement to organize the engineers on a territorial basis. As a result of a report submitted to the council by Mr. Hoover, the council, it is stated, will probably encourage the formation of state engineering councils, a process already under way in many states, including Massachusetts and Minnesota. A federation of New York State engineers, it is said, is a probability of the near future.

Electrical Manufacturers to Elect New Governors at Annual Meeting

IN ADDITION to the regular business to come before the annual meeting of the Associated Manufacturers of Electrical Supplies, which will be held March 15 at the offices of the association in New York, there will be an election of five governors to take the places of the retiring members of the board whose terms expire.

Within the past year the general standards committee of the association has considered various matters of standardization, and the library and publication committee will shortly issue these standards in regular form to all association members. Bulletin No. 25, recently issued by the association, sets forth briefly the objects, aims, activities and accomplishments of the association since its organization in 1915. This bulletin also gives the names of past-presidents, officers and board of governors and shows the wide scope of the work of the various sections of the association.

This Week's New Financing Totals $18,500,000

FOUR new issues by electric light and power companies, totaling $18,500,000, were offered this week. The largest was $10,000,000 first and refunding mortgage series A 7 per cent sinking fund gold bonds of the Ohio Power Company, maturing in 1951 and sold at a price to yield the investor 7.4 per cent. An issue of $5,000,000 general and refunding mortgage twenty-five year 6 per cent gold bonds of the Southern California Edison Company was offered to yield the investor 7.1 per cent. The Oklahoma Gas & Electric Company sold $2,500,000 ten-year bond-secured 8 per cent convertible gold notes at a price to yield a little over 8½ per cent. The fourth issue was $1,000,000 one-year 8 per cent gold notes of the Wisconsin-Minnesota Light & Power Company at 99, yielding 9 per cent.

Of the four issues it will be noted that the first two are for comparatively long terms and were sold at prices to net the purchaser under 7.5 per cent, while the other two issues, totaling $3,500,000, are for ten-year and one-year terms and yield 8.5 and 9 per cent respectively.

Contractor-Dealers to Promote Good Will for Electric Utilities

APPRECIATING that the growth of the industry as a whole depends largely upon the ability of the electric utilities to obtain money for expansion and development, the executive committee of the National Association of Electrical Contractors and Dealers at its annual meeting in New York last week adopted the following resolution:

"Whereas the executive committee of the National Association of Electrical Contractors and Dealers recognizes the present need of public utilities in general, and electric light and power companies in particular, to further their sale of securities to the public, be it hereby resolved, that this committee shall offer its moral and active support in promoting the feeling of good will toward said interests and urge the membership of the organization which it represents to do all in its power toward that end."

California Electrical Safety Laws to Be Extended

AN ELECTRICAL inspection bill has been prepared by the Industrial Accident Commission of the State of California for submission to the Legislature which will prescribe the method of installation and provide for the inspection of all electrical apparatus used for the generation and consumption of electrical energy in places of employment. The act will cover the establishment of construction standards, the issuance of permits for the use of electrical apparatus, the qualifications and appointment of electrical inspectors and the licensing of master electricians. One of the provisions of the act is that "all electrical equipment in places of employment shall be so constructed, installed, operated, maintained and repaired that it will be safe and free from risk or danger of accident or injury to employees by shock, fire or otherwise."

It is to be provided that duly qualified master electricians may issue permits to energize and operate electrical equipment. Inspections may be made by the regular inspectors of the commission or by qualified municipal or county inspectors. The bill has been drawn up in its present tentative form by the Industrial Accident Commission in full co-operation with representatives of the several branches of the industry. Passage by the Legislature is expected within three months.

"Journal of Electricity" Enlarges Its Scope

ENLARGEMENT of the editorial scope of the *Journal of Electricity* and a change in its name to *Journal of Electricity and Western Industry* were announced at a dinner given on Feb. 1 in the Palace Hotel, San Francisco. The date marked the thirty-fifth anniversary of the *Journal of Electricity*, which has been one of the McGraw-Hill publications since September, 1919. Robert Sibley will continue as editor of the enlarged paper.

The *Journal of Electricity and Western Industry* will be devoted to the upbuilding of the West as an industrial section, and it will interpret Western progress through the application of electric power, light and heat in industries and homes. In its enlarged scope the publication will record the progress of the far West not only of the electrical industry as such but also of all industry dependent upon electrical energy. The fullest editorial support will be given to financing the huge building programs of the Western electrical utilities in the development of hydro-electric power, as this is held to be the greatest single asset of the West.

The tremendous value of utilized water power was emphasized by John A. Britton, vice-president and general manager Pacific Gas & Electric Company, who was among the speakers at the dinner, and the relation of industrial research to the use of this energy was explained by Dr. B. M. Rastall, industrial manager San Francisco Chamber of Commerce. "The Real Vision of the Industrial West and its World-Wide Meaning" was the topic of F. T. Griffith, president Portland Railway, Light & Power Company, and E. S. Carman, president American Society of Mechanical Engineers. "Civic Growth and Its Place in Industry" was discussed by M. M. O'Shaughnessy, "Finance and Industry" by C. F. Stern and "The Aid that Helpful Utility Regulation Can Give Industrial Growth" by E. O. Edgerton. Dr. David P. Barrows, president of the University of California, spoke on "The University Ideal and the West."

Among the prominent men of the electrical industry present were Dr. Thomas A. Addison, Pacific Coast manager General Electric Company; A. C. Balch, vice-president San Joaquin Light & Power Corporation; R. H. Ballard, vice-president and general manager Southern California Edison Company; W. A. Brackenridge, vice-president Southern California Edison Company; Wiggington E. Creed, president Pacific Gas & Electric Company; Mortimer Fleishhacker, president Great Western Power Company; H. F. Jackson, general manager Great Western Power Company; S. M. Kennedy, vice-president Southern California Edison Company; F. A. Leach, Jr., vice-president and assistant general manager Pacific Gas & Electric Company; W. G. Kerckhoff, president San Joaquin Light & Power Corporation; Paul B. McKee, general manager California-Oregon Power Company; A. B. West, vice-president and general manager Southern Sierras Power Company; A. G. Wishon, managerial director San Joaquin Light & Power Corporation, and A. E. Wishon, general manager San Joaquin Light & Power Corporation. Among the hundred guests were included prominent representatives of the banking, irrigation, agricultural and manufacturing interests of the entire West.

Plan to Settle Springfield Dispute

A STEP toward the settlement of the dispute between the city of Springfield, Ill., and the Springfield Gas & Electric Company was taken on Tuesday of this week, when an agreement between the city and the company was signed under which a company to be known as the Citizens' Electric Company will be formed to take over the electric and heating properties of the present company and in turn lease them to the city for municipal operation. Under the terms of the agreement securities of the new company are to be sold to produce a cash sum of $500,000 which will be paid at once to the Springfield Gas & Electric Company. The city will also issue bonds to the extent of $500,000, the proceeds to be used for the outright purchase of certain parts of the steam-heating system. An arbitration board will determine the value of the properties, and the excess over the cash payment of $1,000,000 will be paid semi-annually in advance, mortgage bonds at 7 per cent being issued to secure the balance due. While the agreement has been signed, it has yet to be ratified by a vote of the people on the bond issue to be taken on or before July 31.

More Than $40,000,000 of Electric Utility Financing in January

JANUARY, 1921, saw two new records in electric light and power company financing. The total for the month, $40,584,000, exceeds that for October, the record month of 1920, by more than $2,000,000. Another record is found in the 9 per cent yield on a million-dollar-issue of the Wisconsin-Minnesota Light & Power Company which was sold at 99 to mature in a year. There was no issue in this class of securities in 1920 that carried so high a yield. Another short-term issue amounting to $7,500,000 in two-year gold notes was offered by the United Gas Improvement Company to yield 8.30. This month's table as it appears below shows, however, that long-term issues predominate.

Name of Company	Amount of Issue	Period	Class of Security	Purpose of Issue	Rate of Interest	Per Cent Yield	Offered At
Oklahoma Gas & Electric Co	$2,500,000	10-year	Bond-secured convertible gold notes	Refunding	8	8.5	96
Ohio Power Co	10,000,000	30-year	First and refunding mortgage, series A sinking fund gold bonds	Refunding	7	7.4	95½
Wisconsin-Minnesota Light & Power Co	1,000,000	1-year	Gold notes	Refunding	8	9	99
Southern California Edison Co	5,000,000	25-year (due Feb. 1, 1944)	Gold bonds		6	7.10	87 50
United Gas Improvement Co	7,500,000	2-year	Coupon gold notes	Refunding	8	8.30	99.45
Southwestern Power & Light Co	1,250,000	20-year	Bond-secured gold notes	New construction	8	8.30	97 00
Empire District Electric Co. (Mo.)	1,725,000	28-year, 9 month	First lien and general mortgage gold bonds	New construction	8	8.15	98.25
Mississippi River Power Co	3,600,000	10-year	Sinking-fund gold debentures	Refunding	7	8	91½
Detroit Edison Co	5,532,600	10-year	Convertible debenture gold bonds		8	8	Par
Little Rock Railway & Electric Co	700,000	1-year	Bond-secured gold notes		8	8	Par
Lowell Electric Light Corp	1,176,400	.....	Stock	Floating debt and new construction			115
Trenton (Mo.) Gas & Electric Co	100,000	5-year (due Oct. 1, 1925)	Gold notes		8	8.38	98
Utah Power & Light Co	500,000	20-year	First lien and general mortgage		7	7.30	97
Total	$40,584,000						

Would Prohibit New Jersey Utilities from Raising Rates for One Year

THE New Jersey Legislature is considering a bill prohibiting public utilities in the state from increasing rates for service. The measure defines utilities as "every railroad, express, electric light, heat and power, street railway, canal, subway, gas, water, sewer, telephone and telegraph corporation, association, or joint stock company." Any such operating for public use shall not increase its rates within a year after the passage and approval of the bill. The statement attached to the measure sets forth that "the purpose of the bill is to protect the public against unreasonable increases in rates by public utility corporations."

New York Utility Men to Hear About State Water-Power Situation

AT THE meeting of the electric production and distribution sections of the Empire State Gas and Electric Association to be held in Rochester, N. Y., Feb. 10 and 11, one of the principal addresses will be the "Hydro-Electric Situation in New York," by Col. John P. Hogan, one of the associates of Col. William Barclay Parsons, who has been actively engaged in an investigation of the water-power resources throughout the state. Papers which will be presented at the meeting are: "Use of Aërial Power Cables," by Francis A. Westbrook; "Testing High-Tension Insulators Before and After Installation," by E. P. Peck, and "Problems of the Small Plant," by F. A. Dresser.

Other topics to which time has been allotted for discussion are: "Preservative Treatment of Cross-Arms," "Parallel Operation of Single-Phase Transformers," "What Is Being Done by Member Companies to Conform with the Bureau of Standards Covering Line Construction," "Résumé of the Policies of Various Companies Regarding Charges to Consumers for Service Extensions," "Control of Voltage on Long Commercial Circuits" and "Grounding Transformers." There will also be five fifteen-minute talks by superintendents of electric departments on departmental organization in central stations.

New England Electrical League Well Launched

TWENTY-FIVE per cent minimum increase in business during 1921 for the electrical industry of New England was sounded as the slogan for the year by Bowen Tufts, president New England Geographic Division, N. E. L. A., at the organization dinner of the New England Electrical League in Boston Jan. 26, referred to briefly on page 277 of the Jan. 29 issue of the ELECTRICAL WORLD. The responsiveness of the electrical trade to vigorous development work was cited, Mr. Tufts pointing out that in one New England town of about 9,000 residents in December, 1920, a combination house-wiring offer by a contractor-dealer and the outlay of $25 in press advertising resulted in forty-five wiring jobs and the sale of forty-five appliances, amounting together to more than $4,000. From this dealer's efforts the jobber received $1,300 worth of business, the manufacturers $1,100, and the public was saved about $500, due to the handling of the business at a slightly lower rate than would have been the case on single jobs.

Chairman Attwill of the Massachusetts Department of Public Utilities emphasized the right of utility managements to have the *opportunity* to earn a fair return on their company investments. William L. Goodwin, describing the development of electrical leagues in various parts of the country, stressed the importance of the "exchange of service beyond agreement." Olin W. Hill of the Babson statistical organization discussed the value of the domestic load. President Martin J. Insull of the national association touched upon the opportunities before the industry along the general lines followed in his address at the noonday luncheon of the New England Division.

Frank S. Price, Boston, chairman of the organization committee, presented a printed report describing the committee formations in the new development work to be carried forward during the year. The organization of the electrical development committee was given in the ELECTRICAL WORLD of Jan. 29, 1921, page 280. Other committees and their chairmen are as follows: Monthly sales effort, Frank J. Allen, Boston; advertising, W. F. Abely, Boston; data, C. B. Burleigh, Boston; conference, Fred H. Smith, Worcester; organization (relations with other bodies), George H. Cox, Boston; adjustment, A. J. Hixon, Boston.

Super-Power System for Indiana

ALL branches of engineering were represented at the forty-first annual convention of the Indiana Engineering Society in Indianapolis last week and the electrical section of the program, under the auspices of the Indianapolis-La Fayette Section of the American Institute of Electrical Engineers, was exceptionally strong.

In the development of rural business central stations have paid little or no attention to the farmers' viewpoint and to their process of reasoning, according to Professor D. D. Ewing of Purdue University, who said in an address on rural service problems that utility companies should use proved merchandising methods in selling electric service to rural communities, that farmers should pay for the lines and should then lease the lines to the electric utility company at a nominal rental.

A superpower station and transmission system were proposed for Indiana in a paper by Frederick L. Ray of Anderson, Ind.

W. J. Titus and Charles Brossman, both of Indianapolis, were re-elected president and secretary respectively of the Indiana Engineering Society. A. A. Potter, dean of engineering at Purdue University, West Lafayette, Ind., was elected vice-president, and the new trustees were R. C. Yoeman, Indianapolis, and R. E. Gibbon, Terre Haute.

Ten Million Dollars of Common Stock Authorized for Sale to Consumers

THE Southern California Edison Company has been authorized by the California Railroad Commission to issue $10,000,000 of its common stock for sale at not less than $90 per share. The company is planning to sell all of this stock locally to its consumers within the year. Recently $10,000,000 of 6 per cent, twenty-five-year gold bonds were issued and sold by the Southern California Edison Company. The returns from the two issues, it is expected, will provide sufficient capital to finance the hydro-electric developments and the extensions to the transmission and distribution systems of the company during the year 1921.

New York Holds Successful Electric Vehicle Show

THERE opened in New York on Jan. 29, to continue for two weeks, an exhibit of electric vehicles and accessories. The first week was devoted entirely to road truck and passenger vehicles and accessories, and the second week will be devoted to the industrial truck. The exhibit is being held in the showrooms of the New York Edison Company, normally devoted to domestic appliance exhibits. The entire room has been given over to the vehicle show without cost to the exhibitors as part of the Edison company's plan to promote the greater use in New York of all kinds of electrical applications.

New York is probably the greatest market for the electric road truck in the country. More than five hundred enterprises are now using in the aggregate in the metropolitan district almost 5,000 electric trucks and delivery wagons, some of which have been in service twenty years and more. The largest installation is a fleet of 319 vehicles.

Among the companies exhibiting are the following:

Commercial Trucks.—Commercial Truck Company of America, Lansden Company, Oneida Truck Company, Walker Vehicle Company (General Vehicle Company), Ward Motor Vehicle Company.

Passenger Cars.—Berg Electric Car Company, Rauch & Lang, Inc.

Industrial Trucks.—Automatic Transportation Company, Baker, R. & L., Cowan Truck Company, Elwell Parker Company, Hoagland Thayer Company, Industrial Truck Company, Karry-Lode Industrial Truck Company, Lakewood Engineering Company, Mercury Manufacturing Company, Terminal Engineering Company.

Battery Manufacturers.—The Edison Storage Battery Company, the Electric Storage Battery Company, General Lead Batteries Company, Philadelphia Storage Battery Company.

Charging Apparatus and Accessories.—A. & J. Anderson Manufacturing Company, Auto Electric Devices Corporation, Allen Bradley Company, Cutler-Hammer Manufacturing Company, General Electric Company, Westinghouse Electric & Manufacturing Company.

Record Gathering at Lunch

On Wednesday an electric vehicle luncheon was given at the Hotel Astor, at which former Governor Alfred E. Smith, now president of New York City's largest trucking company; William H. Onken, Jr., editor of the ELECTRICAL WORLD who spoke for James H. McGraw, president, McGraw-Hill Company; Robert E. M. Cowie, vice-president of the American Railway Express Company, and Arthur Williams, general commercial manager of the New York Edison Company and under whose guidance the show is being conducted, were the speakers.

The luncheon brought together probably the largest gathering ever held to pay tribute to the possibilities of electric transportation. Mr. Cowie, who represents the largest single user of electric trucks in the country, painted a picture of the future for "electrics" that left nothing to be desired.

Co-operation of all interests must bring success to the electric vehicle industry, according to Mr. McGraw, and this is exemplified, he said, by the development that has taken place in New York, where the New York Edison Company is actively behind the electric vehicle.

Former Governor Smith, who has but recently come into the trucking field, spoke of the need for concerted action to free New York from traffic congestion.

"It looks now as if the electric vehicle were finally coming into its own," remarked Arthur Williams, while discussing the show with an ELECTRICAL WORLD representative. "Last year 536 'electrics' were sold in New York, valued at $2,680,000, or 452 per cent more than in 1919. There is an investment in the metropolitan district alone of $22,000,000 in electric truck development."

However, as Mr. Williams explained, the New York Edison Company sees in the electric vehicle more than its present dollars-and-cents sales. The Edison company sees the "electric" as ultimately caring for the bulk of the city transportation. Mr. Williams pointed out that it is easier to obtain competent drivers for the electric vehicle, that it has an almost unlimited life because it has so few moving parts, that it can go anywhere without fire risk and consequently saves handling charges, and also that by its inability to attain high speeds it acts as an automatic safety check on the repair account.

It is doubtful, however, in Mr. Williams' opinion, whether the electric vehicle will attain its full possibilities until transportation engineering for secondary work has been more fully developed.

"Electric transportation," said Mr. Williams, "will carry the white man's burden of the future. The heavy truck on the street, the smaller industrial truck in the factory, the lifting platform and the conveyor and many other applications will reduce labor requirements, quicken production and make all heavy lifting and hauling a mechanical rather than a manual operation."

Industry Optimistic

More optimism is evident in the electric vehicle business today than ever before. Not so many sales are being made, it is true, but inquiries are coming in every day. The coming year is seen as a year of reducing expenses, and consequently the demand for "electrics" is expected to expand rapidly. As indicative of the point of view in the industry there follow a few expressions of opinion made to the ELECTRICAL WORLD by various manufacturers:

Road-truck business looks decidedly promising at the present time to the Ward Motor Vehicle Company, Mount Vernon, N. Y. The factory is working overtime and shipping its cars much the same as last year. To a certain extent this is due to back orders. Bookings have dropped somewhat recently, but nothing to be compared with the recession in other industries. On the other hand, there is considerable encouragement in the type and volume of inquiries received. These for the most part are from dealers in essential commodities.

Encouraging Inquiries

Industrial truck business looks particularly good. The Baker R. & L. Company is encouraged to the extent of making an additional stock investment of finished trucks and tractors of $250,000. The Karry-Lode Industrial Truck Company is receiving numerous inquiries every day. The Lakewood Engineering Company reports substantial sales. The Elwell Parker Company is going ahead with many new developments.

Reports of battery business, which is a barometer of electric vehicle conditions, confirm the statements of the truck and car manufacturers. Both the Philadelphia Storage Battery Company and the Edison Storage Battery Company report that business has turned the corner and that, while current sales are not so large as formerly, the volume of inquiries is growing rapidly.

California-Oregon Has Reorganization Plan to Reduce Capitalization

THE California-Oregon Power Company, which operates in southern Oregon and three counties of California, has applied to the California Railroad Commission for an order approving a reorganization plan proposd by a bondholders' committee. In addition the company asks that the new company formed as a result of the recommendations of the bondholders' committee be authorized to create a bonded indebtedness of $10,000,000 to obtain funds to meet the cost of necessary extensions and betterments and to meet underlying bond issues as they mature. Authority is also sought to issue 22,200 shares of preferred capital stock and 44,400 shares of common capital stock of the new company. This stock is to be delivered to the present bondholders on the basis of $500 of preferred and $1,000 common for each $1,000 California-Oregon Power Company 5 per cent bond.

The reorganization plan will result in a reduction of $6,062,000 in outstanding securities. It is claimed by the company that the value of its properties in California is $4,320,240, exclusive of its Dunsmuir water properties, said by the company to be worth $127,314.55. To the Oregon properties a value of $2,985,612 is given.

N. E. L. A. No Longer Objects to Oil-Filled Apparatus Safety Rules

REPORTS made to the executive committee of the Technical Section of the National Electric Light Association at its dinner-meeting at the Engineers' Club, New York, on Jan. 19 indicate that the work of the Technical Section is being carried out actively and with excellent co-operation through the several technical committees of geographical divisions. Chairman I. E. Moultrop announced that, although the methods of co-operation pursued are not yet uniform in all respects, progress toward uniformity is satisfactory.

The meetings of the executive committee were well attended, those present at the executive sessions being Chairman I. E. Moultrop, Edison Electric Illuminating Company of Boston; Vice-chairman N. A. Carle, Public Service Electric Company, Newark, N. J.; Vice-chairman H. A. Barre, Southern California Edison Company, Los Angeles; Vice-chairman A. H. Lawton, Consumers' Power Company, Jackson, Mich.; Markham Cheever, Utah Power & Light Company, Salt Lake City; L. L. Elden, Edison Electric Illuminating Company of Boston; L. M. Klauber, San Diego (Cal.) Consolidated Gas & Electric Company; G. E. Lewis, Detroit Edison Company; G. E. Quinlan, Puget Sound Traction, Light & Power Company, Seattle; R. F. Schuchardt, Commonwealth Edison Company, Chicago; A. E. Silver, Electric Bond & Share Company, New York City; W. K. Vanderpoel, Public Service Electric Company, Newark, N. J.; W. L. Wadsworth, Minneapolis General Electric Company; P. Torchio, New York Edison Company; Past-chairman R. J. McClelland, and by invitation, W. J. Canada, George F. Oxley and S. A. Sewall.

After discussion, the committee recommended that the safety rules committee should prepare a statement conveying to the Bureau of Standards the latest information gained by the electrical apparatus committee of the Technical Section with regard to the relative hazards of oil-filled apparatus, and advising the bureau, as a matter of courtesy and frank co-operation, that restrictive rules in the Safety Code appear warranted, although these rules previously were objected to by the committee as not warranted by the experience then in hand. The bureau is to be urged that these rules should be phrased in such a way as to take into consideration factors not adequately considered in rules previously proposed by the bureau for the Safety Code and which were withdrawn by it at the suggestion of the electrical apparatus and safety rules committees.

Chairman Moultrop reported that conferences are being held with engineer representatives of the American Telephone & Telegraph Company with a view to co-operative dealing on mutual inductive-interference problems.

San Francisco Business Men Support State Commission

DEPRECATING unfounded disparagement of the Railroad Commission of California, the San Francisco Chamber of Commerce recently adopted a resolution declaring its confidence that "a fair and impartial examination of the work of the commission will demonstrate its high efficiency and honorable discharge of public duty." It is declared in the resolution that the Chamber of Commerce, "whose membership embraces large users of all characters of public service," has carefully followed the work of the commission and has always found that its decisions have been based on its best judgment, considering the necessities of the situation presented to it. The entire impartiality of the commission's decisions is emphasized.

Seven per Cent Reduction in Southern California Edison Rates

PRELIMINARY to the establishment of complete schedules of revised regular rates, the California Railroad Commission has ordered a reduction from 27 to 20 per cent in the surcharge granted the Southern California Edison Company, which became effective on April 20 last. The reduced surcharge is to continue in effect until further orders by the commission.

The reduced rate is made effective on Jan. 20 throughout the entire territory served by the company, with the exception of that territory in the San Joaquin Valley served by the Mount Whitney Electric Company prior to its consolidation with the Southern California Edison Company. Los Angeles consumers are not affected, because under the terms of the operating agreement the company acts as agent for the city of Los Angeles, collecting on behalf of the city such rates as are fixed by the city itself.

The matter of rates for service charged by the Southern California Edison Company has been under review by the Railroad Commission since last March, when first hearings were held in Los Angeles. Further hearings were held in October, November and December, and an enormous mass of statistical evidence was submitted by the company and by representatives of various agricultural and other organizations.

The evidence submitted in the case showed that the company will have a more plentiful supply of water power during the coming year, as two additional water-power plants are nearing completion. Transferring part of the electrical loads from the steam plants to these new

water-power plants will reduce the amount of fuel-oil purchases and, under the order just issued, a part of this saving is allowed the company's consumers.

Public-Information Conference to Be Held by American Association of Engineers

A "NATIONAL engineering conference on public information" is to be held in Chicago on Feb. 25 under the auspices of the American Association of Engineers. Papers are to be read on such subjects as "Technical News Service," "News Versus Publicity," "How Publicity Helps a Community," "Effective Methods of Publicity Education on Engineering Publications" and "The Engineer as a Public Speaker." Among those who have accepted invitations to prepare papers are F. M. Feiker, vice-president McGraw-Hill Company; John G. D. Mack, State Chief Engineer of Wisconsin; W. W. DeBerard, Western editor of the *Engineering News-Record*, Chicago; William J. H. Strong, head of the Lake Breeze Motor Company, Chicago; C. R. Thomas, in charge of publication of results Forest Products Laboratory, Madison, Wis., and Ivy L. Lee, publicity director of the Interborough Rapid Transit Company, New York.

Ohio Metermen Discuss Power Factor and Line-Loss Measurements

PROBLEMS involved in metering line losses and measuring the power factor of the customer's load were discussed from managerial, operating and metering standpoints at the meter conference held in Cleveland last week under the auspices of the meter committee of the Ohio Electric Light Association.

It was the sense of the meeting that the power factor of customers' installations could be most simply and satisfactorily obtained through the measurements of the energy and reactive components of the delivered kva. Three accurate and practical methods of making these measurements on three-phase circuits were suggested in a paper prepared by J. W. West, Lynn, Mass., and presented in his absence by W. S. Culver, Cincinnati, both of the General Electric Company. Chairman S. C. Henton of Akron voiced the majority opinion in favoring the use of two watt-hour meters and two transformers because this is standard equipment which does not need any special adjustment or special means for testing. On the same subject Ray Wolford of the American Gas & Electric Company presented a paper in which he suggested possible new developments in methods of measuring customers' power factor and kilovolt-ampere-hours.

Another meter described by Mr. West gives line loss when its reading is multiplied by known resistance of the line. This meter is known as the ampere-squared-hour meter and is applicable when the corona losses are unimportant or can be allowed for and where the charging current of the line is not of primary importance. It was brought out in the discussion that these meters run in the same direction irrespective of the direction of power, so that on interconnecting lines where there is an interchange of energy special provision must be made if the losses are to be measured in each direction.

A power schedule with a kilovolt-ampere demand charge, a kilowatt-hour charge and a reactive kilovolt-ampere-hour charge was suggested by H. L. Wallau, Cleveland Electric Illuminating Company, in a paper entitled "Power Factor and Its Measurements." A very constructive paper on the rate engineering of power factor with reference to metering was prepared by F. A. Newton of Hodenpyl, Hardy & Company, Jackson, Mich., and presented by H. H. Coughlan of Akron. Mr. Newton's message was to drop the word "penalty" in referring to charges for low power factor and to realize that the utilities were partly to blame for the present power-factor conditions. It was decided that two days would be given over to the next conference, which is scheduled for Cincinnati on April 22 and 23.

Heavy Power Demand in New Jersey in 1920

ACCORDING to records compiled by the Public Service Electric Company, Newark, N. J., operating in different sections of New Jersey, there was a noticeable increase in power demand in the year just closed. The plants of the company furnished power to the amount of approximately 350,000,000 kw.-hr. for industrial service during 1920, representing about 70 per cent of the total demand. This energy was supplied through a total of about 14,000 power meters. In the lighting branch of the business the increase in this same period totaled about 16 per cent over the year 1919. The advance indicates a large number of newly wired houses. The electric utility did not experience any interruption in service due to the coal situation during the year.

Steps Taken Toward Merger of Washington Power and Traction Properties

DEFINITE action was taken on Jan. 26 by the District of Columbia committee of the House of Representatives looking to the merger of the electric light and power and street-railway companies in the national capital. By a vote of thirteen to one the committee instructed Representative Gould of New York to draft and report favorably to the House a bill removing the statutory prohibition against the consolidation of the Washington Railway & Electric Company and the Potomac Electric Power Company, and a committee of five was authorized to draw up a bill which would bring about a merger of the two Washington traction companies.

It was pointed out that it would be unfair to the Capital Traction Company to put its property into the pool if the Washington Railway & Electric Company is allowed to hold out of the merger its most valuable asset, the Potomac Electric Power Company.

Legislature Quashes California Utility Tax Raise

AFTER a hot fight in the California Legislature to increase the present utility taxes approximately 35 per cent, the move has for the time being met with defeat. The administration forces, under the direct leadership of Governor Stephens, exerted every effort to force the bill through the Assembly after it had carried in the Senate. The Governor has begun a statewide campaign to arouse public sentiment in favor of the bill during the thirty-day recess of the Legislature. If carried as proposed, the taxes on the electrical utilities will be increased from about 5.5 per cent to 7.5 per cent of the gross income.

A. I. E. E. Issues Revised Program for Its Midwinter Convention

THE definitive program of the midwinter convention of the American Institute of Electrical Engineers, to be held in the Engineering Societies Building, New York City, Feb. 16-18, has now been issued and includes a number of additions and changes made since the tentative program was printed in the ELECTRICAL WORLD for Jan. 8 (page 111). The program as it stands follows:

WEDNESDAY, FEB. 16

Afternoon.—Board of directors meeting, 3:30 p.m.; trips to local electrical plants.

Evening.—Address by President A. W. Berresford; "Present-Day Practice Limitations of Oil Circuit Breakers," by H. R. Woodrow; "High-Current Tests on High-Tension Switch Gear," by Philip Torchio.

THURSDAY, FEB. 17

Morning.—"The Maximum Safe Operating Temperatures of Low-Voltage Paper Insulated Cables," by W. A. Del Mar; "Permissible Operating Temperature of Impregnated Paper Insulation in Which the Dielectric Stress Is Low," by Philip Torchio; "Permissible Operating Temperatures of Impregnated Paper Insulation in Which the Dielectric Stress Is Low," by D. W. Roper; "Effect of Heat on Impregnated Paper from Cable Insulation," by W. S. Clark; "The Effect of Heat Upon Paper Insulation," by H. W. Fisher and R. W. Atkinson; "Permissible Operating Temperatures of Impregnated Paper Insulation in Which the Dielectric Stress Is Low," by L. L. Elden.

Afternoon.—"Carrier-Current Telephony and Telegraphy," by E. H. Colpitts and O. B. Blackwell; "Some Phases of Railroad Telegraph and Telephone Engineering," by Stanley Rhoads.

Evening.—Dinner dance at Hotel Astor, 7 p.m.

FRIDAY, FEB. 18

Morning.—"Regulation of Frequency for Measurement Purposes," by B. H. Smith; "Measurement of Relative Eddy-Current Losses in Stranded Cables," by J. A. Cook; "An Electromagnetic Device for Rapid Schedule Harmonic Analysis of Complex Waves," by F. S. Dellenbaugh, Jr.; "The Limitations of the Stop Watch as a Precision Instrument," by A. L. Ellis.

Afternoon—"Short-Circuit Current of Induction Motors and Generators," by R. E. Doherty and E. T. Williamson; "Hysteresis Effects with Varying Superposed Magnetizing Forces," by W. Fondiller and W. H. Martin; "Longitudinal and Transverse Heat Flow in Slot-Wound Armature Coils," by Carl J. Fechheimer.

Evening.—Auditorium, 8:15 p.m.: Presentation of the Edison medal to Dr. M. I. Pupin; Lecture, "Wave Transmission," by M. I. Pupin.

Geological Survey's Daily Energy Figures for November Year's Highest

FIGURES of electrical generation by public utilities for the month of November have just been issued by the United States Geological Survey. They show a total of 3,707,365,000 kw.-hr. as compared with 3,735,609,000 kw.-hr. for October. Hydro-electric generation was 47,341,000 kw.-hr. ahead of October, the November figure being 1,384,413,000 kw.-hr. Unlike the central-station statistics published monthly by the ELECTRICAL WORLD, the figures of the Geological Survey include electric railways.

Average daily production of electricity in kilowatt-hours by public utility plants for the first eleven months of the year was as follows: January, 124,700,000; February, 119,800,000; March 120,700,000; April, 119,100,000; May, 115,600,000; June, 118,800,000; July, 116,800,000; August, 119,700,000; September, 120,800,000; October, 120,400,000 and November, 123,600,000. The total output for the eleven-month period from January to November, 1920, was 40,191,000,000 kw.-hr., an increase of about 15 per cent over 1919.

The output for November, 1920, involved the consumption of more than 3,160,000 tons of coal, more than 960,000 barrels of fuel oil and more than 1,855,000,000 cu.ft. of gas.

Consumers' Power to Use Radio Telephones

THE Consumers' Power Company at Jackson, Mich., has announced that wireless telephones will be installed for use in the operation of its system. The decision was arrived at after a thorough investigation by E. B. Morrow, manager of the transmission and production department, into the feasibility of using the instruments.

Telephone Lines Have No Right to Monopolize Highways

WHETHER transmission lines of moderate voltage shall be allowed to occupy the opposite side of the highway from certain long-distance telephone circuits was directly questioned in the application for a certificate of necessity and convenience made to the Public Utilities Commission of Illinois at Springfield this week by the Homer Electric Light & Power Company. The line that the Homer company proposes to build would parallel important toll circuits of the Illinois Bell and American Telephone & Telegraph companies for a distance of approximately 7 miles. On July 31, 1920, the commission refused the application of the Homer company for authority to build a 13,200-volt parallel line to establish service to a coal mine, on the ground that there was another route available, but on Sept. 28, on a showing that thirty-seven property owners along the route originally proposed had applied for service, the commission granted the application, pointing out, after discussing the telephone interference situation, that "in view of the rapid progress in the field of electric transmission the present-day tendency is to generate electrical energy at central stations and distribute it over high-tension lines. This development in the business," the commission continued, "has made it possible for small villages and rural customers to enjoy electric service where it would otherwise not be available. A large number of villages and towns in Illinois are annually being connected to transmission lines, and there is now appearing a tendency toward rapid development in rural communities. Considering that most of the rural roads are now occupied by telephone circuits, the problem of routing electric lines so as not to cause interference with signal circuits is becoming more and more difficult, and while the signal circuits with priority of occupation are entitled to reasonable protection from substantial interference, it does not appear that there is any right on the part of a telephone company to occupy the public highway to the entire exclusion of the electric lines."

The hearing this week was on an application from the telephone companies, one of them alleging that it had not had notice of the hearing on which the certificate of necessity and convenience was granted. The con-

tention made in the testimony this week is that the power company can construct a line of lower voltage along the road, feeding this from both ends and from a 13,200-volt line along the Wabash Railroad right-of-way a short distance away, and that a 13,200-volt line should not be allowed on the highway in question.

The case has assumed national prominence in that the commission order already made involves a clear denial of the telephone companies' right to monopolize the highway, while a reversal of that order would create a precedent against the building of transmission lines in parallel with important telephone toll circuits.

Figures on Changes in Cost of Living

DETAILED figures showing the changes in the cost of living for a standard family, all articles considered, were given out this week for thirty-two cities by the United States Department of Labor through the Bureau of Labor Statistics. Two tables, one giving the changes for nineteen cities from December, 1914, to December, 1920, inclusive, and the other for thirteen cities from December, 1917, to December, 1920, are included.

Electrical Inspectors Recognize Auto-Transformer Hazards

THE hazards involved in the use of auto-transformers for obtaining lighting service from 220/440-volt and other low-voltage power circuits in industrial plants came in for a rather lively discussion at the meeting of the Western Association of Electrical Inspectors at Detroit last week. H. J. Woods of St. Louis illustrated various combinations in connection with grounding whereby abnormal voltages on the lighting circuits could be caused, and a resolution was passed in which the association recognized the hazards and put itself on record as favoring prohibition of the use of auto-transformers or surrounding such use with safeguards that will prevent trouble. The matter is to be discussed with other organizations interested.

Co-operation between the central stations and inspection bureaus was strongly supported by L. D. Smith of the Minneapolis General Electric Company, and as a step toward greater co-operation the revised articles of the association adopted provide for one associate and one industrial member on the executive committee. Associate members include among others those supervising or inspecting electrical installations for public service companies, while industrial members include contractors, engineers and manufacturers.

Frank R. Daniels of Milwaukee in discussing inspectors' problems pointed out the need of educating and co-operating with the smaller cities and towns where it is difficult to insure proper wiring and where spasmodic inspection has been more or less of a failure. The educational program adopted by the inspectors' association in Wisconsin was described briefly by Mr. Daniels.

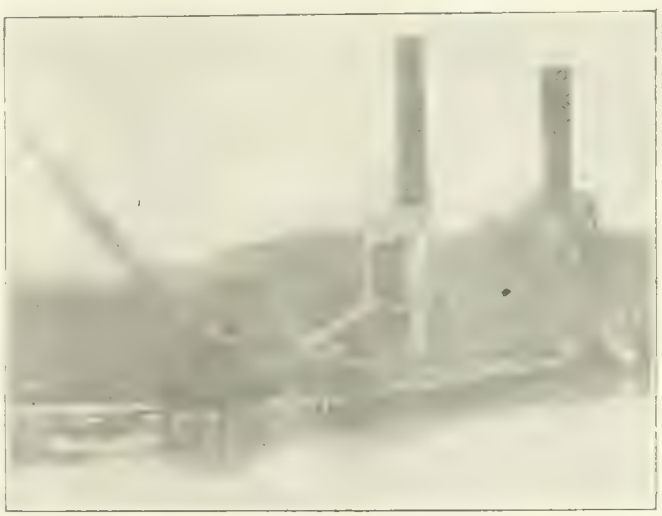
The committee reports on Thursday were the subject of animated discussions, the most important being that on the motor-wiring tables. These have been presented at previous meetings, and the crux of the discussion last week concerned the advisability of limiting the fuse sizes to the safe carrying capacity of the wires protected. A rather prevalent opinion was that on motor circuits where starting loads are short and danger of overheating conductors is small the present limits as to fusing may force the use of conductors larger than are economically justified. The report, which was on the installation and operation of induction motors, was referred to the committee for further study. A resolution was passed indicating that the association would confine its attention on overhead-line construction to matters involving direct fire hazards. These items are largely the transformer and service installations in close proximity to buildings.

The following officers were elected: President, J. H. Fenton; first vice-president, O. M. Frykman; second vice-president, F. O. Evertz; secretary-treasurer, W. S. Boyd; executive committee, Frank Anderson (chairman), William A. Haig, J. S. Mahan, L. A. Barley, J. W. Strub and H. J. Clark.

British Columbia Now Requires Registration of Engineers

AN ACT recently passed by the Legislature of British Columbia incorporates the Association of Professional Engineers in that Canadian province and requires that all persons practicing as "professional engineers" shall register as members of this body. Civil, mining, mechanical, electrical, chemical and structural engineers come within the provisions of the act, but not architects. Those who had practiced in the province for five years prior to the passage of the act may register without an examination up to April 1, 1921, as many engineers who served as such in the war. Temporary licenses to practice may be given to non-residents of the province. An executive council for the association is to be elected by the membership, and this council is to appoint annually a board of examiners which shall examine candidates for membership. The annual fee is to be determined by the association when it draws up its by-laws.

One of New England's Most Efficient Plants



BY INTERCONNECTION with electric light and power plants at Walden, Revere and Boston this steam plant of the Salem (Mass.) Electric Lighting Company has effected an estimated saving of coal reaching 1,200 tons per year. Since 1914 the output of this plant has increased from about 9,000,000 kw.-hr. to 43,000,000 kw.-hr. per year. This is one of the most efficient plants in New England, generating a kilowatt-hour on about 1.8 lb. of coal.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Victoria Falls Again to the Front.—The long-talked-of hydro-electric plant at the Victoria Falls, on the Zambezi River, in South Africa, has come up for discussion again owing to the high cost of coal, and it is said to be probable that work will soon begin on a 250,000-hp. plant.

New Figures on Spanish Water Power.—Statistics published by a Spanish electrical association for 1920 show a total of 618,756 hydro-electric horsepower in use in Spain, compared with 348,297 in 1917. Thus 10 per cent of the potential horsepower, placed at 6,000,000, has been actually developed. At the rate of 1 hp. to 6 tons of coal, it is prophesied that in four or five years production by water power will equal production by fuel.

Y. M. C. A. Courses in Electricity and Illumination.—The Central Technical School of the Chicago Young Men's Christian Association announces two new evening courses to cover fifteen weeks each—one in illuminating engineering and one in applied electricity. The instructor for both courses is Edwin D. Tillson, a testing engineer with the Commonwealth Edison Company, and there will be two sessions of an hour and a half's duration in each course every week.

Electric Lighting in Japan.—Figures recently published by the Japanese authorities put the total number of electric lamps in service in the island empire at 12,210,000, with a candlepower of 150,000,000, or an increase of 800 per cent since 1910. There are 180 lamps to every 100 homes, or a little more than one lamp to every five inhabitants. In the six principal cities the total number of lamps in use is as follows: Tokyo, 1,684,533; Osaka, 842,491; Kioto, 400,413; Kobe, 318,328; Yokohama, 255,008; Nagoya, 202,315.

Power Projects on the Wisconsin River Under Way.—The Wisconsin Valley Electric Company of Wausau is making rapid progress with its dam across the main channel of the Wisconsin River at that place. This dam, which will enable the company to furnish electrical energy in greater quantities to the mills along the valley, will cost $750,000. Application, in addition, has been made by the Wisconsin Valley Improvement Company to the Railroad Commission of the State for permission to construct a reservoir near Tomahawk, about 40 miles above Wausau, where the Spirit River empties into the Wisconsin. It is planned to spend $100,000 there and to impound 50,000,000 cu.ft. of water, which will provide an increase of electrical power in that district of from 9 to 10 per cent.

Customers' Good Will Fails to Bring Higher Rate for Electric Utility.—An instance of public support for an electric light and power company asking higher rates recently arose in Rockford, Ill., where the Rockford Electric Company asked permission from the Illinois Public Utilities Commission to raise its commercial lighting rates 30 per cent and submitted letters from several of its patrons in which the company's service was complimented and a willingness to pay higher prices if necessary expressed. No protest against the application was filed with the commission by the city or any of the company's customers. Notwithstanding these facts the commission refused to entertain the application.

Water Power in the Scottish Highlands.—The familiar Scottish names "Lochaber" and "Grampian" figure in two measures now pending in the British Parliament for promoting private development of hydro-electric power sources in the Highlands. Authority is sought to use the waters of many specified lochs, rivers and streams and to construct the requisite dams and reservoirs. The Lochaber scheme, to cost £2,962,000, is said to have aroused little local opposition and to have a good chance of becoming law, but the Grampian scheme, to cost £1,000,000, is attacked as being designed to benefit only the manufacturers of Dundee and Perth. Signs that both projects will be attacked by those primarily interested in the preservation of Highland scenery and resentful of the intrusion of industry are not wanting.

Minister of Power and Aid to Rural Distribution Recommended for Ontario.—A committee appointed by the Legislature of the Province of Ontario to report on rates for Hydro-Electric Commission power has recommended, as reported in the *Canadian Engineer*, the establishment of a Department of Power in the Ontario government, the appointment of a Minister of Power, the collection of an annual rental of $2 per horsepower on all power developed within Ontario, and the granting of provincial assistance to all municipalities that pay more than $30 per horsepower for "Hydro" power. "Where power is supplied to the agricultural industry," the report says, "then the Minister of Power may give further assistance by granting the local commission of such municipality a sum sufficient to meet the whole or part of the annual charge necessary to pay for the cost of construction and maintenance of the low-tension lines which are necessary for rural distribution, but one of the conditions upon which such assistance may be given is that there must be an average of three services a mile in the rural district served, and the total expenditure for such assistance shall not exceed 50 per cent of the revenue derived from power rentals."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New Mexico Electrical Association.—The New Mexico Electrical Association will meet in convention at Albuquerque on Monday and Tuesday, Feb. 14 and 15.

Wisconsin Electrical Contractors and Dealers' Association.—This association elected the following officers at its recent annual convention in Milwaukee: President, B. L. Burdick, Milwaukee; vice-president, William F. Meter, Oshkosh; acting secretary, H. M. Northrup, Milwaukee; secretary and treasurer, John L. Acker, Sheboygan.

Southern Operating Men to Form Organization.—As the result of a conference held last December at Parksville, Tenn., between representatives of seven large power companies the idea of forming a permanent association was indorsed. A constitution and by-laws are being drawn up, and it is expected that other companies will join those now backing the movement. The next meeting will be held in Atlanta under the auspices of the Georgia Railway & Power Company in the first part of April.

Institute of Radio Engineers.—The annual election of officers recently held by the Institute of Radio Engineers resulted in the choice of E. F. W. Alexanderson as president, Fulton Cutting as vice-president, A. N. Goldsmith as secretary and W. F. Hubley as treasurer. The board of direction of the institute is made up of the officers and the following managers: E. H. Armstrong, W. H. G. Bullard, E. H. Colpitts, L. Espenschied, J. V. L. Hogan, L. R. Krumm, R. H. Marriott, Donald McNicol and George O. Squier.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Philadelphia, Section, Feb. 5; Cleveland Section, Feb. 14; Birmingham Section, Feb. 19; Chicago Section, Feb. 19.

Florida Engineering Society—Lakeland, Fla., Feb. 7 and 8.

American Institute of Electrical Engineers—Portland (Ore.) Section, Feb. 7; Chicago Section, Feb. 28.

A. I. E. E., A. S. M. E. and A. S. C. E. (joint meeting)—Boston, Feb. 8.

New Mexico Electrical Association—Albuquerque, Feb. 14 and 15.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 14-17.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see News of the Industry.)

American Physical Society—New York Feb. 25 and 26.

Wisconsin Electrical Association—Milwaukee, March 23 and 24.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Free Service by Municipal Plant Illegal.—Under the state statutes it is unlawful, the Indiana Public Service Commission has announced, for a municipal plant to render free service or service at special rates to any consumer. The commission disclaims jurisdiction to pass upon the question whether or not a municipal utility can recover from a charitable institution for past free service.

Twenty-four-Hour Service Compelled.—The Eastern Montana Light & Power Company has been required by the North Dakota Board of Railroad Commissioners to render twenty-four-hour service in cases where the board held that a discontinuance of such service would be a hardship to consumers who had purchased power equipment which would be rendered valueless upon a cessation of day service.

Abandonment of Service Authorized.—In granting permission to E. F. Chambers, operating a gas plant at La Junta, Col., to discontinue service and dismantle the plant the Colorado Public Utilities Commission said: "This involves a question of the authority of the commission to compel the owner to invest additional money in the equipment of a utility that has heretofore been a losing venture. It is asserted in the pleadings of the protestants that it is the duty of the owner of a utility so to do and within the power of the commission to compel its being done. But we have not been cited to any legal authority in support of such proposition, nor do we know of any such authority. Therefore the commission holds that it is without power to order it to be done, and that it is not the legal duty of the owner further to invest his capital in the operation of a utility that experience has proved to result in financial loss."

Contract Rates Which Are Not Discriminatory or Unreasonable Defended Against Supersession.—In the case of H. C. Frick against the Duquesne Light Company and the Allegheny County Steam Heating Company, protesting against the supersession of contract rates entered into for a five-year period, the Public Service Commission of Pennsylvania held that the parties to the dispute having agreed that the filed rates were reasonable and would remain stable for a period of at least five years, and the complainant having incurred extraordinary expenses upon that assumption, no ground of public policy existed which required that their joint judgment be set aside until or unless it could be shown that the time element which they had fixed to the legal rate had resulted or would result in a discriminatory or preferential situation inimical to other patrons or the public at large, or that the rates had become so unjust and unreasonable that they should be abrogated on the ground of public policy.

Return of 8.4 per Cent Indicates Prosperity.—Declining to grant an increase in rates for electrical energy asked by the Eastern Wisconsin Electric Company at Fond du Lac, the Wisconsin Railroad Commission observed: "Using the company's figures as they are submitted and without questioning at this time the propriety of the various elements, we find that the annual return will be 8.4 per cent. We are certain, therefore, that the business, at least as far as this particular department is concerned, has been and still is prosperous."

Surcharge and Fuel Clause Granted Cambridge Company in Lieu of Flat Rate Increase.—Refusing the application of the Cambridge Electric Light Company for an increase in its maximum commercial rate from 9 cents to 12 cents a kilowatt-hour, the Massachusetts Department of Public Utilities permitted a surcharge of 1 cent a kilowatt-hour as well as a six-month fuel clause establishing an increase of 1¼ mills a kilowatt-hour for each dollar's excess in price of coal over the rate of $5 a ton. "It seems fair," the decision said, "that the customers paying the maximum price should have the same treatment as the other customers, namely, a 1-cent surcharge and the fuel clause. If, as was urged, a reduction in coal prices is imminent, this charge for the excess coal cost above the pre-war normal will eliminate itself as fast as that desirable objective is attained, and the surcharge also should be eliminated as soon as this can be prudently done."

Claim that Losses Give "Business Value" Called Absurd.—According to a decision by the California Railroad Commission the sum of $14,000 is "just compensation" for the light and power utility which distributes electricity in the city of Banning. The appraisal was made on request of the city, which has in contemplation the purchase of the plant. The commission refused to allow the plant owners a value of $2,000 claimed for the franchise under which the utility was operating and also disallowed a claim of $5,000 made by the company as the value of the business. The claim for "business value" was based on the fact that the company had lost approximately $5,000 during its operation. Declaring this claim unsound in principle and in fact, the commission asserted that if it were allowed "there would follow this absurd result: The greater the losses incurred in a utility business the greater its value, and the less profitable the business the larger the 'just compensation' to the owner. The mere statement of such a theory proves its absurdity."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Surrender of Franchise Involves No Surrender of Other Rights.—An electric service company surrendering its franchise and operating under an indeterminate permit does not, the Supreme Court of Indiana has found in Valparaiso Lighting Company vs. Public Service Commission, surrender any other of its property, as, for instance, its property right in a contract of a power company to furnish it electrical energy, entered into before the enactment of the public service law. A favorable long-time contract of this nature is to be considered like the company's other property in fixing rates to consumers. (129 N. E. 13.)*

Valuation on Five-Year Basis Prior to 1916 Improper.—The Supreme Court of New Jersey has found, in Elizabethtown Gas Light Company vs. Board of Public Utility Commissioners, that in valuing the company's property for the purpose of fixing rates it was unjust for the Board of Public Utility Commissioners to adopt as a standard the average prices prevailing for five years preceding Jan. 1, 1916, instead of allowing for the greatly increased prices at the time to which the rates apply. Allowance should also have been made for the increase in rates of interest on securities; nor was it proper to take the par value of the stock and outstanding bonds as the measure of invested capital where the investment had been built up through many years of successful management by reinvestment of income. (111 At. 729.)

New York State Tax as It Affects Outside Utilities.—The Court of Appeals of New York has reversed the trial court and sustained the Manila Electric Railroad & Lighting Corporation in its appeal from a decision obliging it to pay a license and franchise tax under the New York laws. A foreign corporation, the Court of Appeals holds, to be subject to such taxes must carry on its business in the state and also employ capital within the state, it being necessary that both conditions concurrently exist. When a foreign corporation had no property in the state other than bonds and notes deposited with a trust company as trustee and balance on bank account, and confined its operations in the state to collections and distribution to its stockholders of income from stock and obligations of other foreign corporations, it was not required to pay a license fee or franchise tax. (128 N. E. 892.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

John L. Ganz, electrical engineer, mechanical engineer and lawyer of St. Louis, has been elected treasurer of the Union Electric Light & Power Company of that city. Mr. Ganz was born



J. L. GANZ

in 1884 in Sprague, Mo. He taught school for two years after his graduation from high school and then for four years took a course in mechanical engineering at the Oklahoma Agricultural and Military College and an electrical engineering course at the University of Missouri. In the summer of 1906 he entered the motor and transformer department of the Union Electric Company and in a few years was made machine-shop foreman in charge of mechanical repairs. While holding this position he entered the Benton College of Law of St. Louis, from which he was graduated with the degree of LL.B. in 1916. On Feb. 1, 1917, a few months after he was admitted to the bar, he was appointed claim attorney for his company, and since Nov. 1, 1920, he has been the company's financial officer.

F. A. Williams has been elected chairman of the Public Service Commission of Oregon, succeeding Fred G. Buchtel.

Frank J. Duffy, president of the Southern Railway & Light Company, Natchez, Miss., has been elected chairman of the Board of Water Commissioners of that city.

A. B. Coryell has been appointed superintendent of power of the Laurel (Miss.) Light & Power Company. Mr. Coryell was formerly connected with the Burke-Fowler Electric Company, Alma, Mich.

Eckley Markle, Hazleton, Pa., has been appointed assistant general manager of the Wilkes-Barre & Hazleton Railway Company and the Lehigh Traction Company, Hazleton.

Dr. Louis Bell, consulting electrical engineer, Boston, who has been confined to his home by an attack of pneumonia, is now convalescing. His many friends will be glad to know that he will soon be at his office again.

Harry C. Stevenson has been appointed assistant to President Thomas N. McCarter of the Public Service Corporation of New Jersey and will act as Mr. McCarter's personal representative in the southern division of the territory served by the company's electric, gas and railway properties. He will make his headquarters in Camden. Mr. Stevenson has been connected with the Public Service Corporation of New Jersey ever since its organization in 1903. He began his career in the public utility field in 1897, when he became secretary to the late Thomas C. Barr, then president of the Worcester Traction Company. Later he served as auditor of the Elizabeth, Plainfield & Central Jersey Railway, becoming connected with the Public Service Corporation of New Jersey when the Elizabeth, Plainfield & Central Jersey was absorbed. After serving in a secretarial capacity to several executive officers



H. C. STEVENSON

Mr. Stevenson was, in June, 1907, made assistant secretary of the Public Service Corporation and of its underlying companies. In April, 1917, he was made assistant to Vice-president Edmund W. Wakelee.

H. J. Moulton, who has been assistant district manager of the Southern California Edison Company at Redondo, has been transferred to the position of district manager at Redlands.

Adam Gschwindt, vice-president and general manager of the Rockford (Ill.) Electric Company, was elected president of the Illinois State Electric Association at its recent annual meeting. His connection with the public utility field dates back to 1898, when he became associated with the Economy Light, Heat & Power Company of Scranton, Pa. Since that time Mr. Gschwindt has been superintendent of the steam-heating department of the



ADAM GSCHWINDT

Scranton Electric Company and vice-president and purchasing agent of the American Gas & Electric Company in New York City. He went to the Rockford Electric Company in 1913 in his present capacity of vice-president and general manager.

A. U. Brandt, who until recently held the position of superintendent of electrical distribution in Alameda County with the Pacific Gas & Electric Company of California, has been promoted to the position of electrical engineer of the San Francisco division of that company and will be in charge of the operation and maintenance of the electrical properties and steam generating stations in San Francisco. Although a native of Missouri, where he was born in 1877, Mr. Brandt has gained his electrical experience in California, to which state he went immediately after graduation from the University of Missouri in 1899. From then until 1904 he was an inspector for the Independent Electric Light & Power Company of San Francisco. When that company was purchased by the San Francisco Gas & Electric Company he became an inspector for the California Gas & Electric Corporation of Oakland. After the absorption, in 1905, of the latter company into the present Pacific Gas & Electric Company he filled various successive positions leading up to that of superintendent.

Irwin L. Moore, who has been appointed engineer in charge of special work of the New England Power Company at Worcester, Mass., is the son of General Manager Samuel C. Moore. The younger Mr. Moore is a graduate of Harvard.

John R. Le Vally, formerly sales engineer in the Chicago office of the Locomotive Superheater Company, has been appointed district manager of its new office in Pittsburgh, Pa., which was opened on Jan. 1. Mr. Le Vally is a graduate of the Armour Institute of Technology and has had extensive experience in power-plant engineering



J. R. LE VALLY

and construction. Before becoming associated with the Locomotive Superheater Company he was superintendent of construction in power plants for the Union Stock Yards & Transit Company and the Produce Terminal Corporation, in charge of design, purchasing and erection of several large power stations. During the war Mr. Le Vally was an officer in the United States Navy, serving on the battleship Vermont and the United States transport Huron.

Charles Hackel, formerly connected with the Western Electric Company, New York, has been appointed chief engineer for the Trenton & Mercer County Traction Company, Trenton, N. J., to handle all matters pertaining to power-plant and electrical operations.

A. D. Bailey, chief engineer of stations No. 1 and 2 of the Commonwealth Edison Company, Chicago, has been appointed superintendent of generating stations. Mr. William Wardell succeeds A. D. Bailey as chief engineer of station No. 1, and William Weyker has been appointed chief engineer of station No. 2.

Henry T. Pierce, a transmission engineer, formerly of Worcester, has returned and re-entered the employ of the Power Construction Company, a subsidiary of the New England Power Company. Mr. Pierce has been away from Worcester about a year, having been with Colonel George W. Bunnell, formerly president of the Power Construction Company, in Santo Domingo, West Indies, where he was general manager of the Badahoma Company, sugar manufacturer.

George E. Sanford of the General Electric Company, West Lynn, Mass., has been elected president of the American Society of Safety Engineers.

C. W. Yerger has been appointed district manager of the Boston office of the Cutler-Hammer Manufacturing Company, Milwaukee.

Harry C. Newkirk, formerly Western district manager for L. K. Comstock & Company, has become vice-president and manager of the F. E. Newbery Electric Company, Chicago.

Arthur H. Abbott has been appointed New England representative of the Ohio Electric & Controller Company, Cleveland, with offices at 88 Broad Street, Boston.

Charles B. Hawley, formerly assistant hydraulic engineer for the Aluminum Company of America, Pittsburgh, has entered private engineering practice with offices at Washington.

Fred E. Schornstein, formerly manager of the Red Wing (Minn.) property of the Wisconsin-Minnesota Light & Power Company, has been transferred to the home office of the company at Eau Claire, Wis.

Ruddy Holterman, formerly sales manager of the Holabird Electrical Company, San Francisco, which was recently purchased by the Fobes Supply Company of Portland and Seattle, has been made manager of the new San Francisco office of the consolidated company.

John Tyrone Kelly of the staff of the Society for Electrical Development has resigned to take up the direction of the national publicity and advertising campaign of the National Prosperity Bureau, which was recently launched by representatives of twenty-four national business associations to stimulate a return to normal buying.

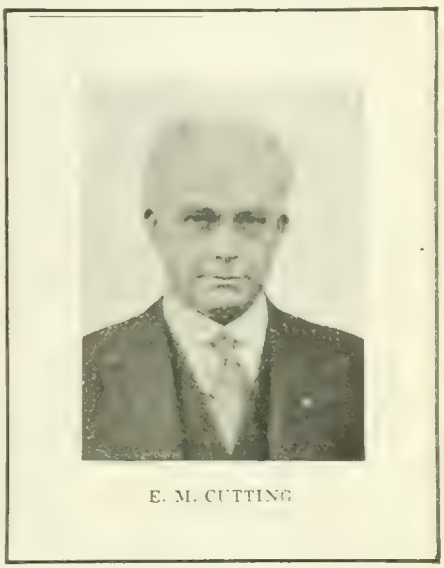
J. L. Finnicum has been appointed sales manager of the Thorardson Electric Manufacturing Company, Chicago. Mr. Finnicum was formerly connected with the Doubleday-Hill Electric Company, Pittsburgh, for eight years as salesman and in charge of the apparatus department. For the last two years he has been acting as district manager at Chicago for the Electric Products Company of Cleveland.

A. H. Griswold, formerly plant engineer for the Pacific Telephone & Telegraph Company, with headquarters in San Francisco, has been appointed assistant chief engineer of the International Western Electric Company, Inc., in New York. After his graduation from the University of Illinois in June, 1901, Mr. Griswold entered the engineering department of the Western Electric Company. In 1905 he became affiliated with the Pacific Telephone & Telegraph Company.

James R. Werth has been appointed commercial service manager of the West Penn Power Company, Pittsburgh.

Robert M. Eames, who was recently appointed general sales manager of the Bryant Electric Company, Bridgeport, Conn., succeeding Frank V. Burton, has been active in the sales organization of the Bryant Electric Company for fifteen years. For the last few years he has been its export manager.

E. M. Cutting, Western manager of the Edison Storage Battery Company at San Francisco, recently came East to take up the duties of assistant to the general manager, Frank D. Fagan.



E. M. CUTTING

For many years Mr. Cutting was signal supervisor on the Southern Pacific Company's lines in the Far West, and later he was appointed to the position of engineer of train lighting, heating and ventilation for the same company. In 1913 he accepted the position of Western manager of the Edison Storage Battery Company.

Obituary

Charles E. Chapin, president and treasurer of the Charles E. Chapin Company, New York, manufacturer of brushes for electrical machinery, died suddenly Jan. 29, of apoplexy, at his home in Greenwich, Conn. Mr. Chapin was born in Collinsville, Conn., in 1854.

Wilbert H. Doughty, formerly a member of the electrical contracting organization of the Doughty & Welch Electric Company, Inc., Fall River, Mass., died recently. Mr. Doughty was a native of Brunswick, Me., and for some time traveled in the interests of the Thomson-Houston Electric Company and the Thomson Electric Welding Company, with headquarters at Lynn, Mass. Later he was at the head of the motor department of the Fall River Electric Light Company. He retired from the Doughty & Welch company in the summer of 1920.

Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of
Electrical Apparatus and Supplies

Further Signs of Business Improvement Seen in Municipal Borrowing

EVERY DAY there are signs pointing toward an improvement in the general business situation, and the most marked this week is the number of municipalities that are rushing into the market for money. Many of these demands, of course, are for short-term loans in anticipation of the payment of taxes. A very substantial number, however, are seeking large sums for a long time. In these cases money is to be spent for permanent improvement, the effect of which will naturally make itself felt in industry.

Road and highway work will be undertaken this spring in greater volume than before in years. Transportation is available, as is also labor, and costs are lower. In the South this work is already under way in numerous instances. In many of these cases it is not improbable that sums aggregating a large amount will be spent for lighting.

Anyhow it takes only a few such activities to start others.

Bare-Copper-Wire Trade Marking Time

WITH electrolytic copper still at the extraordinarily low figure of 12.75 cents delivered for prompt shipment, the market for bare copper wire remains quiet. Recently one or two producers have reported that sales showed a slight improvement over December's business, but general demand is light. Wire manufacturers apparently appreciate the unusual opportunity which is offered to buy and stock copper for their future needs at its present low figure. Some are actually doing this as a matter of fact, but several others assert they have not the money and are not able to carry interest charges on a tied-up investment such as a large stock of copper would represent.

Stocks of finished bare copper wire are inconsiderable. The declining market and the policy of drawing wire for each individual order has served to keep stocks low. But as current buying is mostly of the necessity class, such as for telephone repairs, deliveries are entirely favorable, ranging from about two to three weeks. There is considerable shopping practiced by consumers, as prices under competition are very often shaded. Some manufacturers will not quote a base price, but, from the quotations of others, from 15 cents to 16 cents would appear to be the market on bare copper wire. The price curve, viewed from its peak quotation, has presented a gradual downward curve, reductions being made as recently as the latter part of January.

Mill operations are on a curtailed basis, not so much in the actual number of hours that plants are running as in the amount of work that is accomplished. Wage reductions of about 10 per cent have been put into effect in a few instances, and working forces in some cases have been reduced too.

Hundred-Million Mark Passed for 1920 Electrical Exports

WITH the month of December turning in a record value of electrical exports amounting to $13,812,251, the year 1920 finished with a total value of these exports which hangs up an annual record of $102,618,508, a figure approximately 15 per cent higher than the previous high year on record—1919. This is nearly equal to the total of exports for the years 1917 and 1918 combined.

The month of December exceeded that of November by three and three-tenths million dollars, or 30 per cent, and exceeded December of a year ago by almost 110 per cent. During December, 1920, more generators, fans, insulated wire and cable, interior-wiring supplies, meters and measuring instruments, motors, telephone and miscellaneous equipment left the country than during any other month.

Special attention is focused on the 1920 increases over 1919 on certain items. Rheostats and controllers increased nearly 200 per cent, interior-wiring supplies 50 per cent, generators 40 per cent, transformers 30 per cent, motors, switches and accessories 25 per cent, and miscellaneous equipment 20 per cent.

While it is generally stated that the export market during the last few months of the past year was quite dull, and is still so, it is probable that a great part of the electrical exports billed at that time of the year—high as they were—were booked during midyear or earlier, and prices at midyear were about at their peak on most classes of apparatus and wiring supplies. But they were higher during the first half of 1920 than they were during 1919.

Exchange rates in most foreign countries are still quite unfavorable for purchasers in the American market, but many countries found it necessary to purchase in the American market because European manufacturers were not able to supply both their own and a foreign market. This condition during the latter half of 1920 was gradually being overcome, and England and Germany are now prominent factors in the electrical markets of the world.

The accompanying table is made up from figures compiled by the Bureau of Foreign and Domestic Commerce.

Articles	Dec., 1919	Dec., 1920	1913	1914	1915	1916	1917	1918	1919	1920
Batteries	$477,102	$649,769	$359,123	$635,522	$1,364,999	$2,025,250	$3,624,222	$3,178,437	$5,998,337	$6,633,542
Carbons	100,496	123,793					*736,717	1,600,920	1,391,765	1,477,831
Dynamos or generators	583,025	1,487,543	2,374,122	2,372,816	1,872,191	1,867,565	2,356,780	3,363,349	5,799,885	7,937,935
Fans	32,648	257,432	415,774	295,966	374,113	313,771	622,731	847,327	1,421,160	1,365,766
Heating and cooking apparatus	110,575	206,548					1,256,533	686,339	1,579,757	1,801,127
Insulated wire and cable	499,315	1,301,307	*1,256,865	1,321,451	2,761,609	4,943,577	7,187,951	5,604,114	8,815,212	8,178,539
Interior wiring supplies, including fixtures	245,434	442,129	*408,253	591'136	882,981	901,657	1,405,772	1,428,615	2,319,498	3,386,068
Arc lamps	1,088	2,893	134,053	42,782	23,968	15,467	16,418	14,139	16,893	26,717
Carbon-filament lamps	16,678	19,622	254,893	88,025	150,111	124,776	187,876	102,872	202,590	114,542
Metal-filament lamps	311,308	463,487	301,791	278,061	873,862	1,420,309	2,884,675	3,369,192	4,674,317	4,050,549
Magnetos, spark plugs, etc	232,762	314,185					1,757,848	2,749,705	3,034,775	3,601,419
Meters and measuring instruments	227,955	332,314		*157,386	657,129	884,241	1,213,278	1,887,925	2,891,307	2,676,548
Motors	778,039	1,702,846	4,886,508	3,300,839	3,279,174	4,932,831	6,484,972	8,225,197	10,635,476	13,263,657
Rheostats and controllers	35,836	81,569					*93,612	288,757	514,760	1,407,719
Switches and accessories	216,020	568,343					1,025,003	2,195,300	3,564,772	4,438,709
Telegraph apparatus, including wireless	41,767	101,665	147,233	93,563	136,890	209,343	555,703	378,806	830,887	713,798
Telephone apparatus	330,223	544,068	1,659,326	1,251,788	910,562	1,813,969	2,212,237	2,687,483	3,783,398	3,898,987
Transformers	297,869	696,057	872,661	934,312	704,373	1,051,168	1,747,884	3,528,673	3,787,851	4,803,158
Miscellaneous	2,127,070	4,516,741	15,126,761	8,599,468	10,316,548	19,740,151	21,107,867	17,845,376	27,827,071	32,841,897
	$6,665,660	$13,812,251	$28,197,363	$19,963,115	$24,308,510	$40,244,075	$55,478,079	$59,982,526	$89,089,711	$102,618,508

Maintenance Demand for Brushes Holding Well

WHILE the market for carbon brushes for strictly maintenance work is holding up about on a normal plane, buying for new motors and generators has fallen off. The curtailment of production in the automobile manufacturing field has reacted on the brush producer, since a large volume of brush business is done for the automobile trade. This, of course, releases production capacity for the making of brushes for the strictly electrical market, so that shipment is short.

Motor production in itself has suffered a recession, both in fractional sizes and in integral sizes for industrial work. There have been somewhat fewer brushes needed for maintenance also of the industrial sizes because of curtailed operation in the mills of many of the larger industries of the country.

These factors help shipments, one and two weeks being the average length of time quoted for the filling of orders, while other quotations will take up to six weeks. Where it is necessary to fill a rush order, a small quantity of brushes can be got out in two days. And this comes right down to what seems to be more and more of a tendency today. Too many of these rush orders for overnight shipment are coming in to the manufacturers. The practice seems to be developing into one of waiting until the last minute and then ordering only a minimum number of pieces. Traction companies are particularly in the limelight in this connection, and they are the consumers which heretofore have been noted for keeping good stocks of brushes—at least to cover all emergencies. Of course, the financial condition of most roads is such as to require the limiting of future buying, but it would seem that purchases could be kept out of the rush class for this type of maintenance material, which is bound to wear out. The reaction comes, of course, on the producing abilities of the manufacturer.

Although stocks of foreign brushes are kept in this country, there is little stocking done by domestic manufacturers because of the great number of sizes, qualities and duties required by motor and generator manufacturers. There seems to be no standardization of brushes, but the question of correct brush application to the needs of the machine is receiving much more attention than it has in the past. There is no evidence of a price change in this product for the near future.

Malleable Iron Castings in Easier Supply

THE supply of malleable iron, which six months ago was all the way from a year to half a year behind orders on hand, has eased up very materially. As regards new business the market is absolutely quiet, for little or nothing in this line is being bought at present. Those manufacturers specializing in supplying the automobile trade have probably been hardest hit by the slump in business, as the automobile industry was about the first to react to the general falling off of demand. The previous press of orders for malleable castings had been so great, however, that some producers are only just now beginning to catch up on back orders.

Others who were perhaps quicker to feel the buying slump are at present working on a curtailed operating schedule that is down to three days a week in some instances. Wage reductions of 10 to 15 per cent and laying off of workmen have been quite numerous too. On the other hand, many malleable-iron factories have taken no steps in that direction.

Deliveries cover a wide range, dependent on the manufacturer and the type of casting. On the whole, the situation is favorable, because mills are now so situated that they can speed up if necessary. In order to keep the working forces intact and busy, however, there is probably a current tendency not to hurry on filling orders unless the need is urgent. This, as well as the large amount of pattern work required on certain material, may account for the extreme delivery period of two to three months that is quoted. From close to stock up to four or five weeks would seem to be a more representative figure. Stocks of finished material, as a matter of fact, virtually do not exist, as the unsteady market makes this inadvisable. For the same reason raw material is being bought in sparing quantities by some of the malleable castings makers.

Prices have trended downward following declines in fuel, pig iron and in some cases labor costs. The reductions made from peak prices average in several instances from 10 to 20 per cent. Further price developments, of course, depend upon the trend of the underlying markets, but according to one of the large companies in this field, which has already made two price reductions during January, the malleable-iron market has not yet touched bottom.

Cross-Arm Prices Show Reductions

CONDITIONS in cross-arm buying seem to be rather uneven. Price reductions of about 15 per cent, effective Feb. 1, are reported from the East and Middle West, but none is heard of from the South to date. Buying in the New York district is on a pretty fair basis, several satisfactory orders recently having been placed. Mid-West demand is only fair, while from the Atlanta territory the movement is quite slow. Stocks in jobbers' yards are reported good in all sections.

New prices for fir arms, two-pin, 3¼ in. x 4¼ in. x 3 ft., are quoted in New York at $61.13 per 100 in less than 1,000-lineal-ft. lots, and $54.34 in 1,000-ft. to 3,000-ft. lots. These in Chicago are $56.70 and $50.40. The N. E. L. A. fir arm, four-pin, 3½ in. x 4½ in. x 5 ft. 7 in., is quoted in New York at $138.26 and $122.91 and in Chicago $128.25 and $114, same quantities. The four-pin, 3¼-in. x 4¼-in. x 5-ft. arm is $90.56 in New York and $84 in Chicago, 1,000-ft. to 3,000-ft. lots.

From Atlanta, in lots of 1,000 lineal feet and over, two-pin, 4-ft. fir arms are quoted at $62; four-pin, 5-ft. arms at $104; N. E. L. A. arms, two-pin, 3-ft., at $106, and four-pin, 5-ft., at $157.

The Metal Market Situation

BUSINESS in the domestic copper market continues on a low level. Consumers are apparently showing no buying interest, while on the other hand large producers exhibit no impatience to sell. The result is an *impasse*, so far as business goes, especially as the spurt in foreign buying that was reported two or three weeks ago seems to have petered out. Producers continue to hold immediate deliveries at 12.75 cents delivered, with ¼ cent more covering the first quarter, but this price is not received as smaller agencies are shading prices. In the outside market copper can be obtained at 12.75 cents per pound for prompt delivery, with a slightly higher quotation for futures.

Through the issuance of securities to the public, the Copper Export Association is planning a way to dispose of about 400,000,000 pounds of copper to foreign countries, principally European countries. If this plan goes through it is expected that the tone of the market will become much firmer and that domestic activity will take on new form.

NEW YORK METAL MARKET PRICES

	—Jan. 25, 1921—	—Feb. 1, 1921—
Copper	£ s d	£ s d
London, standard spot	67 0 0	69 10 0
	Cents per Pound	Cents per Pound
Prime Lake	13.50	13.25
Electrolytic	12.75	12.75
Casting	12.50	12.37½
Wire base	15.75	15.75
Lead, trust price	4.75	4.75
Antimony	5.37½	5.25
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Zinc, spot	5.80	5.50
Tin	32.75	33.00
Aluminum, 98 to 99 per cent	28.30	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00–11.25	11.00–11.25
Brass, heavy	6.00– 6.50	6.00– 6.50
Brass, light	4.00– 4.50	4.00– 4.50
Lead, heavy	3.75– 4.00	4.00– 4.25
Zinc, old scrap	3.00– 3.25	3.00– 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

IN NEW ENGLAND, the Southeast, the Atlantic States and the Northwest there is apparent a slight upward turn in the electrical business. Textiles and leather have opened up in New England and cottonseed-oil mills in the South, while building has started in the Northwest. The volume of business is still much below normal, but a definite trend is noticeable. The Middle West is quite inactive. The Northwest shows the greatest come-back in residence construction, other sections being quiet. Inquiries, though, feeling for prices, are quite in evidence.

Money is reported tight in the mountain regions—not that it flows easily anywhere just now—and collections are still requiring constant attention.

Stocks are ample for all present needs, and although the trade in general is looking forward to an active spring season it is not buying ahead to meet that condition as things stand at present.

Non-employment is on the increase, and shorter hours and lower wage scales are becoming more prevalent.

NEW YORK

There seems to be a division in the trade this week as to whether the turn of the tide has come which will lead to better business from now on. At least three houses besides those reported last week state that they have noticed a little better tone, a slightly improved volume of sales over the whole line of electrical material recently. On the other hand, three other houses of equal standing report that conditions are absolutely no better as far as they are concerned. Additional evidence from one of the largest electrical jobbers in the country who last week said general conditions showed improvement shows that this view was prematurely based on temporary evidence.

Regardless of the pros and cons of the situation the very fact that even a few jobbers are increasing their sales—and at least two local houses went ahead of December business in their January sales—is cause for encouragement. The trade is not allowing an optimistic feeling to overcome a sense of business caution, however, for at the present time there is hardly a dollar's worth of material on outstanding order. Despite that shelves are well filled with every line of material, and no difficulty is experienced in obtaining any goods immediately. Prices remain steady except for an increase in wiring porcelain from one source.

Conduit.—Demand is light, the few sales that are made being in small lots. Stocks are well filled in all sizes. In lots of 2,500 ft. ½-in. black is quoted from $70 to $79 per 1,000 ft., and ¾ in. from $93 to $105.

Locknuts, Washers and Bushings.—Sales are light, about on the same level as conduit, and the supply is adequate. Jobbers' discount in lots of 1,000 ranges from 50 to 60 per cent.

Rubber-Covered Wire.—Jobbers are selling in small quantity, but the general demand remains as light as heretofore. Stocks in many cases are held down to normal but in others are too large. Nominal quotations by jobbers on No. 14, in lots of 10,000 ft., range from $7.75 to $9.

Schedule Material.—The bottom seems to have dropped out of this market in so far as demand reported by jobbers goes. Efforts are devoted to keeping down stocks in this line. In some cases these are successful, in others far from successful. Prices are whatever can be obtained.

Non-Metallic Flexible Conduit.—Little or no call exists for loom, and stocks in this line too cannot be too small to suit jobbers. In 1,000-ft. lots the ⅜-in. size is quoted at from $25 to $30 and ½-in. from $27.50 to $32 per 1,000 ft., though lower prices than these have been obtained.

Knife Switches.—Very few are carried in stock, as virtually no demand is felt at present. One representative product in the single-throw, double-pole, 30-amp., 250-volt size is quoted at $1.76 with fuse in lots of twelve, and another make at $1.06.

Flexible Armored Conductor.—The supply is more than adequate to meet the extremely slow demand. The market for No. 14 two-wire, double-strip ranges from $63 to $65 per 1,000 ft. in quantities of 1,000 ft., although one large house has quoted as low as $55, which is below most manufacturers' prices.

Dry Cells.—"Necessity" buying accounts for a fair volume of sales, but otherwise demand is not large and the supply is plentiful. There seems to be a strong feeling in the trade that prices of batteries, in view of lower material costs, should drop. No. 6 in barrel lots is worth 36 cents.

Bells and Buzzers.—Although jobbers in this territory are making no sales and hold small stocks several manufacturers still report back orders for as long a period as three months. This demand has in large part come from other sections. Manufacturers' stocks as yet do not exist, but the shortage of castings and steel tops has been relieved and supplies should now accumulate in anticipation of a return of building.

Porcelain. — The American Jobbers' Supply Company, Woolworth Building, New York City, announces an increase in price of knobs, tubes and cleats, effective Jan. 18. The increase amounts to about 10 per cent.

CHICAGO

The business revival which seemed to be promised by the increase in the number of inquiries received a few weeks ago has not occurred. These inquiries, while still numerous, seem to be more in the nature of gathering information than of placing business. In the construction field it is known that many prospective builders are systematically calling for figures every few weeks, with the avowed intention of watching the market and taking advantage of the first real drop. Machinery dealers report that certain railroads have announced that they definately want to buy certain equipment but that they will place no orders until a price revision occurs. Just how far similar ideas are governing the electrical goods buyer is problematical.

All elements of the trade are showing increased sales activity, and contractor-dealers report their expectation of heavy business in the spring. This is dependent entirely on the trend of building material prices in general, as it seems beyond doubt that no great building progress can be made until brick, cement, aggregate, etc., follow the price trend indicated by lumber.

Motors.—No activity is reported, even the volume of inquiries noted a short time ago having fallen off. Stocks are accumulating and the volume of orders on file is steadily decreasing. Price lists are held firm, but some cutting on the part of overstocked dealers is reported and is having a demoralizing effect.

Control.—A comfortable amount of business is still being done on back orders, but the volume of new orders is below manufacturers' capacity. No change in price has occurred, and the cutting noted in the motor trade is not in evidence.

Transformers.—This business continues unchanged, although some inquiries are noted for transformers for farm-line service. The gradual steady movement of crops to market in the Central West is relieving financial conditions in that territory and restoring to the agricultural interests a portion of their buying power.

Copper Wire.—Business is good. Weatherproof is quoted on a 20-cent base, which makes No. 6 triple-braid, in 500-lb. lots, 21 cents and No. 8, 21½ cents per pound. Bare copper varies in price with different suppliers, an 18-cent base being a fair reflection of present average price.

Poles.—No change in price is reported, nor, according to producers, is any in sight. Current reports are to the effect that production costs are being reduced.

Insulators.—Absolute inability to catch up with demand is reported, deliveries on heavy types still ranging upward of four months. Prices are firm on the high level and demand continues insistent.

Heating Appliances.—Price list No. 25 of the Hughes line, effective Jan. 15, quotes a three-burner range at $150 in the plain finish. This amounts to about a 10 per cent reduction. Similar price revisions are shown on most items of the line. Sales of this class of material are reported as slow.

BOSTON

Business is spotty in New England electrical circles. Jobbers report well-distributed buying except from Boston contractor-dealers, whose affairs are disturbed by the strike in the building trades. Prices show little change compared with last week, although some weakness in retail prices is noted under sharp competition to move stocks. Collections are still slow and require close observation. Central stations appear to be developing more inquiries, and industrial buying is rather better, at least in the textile and leather industries. Conditions have been much improved in textile circles by the resumption of production accompanied by lowered wage scales. Jobbers' stocks are well filled in practically all staple lines, and deliveries are excellent with few exceptions.

Motors.—Local stocks are better than for some time, although some gaps exist in starting equipment, bases and pulleys. Prices are firm. Back orders still occupy manufacturers. On three-phase motors, which cannot be shipped from stock for one reason or another, deliveries of ten to sixteen weeks were being quoted Monday by a leading producer. A few motors as large as 100 hp. were reported in local stocks the first of the week, and earlier shortages of small integral horsepower motors had been largely overcome.

Wire.—Good sales of weatherproof are noted since the year began. In 5,000-ft. lots No. 6 is selling for 18 cents per pound. Rubber-covered wire is moving slowly at $8 per 1,000 ft. in 5,000-ft. lots. Bare base is about 17.5 cents. Stocks are ample.

Sockets.—A few are moving, but no serious drain on existing stocks appears.

Flexible Armored Conductor.—Moderate sales are being put through, No. 14 double-strip bringing $67 per 1,000 ft. in 1,000-ft. lots.

Porcelain.—Shipments have overcome recent low stocks. In barrel lots $\frac{5}{8}$-in. x 3-in. tubes sell for $11.50 per 1,000 and "Nail-it" knobs for $27.50.

Magnet Wire.—Production has gained so much on orders that some new business can now be taken on. No surplus of magnitude has accumulated as yet and manufacturers appear actively occupied filling back orders.

Fans.—Some buying from manufacturers has begun, but the carry-over from last season has prevented heavy purchases so far in advance of the season. Fans will be purchased later on a quota basis in some cases, and one jobber who sold $87,000 worth last year and carried over but $1,500 worth will shortly canvass his dealers to get a line on this year's expectations. Prices remained firm up to the beginning of the week.

Rigid Conduit.—Local stocks are well supplied and no marked shortages are complained of. Prices Monday on the following sizes were: 1-in. black, $164.90 per 1,000 ft.; galvanized, $175.10; $\frac{1}{2}$-in. black, $84.15; galvanized, $89.25—all in less than 2,500-lb. lots.

Appliances.—Heaters and cleaners are moving slowly. Table appliances are rather quiet and washing machines in moderate demand.

Storage Batteries.—Within the last fortnight a better feeling has been noted in the automobile industry, and it is expected that this will soon be reflected in increased sales of battery equipment. Local stocks are in good shape, and deliveries to distributing depots for spring business are reported much better than last year.

ST. LOUIS

Inquiries have continued to be numerous during the past week, though there has been no improvement in actual sales noted to correspond to this. The attitude of business in general throughout this territory seems to be cheerful, and there is a great deal of construction work in contemplation for spring, but the tendency of the buyer to shop around and make five inquiries to one order shows that entire confidence in the stability of the market has not been established as yet. That practically all buying just at present is of the hand-to-mouth kind is shown by the number of orders billed during January by several jobbers. This approximately equals the number billed in January of last year, although the total volume of business will be greatly below that of the same period during 1920.

Jobbers' stocks of wiring and line materials are easily capable of taking care of the present demand but will fall short of meeting the requirements of the building program predicted for spring and summer. Jobbers are not increasing their stocks on this account, though, preferring to wait until that program materializes. Collections are averaging about sixty days with little hope of improvement in the near future.

Transformers.—Demand for both power and distribution transformers has slowed up considerably, and transformer manufacturers are making delivery out of stock on their regular sizes and types. Power transformers of the 66,000-volt types are being promised on four to five weeks' delivery, which is considered close to normal.

Tape.—Both the rubber and the black friction tape have been moving fairly well during the past week, but jobbers have more than enough to take care of the demand. The quotation on both is around 45 cents a pound in 100-lb. lots.

Wire.—Large stocks are still on the hands of St. Louis jobbers. Though practically no large orders are being placed there seems to be a steady volume of small sales of both rubber-covered and weatherproof. Quotations on No. 14 rubber-covered are hovering around $8.50 with occasional sales slightly below that figure. Weatherproof remains on the 22-cent base and bare on an 18-cent base. Demand for bare continues quiet.

Rigid Conduit.—Both black and galvanized are moving slowly, and jobbers' stocks are practically complete in view of the demand. A representative quotation is $77 per 1,000 ft., in 5,000-ft. lots, on the $\frac{1}{2}$-in. black.

Washing Machines.—Dealers report retail sales improving, though still far from good. There is no indication that manufacturers in this territory will readjust prices at present.

Non-Metallic Flexible Conduit.—Demand remains quiet and stocks continue large. The $\frac{1}{4}$-in. conduit is quoted at $30 per 1,000 ft. and the $\frac{3}{2}$-in. at $27.50.

Schedule Material.—Stocks are large and sales continue small, though there have been quite a good number of inquiries made during the past week. Prices in general are firm.

Locust Pins.—Demand is spotty. The railroads are buying on a hand-to-mouth basis, and jobbers are finding it easy to supply their requirements out of stock. The $1\frac{1}{4}$-in. x 8-in. size pins are quoted around $30 per 1,000 in lots of 5,000.

ATLANTA

Reports throughout the district indicate a slow but nevertheless general revival of business activities, the most marked being in the industrial lines. Textile mills that have either been shut down or on part time are resuming operations on a normal basis with resultant decrease in non-employment. Cottonseed oil mills, many of which have been shut down since the Christmas holidays, are reopening and expect to keep in operation for several months to come.

Chattanooga reports 3,000 fewer unemployed there than on Jan. 1. Numbers of wage reductions by the textile trade are reported, while the Savannah Master Builders'

Association has followed the lead of the Atlanta branch and announced a general reduction in the building trades. The wage reduction proposed by the Atlanta, Birmingham & Alabama Railway, to become effective Feb. 1, has been ordered held up by the United States Labor Board, pending the filing of a petition by the railway company and a hearing upon it. This will cause a considerable postponement of an action that was being watched with interest by shipping and railway operatives throughout the United States. Except in the large centers, building has shown no sign of revival. The Southern Pine Association, 125 of the largest mills reporting, shows a reduction in the number of unfilled lumber orders of 1,000 cars since Jan. 1, with the mills operating at 50 per cent of their normal production.

Athens, Ga., suffered a disastrous fire in its business section last week, the greater portion of two blocks being destroyed and the damage being placed at between $2,000,000 and $3,000,000. Plans are already announced for the rebuilding of the devastated section. This, combined with rebuilding of other structures destroyed by fire—damage from fires in this section having shown an increase of approximately 40 per cent over December—will cause a revival in the demand for material entering into the building field.

Flexible Armored Conductor.—The market is very sluggish, heavy stocks being held by all jobbers. Price quoted on No. 14, two-wire, is $75 per 1,000 ft. with very few takers.

Fuses.—While a slump in demand is noted, the movement continues to hold steady with a reduced volume of orders. Stocks are reported in fair shape with the most active movement credited to the renewable type. No change in price is yet reported.

Safety Switches.—Requirements of the new code for safety switches on all approved installations have, of course, served to increase materially the demand in this line, and all popular sizes are reported active. Because of the anticipation of needs stocks are reported in good shape with shipments quite satisfactory. Price, two-pole, 3-amp., lots 20 to 100, $2.31 each.

Poles.—Jobbers report an increase in demand and anticipate still heavier movement within the next sixty days, the trade seeming to prefer the cedar to the chestnut variety. Stocks are in good shape, weather conditions having been favorable to good production. Prices, Western Red Cedar, f.o.b. Atlanta, 30-ft., 7-in. top, $20.05; 35-ft., 7-in. top., $24.

SAN FRANCISCO

Heavy storms have done considerable damage in the state, but as far as can be ascertained they have not seriously affected the 1921 crops. For some months past the prospects for a record-breaking year for the power companies seemed unusually propitious, with much new power ready for distribution and with a fine snowfall in the mountains in frozen storage. Stock sales to the general public have been very encouraging, too. Now, however, the Great Western Power Company is threatened with a general strike of its linemen, who resent a wage reduction to $7 per day in place of $8 paid last year by that company only. The matter is now under discussion. The Pacific Gas & Electric Company's linemen are still receiving $7 and recently voted to continue on that basis.

Building has dropped during January, and most contractors are working about one-half their normal force. In fact, in certain Bay districts some contractors are contemplating the remodeling of their business along merchandising lines where their territories, chiefly containing bungalows, have been solidly built up and are now fixture and appliance territories instead. The general tone of the market is rather pessimistic on the part of the dealer and cautious on the part of the consumer. The retrenchments of the latter and a general belief in substantial price slashing are reflected in the hand-to-mouth buying of the farmer.

Alameda, across the bay from San Francisco, has been officially named as the site for the twenty-five-million-dollar United States naval base. It is stated, though, that the present huge Mare Island establishment will not be abandoned but maintained as a supplementary resource. Destroyer and submarine bases in San Diego are also recommended.

SEATTLE—PORTLAND

Building in Seattle since the first of the year has shown steady improvement, and from present indications operations will be in force much earlier than originally anticipated. The recent action of the master builders' association in reducing wages in the structural game 20 per cent, effective Feb. 1, coupled with a reduction in cost of lumber and other building materials, assures a considerable amount of building for this section this year; in fact, some really optimistic authorities assert that $35,000,000 worth of new construction will now proceed.

Electrical jobbers in both Seattle and Portland territories report that business is picking up slightly and that there is a downward trend in prices in certain lines. Collections are reported in rather poor shape, and some dealers in the country districts find this particularly so. It is certain that within sixty days, unless conditions improve amazingly, there will be many liquidations among the smaller dealers. However, this is not expected to interfere seriously with business generally throughout this section. The average period of collections ranges from forty-five to sixty days. Dealers and contractors state that business is holding up well, and contractors, particularly in the Seattle district, report a gradual improvement and a considerable amount of new work in prospect for the immediate future.

Portland district states that a very large number of permits for residences have been taken out since the first of the year, indicating a large building program during 1921. Manufacturers in this section report very little change in business, although the future looks promising. Stocks are gradually improving.

Schedule Material.—On account of an increasing amount of new construction since the first of year in Puget Sound districts, this merchandise is moving nicely. Stocks of sockets, switches, cutouts, etc., are in good shape, but some sizes of fuses are hard to get in package quantities.

Domestic Appliances.—In Seattle and Puget Sound cities the movement of washing and ironing machines and vacuum cleaners has dropped off noticeably, awaiting lower prices. Stocks are in fine condition.

SALT LAKE CITY—DENVER

Collections continue slow throughout the entire Rocky Mountain region. Banks are still reluctant about granting loans and in many cases are not able to handle paper even if they were so disposed. Lack of confidence in banking institutions, with no tangible reason, is handicapping business. In some quarters it is believed that many farmers are hoarding their money rather than risk it in the safekeeping of banks. This, of course, keeps much needed capital out of circulation and retards the return to normal merchandising.

Few building permits are being applied for and little or no construction is under way. A falling market in building materials, however, should act as a decided impetus when spring has arrived. Real estate firms are doing everything possible to launch a building boom and declare that indications point to gratifying activity within a few months. Meanwhile electrical dealers are getting prepared in the way of stocking with house-wiring materials. The general market condition is satisfactory, and slow but certain improvement is noted. A conservative estimate puts trade on a 65 per cent normal basis with a tendency to growing volume.

Portable Lamps. — There is a general tendency toward overstocks. The variety of designs and grades is almost endless. There are sales advertised on every hand.

Appliances.—These are moving generally with only fair success.

Lamps.—"Fill-your-sockets" campaigns are now on and meeting with satisfactory success. Where dealers have employed Boy Scouts to make a house-to-house canvass the returns have been good.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Wire Company Purchases New Plant

The Acorn Insulated Wire Company, 73 Richards Street, Brooklyn, N. Y., has acquired the plant of the Davis Oil Company on Ninth Street, extending to the Gowanus Basin bulkhead, for a new plant for the manufacture of insulated wire and other products. The property is 146 ft. x 380 ft., improved with five-story buildings, and has been held at about $150,000.

Technical Book Publisher Moves to New Quarters

The McGraw-Hill Book Company has just removed from its old quarters at 239 West Thirty-ninth Street, New York City, to 370 Seventh Avenue. The company occupies the entire tenth floor of the new Penn Terminal Building, extending from Thirtieth to Thirty-first Street, with floor space of 20,000 sq.ft. This is the third home of the book company since its organization in 1909, the two former homes having been in different spaces of the Thirty-ninth Street building.

New York Jobber Opens New Branch

The Royal-Eastern Electrical Supply Company, 114-116 West Twenty-seventh Street, New York City, distributer of General Electric Company's products, announces the opening of another new branch house, this one at 382 Jackson Avenue, Long Island City, where a complete line of electrical supplies and "Edison Mazda" lamps will be carried. The building is 25 ft. x 100 ft. and is of one-story-and-basement construction. The change took place Feb. 1, with George Young in charge.

Westinghouse Forms Illuminating Engineering Bureau

A new branch of technical service, the illuminating engineering bureau of the Westinghouse companies, has recently been created to assist Westinghouse interests and their field representatives in the application and sale of lamps, industrial lighting fixtures and lighting appliances. The work of the bureau will embrace the preparation of complete specifications on industrial, commercial, residential and street lighting, the preparation of technical articles and lectures, the testing and development of new accessories and the co-operative activities of engineering societies.

District illuminating engineers and lighting specialists have been appointed to work with the company's lighting salesmen. Headquarters of the bureau will be located at the lamp company's works in Bloomfield, N. J., under the general supervision of the lighting service department of the lamp company. A branch will be established at the George Cutter works of the Westinghouse Electric & Manufacturing Company in South Bend, Ind. S. G. Hibben at Bloomfield will direct the general operations of the lamp company district engineers and the bureau, while C. J. Stahl in South Bend will direct the Cutter specialists.

General Electric Reduces Wages

In line with the tendency of readjustments in wage scales to become more prevalent throughout industry as a whole, the General Electric Company has made downward revisions in the pay of day workers in its Schenectady works of 10 per cent and of piece workers of 15 per cent, effective Feb. 1. The weekly bonus will also be dropped. Wage adjustments have also been made at the Lynn, Sprague and other apparatus and supply plants of the company.

At the same time reductions have been made in some of the lines of apparatus and supplies manufactured by the company.

Western Appliance Building New Plant

The new factory of the Western Appliance Manufacturing Company, which will be located at 5623 Duwamish Avenue, Seattle, Wash., is well under way and its completion is expected very shortly. It will embrace 10,000 sq.ft. of floor space and will be modern in every respect, the daylight feature especially being stressed. In the one and one-half stories, in addition to space for manufacturing 500 "Mercer" ironing machines a month, there will be a gymnasium and a swimming pool.

Insulator Manufacturer Doubles Capacity

The Jeffery-Dewitt Insulator Company, Huntington, W. Va., has just put into operation a new kiln which with its supporting accessories will double the insulator capacity of the plant. In addition, in order to have a continuous source of raw material and to be independent of the market for feldspar, the company has purchased its own feldspar mine.

Fan Manufacturer Occupies New Office Building

Removal is announced of the executive offices of the Robbins & Myers Company, Springfield, Ohio, from plant one to a new concrete and steel building. This has a total of 42,000 sq.ft. of floor space embraced in its four floors and houses about 300 people, taking in the purchasing, cost, mailing, telephone, fan and motor sales, advertising, factory auditing and accounting departments and the general officers.

Philadelphia Jobber Expands Facilities

The Schimmel Electric Supply Company, now at 318 Market Street, Philadelphia, has purchased the building at 526 Arch Street. It is a six-story building, 30 ft. x 200 ft., and together with the basement has a floor space of 42,000 sq.ft. After extensive alterations the building will be equipped as a wholesale electrical supply house, with all the modern facilities to take care of the expansion of the company, according to Mr. Schimmel, who states his belief that the business world is rapidly readjusting itself and that a wave of prosperity is on the way.

New Name for Power-Plant-Equipment Representative

The Great Western Contracting Company, Kansas City, Mo., has changed its name to the Rawlings Industrial Equipment Company. The company is sales engineer for manufacturers of power-plant machinery, representing the Conveyors' Corporation of America, the Springfield Boiler Company and the Cooling Tower Company.

Atlas Valve Acquires Automatic Pump Governor Rights

An announcement from the Atlas Valve Company, 282 South Street, Newark, N. J., is to the effect that the company has acquired by purchase from the Ideal Automatic Manufacturing Company the sole patents and rights to manufacture the Ideal automatic pump governor. This rounds out the company's line of valves, pump governors, regulators, etc.

San Francisco Electrical Jobber Changes Ownership

The Fobes Supply Company of San Francisco has purchased the Holabird Electric Company of that city, and the consolidated organization will continue under the name of the Fobes Supply Company. The Fobes company has also establishments in Portland, Ore., and Seattle, Wash. The San Francisco organization will be a separate corporation, although F. N. Averill is president of all the three companies. R. S. Holterman, formerly sales manager of the Holabird Electric Company, has been appointed manager of the new organization, with headquarters at 523 Mission Street, San Francisco.

Heating Equipment Production Changes Hands

The Dalton-Marsh Company, Danvers, Mass., has been organized to continue the business formerly conducted under the name of the William H. Dalton Company, manufacturer of specialized electric heating equipment, Salem, Mass.

Material Handling Developments

The Conant Machine Company, Concord Junction, Mass., manufacturer of motor-driven coal loaders, has established a selling arrangement with the Fairbanks Company for the marketing of its machines. The Conant company is about to issue a new catalog and is now developing a new line of screening and elevating plants for gravel and crushed stone service, with electric drive.

St. Louis Brass Expands

The St. Louis Brass Company, St. Louis, Mo., manufacturer of "Brascolite" lighting equipment, has announced the completion of a new factory. The new building adjoins the old factory on Washington Avenue near Jefferson Avenue and has a floor area of 75,000 sq.ft., giving the company a total factory space of 125,000 sq.ft. The structure just completed is five stories high and is built of concrete, brick and steel. It is the third addition to be made since the incorporation of the company in 1902, almost all the factory space at present being devoted to the manufacture of lighting units and equipment.

The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, has acquired property near its present plant which will be used later for extensions.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, Md., announces the opening of a new branch office and service station at 75 Fremont Street, San Francisco. This office will have jurisdiction over the entire Pacific Coast territory and will be in charge of M. A. Johnson. At this address there will be a complete stock of parts carried and a factory-trained mechanic will be on hand.

The Ambrevo Electric Company, Chicago, manufacturer of electrical specialties, has filed notice of increase in capital stock from $20,000 to $150,000.

The J. J. Ross Engineering Company, 1006 Larned Street, East Detroit, Mich., manufacturer of battery-charging apparatus, is enlarging its plant.

The Edward R. Ladew Company, Inc., New York City, tanner and leather-belt manufacturer, has closed its sales office at Charlotte, N. C., and has transferred its Southern headquarters to 95 South Forsyth Street, Atlanta, Ga. An ample stock of belting and leather specialties will be carried.

The Watson Elevator Company, 407 West Thirty-sixth Street, New York City, has leased the adjoining building, which it will use for proposed extensions.

The R. W. Lillie Corporation, 30 Church Street, New York City, has taken on representation of the line of externally operated switches manufactured by the Wadsworth Electric & Manufacturing Company, Covington, Ky., for the territory covered by the Atlantic seaboard.

The Majestic Electric Development Company, San Francisco, at its annual stockholders' meeting on Jan. 15 re-elected the former directors, and the board of directors subsequently re-elected the previous officers of the company.

A. H. Lyons & Company, Stephen Girard Building, Philadelphia, has been reorganized under the name of the Lyons Storage Battery Company, Inc.

The Apex Electrical Distributing Company, Cleveland, has removed its Atlanta (Ga.) office from the Candler Annex Building to the Walton Building.

The Burke Electric Company, Erie, Pa., contemplates erecting an addition to its plant to cost about $28,000.

The Continental Radio & Electric Company, 6 Warren Street, New York City, is considering increasing its capital stock from $30,000 to $60,000.

The American Insulated Wire & Cable Company, Chicago, has recently purchased a one-story building at Twenty-second and Fisk Streets, containing 40,000 sq.ft., which will be remodeled and used as a copper-wire rod mill. New equipment to cost about $200,000 will be installed.

Beardslee Chandelier Manufacturing Company, 216 South Jefferson Street, Chicago, held its annual dinner at the La Salle Hotel Jan. 5, which was attended by the officers and directors. Each department in the office and factory was also represented by at least one employee, those present numbering forty-six. W. R. Abbott, vice-president of the Illinois Bell Telephone Company and a director of the Beardslee company, gave an address.

The Electro Service Company, Marietta, Ga., manufacturer of surge arresters, has recently appointed the following sales representatives: The R. W. Lillie Corporation, 176 Federal Street, Boston, and 30 Church Street, New York City, to cover the territory in New England and the upper part of New York State; the W. D. Hendry Company, Hoge Building, Seattle, to represent the company in the States of Washington and Oregon, British Columbia and Alaska; Jones & Hitchin, Lonja del Comercio 216, Havana, Cuba.

The Independent Wireless Telegraph Company, 42 Broadway, New York City, has increased its capital stock to $500,000.

The Electric Storage Battery Company, Allegheny and Nineteenth Streets, Philadelphia, has filed plans for the construction of a two-story building to be used for welfare work for employes.

The American Steel & Wire Company, Chicago, is planning to build a three-story addition to its plant in Worcester, to cost about $150,000.

William S. Higbie, electrical engineer, 114 Liberty Street, New York City, has established an inspection and purchasing service for buyers of power equipment, with offices at the above address. Mr. Higbie was formerly with the Chile Exploration Company, New York City.

Market Data Book and Directory.—"Crain's Market Data Book and Directory of Class, Trade and Technical Publications" is the title of a reference book for advertisers published by G. D. Crain, Jr., 417 South Dearborn Street, Chicago. This is an annual reference book and contains the basic information regarding each trade, industry and profession. It also includes the field covered, the publications and closing dates, the type-page size and circulation.

The Alloy Metal Wire Company, 154 Nassau Street, New York City, has filed notice of increase in capital stock from $100,000 to $200,000.

The Troy Electrical Company, Troy, N. Y., has filed notice of increase in capital stock from $10,000 to $30,000.

The Porter Electric Company, Utica, N. Y., has filed notice of increase in capital stock from $20,000 to $100,000.

The Instantaneous Electric Heater Corporation, Root Building, Buffalo, recently organized with a capital stock of $500,000 to manufacture electric heating devices, has plans under way for the erection of a new plant, which will be equipped for a capacity of about 500 heaters per day. Arrangements have been made for a stock issue of $200,000, the proceeds to be used for construction of the proposed plant.

The Ajax Electric Specialty Company, St. Louis, Mo., has recently appointed nine sales representatives to distribute its products throughout the country, as follows: Clarence P. Denny, 524 First Avenue, South Seattle, Wash., will cover the territory in the States of Washington and Oregon; A. C. Riddell, Higgins Building, Los Angeles, and Marvin Building San Francisco, will cover California, Nevada, Arizona, New Mexico and the city of El Paso, Tex.; the Kiser, Ackermann, Gardner Company, Salt Lake City, will represent the company in Utah, Idaho, Montana and Wyoming; the Kirtz-Bruhm Company, Liberty Building, Buffalo, will cover New York State exclusive of New York City, the western part of Pennsylvania and the State of Ohio, exclusive of Cincinnati; the Electrical Sales Company, Kenyon Building, Louisville, Ky., will represent the company in Cincinnati and Louisville; the F. W. Oettinger Corporation, Grand Central Palace, New York City, will have charge of Philadelphia, Baltimore, Washington, D. C., and the New England States; O. T. Jenkins, 414 Dallas County Bank Building, Dallas, will handle Oklahoma, Texas, New Mexico and Shreveport, La.; Walter Ehamm, Hall Building, Kansas City, Mo., will have charge of Kansas, western Missouri, Iowa and Nebraska; J. A. Jacobsen, 17 North Wabash Avenue, Chicago, will represent the company in Chicago, northern Indiana and Wisconsin.

Foreign Trade Notes

ELECTRICAL SECTION, CANADIAN MANUFACTURERS' ASSOCIATION, MONTREAL.—An electrical manufacturers' section of the Montreal branch of the Canadian Manufacturers' Association was formed on Jan. 5 at a meeting in Montreal. The section is to consist of members engaged in the manufacture of electrical apparatus and equipment, at present members of the association, and such other manufacturers of electrical apparatus and equipment as in the future may become members of the association. M. K. Pike, sales manager of the Northern Electric Company, was elected chairman of the section, and R. Moncel, of the Devoe Electric Switch Company, vice-chairman.

THE MINIMAX ELECTRIC & MANUTURING COMPANY, 99 Bernard Lane, Maisonneuve, Quebec, Canada, has recently established a plant for the manufacture of high-power storage batteries for all purposes. The business is under the management of W. F. Cleaver, who has been connected with the industry for many years.

THE EUGENE F. PHILLIPS ELECTRICAL WORKS, LTD., Montreal, Canada, announces it will begin work at once on the construction of a copper-rod rolling mill to have a daily capacity of 100 tons. The plans provide for an extension for the rolling of copper sheets and the drawing of copper tubes as well as for the erection of a small refinery to take care of the copper scrap from the mill and also from a large wire and cable factory of the company. For the present the company will import electrolytic copper wire bars.

VICKERS, LTD., London, England, is opening a new sales office in Montreal, Canada, in charge of R. S. Griffiths, formerly of Barrow-in-Furness, England, who will have charge of the sale of Vickers' hydraulic turbines and governors, oil engines, etc., in Canada. These engines are manufactured in sizes from 2½ hp. to 450 hp., for both industrial and marine installations. Mr. Griffiths' temporary headquarters will be at the Place Viger Hotel, Montreal.

THE BLACK & DECKER MANUFACTURING COMPANY, Towson Heights, Baltimore, Md., has made arrangements with A. J. Hopkins, formerly with the Canadian Fairbanks-Morse Company and ex-chairman of the Canadian auxiliary of the Automotive Equipment Association, to act as its Canadian representative. Mr. Hopkins' headquarters are at 392 St. James Street, Montreal.

OPPORTUNITY FOR AMERICAN ELECTRICAL MANUFACTURERS IN FRANCE.—According to J. A. M. de Sanchez, director of the economic division of the French commission in the United States, a great opportunity exists for the American electrical goods manufacturer who wishes to export his products to France. This condition has been brought about by the recent efforts of the French government to develop water power throughout France, with the twofold object of conserving coal and supplying a cheap and permanent source of power. American goods, however, he declared, must be of the highest caliber and must be sold on a liberal payment basis.

GERMAN COMPANIES CONSOLIDATE.—Among the many consolidations reported to have taken place in Germany is a working agreement between the Vereinigte Lausitzer Glaswerke and the Siemens & Halske Electricitäts-Gesellschaft for the manufacture of electric bulbs. The glass works was taken at 750 marks per share.

INCREASE IN DEMAND FOR ELECTRICAL EQUIPMENT IN GUATEMALA.—Herndon W. Goforth, American Vice-consul at Guatemala City, reports that an increase in demand for electrical equipment of all kinds has been noticeable since April, 1920. Both electric generating plants in Guatemala City are being enlarged and the generating capacity increased by about 50 per cent, which will be available early in 1921. As soon as this additional power is added to the service a further increase in demand for electrical equipment is expected.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of commission agents in India (No. 34,350) desires to get in touch with American firms for the importation of electrical goods, etc.

A commercial agent in Spain (No. 34,351) desires to secure the representation of firms for the advertising and organizing of sales offices for the sale of electric motors, cooking ranges and labor-saving devices of all kinds.

The engineer of a municipality in India (No. 34,378) desires to purchase three electric elevators for use in public buildings.

A mercantile firm in Spain (No. 34,333) desires to secure an agency and to purchase on its own account electrolytic copper wire from 1 mm. to 9 mm. dish-washing machines and laundry machines for family and hotel use.

A New Zealand purchasing agent (No. 33,334), who is at present in the United States, desires to secure agencies for electrical appliances, including electric household devices, etc.

New Apparatus and Publications

PORTABLE LAMPS.—Catalog No. 69 illustrates the portable lamps of the incandescent Supply Company, 636 Liberty Avenue, Pittsburgh.

METERS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued publication 875 on the Thomas meter for measuring electrically large quantities of commercial gases and air.

ELECTRIC RIVET-HEATING FORGE.—The United States Electric Company, New London, Conn., has issued bulletin No. 5, on its electric rivet-heating forge.

TRANSFORMERS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued bulletin 124, covering its different types of transformers.

TRANSFORMERS.—The Esterline Company, Indianapolis, Ind., is distributing a four-page leaflet describing its new portable multi-range current transformers rated at from 25 amp. to 800 amp.

BATTERY CHARGERS.—The Acme Electric & Manufacturing Company, Cleveland, has issued a folder on its new "Acme Chargers for Industrial Vehicles."

WASHING MACHINES.—The Voss Brothers Manufacturing Company, Davenport, Iowa, has issued a booklet on its nine types of washing machines.

CONDULETS.—Crouse-Hinds Company, Syracuse, N. Y., has issued a folder illustrating actual condulet installations.

DIESEL ENGINES.—The Western Machinery Company, 900 North Main Street, Los Angeles, has issued a catalog describing and illustrating the "Western" Diesel engines, including stationary and marine types.

MAGNET CONTROLLER.—The Ohio Electric & Controller Company, Cleveland, is distributing a circular describing its new "Ohio" two-unit magnet switch magnet controller.

CIRCUIT BREAKER.—The new U-Re-Lite circuit breaker in capacities up to 60 amp. is described in a bulletin of the Cutter Company, Philadelphia, Pa.

APPARATUS FOR ELECTROMETRIC DETERMINATIONS.—The Pyroelectric Instrument Company, 636-640 East State Street, Trenton, N. J., has issued bulletin C-18, describing its apparatus for electrometric and colorimetric determinations of hydrogen ion concentrations.

BLOWERS.—The Electric Blower Company, 352 Atlantic Avenue, Boston, is distributing a six-page leaflet describing its different types of "Marvel" electric blowers, rivet forges, ventilating fans, etc.

MOTORS.—The Mechanical Appliance Company, Milwaukee, has issued bulletin 401, describing the Watson direct-current motors, and bulletin 402, covering the Watson alternating-current motors.

METAL.—"Monel Metal" is the title of a twenty-eight-page booklet published by the International Nickel Company, 43 Exchange Place, New York City.

INDUSTRIAL TRUCKS.—The Elwell-Parker Electric Company, Cleveland, is distributing two four-page leaflets, one describing electric trucks for use in paper mills and the other its malleable-iron pot truck.

FOUNDRY LADLES.—The Whiting Corporation, Harvey, Ill., has issued catalog No. 156, superseding No. 147, covering its foundry ladles.

New Incorporations

THE MID-STATE MANUFACTURING COMPANY, Oklahoma City, Okla., has been incorporated by A. F. Rueb, Oklahoma City; M. J. O'Connor and Ray Ransel both of Edmonds, Okla. The company is capitalized at $16,000.

THE E. M. FAY ELECTRICAL COMPANY, INC., Worcester, Mass., has been incorporated by E. Miller Fay, 10 Morningside Road, R. H. Fay and W. H. Stanton to manufacture electrical appliances and equipment. The company is capitalized at $100,000.

THE METROPOLITAN ELECTRIC SERVICE COMPANY, Oklahoma City, Okla., has been incorporated with a capital stock of $50,000 to manufacture electrical equipment. The incorporators are: Walter Hawkins, T. N. Wells and Cody Fowler.

THE ROCHESTER ELECTRIC SUN SIGNS, INC., Rochester, N. Y., has been chartered with a capital stock of $40,000 by B. M. Olcott, H. D. Gardiner and V. H. Clymer, Syracuse. The company proposes to manufacture electrically operated display signs.

THE C. & D. MANUFACTURING COMPANY, DETROIT, has been incorporated by A. B. Eggert, Ray J. Corrigan, 59 Glendale Avenue; G. T. DuBois and others. The company is capitalized at $50,000 and proposes to manufacture washing machines and other kinds of mechanical laundry equipment.

THE KNIGHT-CHASE COMPANY, Boston, Mass., has been incorporated with a capital stock of $20,000 by John Knight, 100 Queensbury Street, and others. The company proposes to manufacture electric flashing devices and other electrical appliances.

G. E. BLISS, INC., Malden, Mass., has been incorporated by G. E. Bliss, Lewis J. Sage and Chester T. Bliss, 80 Florence Street. The company is capitalized at $15,000 and proposes to manufacture electric heating appliances.

THE YARMOUTH ELECTRIC COMPANY, Augusta, Me., has been chartered with a capital stock of $25,000 to manufacture and deal in electrical products. The incorporators are Harold D. Jennings, Walter S. Wyman and E. A. Ballantyne.

THE BUFFALO ELECTRIC SUN SIGNS, INC., Buffalo, has been incorporated by B. M. Alcott, H. D. Gardner and V. H. Clymer, Syracuse, N. Y. The company is capitalized at $45,000 and proposes to manufacture electrically operated outdoor display signs.

THE KAHN HOLD-UP & BURGLAR ALARM CORPORATION, New York City, has been incorporated by M. Hirschman, M. and B. G. Kahn, 113 East Twenty-fourth Street. The company is capitalized at $100,000 and proposes to manufacture electrically operated alarm systems and equipment.

NORRIS BROTHERS, INC., Robinson, Ill., has been incorporated with a capital stock of $250,000 to manufacture machinery and parts, electrical appliances, etc. The incorporators are Daniel E., Frank H. and Paul E. Norris.

THE UNIVERSAL LAMP COMPANY, 329 Plymouth Court, Chicago, has been incorporated by Roderick H. O'Connor, William H. Gallaher and Charles J. O'Connor. The company is capitalized at $150,000 to manufacture electric lighting equipment, attachments and parts.

THE RENFRO-SMITH COMPANY, New York City, has been incorporated by H. S. Smith, J. F. Renfro and S. M. Cohen, 1834 Broadway, to manufacture motors and electrical products. The company is capitalized at $15,000.

THE MORRIS MANUFACTURING COMPANY, Philadelphia, has been incorporated by F. R. Hassell, J. Vernon Pimm and E. M. MacFarland. The company is capitalized at $100,000 and proposes to manufacture electric lamps and kindred specialties.

THE UNITED GAS & ELECTRICAL ENGINEERING COMPANY, 700 West Baltimore Street, Baltimore, has been incorporated by Philip Raun, Solomon Berkowich and Jesse Fine. The company is capitalized at $100,000 and proposes to manufacture lamps, electric and gas fixtures, etc.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 11, 1921)

1,365,269. Machine-Switching Telephone-Exchange System, Lipa Polinkowsky, N. Y. App. filed Feb. 6, 1919. Full automatic.

1,365,270. Telephone-Exchange System; Lipa Polinkowsky, New York, N. Y. App. filed May 2, 1919. Machine switching.

1,365,285. Brush Holder for Magnetic Chucks; Frank L. Simmons, Woonsocket, R. I. App. filed Jan. 6, 1919. Contact members are covered.

1,365,292. Method of Making Condensers; Phillips Thomas, Edgewood Park, Pa. App. filed April 18, 1919.

1,365,302. Direct-Current Motor; James Burke, Erie, Pa. App. filed March 14, 1917. For drills, etc.

1,365,305. System of Electrical Distribution; William A. Darrah, Wilkinsburg, Pa. App. filed June 11, 1915. Electromotive forces of constant value continuously impressed upon translating devices.

1,365,311. Alternating-Current Welding System; Otto H. Eschholz, Wilkinsburg, Pa. App. filed June 25, 1919. No moving parts.

1,365,316. System of Control; Arthur J. Hall, Wilkinsburg, Pa. App. filed Oct. 3, 1917. Automatic control of electric railway vehicle.

1,365,317. System of Control; Arthur J. Hall, Pittsburgh, Pa. App. filed Feb. 25, 1919. Control of plurality of motors.

1,365,322. Control System; Henry D. James, Edgewood Park, Pa. App. filed Dec. 2, 1918. Motor starter and controller.

1,365,323. Control System; Henry D. James, Edgewood Park, Pa. App. filed May 12, 1919. For controlling excitation during acceleration.

1,365,325. Control Apparatus; Howard H. Johnston, Edgewood Park, Pa. App. filed March 7, 1919. For preventing rapid movement of drum controller.

1,365,331. Electric Resistance Element; Leon McCulloch, Wilkinsburg, Pa. App. filed June 8, 1916. Coated resistors.

1,365,332. Electromagnet; Benjamin McInnerney, Council Bluffs, Iowa. App. filed March 28, 1917. Noise reduced.

1,365,421. Control Apparatus; Thomas C. MacKau, Pittsburgh, Pa. App. filed June 9, 1919. Liquid-rheostat resistance varied by bubbles of air.

1,365,425. Soundproof Shield; Walter A. Shewhart, Brooklyn, N. Y. App. filed Dec. 26, 1919. Telephone.

1,365,441. Series-Multiple Control; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 10, 1917. Operation of polyphase motors on single phase.

1,365,465. Cable for Thermo-Electric Circuits of Grain Tanks; Leonard H. Des Isles, Chicago, Ill. App. filed July 24, 1918. Means for forming dead air spaces.

1,365,470. Wave Distribution; Henry C. Egerton, Passaic, N. J. App. filed July 26, 1917. Transmitting identical messages through a plurality of media.

1,365,481. Resistance Device; Emery G. Gilson, Schenectady, N. Y. App. filed April 23, 1920. With marked negative thermal coefficient of resistance.

1,365,491. Electric Contact Device; Julius F. G. P. Harmann, Copenhagen, Denmark. App. filed April 20, 1920. For interrupters, commutators, regulating resistances, etc.

1,365,502. Prevention of Objectionable [illegible] Effects of Dielectric Systems; Arthur F. Knight, Schenectady, N. Y. App. filed Oct. 6, 1917. When putting load on or off.

1,365,[illegible]. [illegible] Regulating System; Willem C. Korthals-Altes, Schenectady, N. Y. App. filed April 18, 1918. Motor controls excitation of dynamo by counter electromotive force.

1,365,519. Electric Edge Heel and Shank Setter; William Lutes, San Antonio, Tex. App. filed Aug. 4, 1920. Applied upon ordinary shoe machinery.

1,365,544. Car-Lighting System; Harry D. Rohman, New York, N. Y. App. filed Oct. 1, 1918. For railway.

1,365,545. Lighting System; Harry D. Rohman, New York, N. Y. App. filed Oct. 1, 1918. Lighting and heating railway vehicles.

1,365,554. Radiant Heating Unit; Milton H. Shoenberg, San Francisco, Cal. App. filed Dec. 27, 1919. Element has improved shape.

1,365,566. Automatic Regulating System; Louis W. Thompson, Schenectady, N. Y. App. filed Oct. 25, 1919. Control by counter-electromotive force.

1,365,568. Electromagnetic Apparatus; Matthew O. Troy, Pittsfield, Mass. App. filed Feb. 3, 1919. Transformer core.

1,365,569. Electromagnetic Apparatus; Matthew O. Troy, Pittsfield, Mass. App. filed Feb. 3, 1919. Core parts.

1,365,576. Radio-Receiving System; William C. White, Schenectady, N. Y. App. filed Oct. 11, 1917. Electron discharge device.

1,365,579. Radio Apparatus; Thomas Appleby and Lloyd M. Knoll, Philadelphia, Pa. App. filed June 14, 1919. Transmitting and receiving apparatus.

1,365,585. System of Control; Ralph E. Ferris, Edgewood Park, Pa. App. filed July 19, 1917. Regenerative operation.

1,365,636. Electric Pocket Lamp; Conrad Boltshauser, Roschach, Switzerland. App. filed July 6, 1920. Improved switch.

1,365,638. X-Ray Apparatus; William D. Coolidge, Schenectady, N. Y. App. filed April 13, 1917. For inexperienced operator.

(Issued Jan. 18, 1921)

15,030 (reissue). Insulated Support for Electrical Conductors; Louis Steinberger, Brooklyn, N. Y. App. filed June 1, 1920. Inductance coils in radio apparatus.

1,365,664. Method of Riveting and Apparatus Therefor; Harry B. Cox, Los Olivos, Cal. App. filed Oct. 8, 1917. Rivet rotated instead of hammered.

1,365,691. Phase-Converter Balancing System; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 28, 1917. Phases held in balance.

1,365,693. Thermostatic Burglar-Alarm System; Simon B. Hess, Jamaica, N. Y. App. filed April 8, 1918. For protection of banks, stores, etc.

1,365,700. Impulse-Starter Coupling for Magnetos; Victor W. Kliesrath, East Orange, N. J. App. filed May 31, 1919. Spring coupling.

1,365,724. Electric Winding Mechanism for Spring Motors; James J. Phillips, Rochester, N. Y. App. filed June 2, 1917. For phonographs.

1,365,725. Meter-Testing Switch; Clarence D. Platt, Bridgeport, Conn. App. filed Nov. 17, 1919. Without interrupting service.

1,365,734. Electron-Tube-Testing Circuits; Samuel P. Shackleton, New York, N. Y. App. filed March 18, 1919. For determining current and voltage relations.

1,365,787. Method and Apparatus for Wireless Signaling; Fred H. Kroger, Brooklyn, N. Y. App. filed Aug. 2, 1915. Quenched spark gap.

1,365,801. Battery Apparatus; Irving R. Solomon, Los Angeles, Cal. App. filed Sept. 11, 1918. For replenishing electrotype and testing level and gravity.

1,365,814. Recording Lock; James W. Tayco, Binghamton, N. Y. App. filed Aug. 18, 1919. Registering lock system.

1,365,821. Trolley-Wheel Guide; Charles F. Falline, Atlanta, Ga. App. filed Oct. 1, 1920. Prevent trolley wheel from jumping.

1,365,874. Trolley Pole; Edgar M. Wages, Los Angeles, Cal. App. filed Feb. 20, 1918. Will not leave wire.

1,365,875. Electrolytic Cell; Louis E. Ward, Midland, Mich. App. filed Dec. 13, 1918. Filter-press type.

1,365,880. Electrode for Secondary or Storage Batteries; James M. Allen, St. Louis, Mo. App. filed Dec. 1, 1919. In two sections.

1,365,885. Portable Electric Light; Bernard Benedict, New York, N. Y. App. filed April 30, 1919. Cannot be short-circuited from outside.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

TURNER, ME. At a recent meeting of the Chamber of Commerce the proposition to extend the electric lighting system through the town was discussed with favor.

MIDDLEBURY, VT.—A power plant of the Hortonia Power Company, Brandon, which supplies energy to Mineville, N. Y., has been destroyed by fire. The loss has been estimated at from $35,000 to $125,000.

BOSTON, MASS.—The Metropolitan District Commission has voted to recommend the Legislature to replace gas and naphtha lamps with an electric light system on boulevards, parkways and state reservations. It has been suggested that the energy be supplied from the state reservoirs in Clinton and Sudbury, where electricity is generated.

BRIDGEPORT, CONN.—The Board of Fire Commissioners plans to expend $24,250 for the purchase of underground cables, alarm boxes and hydrants.

HARTFORD, CONN. — The Board of Water Commissioners, Hartford, is having plans prepared for the erection of a hydro-electric plant and the installation of equipment in connection with the new filtration plant in West Hartford. C. M. Saville, 1026 Main Street, is engineer.

SALISBURY, CONN. — The Salisbury Cutlery Handle Company has petitioned the Legislature for authority to generate and distribute electricity in this town. G. N. Clark is president of the company.

Middle Atlantic States

ANTWERP, N. Y.—The Antwerp Light & Power Company has applied to the Public Service Commission, Second District, for permission to operate an electric light plant.

BUFFALO, N. Y.—The Buffalo General Electric Company, Electric Building, contemplates extensions to its distributing lines in outlying districts of the city. It is estimated that from 140 to 145 miles of wire will be required for the proposed extensions.

GOWANDA, N. Y.—The Iroquois Utilities, Inc., 415 City Bank Building, Syracuse, has been authorized by the State Public Service Commission to issue $145,000 in bonds, of which $83,301 will be used in the construction of a new hydro-electric plant on the Cattaraugus Creek at Gowanda.

McKEEVER, N. Y.—The Iroquois Paper Company contemplates rebuilding the power dam across the Moose River at this point. The cost is estimated at $100,000.

MEDINA, N. Y.—The Western New York Utilities, Main Street, plans to make a survey preliminary to the construction of a third power dam, to be built at Oak Orchard-on-Ridge, 3 miles northeast of Medina.

OGDENSBURG, N. Y.—The City Council has granted permission to the St. Lawrence Transmission Company, Potsdam, to extend a high-tension transmission line through Ogdensburg.

WAPPINGERS FALLS, N. Y.—The Wappingers Electric Corporation and the Dutchess Bleachery have made joint application to the Public Service Commission for authority to transfer franchises and property of the Dutchess company to the Wappingers Corporation, the latter company also applying for permission to operate in Wappingers Falls and adjoining towns.

WATERTOWN, N. Y. — The Northern New York Utilities, Inc., 137 Arsenal Building, has petitioned the Public Service Commission for permission to extend its electric system to the towns of Alexandria and Theresa.

WATERTOWN, N. Y.—C. A. Bingham, city manager, has been directed to employ an engineer and to secure plans and specifications for the installation of equipment in connection with the erection of the proposed municipal hydro-electric power plant.

ATLANTIC CITY, N. J.—The City Council has plans under way for the erection of a two-story, 37-ft. x 50-ft. central station for city electrical systems, including the police and fire alarm at Tennessee and Railroad Avenues.

BLOOMFIELD, N. J.—Scott & Bowne, 80 Orange Street, do not contemplate the construction of a factory and power plant as reported on page 71, Jan. 1 issue.

GLASSBORO, N. J.—The Borough Council has plans under way for extensions to the present street-lighting system, including the installation of 250-cp. lamps and smaller lighting units.

NEWARK, N. J.—The Town Commission of Irvington plans to make improvements and extensions to the present lighting system for increased facilities.

TRENTON, N. J.—The Trenton Flint & Spar Company has plans under way for the construction of a power house at its plant on Marion Street.

CHAMBERSBURG, PA. — The borough officials, through J. H. Mowrey of the municipal electric light department, have plans under way and will receive bids about Feb. 15 for the construction of an electric power plant on Third Street to cost about $150,000. A. C. Woods, Stock Exchange Building, Philadelphia, is engineer.

ERIE, PA.—The Buffalo & Lake Erie Traction Company, Exchange Building, contemplates the installation of a trackless trolley system on Liberty Street Boulevard. Plans include the erection of a double trolley wire for overhead power supply.

FERNHILL, PA.—The water committee of West Chester Borough Council has plans under way for the installation of an electric pump and fixtures in the Fernhill water-works.

GREENVILLE, PA.—The Mercer County Light, Heat & Power Company contemplates the erection of a high-tension transmission line along Canal Street for the purpose of furnishing power to Stoneboro and Sandy Lake. F. A. Conner is general manager of the company.

PHILADELPHIA, PA. — The American Gas Improvement Company, Broad and Arch Streets, operating electric utilities in different parts of the country, has disposed of an issue of $7,500,000 in notes, the proceeds to be used for general operations, extensions and improvements.

CHARLESTON, W. VA.—The West Penn Electric Company, Pittsburgh, Pa., is awaiting the approval of the State Legislature at the March session in connection with the development of water power along the Cheat River. The cost of its projects is estimated at about $15,000,000.

SCHUYLER, VA.—The Virginia Alberent Corporation, W. W. Hepburn, vice-president and general manager, 1417 Pennsylvania Building, Philadelphia, Pa., is having plans prepared for a hydro-electric replacement plant to cost about $60,000. F. R. Weller, Hibbs Building, Washington, D. C., is engineer.

North Central States

CLEVELAND, OHIO. — The Board of Education, East Sixth Street and Rockwell Avenue, has plans under way for additional electric wiring and fixtures in forty-four schools to cost about $100,000. Bids will also be received until Feb. 21 for electric light reflectors and fixtures in the Warren Road School, to cost about $5,000. W. R. McCormack, above address, is architect.

IRONTON, OHIO.—The Tri-State Brick Company plans to erect an addition to its power plant.

FORT WAYNE, IND. — The Board of County Commissioners has had plans prepared and bids will be received about March 1 for the construction of a power house and county farm buildings to cost about $600,000. A. McCoy, Court House, is auditor.

LINTON, IND.—The city officials will soon receive bids for the construction of a power plant to cost about $100,000. Equipment will be installed, including turbine generator, condensers, motors, two 200-hp. water-tube boilers feed pumps, etc. Shrouds-Stoner Company, Tribune Building, Terre Haute, is engineer.

FREEBURG, ILL.—Plans are under way and bids will be received about April 1 for the construction of an electric light and power plant. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

LOCKPORT, ILL.—Bids will be received by J. Lambert, president of the penitentiary commission, Rookery Building, Chicago, until Feb. 24 for the construction of a power house, kitchen, dining hall and bakery at the new Illinois State Penitentiary. Zimmerman, Saxe & Zimmerman, 64 East Van Buren Street, Chicago, are architects.

SPRINGFIELD, ILL.—Plans are under way for the installation of a lighting system on Fourth Street to cost about $81,000. S. Wade, City Hall, is engineer.

ARNOLD, MINN.—The Arnold Welfare Club, of which J. Anderson is secretary, is interested in the establishment of an electric lighting system in Arnold. Energy will be supplied by the Duluth Edison Electric Company, Duluth.

BLUE EARTH, MINN.—The erection of a transmission line from the municipal electric light plant to supply light and power to Ceylon and Dunnell is contemplated.

FERGUS FALLS, MINN. — The Otter Tail Power Company contemplates the erection of a transmission line to Rothsay. C. S. Kennedy is in charge.

OWATONNA, MINN.—A proposition to issue $475,000 bonds for the erection of a municipal light, heat, power and gas plant was submitted to the people at a recent election, but failed to carry.

ST. CLOUD, MINN.—The City Council has been petitioned to erect and operate a municipal light and power plant. A. W. Buckman is city clerk.

COLUMBIA, MO.—Bids will be received by J. S. Bicknell, city clerk, until Feb. 21 for the installation of a 1,000-kw. turbine-generator unit, switchboard and condenser in the light and water plant.

WARRENSBURG, MO.—The City officials contemplate the installation of an electric light plant. F. L. Wilcox, Syndicate Trust Building, St. Louis, is consulting engineer.

FORT WORTH, TEX.—The Peden Iron & Steel Company, Main and Daggett Streets, is having plans prepared for the erection of a steel-roller mill and fabricating plant to cost about $1,000,000. Electrically driven machinery will be installed. D. R. Luce is engineer.

RANGER, TEX. — The Wichita Falls, Ranger & Fort Worth Railroad Company contemplates the erection of a roundhouse and installation of a six-stall electrically driven turntable to cost about $100,000. J. H. Frazier is engineer.

Pacific and Mountain States

LOS ANGELES, CAL. — Plans of the Southern California Edison Company, 306 West Third Street, to cover six years of construction work, have been approved. The program includes the erection of a reservoir at Florence Lake, an 11-mile tunnel from Florence to Huntington Lakes, conduit from Huntington to Shaver Lakes, three hydro-electric generating stations and enlargement of power house No. 8. These developments will involve an expenditure of about $48,000,000 and give the company an additional capacity of 316,000 kw.

LOS ANGELES, CAL.—H. Z. Osborn, chief engineer of the Board of Public Utilities, has submitted plan to the City Council, which provides for the construction of an electric subway system. The cost is estimated at $600,000.

RIVERSIDE, CAL.—The Southern Sierras Power Company plans to extend $2,183,329 for new construction and improvements, including hydro-electric development, rebuilding distribution lines, increasing transformer capacity, extensions to substations and additional telephone circuit.

WILMINGTON, CAL.—The Chamber of Commerce is in favor of holding a special election for the purpose of submitting an issue of bonds for the construction of an electric railway in the city. It is also intended to campaign for improved street lighting, including an extension to the ornamental system on Canal Avenue.

OGDEN, UTAH.—An election will be held the last week in February for the purpose of submitting to the voters a proposition to issue $500,000 in bonds for the erection of a municipal light plant.

KELLOGG, IDAHO.—The Bunker Hill & Sullivan Mining & Concentrating Company contemplates the erection of an electrolytic zinc refinery to cost about $1,000,000.

OVID, COL.—The State Public Utilities Commission has granted permission to the Ovid Light & Power Company to connect with the transmission line between Julesburg and Sedgwick by installing a step-down transformer for the purpose of supplyng energy for light and power in Ovid.



WILLIAMSBURG DAM, WHICH IS UNDER CONSTRUCTION FOR THE PENN CENTRAL POWER & TRANSMISSION COMPANY BY DAY & ZIMMERMAN, INC.

Southern States

DUNN, N. C.—The town officials contemplate rebuilding the power, light and water plant at a cost of about $100,000.

NEWTON, N. C.—Bonds to the amount of $14,900 have been issued for the installation of a light, power and water system.

ATLANTA, GA.—The Georgia Railway & Power Company, Gas & Electric Building, contemplates improvements to its system and the installation of additional equipment.

TAMPA, FLA. — The Tampa Electric Company plans to improve the street-lighting system by installing fifty 100-cp. lights.

MOUNTAIN VIEW, OKLA.—Plans are under way by V. V. Long & Company, Oklahoma City, for power-house equipment to be installed at the municipal pumping station.

OKMULGEE, OKLA.—The B. & A. Mining Company, McBrayer Building, will receive bids until March 1 for complete equipment, including electrically operated coal-mining machinery, hoisting engines, etc., for a new coal mine. The cost is estimated at $75,000.

PERSHING, OKLA.—The city officials contemplate the installation of an electric lighting system.

SAPULPA, OKLA. — The city commissioners have had an estimated prepared for the erection of an ornamental lighting system on six blocks of Dewey Avenue to cost about $16,775.

AMARILLO, TEX.—The City Commission plans to extend the lighting system and install 136 metal standards surmounted with groups of lights.

Canada

ST. THOMAS, ONT.—The City Council contemplates the installation of a rotary converter in the municipal electric station. Councillor Walker is chairman of committee No. 5.

ST. THOMAS, ONT. — Bonds to the amount of $233,000 have been voted for the construction of a dam across Kettle Creek. Electric pumps will be required. W. C. Miller is city engineer and R. S. and W. S. Lea, New Birks Building, Montreal, Que., are consulting engineers.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 10.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa. Annual meeting, Atlantic City, N. J., April 21-23.

AMERICAN ENGINEERING STANDARDS COMMITTEE. Secretary, P. G. Agnew, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, S. E. Dillon, Hot Springs, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York City.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

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COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, M. B. W. Baker, Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-treasurer, E. Donald Tolles, 52 Broadway, New York City.

ELECTRIC FURNACE ASSOCIATION. Secretary, Dr. C. G. Schluederberg, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, F. L. Bishop, Hartford Faience Co., Hartford, Conn.

ELECTRICAL MANUFACTURERS' COUNCIL. Executive secretary, Frederic Nicholas, 522 5th Ave., New York City.

ELECTRICAL SAFETY COUNCIL. Secretary, Dana Pierce, 25 City Hall Place, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbaugh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADE ASSOCIATION OF CANADA. Secretary, William P. Stavely, Royal Insurance Building, Montreal, Canada.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, Charles H. B. Chapin, Grand Central Terminal Building, New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla. Annual meeting, Lakeland, Fla., Feb. 7 and 8.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill. Annual convention, Chicago, Ill., Dec. 9.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

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NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS. Secretary, C. W. Hoffrichter, 8410 Lake Ave., Cleveland, Ohio.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ASSOCIATION OF RAILWAY AND UTILITY COMMISSIONERS. Secretary, James B. Walker, Public Service Commission of the State of New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive manager, M. H. Aylesworth, 29 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

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NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass.

NEW ENGLAND GEOGRAPHIC DIVISION N. E. L. A. Secretary, Miss O. A. Bursiel 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION Secretary-treasurer, Charles E. Twogood Albuquerque N. M. Annual meeting Albuquerque, N. M., Feb. 16-18.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

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OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST GEOGRAPHIC DIVISION, N. E. L. A. Secretary, S. H. Taylor, Electric Railway & Manufacturers' Supply Co., San Francisco, Cal. Annual meeting, Del Monte, Cal., May 25, 26 and 27.

PENNSYLVANIA ELECTRIC ASSOCIATION, State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

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PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 1112 S. Curtis Ave., Richmond Hill, Queens Borough, N. Y.

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SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, Guaranty Building, 522 5th Ave., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTHEASTERN GEOGRAPHIC DIVISION N. E. L. A. Secretary-treasurer, Charles A. Collier, Georgia Railway & Power Co., Atlanta, Ga.

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SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 721 First National Bank Building, El Paso, Tex.

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An Undeserved Reflection on the Electrical Industry

IN ITS anxiety to preserve the public parks of the nation from desecration and vandalism the *Saturday Evening Post*, in a cartoon which appeared in the issue of Jan. 29, has unwittingly departed from its usual good judgment and cast aspersion on the electric light and power industry, which is just as eager to perpetuate and embellish all that is beautiful and useful in nature as is its journalistic critic. Hydro-electric developments may use but they do not destroy or pollute water. We know of no hydro-electric power plant within the national parks except one, and that was placed by the government itself in Yosemite. The plant does not detract from, but rather adds to, the beauty of the park and its enjoyment by tourists. No applications have been made by private interests for power plants within the national parks, and even if any had been made the Federal Power Commission has ruled that no such permits will be granted. Opportunities abound for storing water within the national parks and at the same time adding to their attractiveness. This, however, is neither profanation nor destruction, and we feel that when it was led to include water-power plants in its cartoon the *Saturday Evening Post* was imposed upon. Certainly there is no justification for the inference that the electric light and power industry has harmful designs on the national parks and certainly there is no desire on the part of that industry to go contrary to the wishes of the public.

Efficiency of State Regulation of Utilities Proved

WHAT is wrong with our public service commissions? That is the question which naturally arises in the public mind when increases in rates are granted and when the politician, because of the advances, pillories the utilities and the commissions. That the increases are warranted is not always known; the inference is that the commissions have not been zealous in the public interest. As a result governors have been elected in at least two states, Illinois and Arkansas, on platforms which call for the abolishment of public service commissions. But that commission regulation in either of those states will be done away with we cannot believe. Governors of thirty-four states have gone on record as emphatically approving state regulation of utilities through public service commissions. So satisfactory has been the experience in dealing with public utilities in this way that commissions are now deemed indispensable. In the light of such testimony any movement on the part of the state legislatures of Arkansas and Illinois to dispense with commission regulation would be ill advised. Certainly when the respective legislatures fully consider the matter they will find that in justice to the public and the utilities they must retain the principle of state regulation, even if somewhat modified, rather than return to the more primitive and less satisfactory system of regulation through home rule. State regulation has not been entirely to the liking of public utilities. Commissions have, as a rule, favored the public more than the service companies, so that on the whole as agents of the people they have been effective. We are sure, therefore, that no serious change in Arkansas or Illinois is to be anticipated.

Titles for Industrial Plant Electrical Men

WE BELIEVE a bright future awaits industrial-plant electrical men, those who answer to the nondescript titles of chief electrician, superintendent of electrical department, plant engineer and similar designations. A title may mean much or little to an individual in a particular organization, but in the profession at large titles are indicative of the group status. Looking at the character of its electrical problems of installation and operation, the industrial plant that makes use of say 2,000,000 kw.-hr. and upward annually in its productive processes ranks high among the fields that call for engineers with a fundamental knowledge and experience of electrical work. The time has therefore arrived when the title of industrial electrical engineer should be recognized by the profession and by the industrial employer and awarded to those industrial-plant electrical men professionally qualified and now bearing all sorts of designations. The electrical engineer of today exercises both professional and economic functions, regardless of the particular specialized duties of his occupation, and he merits a title and organization status that will indicate clearly the distinction of the calling.

How Co-operation Has Helped the Electric Vehicle

DURING the past two weeks there was held in the main showroom of the New York Edison Company an exhibition of electric vehicles and accessories. The exhibition was attractive and informative, and it demonstrated what can be done when electric light and power companies and manufacturers of electrical devices get together for a common purpose. In this particular instance the faith which the public utility company has always had in the electric vehicle has been amply demonstrated through works, for during 1920 the number of electric trucks in the community increased almost 500 per cent over the preceding year, largely through its efforts. As a matter of fact, of all the electric trucks now in use in the United States almost one-half are to be found in the metropolitan district of New York City. This wide application is no doubt due first of all to the

inherent economies of the electric vehicle itself in a city like New York, and secondly to the enthusiastic spirit of co-operation which has been manifested by the New York Edison Company to manufacturers of electric vehicles. It indicates clearly the truth of the maxim that "in union there is strength" and shows what might be accomplished in other cities were co-operation carried out as enthusiastically as it is in New York.

A Little More Light on the Cause of Fires

ALTHOUGH we do not desire unnecessarily to harp upon a single string, the matter of the causation of fires, to which we recently referred, seems to involve some peculiarly puzzling statistics that invite comment; for now comes a consulting engineer of the Fire Underwriters' Board and tells the National Brick Manufacturers' Association in annual convention assembled that of $300,000,000 annual fire loss in the United States $70,000,000 is directly due to improperly constructed chimneys.

This amount is dangerously near a quarter of the whole, and beside such a proportion the dangers of electricity, heralded as first in the list of assignable causes, sink into hopeless insignificance. We are beginning to have somewhat of the same feeling about these solemn reckonings that we have regarding the statistics on personal, civic and national losses which are printed in the newspapers from time to time. If summed up—and each total is declared a solemn fact—the amount arrived at would be great enough to pay the expense of the world war and leave something over for the multitudinous "drives" now going on. Quite seriously, statements such as the one we quoted in a previous issue and the one we now quote leave us with grave doubts as to whether the underwriters themselves know or anybody else really knows very much about the cause of fire losses, concerning which they are willing to talk so glibly. The facts may be before them, but there should be a greater degree of agreement in drawing the conclusions than is indicated in the statements we have in hand.

Measurement of Casting Temperatures in the Brass Foundry

THE science and art of pyrometry have made rapid strides in recent years, especially in connection with annealing furnaces. In all of the best annealing processes the temperature and temperature gradient of the product are carefully watched and adjusted. In brass foundries and alloy foundries the same degrees of precision and quantitative technique have not been generally attained, but it is only a question of time when all important foundry furnaces shall have adopted pyrometric methods as a matter of regular routine.

A paper read before the last annual meeting of the Institution of British Foundrymen and referred to in our Digest section drew attention to the importance of careful pyrometry in non-ferrous foundry work. It pointed out that slag and vapors on the surface of the molten material interfered with the precision of radiation pyrometers and of optical pyrometers. It therefore emphasized the necessity of using immersion pyrometers in the crucibles. A thermo-electric couple of nickel and nickel-chromium alloy was recommended for this purpose. Such a junction is stated to generate an emf. of 40 millivolts at 1,000 deg. C., thus enabling robust millivoltmeters to be used as temperature indicators.

As an indication of the importance of measuring and selecting the proper pouring furnace temperature it is mentioned that in the case of a gun-metal composition having definite components of copper, tin, zinc and lead the tensile strength of the alloy reached a maximum when the temperature of pouring was 1,150 deg. C. At pouring temperatures below 1,050 deg. C. the cast bars became unsound, so that there was only a margin of 100 deg. C. between unserviceable alloy and material of the maximum available strength. Similarly, in the case of a certain manganese brass the range of serviceable pouring temperature was very small. For the soundest castings of this composition it should be 970 deg. C. ± 20 deg. C.

Shall Telephone and Power Circuits Occupy the Highways?

WHETHER a telephone company can utilize the highway to the exclusion of all but very low-voltage power circuits was the question raised in a recent case before the Public Utilities Commission of Illinois. The right to construct a line along a highway parallel with important toll circuits was originally refused to a power company because its service could be given over another route. Later on the farmers along the highway in question, for a distance of 7 miles, asked for service, and the right was granted the power company to construct a 13,200-volt, three-phase line that would serve not only these consumers but also several small communities, and at the same time to remove a length of line from an awkward position along a nearby railway right-of-way to a highway location that would facilitate operation and improve service to all consumers. On a rehearing the telephone companies attempted to show that a 2,200-volt line along the highway would provide service to the farmers, though it would be necessary to carry a 13,200-volt circuit parallel with the road along a nearby railway right-of-way for a large portion of the distance, with feed-ins at several points, and to make a double transformation, as compared with the use of a single line on the highway. In an order granting the right to build the power line, issued before the recent hearing, the commission said that "while the signal circuits with priority of occupation are entitled to reasonable protection from substantial interference, it does not appear that there is a right on the part of the telephone company to occupy the public highway to the entire exclusion of the electric lines."

The ELECTRICAL WORLD, without presuming to pass judgment on the particular case at issue, believes that in the words quoted the commission has found the fundamental consideration that must govern the use of highways by utilities if the public is to have the maximum of benefit. Any utility using a highway must so order its own affairs that it can live with other users of that highway. If it cannot do this, then it will shut out a part of the service that the public owning the highway is entitled to receive. The interests involved must get together and work out a solution in which each interest will assume a fair share of the burden. Such hearings as the one referred to may settle specific cases, but they cannot settle the fundamental problem. In fact, they may seriously complicate the problem by creating legal precedents that are directly opposed to the right solution

and will cause endless trouble before they are wiped out. Legal precedents are not needed in these cases, and it is high time that the central-station and telephone industries shall adopt a course that will eliminate such controversies and lead toward a mutually satisfactory settlement of the problem on the basis of the greatest possible service to the community with the least cost in money and the least interference with each other's service. Shutting one or the other off the highways may ultimately drive both ultra-sensitive telephone toll and important power transmission circuits to private rights-of-way—a result that would be little short of a calamity in the densely populated sections of the country. The whole field of rural distribution at moderately high voltages, as well as the rights of sensitive telephone toll circuits, is at issue, for without the use of the highways for such voltages as are involved in the case rural distribution and service to the smaller communities will be practicable only in isolated cases.

Increasing the Ratings of Cables

CONSIDERED from the standpoint of insulation alone, the most important properties of a dielectric are specific resistance and dielectric strength. When, however, the question of capacity enters to these must be added specific inductive capacity and dielectric loss. Unfortunately the relative values of these four properties vary among different substances over a wide range. There are no known laws connecting them, and knowledge of one of these properties for a given substance is no indication of the values of the others.

In the process of development of high-voltage equipment dielectric strength has of necessity been the first consideration, owing to its immediate bearing on the question of life. In the case of high-tension cables, therefore, it is natural that the first insulating materials used should have been selected principally from the standpoint of dielectric strength. With increasing experience the importance of temperature as limiting the rating of the cable has led to the study of dielectric losses. It is not surprising, therefore, that there has resulted from research in this field a better selection of insulating material combining the requisite properties of high dielectric strength and relatively lower specific dielectric losses. In his article on ratings of cables in the Jan. 1, 1921, issue of the ELECTRICAL WORLD W. A. Del Mar calls attention to the increased ratings possible owing to this improvement and also by other means.

A further interesting result of recent investigation in this field is the indication that higher voltage ratings are possible by the use of smaller conductors, it being stated that the dielectric strength of impregnated paper is greater in an electric field that dies off rapidly, as near a small wire, than in a field that is comparatively uniform, like that around a large wire. The claim is made with some reserve and should be accepted accordingly. Such a result would be contrary to the indications of a great deal of experience. It is well known that the breakdown of insulation frequently takes place progressively, beginning at one point, resulting in higher stress on the remainder, and so after a time resulting in complete break-through. It may be well, therefore, that the use of a smaller conductor in a cable of given outside diameter would stand in the beginning and perhaps for some time a higher voltage. Nevertheless, the stress on the inner layers is higher, and we should suppose, therefore, that deterioration would begin earlier on these layers than in the case of the larger conductor. It would thus appear that cables built in this way might stand up initially to higher voltages but would probably have a shorter average life. Further results and more definite announcements on the subject will be awaited with interest.

Meeting Engineering Emergencies in Peace Times

WHAT can be done when emergencies have to be met is graphically told in this issue by Lucien Pahin. The subject is a French hydro-electric plant and the use that was made of it during the war. Not only did the engineers operating that plant devise unusual methods of operation and use them successfully, but a remarkable showing was made, besides, in using a large percentage of the total available energy of two streams.

The figures given by Mr. Pahin show unusual diligence in swinging into action and great adaptability in meeting difficult situations. To the French engineers in charge of the work we can express our compliments but hardly our surprise. American contact with them during the war has led us to expect from them such success in their enterprises. The lessons to be derived from reading the article are applicable to times of peace. Peace-time emergencies should be met with equal boldness. The stakes, though not so immediately vital, still have their importance in the progress of the world. In war time emergencies such as those described remove the fear of new methods. Would not the same attitude be beneficial in times of peace?

Standardizing Meter and Service Practice

THAT standardization is applicable to central-station operation in small cities just as well as in large ones is indicated by L. C. Peterman in his article in this issue on "Uniform Service and Meter Wiring." Mr. Peterman gives us the findings and results of a thorough investigation of general practice with regard to service drops and meter installations. He proposes some general regulations that cover the whole range of conditions found in a city of 20,000 people. The information given is sufficient to provide for some standard method of handling all service requirements that may present themselves in such a place. That great convenience and appreciable savings will follow the adoption of these standards can be predicted without fear of false prophecy. However, we can hardly expect all central-station operators to agree with all of Mr. Peterman's suggestions. Opinions in such matters are too varied, partly because the subject as a whole has not received sufficient attention and partly because operating conditions are different in different localities. However, there are thoroughness and soundness in the data given by Mr. Peterman, and they will afford valuable assistance to those who have not had the opportunity or time for a study of this nature. Furthermore, the information can be used as a guide by those who have come to realize that standardization is fundamentally important to successful operation and who are undertaking a similar investigation on which to base standard rules for service and meter installation.



Arthur Edwin Kennelly

A savant of international reputation, a profound mathematician and an analytical engineer-physicist whose development work is a fundamental contribution to the advancement of electrical science

THE influence that such engineer-physicists as Prof. John A. Fleming and Sir William Thomson (Lord Kelvin) have reflected in British science has been reflected by Dr. A. E. Kennelly in this country. For nearly twenty years he has been professor of electrical engineering at Harvard, and for the past six years has, in addition, served in the same capacity at the Massachusetts Institute of Technology and as director of the research division of its electrical engineering department. With a background of a quarter of a century of practical work as an engineer-physicist, during which time he gained national recognition, he brought to his university work a knowledge and experience which have helped to gain for Harvard and the Massachusetts Institute of Technology the high reputation that their electrical engineering departments now enjoy. As a consulting engineer his services are in wide demand by both private corporations and national engineering bodies.

Like many other pioneers in electrical work, Dr. Kennelly was graduated from the telegraph key into larger fields of service. For ten years he served consecutively as assistant electrician of the British Eastern Telegraph Company, chief electrician of a cable-laying steamer and senior ship's electrician. Then he became associated with Thomas A. Edison and was his principal electrical assistant at Orange, N. J., from 1887 to 1894, later becoming consulting electrician to the Edison General Electric Company. From 1894 to 1901 he was a member of Houston & Kennelly, consulting engineers, in Philadelphia.

Dr. Kennelly is a savant in the true sense of the word. While his work has not been spectacular from a popular standpoint, it has been of fundamental importance to engineering research. He is a profound mathematician, an analytical engineer-physicist and a lecturer who has the gift of lending clarity to complex subjects. He has been a prolific author of technical papers and books. His contributions to engineering and scientific literature cover a broad range, and the results of his work are widely quoted by other investigators and authors. His earliest contributions were on subjects connected with cable testing and the development of alternating-current theory and dynamo-electric machinery. On practical subjects his discussions on the calculations of networks, investigations covering the phenomena of skin effect in conductors and determinations of the heating of electrical conductors are classics in technical literature. Among the most notable of his original contributions are his application of hyperbolic functions in the analysis of electrical engineering problems and his formulation of the fundamentals underlying radio telegraphy and telephony. During the world war as civilian liaison officer in the army Signal Corps his opinions and assistance were eagerly sought by high officials of the allied governments on wireless matters and in the co-ordination of scientific methods. He was born at Bombay Dec. 17, 1861, of British parents.

Making Best Use of French Hydro Plant

Originally Designed for Railroad Electrification, Station Was Utilized for War Loads to Alleviate Loss of Coal Mines—How the Station, Line and Substations Were Changed to Get Maximum Utilization of Water

By LUCIEN PAHIN
Pontoise, France

THE capture by the German army of the most important French coal mines resulted in an annual loss of more than 20,000,000 tons of coal, but the use of hydro-electric energy counteracted in a large measure this enormous loss. The hydro-electric station at Soulom, in the Pyrenees, designed and partly built for railway electrifications, was revamped for supply to government war plants. This required a change from single-phase to three-phase generators, as well as some ingenious arrangements of transformers and transmission lines for loads at various voltages. At the same time a curtailed service was maintained on the electrified railways. This arrangement resulted in a maximum utilization of water at the Soulom plant, which is situated at the fork of two mountain streams, the Cauterets River and the Gavarnie River. The plant was erected by the Southern Railway Company of France to furnish energy to the electrified lines in the southern section of its Pyrenean division.

Water Supply from Two Streams at Different Heads

The design of the plant called for two sections to be established in the same building, one operating at a head of 113 m. (370 ft.), the other operating at a head of 250 m. (820 ft.). In each section three penstocks are connected to three turbines of 3,500 hp. rating. The plant is equipped with six 2,400-kw., single-phase alternators, 6,000 volts, $16\frac{2}{3}$ cycles. From this station energy is transmitted, through six 2,400-kw. transformers, at 60,000 volts, on steel towers carrying four aluminum cables and delivered to five substations, where the voltage is lowered to 12,000. In addition to the station equipment described above two small generators are included in each section, each one driven by a 250-hp. turbine. One is the house-service unit generating direct current at 120 volts. The other generates three-phase current at 6,000 volts and 50 cycles for service to the various interests that were deprived of their water power through the installation of this large plant. By August, 1913, the plant was able to deliver half its planned capacity, the low-head section being completed. The work inside of the station was also completed at that time. In October, 1915, the high-head section of the plant was ready for operation. In July, 1914, the only substations in service were those at Lourdes and Tarbes, operating electric trains on the Lourdes-Pierrefitte, Lourdes-Tarbes and Tarbes-Bagnères de Bigorre sections. Some energy was also sold from the Lourdes substation to the tramway company of Bigorre. The other uncompleted stations were at Pau, Montrejeau and Lannenmezan. These were to operate the Montrejeau-Luchon, Lannemezan-Montrejeau and Lannemezan-Arreau sections. At each one of these substations the pressure was to be lowered to 12,000 volts.

When mobilization came in August, 1914, all construction work as well as the running of electric trains was stopped on account of lack of workmen. In December, 1914, electric trains were again operated on some of the electrified sections, while the completion of the high-tension work in the station was rushed. It became evident at that time that, with only a small part of the railroad lines electrified, a large amount of power could be made available for other purposes, the total capacity of the plant being 28,000 hp. at the turbines. Moreover, the two mountain streams are capable of taking care of the total capacity of the station for the greatest part of the year. Under these conditions it was immediately planned to make use of all the available energy for war purposes.

Water Used Most Effectively for Munitions Plants

The Minister of Armament, after signing some important contracts with the Société Norvégienne de l'Azote, directed it to install at Soulom a plant for the synthetic production of nitric acid and nitrates. In August, 1916, three single-phase Birkeland-Eyde furnaces were being operated on three-phase energy at 10,000 volts and 50 cycles. In order to do this it had been necessary to replace four of the single-phase generators, two in each section of the plant, with four three-phase, 2,500-kw. generators. An extra switchboard with four panels was installed in the station to handle the voltage regulation, the switches and the paralleling of generators. A special annex to the building was necessary for the housing of the 10,000-volt switches controlled from the switchboard. The three-phase, four-wire system was used, with the fourth wire grounded. Each one of the three furnaces in operation was connected between one phase wire and the fourth wire. A fourth furnace was installed as a spare. The total required energy was 10,000 kw. In four months, August to December, 1916, a total of 15,000,000 kw.-hr. was furnished to these furnaces, while the total output to the railroad company was only 1,500,000 kw.-hr.

In the beginning of 1917 the shortage of coal, and especially the irregular deliveries, made it necessary for the ordnance office at Tarbes to consider the stopping of all electric traction in the sections where it had been kept up in order to insure the ordnance power requirements of 2,000 kw. to 2,500 kw. from the plant at Soulom during the day and of 1,000 kw. during the night. This would have resulted in an expenditure for the railroad company of 12 tons of coal a day to handle its trains by steam in the affected sections. Against this a daily economy of 50 tons of coal by the ordnance plant at Tarbes was obtainable. In order to furnish the required three-phase current at 10,000 volts, 50 cycles, to the ordnance plant, the remaining single-phase alternator in the low-head section of the plant was rewound

for three-phase. This arrangement, leaving one single-phase unit in the high-tension section for railway operation, proved to be the most economical in regard to water.

In order to furnish all available energy for the nitrate plant the storage water was reduced to a minimum. Three-phase energy for the ordnance plant generated at about 9,500 volts was stepped up to about 55,000 volts through three of the original 6,000-volt transformers, star-connected on the low-tension side, and delta-connected on the high-tension side to reduce as much as possible the voltage on the low side. From Soulom to Tarbes three of the four aluminum cables of the railway company were used at 55,000 volts, and there the voltage was stepped down in the same manner that it was stepped up at Soulom.

One Side of 60-Kv. Line Operated Grounded

In order to maintain electric traction on the line from Lourdes to Pierrefitte and on the tramways of Bigorre fed from the substation at Lourdes, which was still found possible, a fifth aluminum cable was installed between Soulom and Lourdes. On account of mechanical and electrical considerations it was found advisable not to install another highly insulated wire in the tower line. This fifth cable was therefore attached by a low-voltage insulator to the body of the tower and grounded at one point of the system. The use of this cable and the fourth aluminum cable previously installed, insulated for 60,000 volts, handled the single-phase current. The only remaining single-phase alternator generating at 6,000 volts was connected to the low-tension side of two of the 2,500-kva. transformers, in series. The high-tension side of these transformers was connected in parallel, thus sending single-phase energy at 30,000 volts to Lourdes over the temporary line. At Lourdes two single-phase transformers of 625 kva. rating reduced the voltage from 30,000 to 12,000.

A similar transformer had its low-tension side connected to two of the cables of the transmission line between Lourdes and Pau. This circuit was not grounded and caused no trouble to telephone or telegraph lines, which had not yet been protected from such disturbances. Practically speaking, the voltages at the same instant on each cable were equal to + 6,000 and — 6,000 with respect to ground and therefore neutralized each other.

Between Lourdes and Tarbes, where a larger load had to be handled, it was necessary to obtain 28,000 volts in a similar manner and transmit by using the fourth cable and the nearest catenary of the traction line. This single-phase energy at 28,000 volts was obtained at the substation at Lourdes through two transformers of 625 kva. each, having their high-tension coils fed in parallel by 30,000 volts from Soulom. The low-tension side was connected in series and grounded. Each one of the transformers used was equipped with several taps which permitted the obtaining of 28,000 volts between cables instead of 24,000 volts.

Two transformers rated at 30,000 volts to 12,000 volts, 625 kva., were installed temporarily at Tarbes and furnished the energy for trains between Tarbes and Bagnères de Bigorre. It was possible here, on account of the taps on the transformers, to furnish the full 12,000 volts to the catenary.

The substation at Lannemezan was also fed with 28,000 volts over two of the cables of the transmission line, and the voltage was stepped down as previously described. Here, by using similar transformer connections to those at Tarbes, the Lannemezan-Arreau section was handled.

Delivery of Energy to the National Powder Plant at Lannemezan

Later the Soulom plant was called upon to furnish power to the national powder plant of Lannemezan. Three of the aluminum cables of the double line between Tarbes and Lannemezan were used for that purpose, and the railroad company had to make use on that line of the fourth cable and the catenary for electric traction in the same way as was done between Lourdes and Tarbes. However, between Tarbes and the Bagnères junction (3 km.), where trains from Tarbes to Bagnères were routed, and over three tunnels between Tarbes and Tournay it was necessary to install a fifth cable.

Some months later the government required the exclusive use of the six 2,500-kva. transformers at the station at Soulom for service to the ordnance plant at Tarbes and the powder plant at Lannemezan. This necessitated transmission at 55,000 volts to Lannemezan, instead of 10,000 volts, and stepping down at that point to 12,000 volts. The only difficulty encountered in this change was the fact that it was necessary to maintain electric traction on the branches of Pierrefitte, Bagnères and Arreau. In order to do this two single-phase transformers of 1,250 kva. capacity were installed in an annex of the plant at Soulom. These two transformers (60,000 volts to 12,000 volts) were connected with their low-tension sides in parallel on the remaining 6,000-volt, single-phase alternator. The two high-tension sides were also connected in parallel and delivered 30,000 volts to the fourth aluminum cable and the fifth temporary cable, this line taking care of the station at Lourdes.

	Kilowatt-Hours		
	1916	1917	1918
Nitrate plant	14,429,365	65,908,800	71,818,600
Small users	38,600	73,000	141,400
Electric traction	3,367,015	2,443,000	2,917,000
Tramways of Bigorre	192,000	244,200	253,000
Ordnance plant and powder plant		6,650,000	8,870,000
Total	18,026,980	75,319,000	84,000,000

Output of the Soulom Plant by Years

The various changes that were made at the plant at Soulom, which was originally built to furnish energy for traction, contributed in no small measure to the furnishing of electrical energy for the national defence of France. In doing this the plant gave continuous service, which was not a condition required in its design. Although there is considerable difference between a hydro-electric plant designed and built for electric traction and one designed for furnishing power to industrial establishments, the plant at Soulom was able to measure up to all requirements placed upon it.

In relieving the condition brought about by the loss of coal mines to the Germans the hydro-electric plants in the Pyrenees did their part. In spite of the unfinished conditions of the plants and in spite of the many temporary arrangements required it was possible to maintain electric traction on the electrified lines and to furnish the rest of the energy available to war plants. The table above shows the amount of energy generated at the plant at Soulom and the use made of it in the years 1916-1918.

The energy furnished to the nitrate plant in 1918, in spite of the slowing up following the armistice, was equivalent to the continuous operation at full load for nearly 7,000 hours of the four generators that were reserved for its service. The amount of energy furnished to the ordnance plant and at the powder plant resulted in continuous operation of the generators at full load for more than 3,000 hours. On the other hand, the energy used for the railroad company and the tramways resulted in continuous operation of the generators at full load for only 1,300 hours. Considering the hydraulic end of the plant, the total output in 1918 corresponded to carrying full load for 7,400 hours, giving a coefficient of utilization equal to 64 per cent. During 1918 84,000,000 kw.-hr. generated at Soulom resulted in a saving of 170,000 tons of coal.

Uniform Service and Meter Wiring

Definite Rules Adopted at Chillicothe, Ohio, for Installing Service — Size of Wire and Meter Fixed by Connected Load — All Except Very Small Customers Are Furnished with Three-Wire Instead of Two-Wire Service

By L. C. PETERMAN

Formerly Electrical Engineer Ohio Utilities Company, Columbus, Ohio

IN CONVERTING its distribution system from 125-cycle, single-phase, to 60-cycle, three-phase, the Chillicothe (Ohio) Electric Railway, Light & Power Company made a rather extended study of the methods of supplying service to the consumer's premises.

Methods employed by representative companies along this line showed a considerable range of standards in existence. Adequate reasons were developed, however, for abandoning the prevailing practice of installing closely spaced transformers of very small size, short two-wire secondaries and two-wire services exclusively, and unprotected service wires inside the building, together with the indiscriminate location of service switch and fuses.

For lighting and small power installations a three-wire, three-phase, 2,300-volt system was decided upon,

TABLE I—METER SIZES FOR SINGLE-PHASE MOTORS

Size	Volts	Wire	Maximum Size, One Motor Hp.	Total, Two or More Motors Hp.
5-amp	110	2	¼	¾ or smaller
5-amp	220	3		1½
10-amp	220	3	1½	3
15-amp	220	3	3	4
25-amp.	220	3	5	7

with three-wire 110/220-volt lighting secondaries and 220-volt, three-phase transformers for power. For the larger power customers requiring 300 kw. and above, 6,900 volts was supplied at the primary voltage or at 575 volts secondary.

Two-wire services had proved unsatisfactory for most commercial consumers, not only on account of the large copper required for adequate voltage regulation and the attendant strain on poles, pins and house brackets, but also because it had been found almost impossible to eliminate the effect of starting single-phase, 110-volt induction motors of ½ hp. to 1 hp. and larger. On the other hand, universal application of three-wire services to all loads was proved unnecessary, as the numerous 110-volt heating devices in residences, together with frequent lack of proper planning of the interior branch circuits, in many cases resulted in badly unbalanced loading and nullified the advantages ordinarily secured by the use of 220 volts.

Consideration of the voltage drops in service wires as shown in Tables V, VI and VII set the limit of the two-wire service and meter at 5 amp., solely from the standpoint of economy and general efficiency. This was because the alley distribution employed gave an average length of service of about 150 ft. (45 m.) and it was desired to limit the drop in the service to 1 volt. Accordingly tests were made to determine the connected load which would produce a 5-amp. or 0.55-kw. demand. This was found to be about 1,800 watts for residences and about 800 watts for small shops and stores, and as a result two No. 8 wires and a 5-amp. meter are usually recommended for such loads or smaller, and three-wire services of appropriate size for all larger loads.

TABLE II—THREE-PHASE MOTORS, THREE-WIRE, 220 VOLTS

Meter Size, Amp.	Maximum Size One Motor, Hp	Total Two Motors, Hp	Total, More than Two, Hp.
5	2		
10	4	5	5½
15	6	7½	8
25	10	15	16
50	20	30	33
75	30	40	50
100	45	60	70
150	60	90	100

NOTE—Small sizes: 1 hp. = 3 amp. per phase (approx.). 15 hp. or above 1 hp. = 2.6 amp. per phase (approximate)

TABLE III—SIZE OF SERVICE WIRES, WEATHERPROOF ONLY, THREE-PHASE

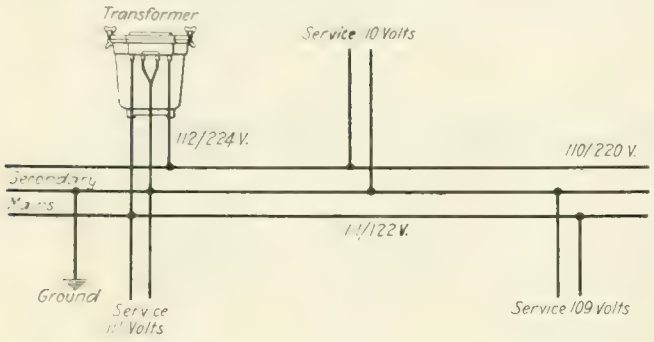
Size, Amp.	Volts	Wire	Length of Service 40-Ft.	80-Ft	120-Ft.	160-Ft	200 Ft
5	220	3	10	10	10	10	10
10	220	3	10	10	10	10	8
15	220	3	10	10	8	8	6
25	220	3	8	8	6	6	4
50	220	3	6	6	4	2	2
75	220	3	4	4	2	1	1 0
100	220	3	2	2	1	1 0	2/0
150	220	3	1	1	1 0	2 0	4 0

Maximum voltage drop allowed: 3 volts for loads up to 100 amp.; 4 volts for 150 amp. load.

For a single large residence having a demand of around 1 kw. a two-wire No. 6 service may be preferable to three No. 8's on account of the unbalance usually encountered, as mentioned above. But for four-family and six-family apartments, the customary two No. 6 wires can profitably be replaced by three No. 8's as the individual two-wire meters can be split across the two sides of the three-wire mains and a fair balance secured.

For such a load of around 2 kw. demand the three No. 8's will greatly reduce the otherwise excessive drop and keep it under 1 volt for virtually all lengths of service.

The maximum voltage drop to be allowed in the secondary proper was set at 2 volts. This permitted a reasonable length of secondary and kept the investment



VOLTAGE CONDITIONS ESTABLISHED AT CHILLICOTHE

per customer at a low figure. Voltage regulation of the primary circuits was arranged as far as possible to give 112 volts at the transformer secondary terminals, resulting in the conditions shown in diagram above.

It will be noted that at the time of peak load on the system, or for about two hours per day, the customers immediately adjacent to the transformer, or about 20 per cent of the total number, will receive 1 volt above the standard of 110 volts, approximately 40 per cent will receive standard voltage and 40 per cent receive a minimum of 1 volt below standard. It is appreciated that some companies, particularly those in the larger cities, would consider such regulation as of too great a range. But in the community under discussion, in view of the standards maintained in nearby cities and towns and because of the necessity of keeping the investment at the lowest possible minimum, the voltage regulation decided upon was considered, and has since proved, very satisfactory.

TABLE IV—SIZES OF PRIMARY FUSES

Fuse each leg of single or three-phase transformer installation, as shown below

Total Kva	One-Phase	Three-Phase	Total Kva.	One-Phase	Three-Phase
1	3	3	22 5	20	15
2	3	3	25	25	15
3	3	3	30	30	20
4	5	5	37 5	35	25
5	5	5	45	40	30
7.5	8	6	50	45	35
10	10	8	75	65	50
15	15	10	100	90	65
20	20	15	150	130	90

TABLE V—VOLTAGE LOSS* IN 100-FT. CIRCUITS WITH 12-IN. SPACING AND CARRYING 10-AMP. LOAD

Size of Wire, No.	Resistance Drop, (Volts)	Reactance Drop, (Volts)	Impedance Drop, (Volts)	Increase of Impedance Over Resistance
10	1 994	0 2618	2.008	0.007%
8	1 254	0 2514	1.279	2.0
6	0 788	0 2406	0.8213	4.2
4	0 496	0 2300	0.5334	7.5
2	0.312	0.2194	0.3514	12.6
1	0 2474	0 2140	0 2871	16.0
1/0	0.1962	0.2086	0 2359	20.2
2/0	0.1556	0 2034	0.1952	25.4
4/0	0 0978	0.1928	0.1364	39.5

*Voltage loss is the numerical difference between voltage at the supply and receiver ends of the line. If skin effect be computed for No. 4/0, the above figure for resistance drop would become 0.0980, an increase of one-fifth of one per cent

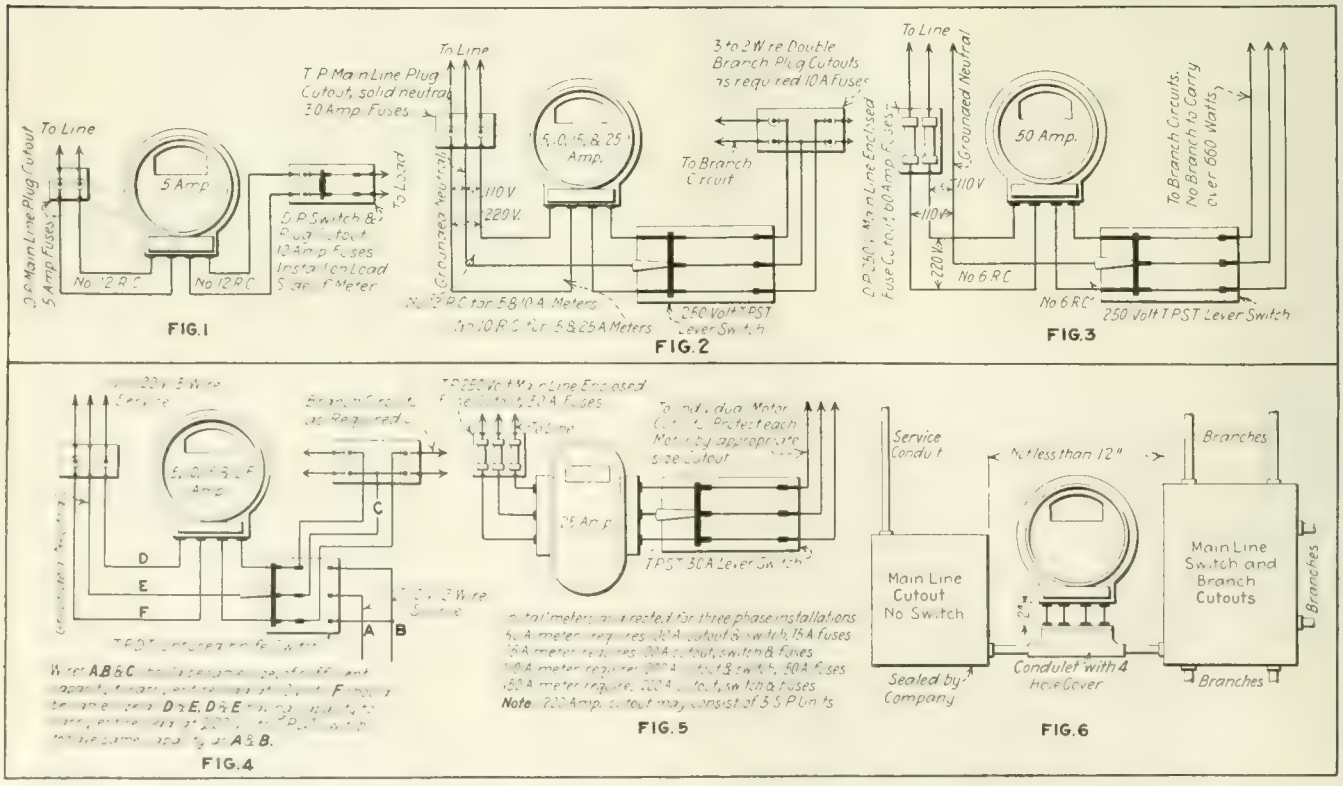


FIG. 1 FIG. 2 FIG. 3

FIG. 4 FIG. 5 FIG. 6

FIGS. 1 TO 6—SERVICE AND METER INSTALLATIONS ADOPTED FOR STANDARD PRACTICE IN CHILLICOTHE, OHIO

[illegible] meters included on soft pine board ⅞ in. thick, painted [illegible] back panel mounted on dry rigid wall. They [illegible] of porcelain knobs where service wires enter building [illegible] wall at cut-out plug connected to meter leads. Fig. 1—Standard metering installation, 110 volts, 5 amp., two-wire, single-phase loads. Fig. 2—Wiring for 220-volt, 5, 10, 15 and 25-amp., three-wire, single-phase loads. Fig. 3—Arrangement for serving 50-amp. single-phase loads at 220 volts, over three wires. Fig. 4—Three-wire breakdown service supplying energy to 110-volt, two-wire isolated plant. Fig. 5—Standard installation for 220-volt or 110-volt, 25-amp. (and lower) three-wire, three-phase delta service. Fig. 6—Meter board for conduit service entrance and conduit interior wiring. Wiring schemes for this arrangement are shown in Figs. 2, 3 and 4.

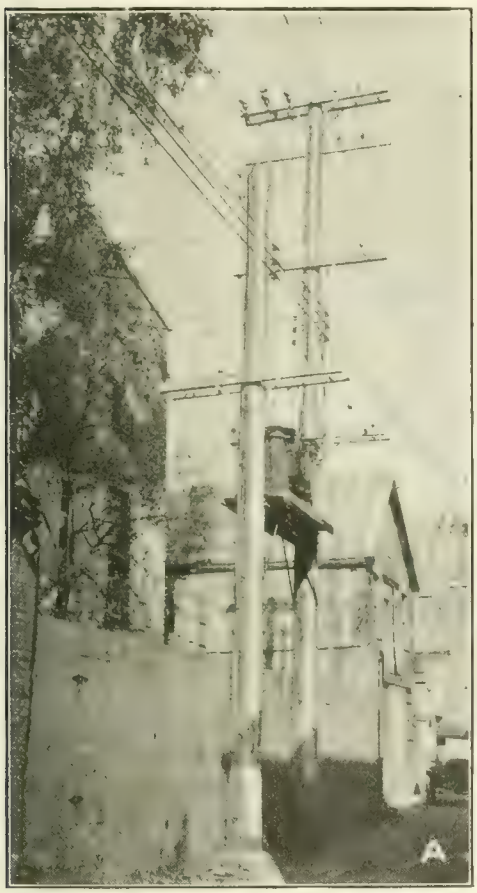
TABLE VI—VOLTAGE LOSS FOR LOAD EQUIVALENT TO CAPACITY OF WIRE (100-FT. SERVICES)

Wire size (B. & S. gage), Number	10	8	6	4	2	1	1 0	2 0	4 0
Capacity in amp	30	50	70	90	125	150	200	225	325
Voltage drop, capacity load, 110-volt, two-wire	6 02	6 40	5 75	4 80	4 39	4 31	4 72	4 39	4 43
Voltage drop, capacity load, 220-volt, three-wire, from neutral to outer	3 01	3 20	2.87	2.40	2.20	2.15	2.36	2 20	2.22

To provide a guide for the installation of services and meters, employees were provided with copies of Table VII, as well as with similar tables covering single-phase and three-phase motor installations. (Tables I, II and III.) Thus the order clerk, having obtained from the inspector the connected load, length of service and

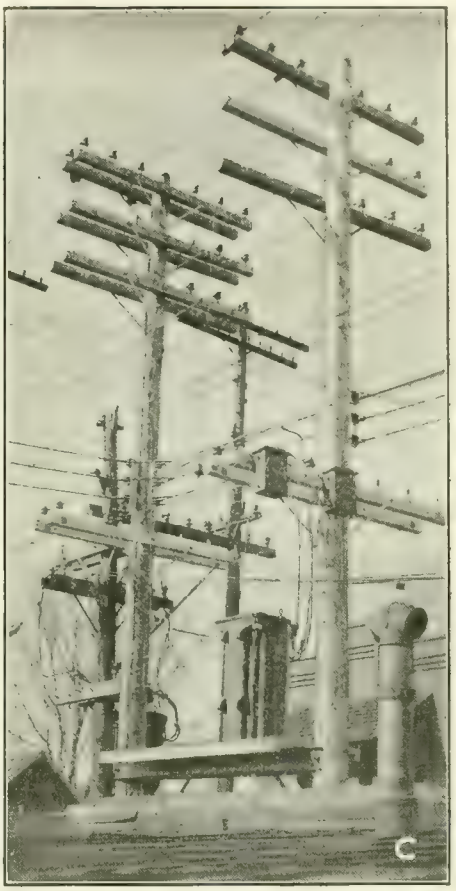
4. For several consumers grouped on the same premises one service only is run for the entire group, individual meters to be centrally located as near the service entrance as possible.

5. Designation of loads requiring two-wire and three-wire services respectively.



TRANSFORMER INSTALLATIONS AND WIRING ON CROWDED POLES. ALL SERVICE WIRES ARE ARRANGED IN A VERTICAL PLANE. SPECIAL CUT-OUT BOXES OR FITTINGS ARE NOT REQUIRED





class of business, is in a position to issue complete orders for connection of the customer. It was felt that this method was preferable to the previous practice, common to many of the smaller companies, of having the line foreman make his own computations, as a saving of time and greater uniformity resulted.

Requirements for Service and Meter Wiring

Specifications were also prepared giving the requirements of the company for service and meter wiring on the consumer's premises. These were approved by the Public Utilities Commission and include:

1. Consumer to purchase and install service entrance conduit, main-line switch, service cut-out and steel cut-out box, and meter wiring.

2. Service wires on the consumer's premises to be installed in rigid iron conduit, main-line cut-out box to be sealed by the company.

3. Meter to be installed wherever possible within 4 ft. (1.2 m.) of service entrance, in which case fuses only are to be installed between meter and supply.

6. All single-phase motors ½ hp. and above to operate only on 220-volt circuits.

Under Rule 1 the company installs only the meter and the weatherproof wires between pole and building. Rule

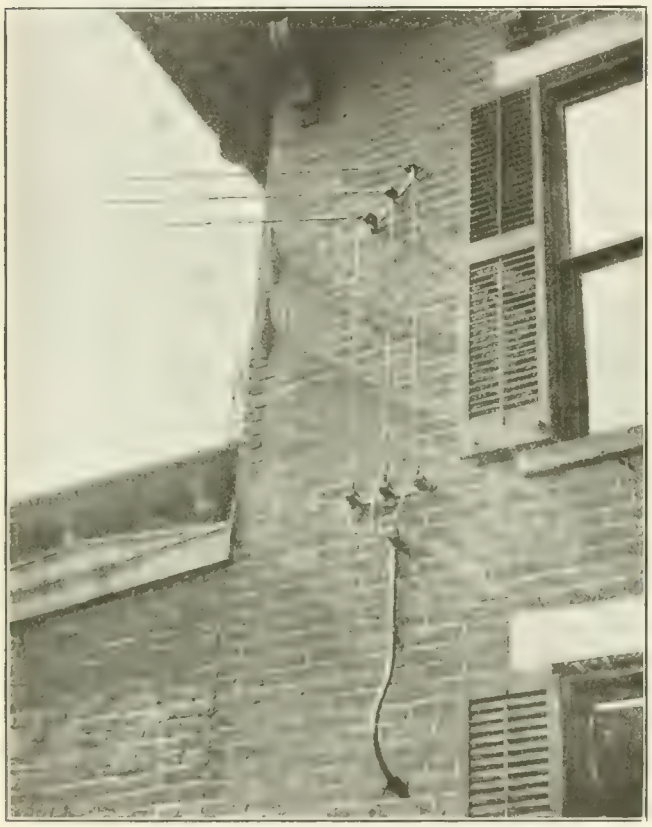
TABLE VII—SIZE OF METERS AND SERVICE WIRES

Maximum Watts Connected	Class of Service	Size Meter (amp.)	Volts	No. of Wires	Length of Service, Feet 60	80	100	120	140	160	180	200
1,800	Domestic	5	110	2	10	10	10	8	8	8	6	6
4,000	Domestic	5	220	3	8	8	8	8	8	8	8	8
800	Commercial	5	110	2	10	10	10	8	8	8	6	6
1,600	Commercial	5	220	3	10	10	10	10	10	10	10	10
3,000	Commercial	10	220	3	10	10	10	8	8	8	6	6
4,500	Commercial	15	220	3	10	8	8	6	6	6	4	4
8,000	Commercial	25	220	3	8	6	6	4	4	2	2	2
16,000	Commercial	50	220	3	4	4	2	2	1	1 0	1 0	2 0
24,000	Commercial	75	220	3	4	2	1	1 0	1 0	2 0	4 0	4 0
33,000	Commercial	100	220	3	2	2	1	1 0	2 0	2 0	4 0	4 0
50,000	Commercial	150	220	3	1	1 0	2 0	4 0	4 0	...	...	...

* Maximum voltage drop allowed: 1.0 volt for loads up to 50 amp.; 1.1 volts for 50 amp; 1.25 volts for 75 amp; 1.5 volts or 100 and 150-amp load. Loads of 50 amp. and up are almost uniformly near transformer location, hence the total secondary drop is not excessive.

2 helps prevent loss of electrical energy by theft and otherwise. A general inspection had disclosed many cases of one, two or more lights connected ahead of the meter when open wiring was used. One extreme case was found where a 3-hp. motor, connected ahead of the meter, had been in daily operation for a period estimated at upward of fifteen years.

Rule 3 was inspired by the observation that many consumers used the service switch as a master switch for their installation and operated it two or more times a day. Transposing position of the switch prevents frequent interruption of current to the meter shunt, improved accuracy of registration resulting. The main fuses are rated at two to five times the capacity of the meter, depending on the meter size, and are always larger than the largest branch fuses. Overloads therefore usually operate only branch circuit fuses which are



STEEL WALL BRACKETS AND CONDUIT ENTRANCE ARE FEATURES OF CUSTOMER'S SERVICE

readily accessible to the consumer. No objection by the underwriters was made to this practice.

Rule 4, covering apartment houses and business blocks, minimizes investment in service drops and facilitates meter reading and testing. Rule 6 was demanded by requirements of good service. In one case a ¾-hp. coffee-mill motor had caused the installation of a No. 2 service on account of the lights flickering badly on starting. After conversion to 220 volts, three No. 8 wires were substituted and the flicker was less noticeable even than with the two No. 2's. The total load was about 2.2 kw.

At the time of the inauguration of 60-cycle service, Chillicothe was one of the largest towns in the country maintaining 125-cycle service. In view of the special nature of motor-driven apparatus required for operation on the old circuits, it is rather remarkable that in this community of 20,000 people there were found upward

TABLE VIII VOLTAGE LOSS* AT VARIOUS LOADS FOR 100-FT SERVICES

110-Volt Service		Size of Wire								
Amp	Kw	No. 10	No. 8	No. 6	No. 4	No. 2	No. 1	No. 1 0	No. 2 0	No. 4 0
5	0 55	1 00	0 64	0 41	0 27					
10	1 1	2 00	1 28	0 82	0 53	0 35	0 29	0 24		
15	1 65	3 01	1 92	1 23	0 80	0 53	0 43	0 35		
20	2.2		2 56	1 64	1 07	0 70	0 57	0 47	0 39	
25	2 75		3.20	2 05	1 33	0 88	0 72	0 59	0 49	
30	3 3			2 46	1 60	1 05	0 86	0 71	0 59	0 41
50	5 5			4 11	2 67	1.76	1 44	1.18	0 98	0 68
		220-volt, three-wire, drop from neutral to outer								
5	1 1	0 50	0 32	0 21	0 13					
10	2.2	1 00	0 64	0.41	0 27					
15	3 3	1 51	0 96	0 62	0 40	0 26				
20	4 4	2 01	1 28	0 82	0 53	0 35	0 29	0 24		
25	5.5		1 60	1 03	0 67	0 44	0 36	0 29	0.24	
30	6 6		1 92	1 23	0 80	0 53	0 43	0 35	0 29	0 20
50	11 0			2 05	1 33	0 88	0 72	0 59	0 49	0 34
75	16 5				2 00	1 32	1 08	0 88	0.73	0 51
100	22 0					1 76	1 44	1.18	0 98	0.68
150	33 0					2 64	2 15	1 77	1 46	1 02

* It should not be overlooked that for equivalent amperage the lower half of the table represents twice the power of the upper part of the table.

of 600 motors and motor-driven appliances which had to be rewound or replaced. This seems to indicate forcibly that the public really wants electrical appliances and will go out of its way to get them. After the change-over the power load quickly jumped from nothing to more than 1,200 kw. and the commercial and residence load increased appreciably.

At the present time a 3,000-kw. substation supplies railway, lighting and power load, energy being purchased from the Ohio Utilities Company.

G. K. Vaughters is general manager of the Chillicothe company, J. C. Martin is secretary-treasurer, and F. K. Sexauer is assistant manager.

Half-Million-Kilowatt Development Proposed on Delaware River

ANNOUNCEMENT of a proposed plan to develop about 500,000 kw. in water power on the Delaware River, at a total cost estimated at $200,000,000, has been made by Paul T. Brady of the Westinghouse Electric & Manufacturing Company. Active work will be commenced as soon as authorization is received from the Federal Water Power Commission. The plan calls for the construction of four dams, at or near Belvedere, Bushkill, Shohola and Butler's Rift, with an average head of 80 ft. The total power capacity of these four dams is estimated at about 500,000 kw. at normal high water. In addition a steam-power plant with a capacity of 100,000 kw. will be erected somewhere in New Jersey in order to supplement the hydro-electric plants during seasons of low water.

Power will be sold wholesale in large blocks in New Jersey, eastern Pennsylvania and southern New York, though it is believed at this time that New Jersey will take the major part of the total output. If present plans are carried out the steam power plant and two of the hydro plants will be in operation by Jan. 1, 1923.

Mr. Brady has applications covering all of the desirable water-power sites in the hands of the Federal Water Power Commission, where they are grouped under the title of Project No. 22. He is at present working in an individual capacity, but will turn the whole proposition over to a corporation as soon as the necessary preliminaries are settled. Associated with Mr. Brady are Duncan, Young & Company, the L. B. Stillwell Engineering Company and the engineers of the Westinghouse Electric & Manufacturing Company.

Governors Hold State Regulation of Utilities Essential

Replies Received by Former Gov. Charles H. Brough of Arkansas from Chief Executives of Thirty-four States with Some Form of Public Utility Commission Very Gratifying in View of Political Efforts to Discredit Commission Rule

IN NOT a few states the principle of state regulation of public service corporations is being questioned by politicians in an effort to make a popular appeal. In virtually every case the commission has been charged with playing into the hands of the utilities by raising rates. So far as can be learned there is no public demand for the abolition of state regulation. In some states, it is true, a governor was elected last fall on a platform one of the planks of which was abolition of state utility regulation. However, sight must not be lost of the fact that the election resulted in a party "landslide" and that local issues were largely ignored by the voters in their preoccupation with national affairs.

One of those states where public utility regulation figured was Arkansas. Gov. Charles H. Brough, who was defeated for re-election, stood out strong for state regulation, and even after the results of the November election became known he continued in his efforts to retain the Arkansas commission. As a part of his endeavors in this direction he sent a telegram late in December to the governors of all the states and received replies from thirty-four having state regulation of utilities. It is evident from these replies, which speak for themselves, that state regulation has justified itself and is too firmly rooted to be dislodged by the political assaults of misinformed demagogues. The replies which were received by Governor Brough are as follows:

PENNSYLVANIA — *William C. Sproul*, Governor.—We have in this state a public service commission which has been extremely useful. We would not think of abolishing it.

ILLINOIS—*Frank O. Lowden*, Governor.—Of course there has been criticism of our public utility commission because of the necessity of increasing rates in consequence of the war. Up to two years ago, however, the decreases in rates were much more numerous and greater than the increases. It looks now as though it would be possible in the next few years for the commission again to reduce rates and indeed protect the public better than could be done without the commission.

RHODE ISLAND—*R. Livingston Beeckman*, Governor.—We find our public utilities commission of three members a great success and can see no reason for abolishing it.

Nevada Gives Five Reasons

NEVADA — *E. D. Boyle*, Governor. — Nevada has had a railroad and public utilities commission since 1907. In 1909 its name was changed and the personnel slightly altered, but the functions remain the same. We consider it an indispensable department, first because it keeps public service corporations out of politics; second, because it properly and intelligently represents the state before the Interstate Commerce Commission on all interstate rates affecting our people; third, because it effects by informal methods satisfactory adjustments of interstate rates and service; fourth, because it shuts out improper and destructive competition, and, fifth, because it saves our industries and people hundreds of thousands of dollars annually. I may observe that there is just the same need for the state public service commission now as existed before passage of Esch-Cummings bill.

Step Backward

IDAHO—*D. W. Davis*, Governor.—This state has a public utilities commission of three members. We expect to continue this commission, as I believe it would be a sad step backward to abrogate state regulation of utilities.

WYOMING—*R. D. Carey*, Governor.—It would seem to me that for any state to do away with its public utilities commission would be a step backward. It is my intention to ask our Legislature to increase the powers of our commission, although it has accomplished much under our present law.

KANSAS—*Henry J. Allen*, Governor.—The Kansas Public Utilities Commission was established January, 1911. Over four thousand cases have been taken before this commission, with the number gradually increasing. Less than 1 per cent of the cases are appealed to the courts. Very few decisions are reversed.

VERMONT—*Percival W. Clement*, Governor.—The public service commission of three members is working out satisfactorily in this state. I am recommending increased authority and facilities to enable the commission to investigate more thoroughly affairs that come up for approval or regulation.

MISSOURI—*Frederick D. Gardner*, Governor.—We have in this state a public service commission of five members. They have been compelled, owing to the high costs of everything, to grant increased rates to public utility corporations. This has raised, of course, a clamor over the state, but thoughtful people and those who have studied the situation realize, in my judgment, that the situation would have been far worse without a public service commission. Personally I most assuredly feel that the public service commission is an important and necessary adjunct of the state government.

No Justification for Abolishment

UTAH—*Simon Bamberger*, Governor.—A public utilities commission was established in Utah four years ago on the theory of urgent need for the proper regulation of common carriers, and I cannot conceive of any justification for its abolishment. Under its direction needs and returns of carriers are investigated, and every effort is made to arrive at an adjustment that is equitable to all. Its decisions are bound to create a limited dissatisfaction temporarily, but in the end its actions almost without exception prove to have been warranted.

MISSISSIPPI—*Lee M. Russell*, Governor.—We are highly pleased with the work of our bond improvement commission. Our people are thoroughly satisfied with this commission and would not do without it.

WASHINGTON—*Louis F. Hart*, Governor.—Several years ago our Legislature created a public service commission of three members to regulate pub-

lic utilities and public service corporations. Our experience with this commission has been most satisfactory. Its work has been of incalculable benefit to the people of our state both in regulating rates and service, lowering the former and raising the standard of the latter.

NEBRASKA—*Samuel R. McKelvie*, Governor.—Our railway commission is a constitutional body. I think it has done good work.

Invaluable Arm of State Government

OKLAHOMA—*J. B. A. Robertson*, Governor.—I think it very essential in these days to have a corporation commission or a similar board to regulate and control public utilities. While our commission has not given entire satisfaction, it is not the fault of the system so much as it is of recent conditions in the business world.

WEST VIRGINIA—*John J. Cornwell*, Governor.—This state has had a commission regulating all public utilities for about ten years. It is indispensable and there is no sentiment for repeal of the law.

LOUISIANA—*John M. Parker*, Governor.—Louisiana has had for a number of years a railroad commission in charge of railroad, telegraph, telephone and express utilities within the state. It has been an invaluable arm of state government, and there is no thought of dispensing with it. Louisiana has no state regulation of municipal utilities. A bill for a general utilities commission failed at the 1920 session of the Louisiana Legislature.

"Proved Its Usefulness," Says Coolidge

MASSACHUSETTS—*Henry F. Long*, secretary to Governor.—Governor Coolidge wishes me to reply to your telegram and say that the public utilities commission of Massachusetts is composed of a chairman and four associate members as a permanently established commission and has done excellent work. There is no intention in Massachusetts of doing away with this commission, which has proved its usefulness.

NORTH DAKOTA—*Lynn J. Frazier*, Governor.—A board of railroad commissioners consisting of three members regularly controls and fixes rates, charges and service of all public utilities. I believe that it is necessary to have some such board with power to make these regulations.

NEW MEXICO—*O. A. Larrazola*, Governor.—The corporation commission in New Mexico has not given all the good results it should for lack of sufficient power under the law. If it is properly empowered to act I consider such a commission not only good but almost indispensable.

MONTANA—*S. V Stewart*, Governor.—Montana's experience with a public utilities commission has been entirely satisfactory.

WISCONSIN—*E. L. Philipp*, Governor, —Wisconsin has maintained a railroad commission for fifteen years, consisting of three members, which has charge of steam railways, water power and other public utilities. The result has been generally satisfactory, and there has been no disposition on the part of the people to discontinue this organization.

KENTUCKY—*Edwin P. Morrow*, Governor.—The experience of Kentucky with a railroad commission is most satisfactory as far as its powers extend. The tendency of legislation is to increase its power and scope into a general public utility commission to include telephone, telegraph, natural gas, etc.

Source of Daily Usefulness

COLORADO—*Oliver H. Shoup*, Governor. —The Colorado Public Utilities Commission during six years has handled 380 formal and 1,100 informal cases besides many other matters not placed on the docket. Its experience because of rate advances, induced by abnormal operating costs in some instances, has been similar to that of other state commissions, but the people of Colorado on the whole have shown confidence in the commission and its work. Efficiency of state regulation is proved by the many cases of home-rule cities applying to the commission for assistance. A study of its activities would show that in regulation and supervision of public utilities and service even more than of rates the commission is a source of daily usefulness to the public. There is no question that state regulation of public utilities has proved its value here.

GEORGIA—*Hugh M. Dorsey*, Governor. —Our commission, the first ever created in the Union, functions well. We would not consider repealing the law.

NEW HAMPSHIRE—*John H. Bartlett*, Governor.—We are well satisfied with our utilities service commission and believe that our method is the best way to regulate utilities.

Here to Stay

MARYLAND—*Albert C. Ritchie*, Governor.—Maryland has had a public service commission since 1910, and state regulation is here to stay.

MAINE—*Carl E Milliken*, Governor.—We have a public utility commission in Maine. I believe in that method of regulating public utilities.

ARIZONA—*Thomas E Campbell*, Governor.—I am a subscriber to the principle of regulation of public utilities through a properly constituted board or commission, preferably the latter. Any success of such a department depends upon its personnel and the powers granted by legislation. I cannot commend the results obtained by the Arizona Corporation Commission, but I charge the weakness to its personnel rather than to failure of principle.

Justified Its Existence in California

CALIFORNIA—*William D. Stephens*, Governor.—The State Railroad Commission of California in regulating public utility rates has justified its existence in every way. California is strongly for just such a body.

INDIANA—*James P Goodrich*, Governor. —Our public utility commission has been in force in Indiana for the past ten years, and has given complete satisfaction. It is undoubtedly a great step in advance and will be retained in our state.

CONNECTICUT — *Marcus H. Holcomb*, Governor.—Our public utilities commission has rendered a valuable service in regulating trolley conditions and other public utilities. Dispensing with the commission would not be considered.

OREGON—*D H. Upjohn*, secretary to Governor.—The public service commission here has functioned successfully. Some efforts have been made to abolish it, but have proved futile so far.

Should Extend Powers

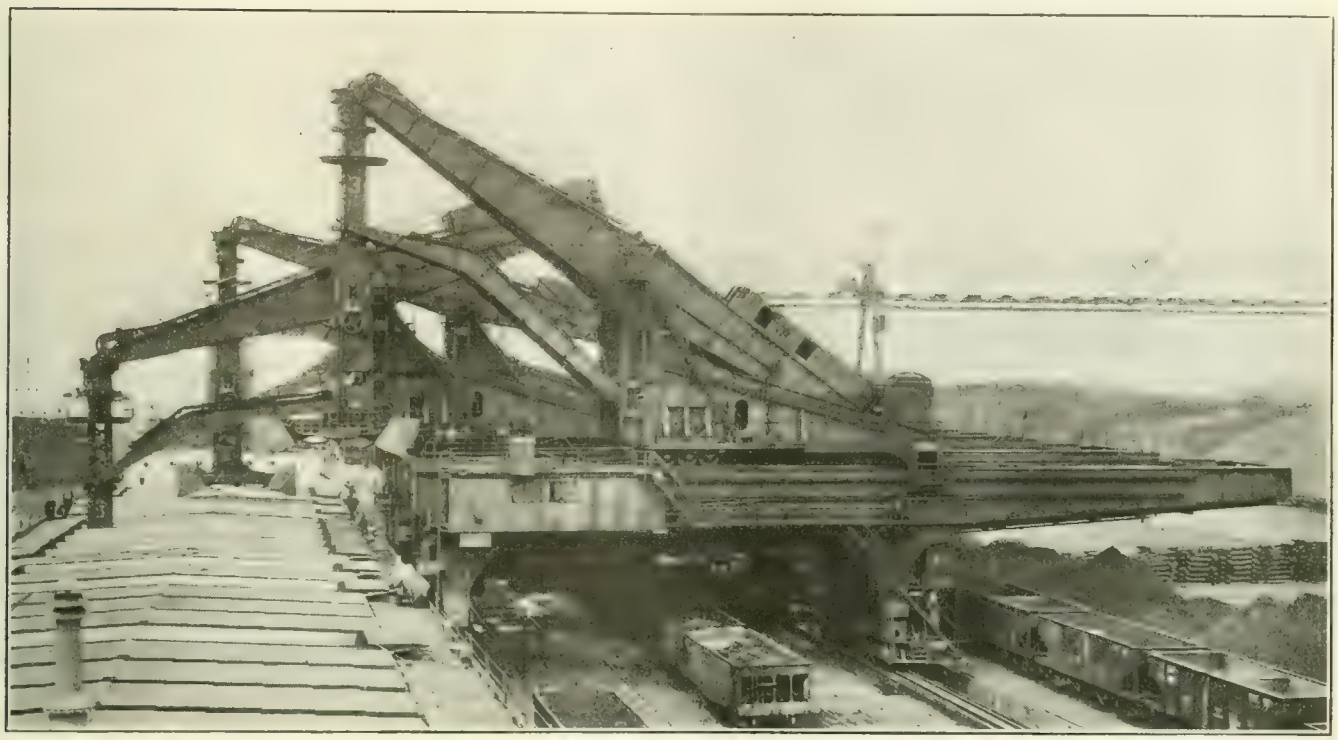
ALABAMA—*Thomas E. Kilby*, Governor. — The Alabama Legislature created a public service commission in 1915, placing upon it the duties of the old railroad commission. The commission did not give general satisfaction, and the Legislature in special session in 1920 placed additional duties upon the commission, increasing salaries and requiring commissioners to live in Montgomery. My belief is that under the present law better results will be obtained.

MICHIGAN—*Albert E Sleeper*, Governor.—Michigan created a railroad commission in 1897 and gradually extended its powers to include other utilities in 1919. A new statute changed the railroad commission to a general public utility commission with broadened powers. I believe such a commission is absolutely indispensable, but its powers should be further extended. I believe our commission, which was created in 1919, has been almost indispensable to the welfare of the state. State regulation certainly should be perpetuated.

Electrifying Facilitates Port Operation*

The Reduction of Port Delays Is Possible Through the Use of Modern Loading and Unloading Equipment — Description of Some Types of Electrical Equipment Which Have Proved to Be Suitable for Such Work

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ORE HANDLING AT GREAT LAKES TERMINALS IS A SPECIALIZED PROBLEM, BUT SHOWS WHAT MIGHT BE DONE AT OTHER PORTS

TO UTILIZE our port facilities economically it is highly important that the delays in port, waiting to unload and load cargo, should be cut down to the minimum. There is no particular purpose in providing economical propelling and auxiliary machinery on shipboard if all the saving obtained by such improvements is eaten up by unnecessary delays of this nature.

We need fewer and more highly skilled, better paid shipmen and dockmen, with the very latest, speediest machines for loading and unloading. Such facilities both ashore and on board ship, combined with the higher skill of America in operating and caring for machinery, afford our chance to offset the higher wage which is paid our seamen and put us on a competitive footing with our friends in the Atlantic or in the Pacific.

The simplest method and the one allowing the most economical handling of freight is the one where standard ships run between two definite ports, always utilize the same terminals and carry only bulk or standard package freight. Under such conditions the special problem may be solved by installation of permanent electrically operated conveyors of different types, electric cranes, mechanical unloaders, etc., and cargo may be handled in much the same manner at ocean terminals as ore is handled on the Great Lakes. The above condition also permits the installation of all the cargo-handling apparatus on shore and eliminates the present steam winch, which is notoriously inefficient, from the ship. It also, by the same elimination, puts the cargo-handling gear where it is used almost continuously and removes this gear from the ship, where it has been a large expense to install and keep in order, and has served no use except for a short time at the end of each voyage.

Although piers with gravity feed have been built in the past twenty years, the present trend is apparently toward the belt-conveyor system, electrically driven. Thus one of the latest coal piers built is the loading pier for the Baltimore & Ohio Railroad at Curtis Bay, Baltimore, at which the cars are dumped in the yard on shore on the tail end of the system of four parallel 60-in. (1.5-m.) belt conveyors, each of which discharges to the vessel by means of a large "tripper" consisting of a movable steel tower, which carries pulleys over which the belt turns back on itself to discharge its load.

The above is given as an example of what may be done in the loading of a uniform bulk cargo, in the case of coal piers; the proposition is simply one of loading; if unloading is to be provided for, an entirely different type of equipment is required, and in such a case for bulk cargoes separate piers are usually provided.

Unloading of bulk cargoes has not been brought to

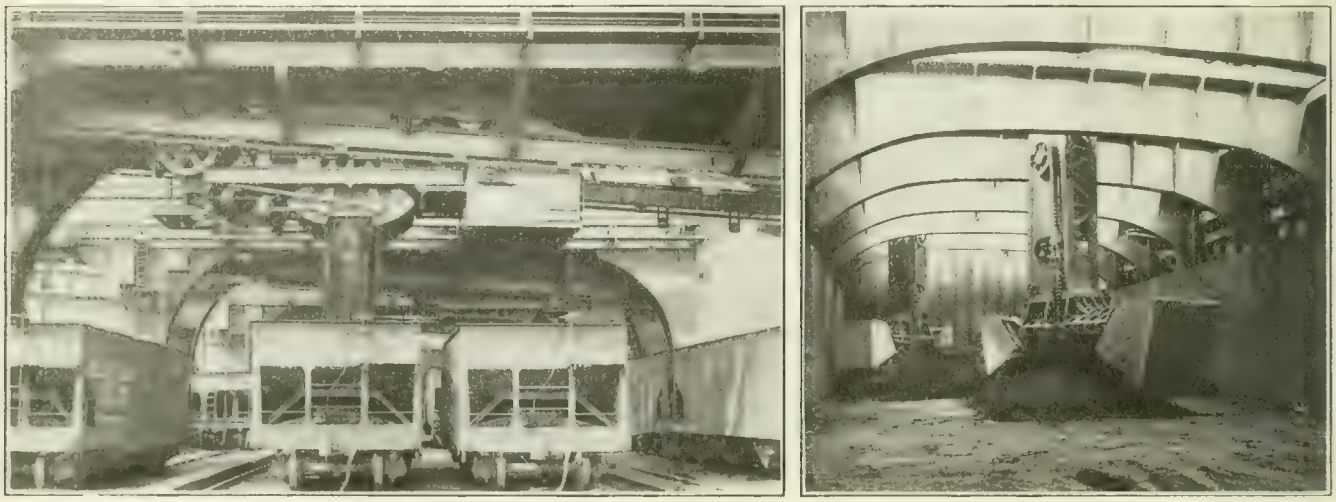
*Discussed at Jan. 28 meeting of American Institute of Electrical Engineers and American Society of Mechanical Engineers.

the same degree of efficiency, as the loading record on the lakes of two and one-half hours for unloading a 10,000-ton vessel, as compared with twenty-three minutes for loading it, will show. The Hulett "grasshopper" unloader is now in general use and consists essentially of a massive frame or walking beam, the front end resting on the face of the dock and the rear end on a slightly raised concrete wall. On this frame is a carriage moving backward and forward over the trough. The outer ends of the walking beam are legs which reach down into the hold, the whole mechanism being operated by one man. When a load of 15 to 20 tons is elevated by the bucket clear of the vessel, the carriage runs back on the main frame until the bucket is over the weighing hopper or trough, and there the load is released. The weighing hopper moves only between the main legs of the machine. A cable runs along side of each track continuously, and the movement of cars is taken care of by the cable. An operator pulls a lever on the mechanical clamp which is attached to the train and moves the train a car length for the next load.

The cheapening of the cost of unloading through the successive steps by which the process has been improved since 1880 is shown by the following figures: Cost of unloading a ton of coal with wheelbarrows, 56 cents; with Brown machine and shovelers, 28 cents; with Brown fast plants, 12 cents; with Hulett fast plants, 4 cents.

At the port of New Orleans, where bananas are unloaded in greater quantities than in any other port in this country, the handling of the unloading by mechanical devices has been developed until practically all of the bananas are now unloaded by machines. The general plan is to employ unloaders of a structural steel framework supported by railway trucks running on standard railway tracks set close to and parallel with the face of the wharf. The framework supports a double boom which can be adjusted into position over the hatchway of the ship. Over the booms constant running chains are installed which are equipped to carry several bunches of bananas in huge slings. The chain is lowered through the hatchway by means of the adjustable booms, and after being placed into position the bananas are placed in this sling and removed from the hold to be deposited on a receiving table on the wharf. Trolley conveyors are utilized for distributing the bunches of bananas to refrigerator cars on railroad sidings running perpendicular to the face of the wharf, these conveyors having branches to each siding.

Mechanical unloaders of a construction similar to that given above have been designed for handling miscellaneous cargoes and are installed or being installed at some army bases. They consist of structural framework with double boom and constant running chain carriers similar to the one mentioned above. The plan in this instance is to carry small trucks loaded with miscellaneous cargoes. These trucks are fitted with small wheels so that when they are deposited on the wharf or in the storage rooms they are automatically released and can be wheeled to any position or location desired. For carrying material within the warehouse it is planned to carry these same trucks automatically on overhead trackways and have them automatically deposited wherever wanted. This type of apparatus is reversible and can be used for both loading and unloading ships.



UNLOADING TIME HAS BEEN REDUCED TO TWO AND ONE-HALF HOURS FOR A 10,000-TON ORE VESSEL BY PROPER ELECTRIC TERMINAL FACILITIES

In the case of bags and bales not very much progress has been made in the utilization of continuous-movement apparatus, although unloaders of the conveyor or continuous-chain type have been developed and installed in some cases. The electric crane has been developed to such efficiency that it is probable that continuous-movement unloading machinery would have a hard time competing with it. Bags and crates unloaded through hatches are lifted in the rope sling by boom or crane and deposited on the wharf deck for handling. In some cases, however, conveyors have been built with a movable section, permitting them to be extended to the deck of the ship, where bags, barrels, etc., are fed to slings which lower a slingful at a time into the hold. In case of unloading the slings are used to take the freight from the hold.

Miscellaneous Cargo Difficult to Handle

For the handling of miscellaneous cargo an electric crane is most essential, and it appears preferable that the cargo be handled directly into the ship's hold with the crane without the use of the ship's booms. The number of cranes to be provided at the pier depends to a great extent upon the character of the pier itself. If room and facilities are available for feeding cargoes

to each hatch, then there should be sufficient cranes to work all hatches. It may be noted that in new basins at Hamburg the cranes are spaced every 100 ft. (30 m.). When the cargo is to be distributed in part or in whole by lighters from a pier, a desirable arrangement is to provide cranes on dolphins on the offshore side of the ship for loading and unloading to lighters at the same time the cargo is being handled on the pier. Incidentally, in connection with electric cranes, it should be noted that electric heaters are desirable for the comfort of the operator in cold weather.

On the wharf itself means are required for handling the loads for conveyors or crane hoists to and from the ship, and the old method, which is common today on many of our wharves, is the use of the hand truck. For short movements the hand truck cannot properly be dispensed with, but for most movements on the wharf the electric truck or tractor with trailer or the continuous-movement, portable piler with trailer can and should supersede the hand truck and eliminate many of the men now required to handle cargo. These trucks or tractors are usually of the storage-battery type and have demonstrated their thorough usefulness. For handling cargo on the pier an overhead trolley hoist, either of the monorail type or of the double-track type commonly used in large factories, has been developed.

For stacking freight at the terminal a tiering machine has been utilized which allows not only much more rapid tiering, with the elimination of most of the manual labor, but also tiering to much greater heights.

Stacking Machine Saves Time

In some cases two-decked piers have been built in order to save space and in order to keep incoming and outgoing freight separated without moving the ship. This form of pier usually requires a connection between the two decks and involves elevating and lowering from one deck to the other. These movements are accomplished by electric freight elevators, by continuous-movement parcel elevators, etc.

For moving freight cars at the terminal electric locomotives, of either the trolley or storage-battery type, may be provided, or electric gypsies installed. For handling ship's lines and moving ships at the pier electric winches can be used, and in addition, electric winches of the permanent or portable type can be utilized for whips, either for handling cargo on the ships or for handling on the pier itself.

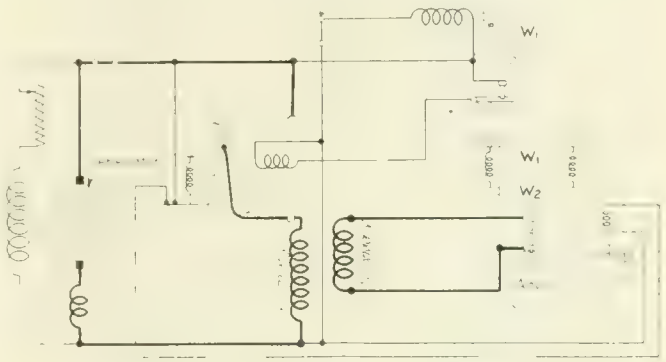
To sum up, the following are some of the electrical apparatus and devices which are available for use at terminals: Cranes, belt or chain type; conveyors, trucks, tractors with trailers, tiering machines, pilers, mechanical unloaders, permanent or portable winches, freight elevators, overhead trolley hoists and locomotives.

The electrical supply at the terminal should be of the same voltage and kind of current (direct current generally) as that in use on board ships which are to be handled. This will allow the ship to receive electrical energy from the pier for the ship's purposes, and the ship generators can be shut down while at the dock, so that all overhauling on the ship's steam and electric system can be made at the same time that freight is being discharged and received. This should materially reduce the average "turn-around" time and allow the ship's main and auxiliary machinery to have a thorough examination and overhauling while in port.

It is believed that modern port terminals offer a good electric load which central stations should endeavor to develop in order to increase the efficiency of the terminals as well as to improve the load factor of central stations.

Electro-Percussive Welding

PRODUCTION of large quantities of duplicate parts which require welding has been found to be expedited by the electro-percussive process of welding. The apparatus consists essentially of a device for producing a percussion of the parts to be welded simultaneously with a discharge of electrical energy, the energy being taken from a condenser or a magnetic field. Use is made of electrolytic condensers charged by direct current of low value, or an arrangement is used, as shown in the cut, utilizing the energy stored in a magnetic field and discharged through the parts to be welded at the moment of weld. The discharge takes place between the points to be welded with explosive violence, and at



SIMPLIFIED DIAGRAM OF WELDING

Immediately after the transformer primary circuit is broken by the falling of weight, W_1, the parts to be welded, which are connected to the secondary circuit, are slightly separated and an arc is produced between them. Completion of the fall of the weight forces the parts together, making the weld.

that instant the hammer forges the parts together into a perfect union. The time of fusion and union of the parts is only approximately .0095 second. The time sequence of events shown in an oscillogram taken during a weld between ⅜-in. (9.5-mm.) copper and steel rods indicated a peak current of 2,600 amp., an arc voltage of 30, a maximum power of 60 kw. and an energy consumption of 0.00077 kw.-hr. The time of the complete operation was 0.094 second.

The advantages of this process are as follows: At least three-fourths of the power consumption is saved as compared with butt welding; the speed of the process is very great and thus production depends almost entirely on the time required to handle the pieces; unusual welds may be accomplished, such as welding of small rods to heavy plates or blocks, without previous treatment or preparation of the surface; the energy is consumed in a very small amount of material and does not heat up the rest of the stock, and it may therefore be used where excessive temperatures of the whole stock would cause a loss of temper; unlike metals may be welded as readily as metals of like kind; the character of the welds realized after a proper adjustment of the apparatus is made is independent of the skill of the operator, thereby reducing labor cost, and the percussive process produces a much smaller fin or flash than butt-welding. The reduced fin results in a decreased cost for finishing the parts.

Errors from Paint and Window in Photometric Sphere

Selectivity of Window and Paint May Cause 5 per Cent Error When Measuring Gas-Filled Lamp with Vacuum Comparison Lamp

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THE advent of the gas-filled tungsten lamp and the introduction of the lumen rating have resulted in the largely increased use of the integrating photometer. Of the many types the Ulbricht sphere has come to be recognized as the most convenient and satisfactory, and it has been in commercial use for a number of years. The use of vacuum lamps, however, for the measurement of spherical candlepower of gas-filled lamps has introduced the question of possible errors resulting from the lack of whiteness in the paint with which the sphere is coated and the selectivity of the milk-glass window.

The tests described below show that in the measurement of lamps whose integral color lies within the range of color between a kerosene flame and a vacuum tungsten lamp operating at normal voltage—and this is roughly the change which would be encountered in measuring gas-filled tungsten lamps in terms of vacuum tungsten lamps—the error due to the selectivity or lack of whiteness of the paint and the milk-glass window for the sphere in question is less than 5 per cent and the effect attributable to the paint alone is still less.

The theory of the sphere calls for an inner surface non-selective and obeying Lambert's cosine law of incidence and emission. Since it has been found possible only to approximate such a surface, and since other sources of error are present, the substitution method of photometry must be used, and by this means and the use of a sphere of adequate size most of the errors are reduced to a second-order magnitude and can generally be neglected.

If it were always possible and convenient to have standard lamps of the same type of light distribution and giving light of the same color as that of the lamps to be tested, then the character of the paint or other material used to line the interior of the sphere and form the diffusing surface would be unimportant as long as it was moderately white and not subject to sudden changes in color or diffusing properties. But in practice it has been found desirable to make a surface as nearly white and as nearly matte as possible, and a very considerable amount of experimental work has been done on paints and substances of the type of magnesium carbonate in order to find one which would be both white and matte and remain so for a reasonable period of time. The milk-glass diffusing plate, also, used as the window and the object of photometric measurement is likely to be selective in its transmission. The effect of this will be the same as that produced in ordinary photometry if an absorption screen which has different transmission factors for light of different wave lengths is used in the measurement of sources of different integral color.

Aside from the experiments of Dyhr,* little if any work seems to have been done on the magnitude of this particular error. The question is of especial importance in connection with the measurement of gas-filled tungsten lamps in terms of vacuum lamps. The latter can be readily standardized by the point-by-point method, but they differ considerably in color value from the higher-temperature gas-filled lamps. Another reason for determining the magnitude of the selectivity error lies in the advantage of knowing how much discoloration is permissible before the paint must be renewed.

Some data on this question were obtained in connection with a test, using an 80-in. (200-cm.) Ulbricht sphere, to determine the total light absorption in some vacuum lamps tinted to a color such that the resultant light matched that of a kerosene flame.

Two Test Methods Check Conclusions

Two methods were employed. In the first method a set of ten frosted lamps of the ordinary 40-watt type were measured for mean horizontal candlepower. Using a universal rotator, the reduction factors of three of the lamps were measured and the average value was applied to the mean horizontal candlepower values of the rest of the lamps to give the mean spherical candlepowers. The latter were then obtained directly in the sphere. Then the ten lamps were tinted, and a similar set of measurements was carried through both on the regular photometer and in the sphere.

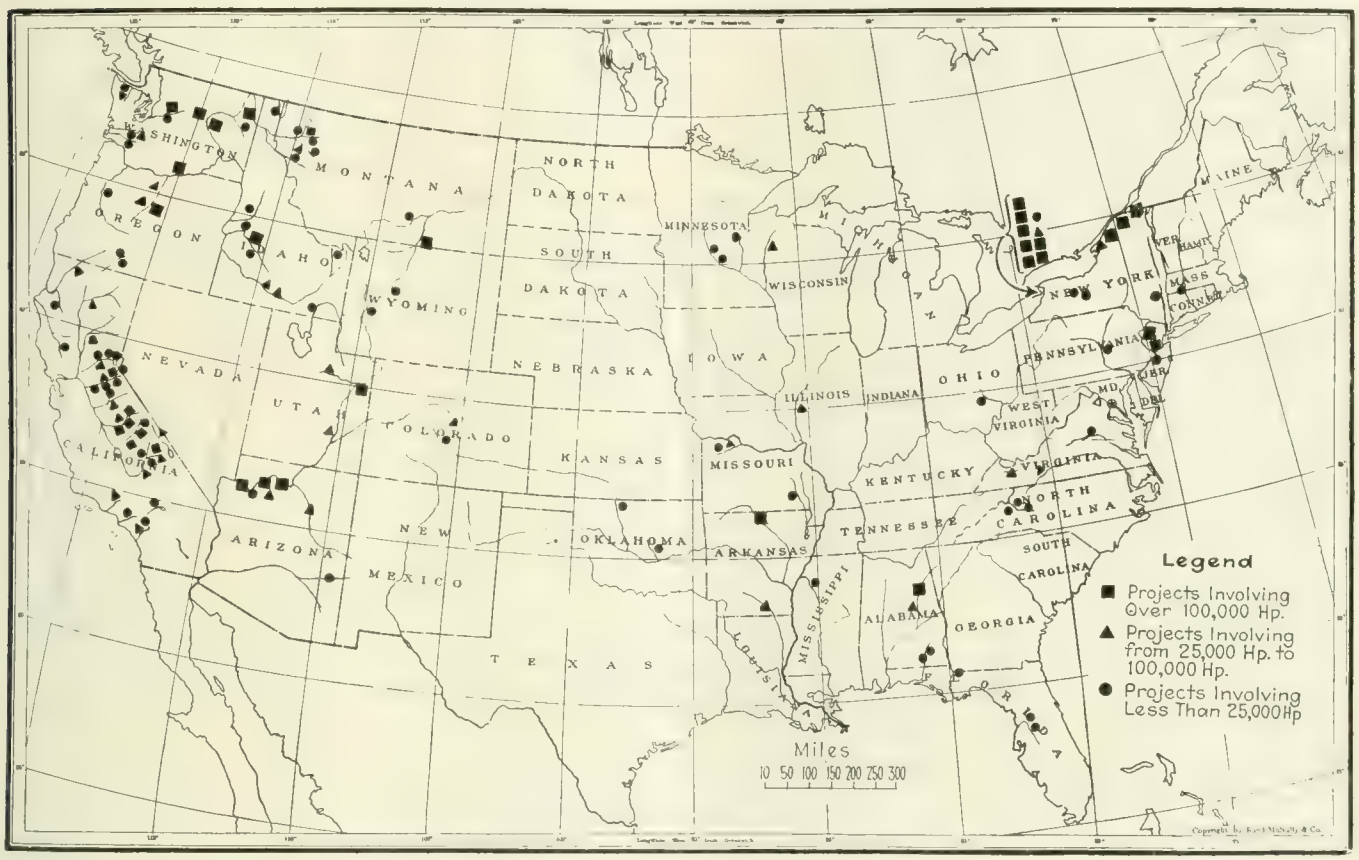
To eliminate as far as possible the complications due to heterochromatic photometry another method was used as a check. Calling a lamp which matched in color the kerosene flame the red lamp and an ordinary clear bulb lamp the clear lamp, measurements were made on the ordinary photometer of the mean horizontal candlepower of the red lamp against the stationary candlepower of another red lamp used as a comparison lamp. In exactly the same manner the clear lamp was compared against a clear lamp. From these data and the known reduction factors of the red and clear lamps the ratio of the mean spherical candlepowers was computed in terms of the ratio of the stationary candlepowers of the comparison lamps. The ratio of the mean spherical candlepowers was then obtained in the sphere, taking care so to orient the red and clear comparison lamps that their stationary candlepowers in the direction of the photometer head were the same as when they were used on the regular photometer bench. Owing to the selectivity of the paint and window of the sphere, there was a color difference evident in the photometer during these measurements on the sphere, but the effect was present in the same direction and so nearly to the same extent with both types of lamps that the heterochromatic error would be negligible.

The results by the first method showed a difference in the average of the mean spherical candlepowers of the ten tinted lamps obtained in the sphere and directly by the point-by-point method of 4.5 per cent. The second method gave a difference in the same direction in the ratio of tinted to clear lamps of 5.1 per cent. The latter test was made about a month and a half after the first test, and in the meantime the paint may easily have discolored sufficiently to account for part of the slight discrepancy in the results by the two methods. By altering the voltage of the comparison lamp as used with the sphere, the departure from whiteness of the light transmitted through the milk-glass window, due to the combined effect of the selectivity of the paint and the glass, was found to be roughly the same as the difference in integral color of a vacuum tungsten lamp when operated at normal temperature and at a temperature 400 deg. C. lower.

*Elektrotechnische Zeitschrift, Vol. 31, page 1295 (1910).

Water-Power Applications, 13,469,181 Hp.

Federal Power Commission Reports 168 Applications for Preliminary Permits on Jan. 29
Twenty-five Applications Filed During Month of January—Arizona Leads
All States in Total Horsepower Involved



LOCATION AND SIZE OF HYDRO-ELECTRIC PROJECTS ON FILE WITH FEDERAL POWER COMMISSION JAN. 29, 1921

WATER-POWER applications on file with the Federal Power Commission on Jan. 29 numbered 168, totaling 15,924,831 hp., of which 2,455,650 hp. was in conflict, giving a net total of 13,469,181 hp. In January twenty-five applications, involving 851,100 hp., were placed on file. It appears that applications involving the larger feasible power projects of the country were filed prior to 1921. The filings for January averaged only 34,000 hp., whereas the average of all applications filed to Jan. 29 was 94,800 hp. The average of the applications filed during 1920 was 106,500 hp. During January only two new projects totaled or exceeded 100,000 hp., and one of these was in conflict with a previous filing. The horsepower involved in all applications is about 27 per cent of the estimated maximum potential water powers of the country and 57 per cent of the estimated minimum potential water powers. The location and size of the various projects on file with the Federal Power Commission on Jan. 29 are indicated on the map.

Table I gives the distribution of the contemplated power developments among the various states. The high figures shown for Arizona are confined in large part to contemplated projects in the Grand Canyon of the Colorado River, and the greater portion of the projects in New York State are at Niagara Falls and on the St. Lawrence River. The projects in California are well scattered, and practically every important watershed in that state is involved in one or more applications. More than one-half of the states of the Union are represented, the waters of only twenty-three states not being involved.

TABLE I—DISTRIBUTION OF CONTEMPLATED POWER DEVELOPMENT AMONG THE VARIOUS STATES

Alabama	155,000	New Jersey	432,300
Alaska	134,350	New York	2,883,750
Arizona	4,159,200	North Carolina	3,400
Arkansas	125,000	Oklahoma	4,500
California	2,509,903	Oregon	539,250
Colorado	50,700	Ohio	150
Florida	9,000	Pennsylvania	20,000
Idaho	277,740	Utah	205,000
Illinois	40,000	Virginia	148,000
Massachusetts	20,000	Washington	1,115,000
Minnesota	17,000	Wisconsin	75,000
Mississippi	1,500	Wyoming	5,010
Missouri	32,000		
Montana	506,428	Total	13,469,181

In Table II is given a list of the applications filed with the commission from Dec. 30, 1920, through Jan. 29, 1921. Lists of applications filed prior to Dec. 30 appear in the ELECTRICAL WORLD of Jan. 1 and Jan. 15.

By far the largest single development yet proposed under the new water-power legislation is that by the Southern California Edison Company in the Grand Can-

TABLE II—LOCATION AND SIZE OF WATER POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM DEC. 30, 1920, TO JAN. 29, 1921, INCLUSIVE

Name of Company	Location of Project	Capacity Hp
ALASKA:		
Geo. C. Hazelet, Cordova, Alaska	Outlet of Power Lake	12,000
Paul Barber, 233 W. Monroe St., Chicago	Outlet Swan Lake, Mirror Lake and Big Lake	29,000
J. G. Galvin, care M. D. Lechey, 620 Alaska Bldg., Seattle	Mill Creek and Lake Augusta near Wrangell	10,000
Alaska Development & Mineral Co., Care Burdett, Thompson & Low, 4 Ontario Bldg., Washington, D. C.	Lake at head of Deer Creek and reservoir on Annan Creek	14,000
Lincoln Waln et al., care W. T. Young, P. O. Box 6, Nashville, Tenn.	Power Creek, 4 miles from Cordova	300
Alaska Public Utilities, Cordova, Alaska	Power Creek, 4 miles from Cordova	300
ALABAMA:		
Houston Power Co., Newton, Ala.	Choctawhatchee River at Hollis Bridge site	2,000
ARIZONA:		
Pacific Gas & Electric Co., Phoenix, Ariz.	Transmission line	
CALIFORNIA:		
C. E. Loose, Provo, Utah	East Walker River, Mono County	8,000
Great Western Power Co., 233 Post St., San Francisco	North Fork Feather River, Butte County	5,200
City of Los Angeles, Dept. of Public Service	South Fork Kern River	43,450
Southern Sierras Power Co., care H. L. Huber, First National Bank Bldg., San Francisco	Headwaters of Snow Creek near Beaumont	12,000
C. E. Fairchild, 10 West Citrus Ave., Redlands	Bear Creek and Santa Ana River	12,750
COLORADO:		
J. F. Meyer et al., care of E. E. Drach, 1133 Clarkson St., Denver	Frying Pan River	50,000
FLORIDA:		
Harold Winter, care W. W. Trammell, Tallahassee, Fla.	Turkey Creek at Turkey Creek Hill.	400
IDAHO:		
Idaho Power Co., care M. O. Leighton, McLachlen Bld., Washington, D. C.	Transmission line	
Elmore Copper Co., care Wilkerson, Cassells, Putter & Gilbert, The Rookery, Chicago	South Fork Boise River	3,000
City of Boise	North and South Forks of Payette River	12,000
NEW YORK:		
New York & Ontario Power Co., care G. E. Van Kennen, Ogdensburg	South Channel of St. Lawrence River at Waddington	25,000
New York & Ontario Power Co., care of Spratt & Van Kennen, Ogdensburg	St. Lawrence River from Murphy to Lotus Island	250,000
Lockport Paper Co., care Clinton & Clinton, Buffalo	State Barge Canal at Lockport	500
OHIO:		
McConnelsville-Malta Electric Co., McConnelsville.	U. S. dam No. 7 on Muskingum Riv.	150
OREGON:		
H. S. McGowan, McGowan.	Metolius Power Site on Deschutes River	84,000
H. S. McGowan, McGowan.	Reclamation Power Site on Deschutes River	47,000
S. A. Mosher, et al., Lakeview	Deep and Camas Creeks	1,000
C. S. Benefiel, Paisley	Small stream	50
UTAH:		
Utah Light & Power Co., care M. O. Leighton, McLachlen Bldg., Washington, D. C.	Green River above Green River	80,000
Utah Power & Light Co., care M. O. Leighton, McLachlen Bldg., Washington, D. C.	Green River above Bridgeport	100,000
WASHINGTON:		
C. I. Kephart, 1415 Rhode Island Ave., N. W., Washington, D. C.	Kalama and Lewis Rivers	19,000
C. I. Kephart, 1415 Rhode Island Ave., N. W., Washington, D. C.	Spirit Lake and Toutle River	25,000
WYOMING:		
Wyoming Paper Co., Stockton	Stream not named	5,000

yon of the Colorado River. This project contemplates a high dam and large reservoir near Lees Ferry, Colorado River, in Coconino County, Ariz. Three power developments are proposed—from the dam to point near mouth of Little Colorado River, involving 1,240,000 hp. and known as the Marble Canyon unit; the Bright Angel unit from the mouth of the Little Colorado River to Kanab Creek, a distance of 85 miles, involving 1,090,000 hp., and the Diamond Creek unit from Kanab Creek to the western boundry of Arizona, a distance of 45 miles, involving 1,240,000 hp. The total proposed development under this permit is 3,570,000 hp.

Performance of Electrically Operated Steam Boilers

DUE to the high price of fuels there are hundreds of boilers operated electrically in Switzerland, according to E. G. Constam-Gull, chief engineer of Escher Wyss & Company, Switzerland. With coal at about $49 per ton and wood at $28 per cord, many manufacturers have turned to the cheap surplus hydro-electric energy for steam production.

The performance of the typical Revel boiler may be judged from an extract of the results obtained in tests conducted by the Swiss Association of Boiler Proprietors. The high efficiency attained corresponds to an evaporation of 2.9 lb. (1.3 kg.) of so-called standard steam per kilowatt-hour. The steam produced had a content of water of only about 3 per cent, compared with a steam of 5 to 10 per cent humidity produced by ordinary fired boilers. The evaporation and heating of steam in the Revel boiler is accomplished within the immediate vicinity of the water level, that is at the surface of evaporation. The results of the tests follow:

ELECTRICAL READINGS

Mean electrical tension (rectified)	219 volts
Ammeter readings	384 amp.
Mean electrical energy readings of the kilowatt meter (rectified)	367 kw.
Mean electrical energy per hour	146.7 kw.-hr.
Coefficient of correction of the kw. meter	0.96

EVAPORATION

Mean gage pressure in the boiler	94.5 lb. per sq. in.
Mean temperature of feed water	50 deg. F.
Mean temperature of the waste water before check valve	57.2 deg. F.
Initial heat per pound of steam	1,176 B.t.u.
Total evaporation (gross)	1,015 lb.
Steam produced per kw.-hr. (gross)	2.77 lb.
Water of 50 deg. F. inlet temperature converted into steam at 212 deg. F. (normal steam)	2.83 lb. per kw.-hr.
Quantity of water contained in the steam	29.8 lb.
Percentage of water contained in the steam	2.9
Total quantity of feed water fed into the boiler	1,700 lb.
Since 685 lb. of waste water flowed out through the check valve, this was raised from the initial temperature of 50 deg. F. to 57.2 deg. F.	
Hence heat utilized from steam production	= 1,015 × 1,176 = 1,193,000 B.t.u.
Necessary heat for raising the temperature of the waste water	= 685 × 7.2 = 4,930 B.t.u.
Total electrically generated effective heat	= 1,197,930 B.t.u.
Efficiency of evaporation	95.3 per cent
Converted for the heating of the water	= 0.4 per cent
Total efficiency	95.9 per cent
Losses	4.3 per cent

As will be seen from the foregoing table, 1 kw.-hr. converted 2.83 lb. (1.28 kg.) of water from 50 deg. F. into steam at 212 deg. F. (normal steam) and therefore the efficiency of evaporation was 95.7 per cent. The electrical energy was used at the rate of only 146.7 kw. although the boiler had been designed for a capacity of 200 kw. This information concerning the use of electrical energy for steam raising was compiled by E. G. Constam-Gull in an article for Aug. 12, 1920, in the *Canadian Engineer*.

Edison at Thirty Years

Already Famous in 1876, with Two Hundred Patents to His Credit—Forty-two-Year-Old Sketch of His Early Achievements

YESTERDAY was the seventy-fourth birthday of Thomas Alva Edison, of whom every one will say:

> What story is this of the year of his birth?
> Let him live to a hundred. We want him on earth.

Mr. Edison refuses to grow old, and it is hard to realize that he was already famous in that far-off year that saw the Philadelphia Centennial. In 1878 or 1879, when he was a year or two past thirty, the accompanying portrait and biographical sketch of him appeared in Volume III of the "American Portrait Gallery," a collection of steel engravings now long out of print, published in New York by J. C. Buttre. The engraving bears the signature of A. H. Ritchie, N. A. The letterpress that accompanied the 240 portraits was, according to the title page, furnished by Lilian C. Buttre, who in this instance doubtless drew upon contemporary press notices of her subject. This forty-two-year-old sketch of Edison has a historical interest of its own. Some of its statements may be apocryphal, but we reprint it exactly as it appeared:



EDISON FORTY-TWO YEARS AGO

"Among the many ingenious men brought to public knowledge by electric art, no one has excited more genuine interest than Thomas Alva Edison of Menlo Park, N. J. He was born at Milan, Ohio, Feb. 11, 1847, of parents whose ancestors came from Holland. Going to the public schools until the age of fourteen, he then began to sell newspapers upon the trains of the Grand Trunk Railway, and first used the telegraph to bulletin at the various stations ahead the features of the morning news, which in those war days were likely to be startling enough. An operator taught him how to telegraph; then, to perfect his knowledge, he and a companion erected a short line between their houses at their own expense, which was small, since young Edison made everything himself, instruments and all. Battery material was dear, and to save cost he betook himself to experiment. He had seen sparks emitted from a cat's back; he inserted a tom-cat in the circuit, using the fore and hind feet as electrodes. The connections, after some resistance, having been duly made, he tried to start an induced current by rubbing the cat's back. But it would not work the line and was abandoned. The experiment illustrated the humor of the man. Then young Edison got some type and a press, set it up in the baggage car, and printed the *Grand Trunk Herald* every day on the express train. When this came to an end, he started a chemical laboratory and experimented until he set the car afire, when he and his laboratory were ignominiously bundled out. After that he was employed as a railway telegraph operator, and then went to Cincinnati in the employment of the Western Union Telegraph Company. It was here that his penchant for experimenting began to be so strongly manifested. The results were that he patented the duplex machine, by which two dispatches could be transmitted on the same wire at the same time. In 1872 the quadruplex system of telegraphy was got into shape by him, by which four messages can be sent simultaneously on one wire, two one way and two the other, and which is in daily use now. This was quickly followed by other very important inventions. The 'Electro-Motograph,' the 'Edison Universal Printer,' the 'Electric Pen,' the 'Domestic Telegraph Call,' the 'Chemical Automatic Recording Telegraph,' are only a few of the subjects to which he has applied his thoughts.

"Three very important inventions of his are the 'Carbon Telephone,' the 'Phonograph' and the 'Electric Light.'

"These with other patents now bring him in a large revenue, and the Western Union Telegraph Company pays him a good yearly bonus for the simple refusal of the first right to buy any and all of his discoveries which relate to telegraphy. Some idea of Mr. Edison's prolific brain may be gathered from the number of his patents. Of these there have been issued to him since 1870 over two hundred.

"He has now one of the amplest laboratories and the finest array of assisting machinery to be found in connection with scientific inquiry. 'His laboratory is a wonderful place. Downstairs are his office and unpacking room, where are hosts of books and steam engines and machinery, where the best workmen turn for him the delicate parts of iron and brass which are to be put together in his cunning constructions. Upstairs is the workroom. Plenty of windows give light and air and a pleasant view. Gearing from the engine can be attached anywhere needed. Telegraph wires run to New York and Washington, and a circuit of 3,000 miles can be secured, if necessary, to ascertain whether some designed improvement which works well enough in the laboratory will cope with conditions of long out-door lines. Everywhere are the implements and evidences of his craft, batteries, insulated wires, gas jets innumerable, the gas being made on the premises; telegraph machines, telescopes, microscopes, spectroscopes, and the tables are crowded with parts of new models and fragments of old machines.'

"Mr. Edison's tall form is somewhat bent with much stooping over his work, and his brown hair is streaked with gray. He wears no beard or mustache, and in rest

would hardly be called a handsome man; but when he speaks the face instantly speaks too, and the keen blue eyes, far apart, light up with quick and happy intelligence. Careless in matters of personal appearance, deaf enough to give him an abstracted look, fond of fun, quick and facile at caricature, abstemious and simple in his habits, happy only in his laboratory and his home near by, reckless of money when applied to his scientific needs, regarding time as the one precious thing, he is a man of such strong characteristics as make an indelible impress upon the world wherever he goes."

Readers' Views and Comments

Waters of National Parks Can Be Used Without Injury to Their Scenery

To the Editor of the ELECTRICAL WORLD:

SIR: After reading and passing on to the directors of this association the editorial in your Dec. 18 issue "The Beauty of Use" I am instructed to write and commend you for it. The people who live here in the shadow of the greatest of our national parks are very decidedly for the perpetuation and development of all national parks, but we know that the valuable water having its source in these reservations can and should be utilized, particularly since this can be done without the slightest injury to the national playgrounds.

JEROME G. LOCKE,
Secretary Yellowstone Irrigation Association.
Livingston, Mont.

Basis for Standardizing Electrical Apparatus

To the Editor of the ELECTRICAL WORLD:

SIR: It is generally agreed that the most applicable relation between consecutive sizes and ratings of electrical equipment is a geometric ratio; that is, a constant-percentage increase. The writer desires to point out his belief that this ratio should be an integral root of the number ten, so that some rating several sizes larger than the base rating will be exactly ten times larger.

The Arabic or "decimal" notation (with the number ten as the key) is the basis of all modern mathematics, higher and common; of the decimal logarithms of the American money system and of the metric system. Every non-decimal system of measurement used by engineers is commonly corrupted so as to be more readily significant by the adoption of a well-known unit of the system as a standard, even if a disproportionately large or small number has to be used to indicate the quantity. For instance: City surveyors express measurements of length in feet and hundredths of feet, even if miles, rods, yards and inches, or a combination of these, would give smaller figures. The tool and machinery trades use the inch and the decimal parts of it. In all the industries of design and construction where the metric system is not yet in use there is a tendency to use but one unit and to express quantity by the decimal system of numbers. Accordingly, it is desirable to have decimally recurrent ratings in electrical equipment such as: 1, 1.6, 2.5, 4.0, 6.3, 10, 16, 25, 40, 63, 100, 160, 250, etc. If the ratio between adjacent sizes is also to be constant it must be an integral root of ten.

A study of the roots of ten shows that the fifth and tenth roots ought to cover a wide range of equipment. They also have the additional merit of psychological appeal, because many terms of the series are approximately equal to whole numbers. The fractions ½ and ¼ do not appear, but fractions, simple or complex, are almost obsolete in ratings, being replaced by decimal expressions, so that recurrent ratings may be symmetrical, as 1.5, 15, 150, 1,500, etc. The alternate terms of the tenth root constitute the fifth root, so that where the fifth root is found to give gaps too large it is easy to interpolate new sizes without destroying the standards already established. The fifth roots, approximately to two significant figures, give the following series: 1.0, 1.6, 2.5, 4.0, 6.3, 10.0. The tenth root series is: 1.0, 1.3, 1.6, 2.0, 2.5, 3.2, 4.0, 5.0, 6.3, 7.9, 10.0.

The standardization of motor sizes is intimately related to the standardization of wire sizes, which was completed a long time ago. The even sizes of the B. & S. wire gage are the only ones used commercially in distribution, and the resistance or voltage-drop ratio between these is 1.59. That is, the ratio between maximum motor loads on wire lines, long enough to be determined by permissible voltage drop, and two gages apart, is almost exactly equal to the fifth root of ten, 1.5849, suggested as a ratio between adjacent motor ratings. The ratio between the underwriters' current ratings for sizes three gage numbers apart is almost exactly 1.59.

It seems that 1.58 is not too large a ratio between ratings of electrical motors, where in extreme cases the normal voltage may be 5 per cent different from the rating, where the voltage may vary 10 per cent from normal, where there is usually 10 per cent to 30 per cent inaccuracy in the estimate of the average and maximum load, where the load may vary 10 per cent with the weather (in the case of belted plain-bearing shaft drives without an idler), and where improvements in manufacturing practice may increase the load 25 per cent. There are very few installations where the maximum future load of a motor may be calculated closely. In the metal-working industries there are none. The load on a motor driving a drill press, rated by a maximum-sized hole, may be changed 40 per cent tomorrow by the development of a better grade of high-speed steel for drills or by the use of a harder alloy steel to be drilled. The duty of a crane motor may be increased greatly when a dynamic braking controller replaces an obsolete mechanical lowering brake. It would seem that a motor raising a bascule (or jackknife) bridge would always have a constant load, but high winds and the influence of temperature, age and lubrication on the bearings prevent reasonable accuracy, and it is customary to specify motors with a normal torque twice the estimated load.

Accordingly, with so much uncertainty as to present and future loadings, with an increase in the cost of production as well as of maintenance for closely spaced ratings, and with a common factor of safety among engineers of from 4 to 10, it seems reasonable to use a ratio between sizes of 1.58. Using this ratio, the following ratings are suggested: 1, 1.6, 2.5, 4.0, 6.3, 10, 16, 25, 40, 63, 100, 160, 250, 400, 630, 1,000, 1,600, etc.

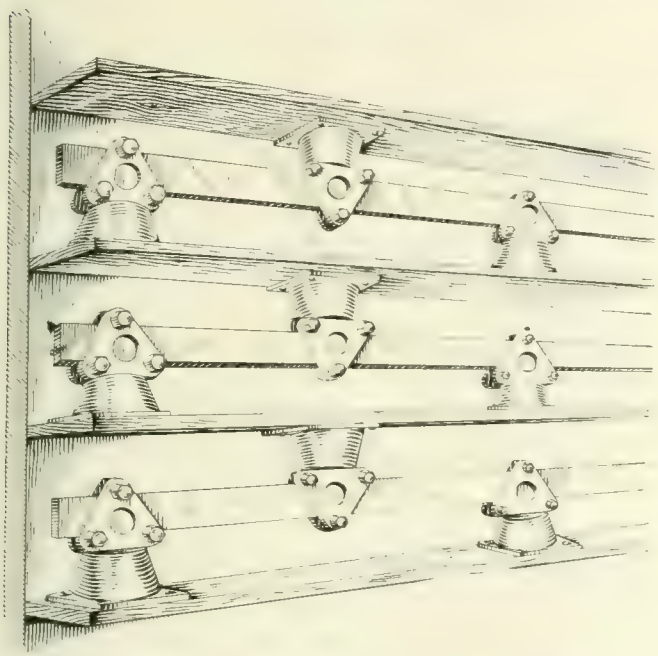
E. E. GEORGE.
Highland Park, Ill.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Bus Supports Must Be Well Designed to Withstand Short Circuits

BECAUSE very heavy stresses are put on busbar supports when overloads of the nature of short circuits occur, the supports must be carefully designed and so placed that damage will be least if the bus collapses. A good arrangement in which the supports are in compression is shown in the drawing. To give an idea of the forces that are acting, it may be pointed out that in a 30,000-kva. normally rated 2,200-volt, three-phase, 60-cycle generating station having 10 per cent generator reactance the busbar supports, 4 ft. apart, would be subjected to a stress equal to 2,560 lb. under short-circuit conditions. The magnitude of the mechanical stresses between buses was determined by the following formula which gives the pounds stress per foot length of bus under short-circuit conditions: $F = (K \times I^2) \div (10^7 \times A)$.



SCHEME FOR RUGGEDLY SUPPORTING BUSES

In this formula F = the force in pounds per foot length of bus; K is a constant which varies slightly for different arrangement of buses, but is usually 10; I is short-circuit current, and A is the distance in inches between buses. The symmetrical short-circuit current resulting from a three-bus short circuit is as follows:

$$\frac{\text{Kva (three phase)} \times 1{,}000 \times 100}{\sqrt{3} \times \text{voltage} \times \text{per cent reactance}}$$

This formula is sufficiently accurate for most practical purposes in calculating the forces on buses with the supports arranged in the usual method suitable for a switchboard. The variation in the constant 10 for different arrangements is not very great. As a figure easy to remember this formula gives a stress of 10 lb. per foot when the buses are 10 in. apart and the short-circuit current is 10,000 amp.

This information was given by G. P. Wilson of the Westinghouse Electric & Manufacturing Company, in a paper presented before the Chicago Section of the Association of Iron and Steel Electrical Engineers.

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Determining Salt Concentration at Which Boilers Start Priming

REALIZING that it was essential to minimize boiler priming, which had caused damage to the turbine blading and step bearings, a test was made by the Southern California Edison Company to determine the concentration of salt at which priming began. To carry out this test sea water was pumped into a boiler and was mixed with the concentrated fresh water already in it. The quantity of sea water added was determined by titration after each addition of salt water. It developed that priming began at about 300 grains of salt per gallon (5 grams per liter) and a working concentration of 200 grains of salt per gallon (3.4 grams per liter) was adopted. This limiting salt concentration probably varies in different localities according to the proportions of other substances in the feed water. The analysis of feed waters at Long Beach and Redondo is given in Table I.

A way was thus found to determine with a fair degree of accuracy how nearly unstable the boiler water surface was. A routine was followed of sampling the water from each boiler daily, and the salt content was thus determined. From this the boiler-room foreman was instructed as to how much and often to blow down each individual boiler. Later it was found unnecessary to test boilers every day, provided that the concentration of salt in the condensate was known. With conditions at the steam plants very constant, and knowing the amount of condensate per hour, its salt content as determined by test and the number of boilers being fed, it

TABLE I—ANALYSIS OF FEED WATERS—GRAINS PER GALLON

	Long Beach, Raw	Redondo, Raw	Redondo, Treated
Iron, aluminum and silicon oxide	1 44	0 96	0 55
Calcium carbonate	4 44	8 42	5 83
Magnesium carbonate	2 53	4 00	2 63
Calcium sulphate	None	None	None
Magnesium sulphate	0 83	None	None
Calcium chloride	None	None	None
Magnesium chloride	None	None	None
Sodium and potassium carbonates	5 20	1 11	4 46
Sodium sulphate	1 20	3 58	3 05
Sodium chloride	3 96	6 94	6 64
Volatile and organic matter	4 56	2 57	2 10
Total incrustants	8 41	13 38	9 01
Non-incrustants	15 75	14 20	16 25

was easy to calculate the necessary extent of blow-down to remove as much salt as entered with the condensate, maintaining a constant boiler concentration. Table II gives these data for the 850-hp. boilers:

TABLE II.—BLOW-DOWN REQUIRED WITH VARIOUS AMOUNTS OF SALT IN CONDENSATE.

Grains of Salt per Gal. in Condensate	Blow-Down One Gage 360 Gal. Every
2	8 hours
4	4 hours
6	2½ hours
8	2 hours
10	1½ hours

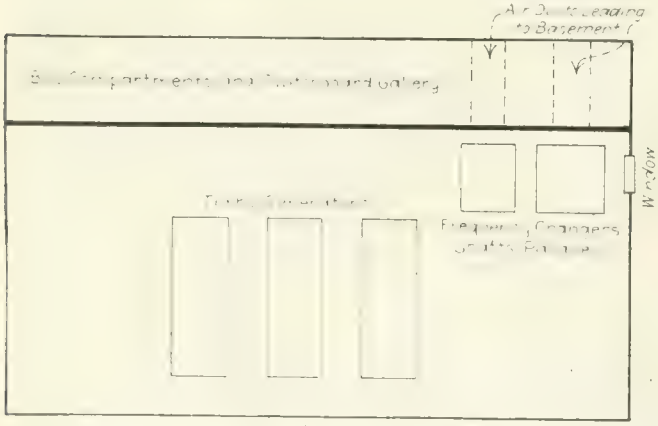
With normal evaporation of 35,000 lb. per hour and make-up water containing 6 grains salt per gallon, this schedule will maintain a concentration of 200 grains of salt per gallon in the boiler.

It does not follow that because a 200-grain concentration was found preferable to one of 300 grains a still further reduction would be still more desirable. The most economical boiler operation will result when there is the least amount of blow-down consistent with the absence of concentration troubles.

Southern California Edison Co. R. J. C. Wood,
Los Angeles, Cal. Electrical Engineer.

Ventilating Rotating Electric Equipment a Design Problem

AN ADEQUATE supply of air to uninclosed rotating electrical equipment in order that the ventilating provisions in the machine design may be effective is an important item in plant and substation layout. This is not always assured even though ample air inlets to the room are provided. Drawing A indicates a layout of two frequency changers in a room with three turbo-generators from which a large quantity of air was constantly discharged into the room. Despite wall openings in the wall near the frequency changers there was a constant recirculation of hot air through the machines, resulting in serious heating troubles. Recirculation was detected by throwing bits of light material

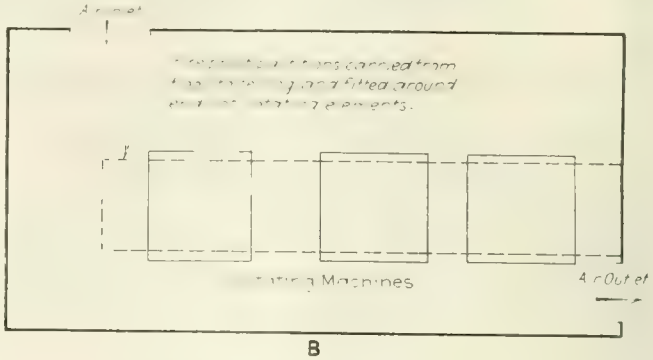


A

FREQUENCY CHANGERS (TO RIGHT) WERE OVERHEATED BY RECIRCULATING AIR

into the air currents discharged from the machines and finding them drawn back again after a few moments to the air intakes on the rotating elements. The cause was a dead pocket in the corner of the room in which the machines were installed. The only remedy available was to force air from the basement up around the machines in such a way as to break up the recirculating currents. The basement was under the machine floor and had ducts leading outside the building. Accordingly fans were placed to force air into the basement and up through floor openings to the machines. Some modification in the machine air vanes also was required.

Another type of problem is shown in drawing B. By means of fans air is brought into the room at one side and carried diagonally across, passing the machines



B

PARTITIONS BUILT TO PREVENT MACHINES BECOMING OVERHEATED

on the way through the room. The difficulty encountered was recirculation of the air not only by individual machines but recirculation of air discharged from one machine by an adjoining machine. Inclosures, as indicated, carried to the ceiling and fitted tightly about the ends of the rotating elements worked a marked improvement not only in lowered machine temperatures but in more comfortable operating conditions.

The solutions in either case are of a more or less makeshift character, but they call attention to a problem that should be watched in making station layouts. Trouble is more likely to be experienced where equipment is crowded and also where full-load conditions occur during the hot summer months.

Chicago, Ill. Field Editor Electrical World.

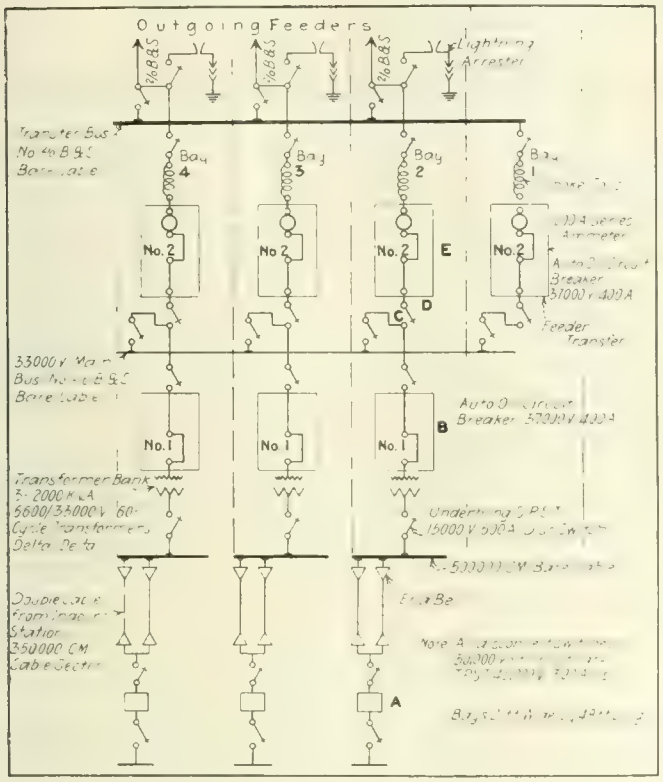
Cost and Characteristics of New Dayton Substation

INSTEAD of the usual double-bus system a main bus and a transfer bus have been installed in the first half of what will be a 36,000-kva., 6,800/33,000-volt substation of the outdoor type for delivering energy to the 33,000-volt transmission system of the Dayton (Ohio) Power & Light Company. The cost as of the summer of 1919 averaged $6.36 per kva. of rated transformer capacity installed.

The substation is about 500 ft. from the Millers Ford station, from which it is controlled and fed with three-phase energy at 6,800 volts. The low-tension oil circuit breakers are part of the feeder equipment of this station, and energy is delivered from them to the low-tension side of the transformers by two 350,000-circ.mil, three-conductor sector cables for each bank.

The current transformers on the high-tension and low-tension sides of the transformer banks have current ratios inversely proportional to the voltage ratios and are differentially connected to inverse-time-limit, definite-minimum, induction-type relays, so that in case of trouble between the low-tension and high-tension oil circuit breakers the relay will trip both switches, clearing the fault, but will render both the high-tension and the low-tension switches non-automatic in case of trouble on the feeders. The feeder breakers, however, are automatic, the bushing-type current transformers being connected to inverse-time-limit, definite-minimum, induction-type relays.

The station is so designed that each feeder may be operated independently from its own set of transformers, or the transformer banks may all be operated in parallel and the feeders fed from a common bus. A spare feeder equipment in No. 1 bay enables any feeder



OUTDOOR SUBSTATION RATED AT 18,000 KVA., 6,800/33,000 VOLTS

oil circuit breaker to be removed from service for inspection or repairs without an interruption to service.

Under usual conditions of operation oil circuit breakers *A*, *B* and *E* (see diagram) and disconnecting switches *C* and *D* are closed. The transfer breaker *X* and disconnecting switches are open, and all transformers are in parallel on the main bus from which all feeders are energized. During storm periods, however, all transformer banks are energized, disconnecting switches *C* are opened, and each feeder is operated on its own transformer bank, so that in case of a short circuit or flash-over the transformer capacity feeding into the fault would be only 6,000 kva. instead of the full substation capacity.

Any feeder breaker may be removed from service by closing the disconnecting switches on both sides of the transfer feeder oil circuit breaker, closing disconnecting switch on the feeder the oil circuit breaker of which is to be inspected or repaired, and then opening the disconnecting switch on each side of the feeder oil circuit breaker to be removed from service.

Equipment for 18,000 kva., which is the first half of this substation, was erected at a cost of about $114,500, or $6.36 per kva., as shown in the table appended. It contains the following equipment: Nine 2,000-kva. 6,800/33,000-volt, single-phase, water-cooled transformers; three 35,000-volt, 400-amp. solenoid-operated oil circuit breakers with bushing-type current transformers for high-tension switching; three similar oil circuit breakers with the addition of three series ammeters for the three outgoing 33,000-volt, three-phase feeders; one similar oil circuit breaker for the feeder transfer equipment, and three 35,000-volt ungrounded-neutral electrolytic lightning arresters, one for each outgoing feeder. Remote manually controlled disconnecting switches are provided for disconnecting the various pieces of equipment from the line, the operating handle in all cases being brought to a uniform distance above ground for manual operation.

There is a broad-gage track and transfer truck in front of the transformer foundations for moving equipment from the transformer pad to the hoist and to the railroad siding just back of the hoist.

COST OF 18,000-KVA., 6,800/33,000-VOLT OUTDOOR SUBSTATION

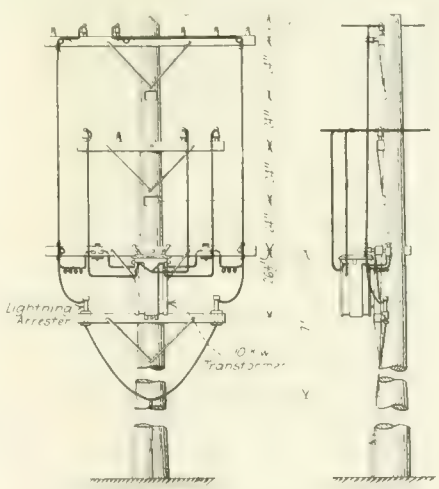
Foundations and superstructure, including transformer hoist, transfer truck and track	$16,259.02
Equipment, including nine 2,000-kva., 6,800/33,000-volt, one-phase, 60-cycle water-cooled transformers, switching equipment, switchboard, cables, pump house, well and pump	93,960.96
Engineering and supervision	4,279.63
Total cost first half of substation	$114,499.61
Average cost per rated kva.	$6.36

On account of the impossibility of getting a considerable number of control cables into the switchboard room of the generating station, some thirty-five-conductor cables were provided from the switching bay to a junction box in the substation.

W. SHULER,
Electrical Engineer,
Dayton (Ohio) Power & Light Co.

Mounting Lightning Arresters Close to Transformers

LIGHTNING arresters protecting transformer installations should be installed as near the transformer as possible. The method shown in the illustration allows placing the arrester on the transformer pole without subjecting the linemen to the danger of a ground wire on the same pole with a transformer. The short arm ordinarily used at the lower end of the transformer hangers is lengthened to provide support for the arresters, and the ground-wire connection is carried far enough down the pole to prevent the lineman from coming into contact with it and the primary wiring at the same time. All vertical wiring is placed on the face of the pole and the rear is kept clear for working space. The method also has the advantage of providing the most direct path through the arrester to ground as the number of sharp bends is a minimum. While the coil in the connection to the fuse box provides some choking effect its main purpose is to provide extra conductor length in case of breaks due to damage by fuse-box binding screws and handling of the connections.



STRAIGHT SHORT PATH THROUGH ARRESTER PROTECTS TRANSFORMER

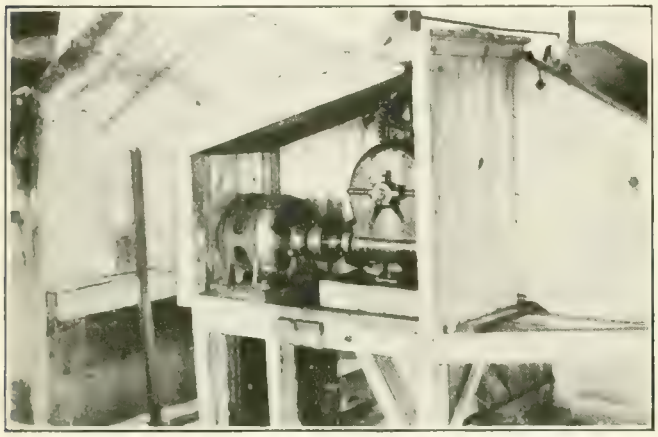
R. A. HAMMOCK,
Superintendent of Distribution.
Denver (Col.) Gas & Electric Company.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Weatherproof Compact Motor Mounting on Conveyor

A COMPACT and accessible motor mounting at the top of a conveyor is shown in the accompanying illustration. The motor is mounted in a housing at the side of the conveyor, which it drives by worm gearing and spur-gear connections. Minimum space is required



HOUSING FOR MOTOR ON CONVEYOR HAS SLANTING ROOF AND HINGED DOOR

for this drive, and the inclosure of the motor with slanting roof protects it from salt water. The hinged door and the fact that the motor is mounted about 3 ft. above the floor level make inspection easy.

EUGENE CARPENTER.
Cape & Vineyard Lighting Company,
Falmouth, Mass.

Desirable Mechanical Features of Electric Machines

IN GENERAL the mechanical points which should be studied in investigating electrical machinery are summed up in the following list:

1. Good mechanical proportions. This includes ample bearings readily renewable, a sturdy frame, a strong shaft, strong bolts which will not be twisted off and similar details.

2. Good finish. This is important because good finish usually is put on good material. By good finish is meant a workmanlike finish. Highly finished small parts, such as are used on an automobile, would be out of place on a motor or generator.

3. Simplicity. Simplicity involves small numbers of parts, and these of easily understandable form and application, so that an ordinary workman can readily take the machine apart and reassemble it.

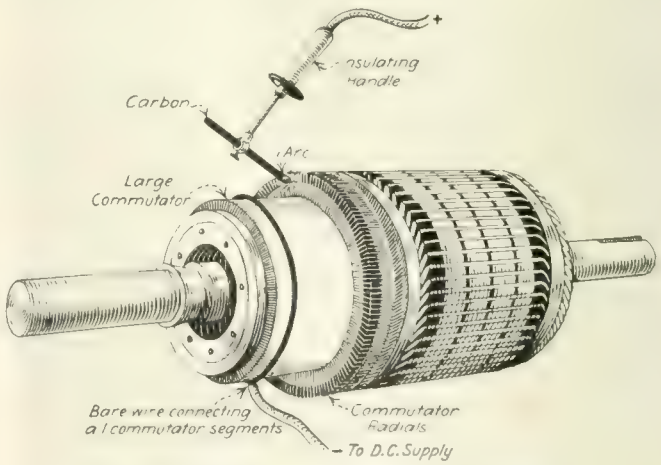
4. Operating attention. The less attention required the better. Proper attention concerns self-feeding brushes, a good but simple oiling system, bearings designed so they will not throw oil, well-fitted bolts, screws and nuts with proper devices to keep them tight when once set up, good connections and good arrangements for keeping dirt out of the vital parts.

5. Accessibility. The machine must be designed so that its operating parts can be easily and quickly inspected, and so that if renewals or replacements are to be made time will not be wasted. Nuts requiring special spanners or wrenches, inconveniently placed screws and similar complications should be rigidly excluded.

6. Interchangeability. This point needs no explanation. The day of the hand-built, made-to-order machine is over. Interchangeability goes with standardization, and these mean sustained quality. JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Soldering Large Commutators by Electric Arc

THE difficulty usually encountered in soldering very large commutators may be diminished by heating the commutator connections with a small electric arc. An arc of approximately 5 amp. at 125 volts direct current has been found satisfactory for this purpose. The intensity of the arc can be regulated with an adjustable rheostat. For use in this process the writer has constructed an electrode holder with an insulating handle as shown in the accompanying drawing. The electrode used is a carbon rod, an arc-light carbon serving well. This



SMALL ELECTRIC ARC USED FOR SOLDERING HEAVY COMMUTATORS

holder is attached to a flexible lead which is connected to the positive side of the direct-current line. The negative connection is made by means of a bare wire wrapped two or three times around all the commutator bars. If the arc is regulated to the proper size, a very rapid and clean job is possible. Care should be taken not to use an arc so large that it will burn the risers.

The use of such a method will eliminate much of the trouble usually encountered in soldering heavy connections to heavy strap conductors. Even with extra-heavy soldering irons of special shape, soldering large commutators is usually a very slow and tedious undertaking.

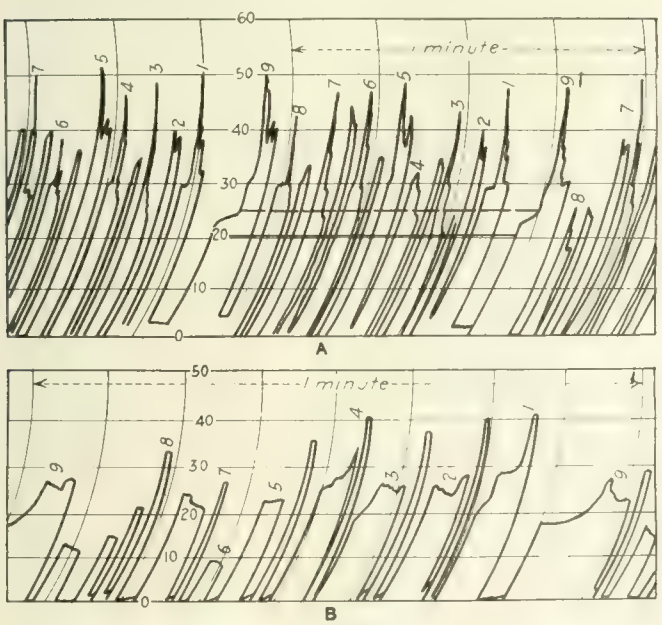
Trail, B. C., Canada. R. H. N. LOCKYER.

Automatic Controller Operates Blooming-Mill Lift Tables Successfully

AN AUTOMATIC controller for the motor drive of the rollers of the lifting tables of a 40-in. blooming mill in one of the largest Pittsburgh steel works has given very successful service. After three makes of automatic controllers had been used, with all the well-known troubles usually encountered in this application, a type which had given good service in smaller applications was tried with success. The blooming mill in question rolls ingots weighing 5,200 lb. and measuring from 16 in. to 18 in. square in section. The advantages of the controller lay in its reliability, simplicity of parts and operation, small number and interchangeability of parts and ease of making adjustments to obtain the desired results.

The ingots are rolled in nine passes which produce the bloom sizes given below. By mechanical means the ingot is manipulated between certain passes as indicated:

First pass—15 in x 18 in.
Second pass—13 in. x 18 in., edge up.
Third pass—13 in. x 15 in..
Fourth pass—13 in. x 13 in., edge up.
Fifth pass—11 in. x 13 in.
Sixth pass—11 in. x 11 in., edge up.
Seventh pass—11 in. x 9 in.
Eighth pass—9 in x 9 in., edge up.
Ninth pass— 9 in. x 9 in., to 28-in. mill.

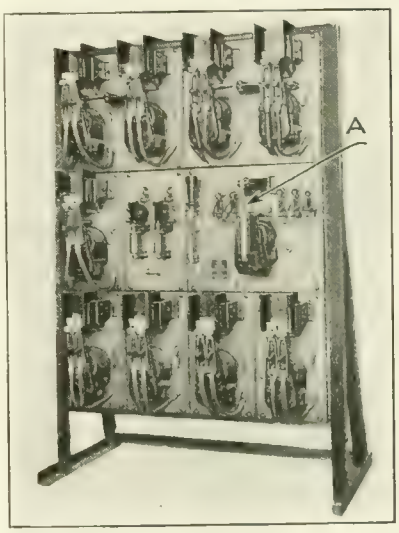


RAPID REVERSALS IMPOSE SEVERE DUTY ON MILL-TABLE CONTROLLERS

The top curve shows operating conditions as first recorded, while the lower curve shows conditions after adjusting the resistance steps. The curves were taken with a 100-millivolt, 2,000-amp. shunt on a 220-volt circuit.

The time of rolling the nine passes is from fifty seconds to sixty seconds. The table rollers are rotated by means of two 100-hp., 220-volt Crocker-Wheeler motors. As these two series motors are connected in parallel so as to be operated by a single set of reversing switches, the service is severe on the controller.

The accompanying illustration shows the 200-hp. Rowan automatic full-speed reversing controller which has been in use about half a year. It operated in continuous service for three weeks before the first change in arcing tips. The rapidity with which the switches must make and break contact may be appreciated after a study of the ammeter curves. The arcing tips and the arc shields on the controllers formerly used had to be changed about twice as frequently as those on the present board. The blooming-mill time delay charged against the electrical department varies almost directly with the number of times that the parts of the controller board have to be changed. The first arc shield to be replaced was of defective material and had to be changed after two months of service. Those who are familiar with the maintenance of contactor panels on this sort of application will realize the great improvement provided by this controller in the life of the parts mentioned.



LIFTING TABLE CONTROLLER WHICH IS ACTUATED BY ACCELERATING RELAY (A)

As this controller was the first of its type and size to be used, it is natural that a few weak points should come to light. The knife switch provided on the board, connected in series with one of the motor circuits to permit of testing the board without turning the motors, and the flexible leads on the circuit breaker were not of sufficient current-carrying capacity. Moreover, the piston rod in the dashpot of the accelerating relay contained a weak spot. These features have now been taken care of by the manufacturer of the controller so that new boards of this relative size will not give rise to the same troubles.

ENERGY CONSUMPTION 1.5 KW.-HR. PER INGOT

This controller has been in constant operation since its installation, with the exception of a very few minutes. To obtain an idea of the amount of power handled by the controller a 1,000-amp. watt-hour meter was connected in the line. From 11 a.m. on a Monday until the same time the following Saturday the meter registered 7,430 kw.-hr. During that time there were 4,887 ingots rolled. The next full week 7,810 kw.-hr. was used, and the following week 7,930 kw.-hr.

From the above, the power per ingot is about 1.5 kw.-hr., and the current would be about 410 amp. This current value is shown on the first-curve chart, from which the root-mean-square value was roughly estimated to be about 500 amp., as indicated. The feed of the first-curve chart was 3 in. per minute, and that of the second was 6 in. per minute, the paper being marked off in ¾-in. divisions.

On the curves the pass numbers are indicated to correspond with the pass numbers given in the above

table. The first curve plainly shows the effect on the current produced by the closing of the accelerating contactors.

After the first curve was made it was desired to secure smoother operation; therefore, the grouping of the resistance elements was changed and adjustments were made on the accelerating equipment, with the results indicated by the second curve, showing a reduction in the current peaks.

Except at the start of the first pass, the current peaks are obtained when plugging to stop motors between passes. Pass No. 8 is made with great caution because of a peculiar characteristic of this mill which makes the bloom liable to turn in the guides upon entering this pass; therefore, the master controller is thrown on and off a number of times during the pass. The individuality of the operator is, of course, somewhat reflected in the operation of the mill; but as a general rule the current cycle for each ingot is fairly uniform, as the curves show.

Accelerating Armature Dashpot an Important Feature

The main feature which makes this automatic controller different from those used before is the accelerating relay which is shown in the right-center panel section. It is similar to the contactors. The chief points of difference are that it is provided with a dashpot to delay the action of the armature and that the armature is provided with a horizontal bar upon which are fixed contact arms so set as to close in the desired sequence. This armature is actuated by a shunt coil which is bucked by a small series coil when the motor current reaches a high predetermined value. This value is so chosen that the dampening action is usually only the result of the drag of the dashpot. The dashpot is, therefore, a very important feature of the accelerating relay. As there has been no splashing of oil, the use of the dashpot has not proved objectionable.

The current through the circuit-breaker coil may be traced from one side of the line to the other even when the master controller is on center position. The circuit breaker therefore stays closed instead of opening and closing with every movement of the master switch. Of course, in case of an overload the breaker will open because of the action of the relays in the magnet circuit. In case of voltage failure, when the master switch is off center, the breaker will open. With the master controller returned to center the circuit breaker will reset whether it had been opened by overload or undervoltage.

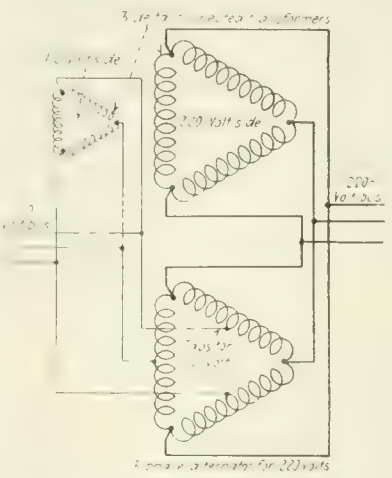
Upon throwing the master switch one way or the other the corresponding contactors at the top of the controller are closed. The closing of these contactors provides a circuit for the flow of current through the shunt coil of the accelerating relay, and the pull of this coil starts the action of the relay.

There is one more contact arm on the accelerating relay than there are accelerating contactors on the board. This extra arm is the first to make contact. Its function is to provide an additional interlock between the forward and reverse contactors. The interlocking is done by the connecting of a resistance in parallel with the contactor coils so as to rob them of part of their current and thus prevent the contactors from closing. This resistance is of such value as to avoid causing the opening of closed contactors because of the reduction of current flow. If desired, the electrical interlocking may be made inoperative by changing the angle at which the little contact arm is fixed to the accelerating relay. As the accelerating relay closes one little contact after another, the magnet coils on the corresponding accelerating contactors are excited, and as a result the starting resistance is cut out a step at a time.

D. W. Blakeslee,
Pittsburgh, Pa. Electrical Engineer.

Use of 220-Volt Alternator for Delivering 110-Volt Energy

To get energy at 110 volts from a 220-volt alternator taps were made at the middle point of the delta winding of the alternator, as shown in the accompanying diagram, and thus the machine was enabled to carry 110-volt load when transformers for cutting the voltage down to 110 volts were not available. The necessity for operating in this manner was caused by the growth of the 110-volt load in the plant of the Curtiss Aeroplane & Motor Corporation, Garden City, Long Island, N. Y., during war time. This load grew to such an extent that the transformers used to feed it were not of sufficient size. These transformers were 220/110-volt transformers connected in delta to the 220-volt bus of the plant, this bus being fed from another set of 6,600/220-volt transformers. Owing to the fact that deliveries could not be had on the extra transformers which were needed, an attempt was made to supply the 110-volt load by means of the three-phase, 220-volt delta-connected generator which is run in parallel with the line from the Nassau Light & Power Company feeding the plant in order to insure a constant voltage. The generator is also used, overexcited, to raise the power factor of the line.



TAPS TAKEN FROM 220-VOLT GENERATOR TO SUPPLY 110-VOLT LOAD

To obtain the much-needed additional energy at 110 volts the delta connection of the generator was tapped at the middle points, as already indicated. After making this connection it was found that the generator could be synchronized with the 110-volt bus of the plant and thus relieve the transformers already installed of a good deal of their load. In fact, after the machine was operated in this way for some time the 110-volt load was carried entirely by the generator and the 220-volt switch was opened. Before synchronizing the machine with the 110-volt bus 10-amp. fuses were put in the machine circuit on the 110-volt side in order to prevent serious damage in case the machine could not be synchronized. It was, however, synchronized satisfactorily, and consequently permanent lines were installed through a 200-amp. switch.

Of course, it must be remembered that the output of the generator from these 110-volt taps is only half what it would be from the 220-volt leads of the machine. This machine was not overloaded, as it actually carried

only 60 kw. constantly, although it is an Allis-Chalmers 150-kw. turbo set.

W. E. TATEM.
Curtiss Aeroplane & Motor Corporation,
Garden City, N. Y.

Power Requirements in Sawmills

THE sizes of motors used in the ordinary sawmill for different operations are given here in Table I. The second table shows the power consumption in mills handling different kinds of timber. In estimating the power to be used in sawmills two factors to be remembered are the form of the finished product and the hardness of the wood. These factors have a wide bearing on the amount of power required. Sawmill and woodworking machines are almost always driven by squirrel-cage induction motors, although hand mills, heavy band resaws, etc., which require a large starting torque, are driven by wound-rotor machines. The energy is commonly 60-cycle, three-phase, furnished at 480 volts or 600 volts.

TABLE I—SIZES OF MOTORS FOR DIFFERENT OPERATIONS IN SAWMILLS

Machine Operated	Motor Size (Hp.)
Log jack, for hauling logs into the sawmill	25 to 50
Circular log cut-off saw, for dividing long logs after being drawn into the mill	25 to 50
Drag saw, for cutting off logs too large for the circular saw above mentioned	15 to 40
Overhead log canter, for turning large logs lying on the log storage deck or on the carriage	10 to 20
Band mill, for ripping the logs which are moved back and forth in front of it on the carriage	100 to 300
Circular head saw, sometimes used instead of band mill	100 to 400
Power setting machine, for moving log forward after every cut into position for the next cut. This machine is mounted on the carriage. Two types are used, one direct steam-driven, the other power-driven The latter is used exclusively for the heaviest work, and motor may be mounted on carriage	5 to 10
Live rolls, or power-driven rolls, for transporting lumber after being sawed. These are connected and driven together in trains of six to twenty or more, according to the mill design; power required per roll	0.4 to 0.6
Band resaw for further reduction of large pieces dropped by the head-band mill. It may be either vertical or horizontal. The latter is used for resawing slabs as well as splitting thick stock from the head band	75 to 200
Transfer chain tables, for moving lumber sidewise between machines. These are of such varying length and width according to the individual case that no power requirement can be specified.	
Gang mill, for sawing entire log into boards at one passage through the machine. Two opposite slabs are taken off the log by the head-band saw, giving the log two flat faces, after which it is fed to the gang	50 to 400
Edger, for ripping bark edges from the boards and squaring them	15 to 250
Slab slasher, for dividing waste stock into short lengths for lath, stove-wood or other by-products	20 to 75
Trimmer, for cutting ends off boards and making them of standard length	20 to 75
Swing cut-off saw, for hand-trimming of large timbers, etc	10 to 25
Timber sizer, for surfacing two or four sides of timbers at one operation	50 to 60
Lath bolter, for preparing lath bolts from slabs or other waste wood	30 to 60
Lath machine, for making lath from bolts	20 to 30
Hog, a grinder with knives on a revolving disk, for chipping waste wood for fuel or other purposes	25 to 150
Planers, of great variety in size and type. The largest standard size requires about 75 hp.	
Exhaust fans, for transporting dust and shavings from planers to fuel storage house	25 to 150
Chain conveyors, for transporting waste wood and sawdust, the length varying with the mill design up to about 350 feet	5 to 30

TABLE II—POWER CONSUMPTION OF VARIOUS SAWMILLS

Drive	Timber	Amount of Lumber Sawed in Ten Hours (Ft. B. M.)	Average Horsepower	Horsepower Required per 1,000 Ft. of Lumber Sawed per Ten Hours
Electrical	Sugar pine	107,000	470	4 39
Electrical	Fir	140,000	600	4 28
Electrical	Yellow pine	225,000	1,090	4 87
Electrical	Fir	125,000	600	4 80
Electrical	Mixed hardwood	85,000	672	7 90
Electrical	Yellow pine	190,000	2,140*	11 26*
Electrical	Fir	115,000	1,260*	10 96*
Electrical	Fir	121,000	1,152	9 52*
Mechanical	Sugar pine	114,000	610	5 36
Mechanical	Yellow pine	175,000	1,014	5 86

* Power for entire plant, including planing mill.

As a general rule heavy and sudden peaks are encountered, and allowance must be made in selecting motors. It is found that as an average the load factor of the entire mill is about 60 per cent of the total name-plate rating of the motors.

Allan E. Hall, Allis-Chalmers Manufacturing Company, presented these facts at a recent meeting of the American Society of Mechanical Engineers.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Home-Made Swinging Reflector Arm for Safe Maintenance

TO INSURE safety to men replacing lamps which overhang the edge of the roof and to afford firm support to the lamps in heavy gales a contrivance which allows the lamps to be swung over the roof was after some experimentation adopted by the Graton & Knight Manufacturing Company, Worcester, Mass. Outside illumination of that portion of the yard adjacent to the factory building is provided by 200-watt gas-filled lamps mounted in Wheeler reflectors attached to pipe arms carried near the edge of the roof, as shown in the photograph. The lamps are about 75 ft. above ground and extend about 2 ft. beyond the roof. Each lamp is fed and supported by a ½-in. pipe bent at the inner end and carried through a vertical hole in a 3-in. x 4-in. cross-arm strapped to a vertical 2-in. pipe standard 10 ft. high. About 3 in. from the outer end of the arm a ½-in. coach screw is used as a pin to wedge the pipe bracket against a block of wood about ¾ in. wide and of the same height mounted on top of the arm. This block forms a backing against which the pipe lies when swung outward over the roof. To insure that the pin shall stay in place under severe weather conditions the hole in which it fits is drilled at a slight angle. The



OVERHANGING LAMP IS SWUNG IN FOR CLEANING AND RENEWING
Pipe support is fitted in hole in cross-arm.

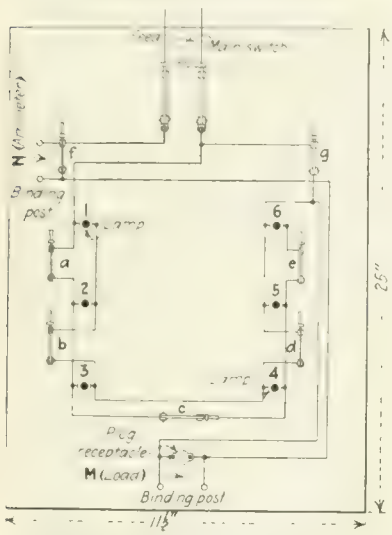
arm, as shown, swings about on the vertical portion of the pipe for inspection and lamp maintenance. Energy is supplied from an overhead line fed into the bracket through a condulet. The upright standard is fastened with a flange into a horizontal plank, which in turn is fastened into the roof timbers below the gravel surface.

Graton & Knight Mfg. Co., Worcester, Mass.

A. H. MAGNUSON, Electrical Engineer.

Simple Board for Testing Small Equipment

A SIMPLE and inexpensive lamp board which will be found useful around an industrial plant may be made as outlined in the accompanying diagram. With such a board fitted with six 200-watt lamps and connected to a 110-volt line the writer has obtained current varying from 11 amp. to 0.36 amp. The resistance at the same time changed from about 300 ohms to 10 ohms. As shown in the diagram, there are six lamps, numbered 1 to 6, mounted on a board 25 in. x 11½ in. The feed line is led into the top of the board, and one side of the line passes straight through to the load post *M* with an ammeter inserted at *N*. The switch *f* is used for short-circuiting these ammeter binding posts. The other side of the line passes through the lamps, the current passing through more or less lamps in series and parallel according to the position of the knife-blade switches *a*, *b*, *c*, *d*, *e*. The switch *g* is used to short-circuit these lamps and put current directly on the binding post *m*. A screw-plug receptacle is connected across the binding post *M*. By varying the position of the switches as the accompanying table indicates, the current at the binding post *M* is changed from 0.36 amp. to about 11 amp. The switches *a*, *b*, *c*, *d*, *e*, *f* and *g* are 15-amp., 125-volt switches. All connections are made on the back of the board by means of back-connected switches. For convenience a snap switch may be used for the main switch, although this is not advisable if large lamps are to be used and energy is to be on for any length of time, because the heat from the lamps may soften the switch button so that the switch cannot be operated. This objection may be overcome by mounting the switch at the bottom of the board. With nitrogen lamps it is well to use diffusing caps to eliminate the discomfort which will result from glare.



HOMEMADE BOARD FOR TESTING SMALL EQUIPMENT

POSITION OF SWITCHES FOR DIFFERENT CURRENTS AND RESISTANCES

Amp. with Terminals *M* Short-Circuited	Resistance in Series, Ohms	Switches Closed
0 36	303	None
0 52	272	*e*
0 61	182	*d*
0 73	151	*c*, *e*
0 78	141	*c*, *d*
0 81	136	*c*, *d*, *e*
0 91	121	*a*, *b*, *d*
0 99	111	*b*, *c*, *e*
1 82	61	*b*, *d*
3 64	30	*b*, *c*, *e*
5 46	20	*a*, *b*, *d*
7 28	15	*a*, *c*, *d*, *e*
9 1	12	*a*, *b*, *c*, *d*
10 9	10	*a*, *b*, *c*, *d*, *e*

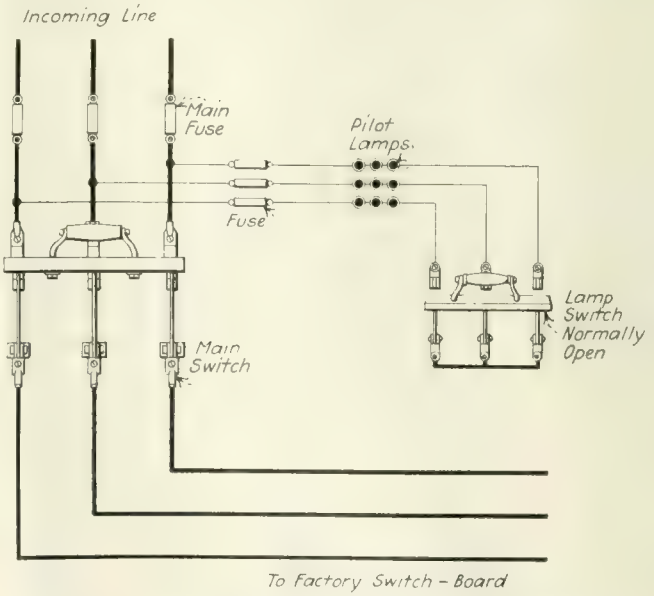
This board has been used by the writer for various purposes, among which are charging storage batteries, testing fuses, lamps and coils of low or medium resistance for open circuit, testing ammeters, making current tests of small appliances which operate at a voltage equal to that of the lamps, and testing extension lights or portable tools, such as drills or grinders. By connecting these appliances in series with several lamps in multiple they may be tested without danger of blowing a fuse or damaging the appliances if they are short-circuited.

A. H. PLATT.

Bridgeport, Conn.

Pilot Lamp to Indicate When Service Is Cut Off

IN ORDER to determine when some circuit in the factory goes dead, whether the power company's service has failed or whether the trouble is inside the factory, pilot lamps such as are shown in the accompanying drawing will save considerable time. The connection for these lamps is taken at the main low-tension switch as near the blades as possible and on the service side of the switch. A small fuse is installed near the main switch, and a No. 14 wire, two, three or four-conductor, according to the system, is run to the signal lamps placed at any convenient point in the factory. A sufficient number of lamps must be used to stand line voltage $\div \sqrt{3}$. A three-pole switch is connected in order to short-circuit the lines, as shown, at any point which can be quickly reached by an operator who notices that energy has failed. If desired, more than one of these switches may be installed, they being placed at different points in the factory. When the power goes off, on closing this switch the lamps will light at full candlepower if the service from the incoming line is complete up to the factory's entrance switch. If the incoming service is entirely cut off, they will not light. If one phase of the service is cut off, two sections of the lamps will burn, but not at full brilliancy.



PILOT LAMPS USED IN FACTORIES TO TELL WHERE POWER HAS FAILED

By the use of such lamps it is possible to ascertain whether the trouble is in the factory or outside of the factory and whether or not to call the power company.

East Berlin, Conn. H. S. RICH.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Attractive Booklet Tells Consumers of Company's Aims and Achievements

AN INTERESTING booklet entitled "The Spirit of the Age" has been recently issued by the Depew & Lancaster (N. Y.) Light, Power & Conduit Company to inform its customers of the scope and aims of the company. A brief description is given of the influence of electric service upon the development of civilization and of the conveniences it now affords. Following this is a story of the evolution of the company since it was started some twenty years ago as a small plant in the rear of a dry goods store to light the premises. It now supplies service to an estimated population of 75,000 in twenty-two towns and villages. Numerous views of the company's property and its facilities for service are shown in the booklet, which is about 8 in. x 10 in. in size and carries the attractive cover shown in the accompanying cut.



AN EFFECTIVE MEDIUM OF PUBLICITY

E. Feyler, who installed the original plant, is now president-treasurer of the Depew & Lancaster Light, Power & Conduit Company.

Merchandising in Small Communities

IN COMMUNITIES which are too small to warrant the company distributing electric service maintaining an office the Scioto Valley Traction Company, Columbus, Ohio, makes a local hardware dealer its agent for the sale of electrical merchandise and for the collection of bills. The company supplies the necessary stock, advertises the merchandise in the local newspaper and carries the time-payment accounts. The hardware dealer is thus relieved of investment, advertising expense, and the liability of carrying accounts. The line of electrical merchandise and the central-station advertising bring people to the store, and the central-station company pays the dealer 10 per cent commission on all the electrical merchandise he sells. When the merchant also acts as a collection agency for the company he is allowed 5 per cent of the amount collected.

The company first tried to negotiate with electrical contractors and dealers, but they expressed dissatisfaction with the amount of the commission, did not have suitable stores in which to display appliances, or preferred to push the sale of farm-lighting plants in competition with central stations. The arrangement was then made with the hardware dealers and has been found very satisfactory in communities of from 250 to 1,200 inhabitants.

Brooklyn Utility to Have Consumer and Employee on Directorate

STEPS to have a representative of the public and an employee of the company on its board of directors are being taken by the Kings County Lighting Company, a utility supplying gas in a southern section of Brooklyn, N. Y., having a population of approximately 250,000. This action, which has grown out of a long series of rate hearings whereby the company was successful in obtaining a rate for service which would attract new capital for needed extensions, is part of a program laid out by Ralph Elsman, president of the company, for a better understanding with consumers.

In order that the company could adequately serve its customers the Public Service Commission issued an order requiring it to make improvements and extensions costing upward of $2,000,000, these improvements representing expansion, deferred by war conditions and the rate litigations. Application was made to the commission for the approval of $2,000,000 of 8 per cent preferred stock. After several hearings such approval was granted, and the stock is now being offered primarily to consumers and residents of the district supplied by the company. In addition, Mr. Elsman has announced his intention of having on the board of directors a representive of the consumers, chosen by themselves, and a representative of the employees of the company. He has also invited the civic associations and local newspapers of the district each to designate a representative to serve on an advisory committee to the company to take up complaints directly, to determine on a method whereby a director-representative of the consumers may be chosen and to suggest any other measures that the company may adopt that will be helpful in bringing about closer co-operation between the company and its community.

In proposing this arrangement the following letter was addressed to the civic bodies and newspapers of the section:

TO CIVIC ASSOCIATIONS.—In November, 1920, when I acquired control of the Kings County Lighting Company, I promised that the facilities would be enlarged, the plant capacity increased, the quality and quantity of gas increased, street mains and house services laid and meters set. Contracts were immediately let. The plant capacity has now, within less than two months, been increased by over 2,000,000 cu.ft. a day, so that, with a total capacity of 11,000,000 cu.ft. per day, the plant will be able to furnish

every one this winter with gas of a good quality and pressure.

There were 12 miles of mains and services to be laid, and 70 per cent of this work is now done. Likewise, the forces of the company began setting meters, and over 500 applicants for meters have now been taken care of. As to the improved quality of gas, I am sure every consumer has noticed the very great improvement.

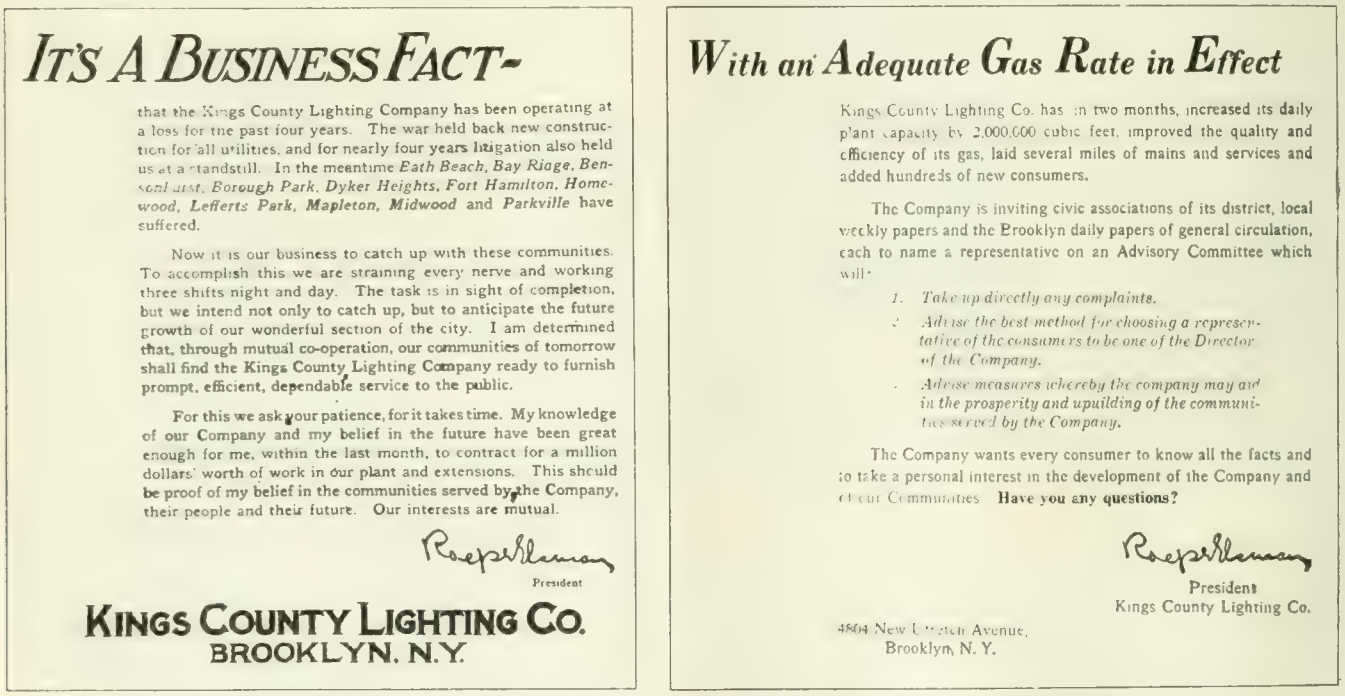
Briefly, between $500,000 and $600,000 has thus been expended in two months to improve the company's property and to benefit its consumers. Incidentally such improvements would not have been possible if the company had not been able to secure a higher gas rate.

You will realize that getting these improvements done has occupied very fully the time and energies of the officers of the company. The work has now reached the point, however, where I want to take up additional matters. After the new rate went into effect, I promised the improvements referred to above, and I stated that I intended to have a representative of the public and of the employees on the board of the company.

a representative to serve on this committee. Yours very truly, RALPH ELSMAN, President.

In addition an active campaign, of which two typical advertisements are shown here, is being carried on in the local newspapers and Brooklyn papers of general circulation and in the New York metropolitan papers, setting forth the policy of the company, the advantages of its territory for residents and the accomplishments possible as the result of obtaining an adequate rate. The company is sending two or three pamphlets to each of its 40,000 consumers and prints a statement of the purposes of the company on the back of its gas bills. It also places a sticker on the front of the gas bills, the text of which is changed every week. The company is thus endeavoring to bring home to its consumers the direct relationship that exists between an adequate rate that pays operating expenses and a reasonable return and the expansion of a territory served.

Associated with Mr. Elsman in relation to the company is Travis H. Whitney, who served for nine years as secretary of the Public Service Commission of the First District of New York and three years as a commissioner, the last five months of which he was chairman of the commission.



TYPICAL ADVERTISEMENTS WHICH ARE GAINING FRIENDS FOR THE KINGS COUNTY LIGHTING COMPANY

I have not yet been able to determine the best method that should be followed in the selection of the public representative. At the same time I realize that, hard as has been the work of the contractors and the officers and employees of the company, all causes of complaint have not been met. Consequently, may I suggest that an advisory committee be formed, made up of representatives of the various civic organizations of the district? Such a committee will thus be able to take up directly three classes of questions—first, any complaints in the different sections of the district; second, discussion and recommendation of a method that seems most satisfactory to all for the selection of a representative of the public to serve as a director of the company; third, any other matters whereby the company may aid in the prosperity and upbuilding of this district.

I consider that, by reason of its natural advantages and of the four rapid-transit lines, this district is destined to have, by comparison with any other part of Greater New York, a greater growth and a resulting prosperity to our property owners, builders, storekeepers and public generally.

As the company is anxious to have the assistance and advice of such a committee at the earliest moment, may I suggest that you, as president of your association, be a member of such committee or designate a representative? In addition, I am asking the weekly papers in this district and the Brooklyn papers of general circulation each to name

Pacific Gas & Electric Sells $1,374,000 Stock in Twenty-four Days

BETWEEN Jan. 1 and Jan. 24 the Pacific Gas & Electric Company, San Francisco, sold $1,374,000 of its preferred stock to its consumers. This high rate, reaching an average of $68,700 per business day, has been due to an energetic campaign carried on since July 1, 1920, during which time a total of $5,008,550 of preferred stock was sold to consumers and the general public. Since the company first undertook the sale of stock locally in June, 1914, a grand total of $19,810,050 of stock has been sold, placing a total of 10,273 preferred and 2,839 common stockholders on the books as of Dec. 9, 1920.

Real Owners of Public Utilities

PUBLIC utility executives and managers whose companies are largely owned by out-of-town investors are frequently faced with the accusation that a little coterie of New York financiers control the property. The Merchants' Heat & Light Company of Indianapolis answers the question "Who Owns the Public Utilities?" in an interesting and effective manner as follows:

"Some of us—many of us, in fact—have carried around for a long time a mistaken idea about what kind of people actually own the public utility companies which supply gas, electricity, telephone, street railway and interurban service to millions of men, women and children in almost every part of the United States. Those of us who don't know, or may have been misinformed, are inclined to have and nourish the idea that public utility companies are owned by little bands of capitalists, bankers, and wealthy business men, with here and there a frantic financier or a gentleman crook thrown in to invent ways and means by which the public may be defrauded and a barrel of profit produced every year, or a fancy showing made upon which some 'sucker' can be induced to buy the property at several times its actual cost or value. Some of us who have political aspirations have been inclined to promote and encourage that line of thought, thinking thereby to gain public favor.

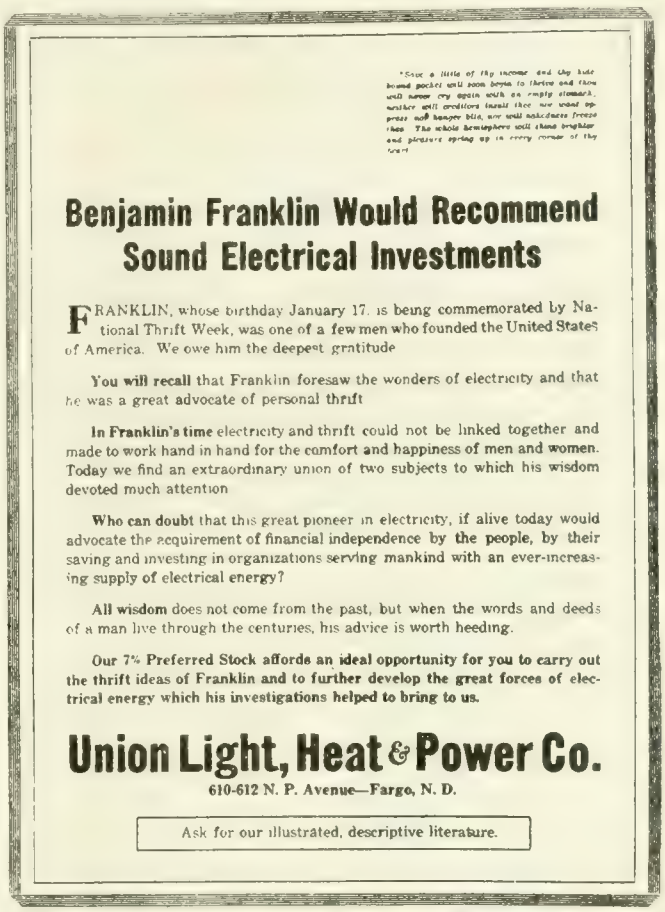
Who the Real Owners Are

"Well, you ask, if a lot of us are laboring under a misunderstanding, who are the real owners of the public utilities of the country? They are doctors, lawyers, merchants, teachers, ministers, clerks, stenographers, mechanics, policemen, firemen, railroad men, widows, orphans, and, last but not least, many elderly people whose period of activity is passed and who have invested a part or all of their savings in the bonds and stocks of public utility companies. They are the kind of people who live next door, whom you meet on the street, in business places, in churches, in theaters and actually rub elbows with you every day of your life. Other investors in these properties are life insurance companies, fire insurance companies and savings banks. Every time you pay an insurance premium your money goes into a fund which must be invested in order that the company may earn money with which to carry on its business and meet the obligation in your policy when it falls due. The savings bank pays you interest on your deposit. In order to do this and meet the operating expenses of the bank your money must be invested and made to produce more than the interest you receive. Insurance companies and banks own and hold large amounts of the bonds of public utility companies.

"Every man or woman who has an insurance policy or a savings bank account is, therefore, indirectly vitally interested in having the public service companies of the country carry on their business successfully and profitably.

"The public utility business of the United States is a truly American business—of the people, by the people and for the people—and the profits (if any) are shared by the people. Were it not for the money which has been furnished by the people in almost every walk in life, it would not have been possible for active, energetic men to build the public utility plants, to accomplish what has been done for the comfort and convenience of the millions of people served daily or hourly by these companies. Any honorable concern is entitled to conduct its business on a profitable basis in order that it may render satisfactory service to its customers and pay to its investors a fair return on the money they have invested in it. The public utility company is no exception."

Byllesby Properties Co-operate in "National Thrift Week"



"Save a little of thy income and thy hole-bound pocket will soon begin to thrive and thou will never cry again with an empty stomach, neither will creditors insult thee nor wood oppress and hunger bite, nor will nakedness freeze thee. The whole hemisphere will shine brighter and pleasure spring up in every corner of thy heart."

Benjamin Franklin Would Recommend Sound Electrical Investments

FRANKLIN, whose birthday January 17, is being commemorated by National Thrift Week, was one of a few men who founded the United States of America. We owe him the deepest gratitude

You will recall that Franklin foresaw the wonders of electricity and that he was a great advocate of personal thrift

In Franklin's time electricity and thrift could not be linked together and made to work hand in hand for the comfort and happiness of men and women. Today we find an extraordinary union of two subjects to which his wisdom devoted much attention

Who can doubt that this great pioneer in electricity, if alive today would advocate the acquirement of financial independence by the people, by their saving and investing in organizations serving mankind with an ever-increasing supply of electrical energy?

All wisdom does not come from the past, but when the words and deeds of a man live through the centuries, his advice is worth heeding.

Our 7% Preferred Stock affords an ideal opportunity for you to carry out the thrift ideas of Franklin and to further develop the great forces of electrical energy which his investigations helped to bring to us.

Union Light, Heat & Power Co.

610-612 N. P. Avenue—Fargo, N. D.

Ask for our illustrated, descriptive literature.

ABOVE is reproduced one of the advertisements used by the utility properties of the Standard Gas & Electric Company during "National Thrift Week," Jan. 17 to 22, tying this movement in effectually with the customer ownership programs of the Byllesby companies.

To Instruct Public School Students in Rudiments of Utility Operation

EDUCATION of the students of the Jackson (Mich.) public schools in the elementary principles of electric power generation and distribution is being undertaken in co-operation with the Consumers' Power Company. Classes will visit the plants of the company from time to time under the guidance of the company's instruction department, and an effort will be made to give the students an understanding of the utility's work in such respects as will be interesting from a consumer's viewpoint.

In addition, men from the instruction department will address the students at the schools from time to time and demonstrations of the workings of electric and gas meters will be undertaken.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Alternating-Current Generators for Ship Propulsion.—E. H. FREIBURGHOUSE.—The importance of reliability in the design of these generators is brought out and some description follows dealing with the actual design and construction of alternators for such service. Great care is taken to watch the temperature in the various parts of the apparatus, especially since there is such wide variation in the operation of the machine in regard to speed and excitation. Fire-extinguishing apparatus is provided and heating coils are used inside the machine in order to prevent condensation of moisture.—*General Electric Review*, February, 1921.

High-Tension Transformers for X-Ray Work.—RUSSELL S. WRIGHT.—The author maintains that a satisfactory classification regarding either output or efficiency has not been reached, neither has any effective means been found for rating either induction coils or the closed circuit high-tension transformer in terms of their value to the radiologist. The author emphasizes the necessity for co-operation with medical experts in the design of this apparatus.—*Journal Institution of Electrical Engineers* (London), August, 1920.

Phase Compensation for Polyphase Motors.—VAL A. FYNN.—This article is a continuation of a series which the author contributed to the ELECTRICAL WORLD in 1913. In the former series he dealt with phase control in general and with the only method of controlling the power factor in synchronous motors with shunt characteristics which has, he says, become of practical value. In this article he considers other means of controlling the phase difference in non-synchronous single-phase motors and then passes to the phase control of non-synchronous polyphase motors, with numerous wiring and vector diagrams.—*Journal A. I. E. E.*, January, 1921.

Lamps and Lighting

Recent Developments of High-Current Arcs, with Special Reference to Searchlights.—J. PALEY YORKE.—This paper deals principally with the developments which have been made in high-current arcs between plain carbons during the war period and with a method of comparing the relative intensities of searchlight beams at working ranges. The main development of the high-current arc has been in the direction of increasing the current density through the carbons and across the arc gap. It is said to be possible to run plain carbons smoothly and silently at a current density up to 0.31 amp. per square millimeter of area of the positive carbons by means of electromagnetic control. The effects of impregnating carbons in so far as they apply to searchlamps are also described, and the characteristics of the high-current arc are briefly touched upon.—*Journal Institution of Electrical Engineers* (London), August, 1920.

Medical Lighting, Including Hospitals and Dental Offices.—A. L. POWELL AND H. H. ALLISON.—Hospitals as a class are held to be far behind other types of buildings in the matter of adequate lighting. Of one hundred hospitals in New York City visited only two were provided throughout with lighting equipment of the most modern type. Although these hospitals were equipped with the best surgical apparatus, artificial illumination had received practically no attention. The authors take up the hospital and general offices, room by room, to show what the requirements are for such rooms and to suggest suitable apparatus.—*Bulletin L. D. 121, Edison Lamp Works*, November, 1920.

Generation, Transmission and Distribution

Studies in Tidal Power—III.—NORMAN DAVEY.—In this number of the series the utilization of the gross power available is considered, as are the limitations and conditions that arise in the use of waterwheels in the service. Previous articles showed methods of calculating tidal power. An outline of the physiographic, engineering, commercial, industrial and economic problems which must be investigated in connection with tidal power is given. It is said that a good case may be made out for such a development in the Severn estuary.—London *Engineer*, Dec. 17, 1920.

Voltage Regulation on Long Alternating-Current Lines.—THIELEMANS.—The author takes as his starting point the old theorem saying that any condition of loading in an electric system may be formed by superposing the corresponding no-load and short-circuit conditions. The equation system of a transmission line then is formed, and a tripolar diagram is derived, which permits a rapid determination of voltages and currents for any given load and power factor of load. The diagram is used for a study of voltage regulation by means of synchronous condensers. A special "compensated voltmeter" is used in another system of voltage regulation. This voltmeter is installed at the generating station, but indicates the voltage at some point down the line—for instance, at the receiving station—and by means of a voltage regulator controls the generator excitation so as to maintain a constant received voltage. The compensated voltmeter, in order to give the desired indication, is connected so that it measures the vector sum of sending-end voltage plus the drop across a certain impedance through which flows a current proportional to the sending-end current. It is easy to show, by means of the system equations, how the voltmeter should be calibrated in order to show received voltage and what value the compensating impedance should have. The best regulating system seems to be one where an undercompensated voltmeter, controlling the generator excitation, is combined with a constant-voltage synchronous-condenser regulator at the receiving end. The effect upon voltage regulation of the terminal transformers is discussed. The article includes some rather complete three-phase voltage regulation diagrams, which refer to lines of 450, 500, 1,000 and 1,500 km. length at 50 cycles.—*Revue Générale de l'Electricité*, Sept. 25, Oct. 2, 9 and 16, 1920.

Preservative Treatment of Wood Poles—R. V. ACHATZ.—A survey of the State of Indiana was made and showed that a considerable proportion of the poles erected at the present time are receiving some kind of treatment. The most commonly used preservatives are derivatives of coal tar. Dead oil of coal tar or creosote oil and the higher boiling oils known as carbolineums are the most satisfactory preservatives. The commonly used treatments in Indiana are the brush treatment and the open-tank treatments, either by dipping or by the hot and cold process. A study of the economic side of pole preservation shows that under average conditions an increase in life of about two years will justify brush treatment, about three and one-half years will justify the open-tank dipping treatment in hot creosote, and about seven and one-half years the hot-and-cold-bath open-tank treatment. It is also said to be possible to increase the life of poles already in service to some extent by reinforcement and treatment after setting. Specifications adopted by various bodies for the purchase of preservatives and specifications for the application of the treatments recommended are included in the appendices of the paper.—*Circular No. 2, Engineering Experiment Station, Purdue University*, June, 1920.

Hydro-Electric Power in Norway.—W. E. WILLIAMS.—The latest available data, as summarized in this article, indicate that the total available power of southern Norway is 9,531,000 hp., of which 1,250,000 hp. is already utilized or in course of development. Water-power sites are said to be economically available if the cost of production does not exceed £25 per horsepower (pre-war conditions) and the horsepower is greater than 1,000. The location of the principal falls already developed at least in part and data concerning them are given in the following table:

Name of Station	Fall in Feet	Hp. Available	Hp. Developed	Use to Which Power Is Put
Rjukan I	930	136,000	135,000	Nitrate production
Rjukan II	830	122,000	122,000	Nitrate production
Tysse (Odda)	1,260	150,000	125,000	Carbide, cyanamide, etc
Glommen Falls				
Morkfos	66	70,000	44,000	
Kykpelsmo	62	66,000	42,000	
Vamma	87	93,000	58,000	Nitrate and general supply
Sarpsfos	66	70,000	44,000	Cellulose factories and carbide
Notodden (three falls)	305	72,000	60,000	Nitrate and carbide
Boilesfos (Arendal)	200	31,200	31,200	
Bielvo (Aalvik)	2,900	43,000	43,000	Town supply and carbid
Samnanger		30,000	30,000	Town supply
Vigelanfos	59	14,400	14,400	Aluminum
In course of development				
Mattre		96,000	74,000	
Tyin (Aardal)	3,500	80,000	80,000	
Austdola		43,000	43,000	
Lilledal	2,600	91,700	91,700	
Aura	2,600	156 000	142,000	

Further details of the principal installations shown in the table are given in the original article.—*Beama*, November, 1920.

The Distribution of Electricity.—W. B. WOODHOUSE.—Dealing with the distribution of electrical energy in broad measure the author's conclusions may be summarized as follows: (1) Three or more pressure systems are necessary for economy (a) for detail distribution, (b) for power purposes, and (c) for transmission or tie-line purposes. (2) The detail distribution pressure is fixed at a single-phase pressure of from 200 volts to 250 volts. (3) The size of the distributing substations is determined by the density of load and the size of power users' installations. (4) The distance between these substations depends primarily on the distribution pressure. (5) The main distribution pressure is determined by the number of substations in the area, the total load and the economical balance between expenditure on mains and substations. In industrial areas a pressure of 10,000 volts appears economical. (6) The extent of each power distribution network may be reduced with economy as the load develops and the size of substations increases. (7) The transmission pressure is primarily determined by a consideration of pressure drop and total power. No advantage is gained by exceeding a minimum fixed to meet demands anticipated to arise in a period determined by the rate of growth of load. (8) Main substations are determined in number by the load on the power distribution networks, the pressure distribution and the number of generating stations.—London *Electrician*, Dec. 3, 1920.

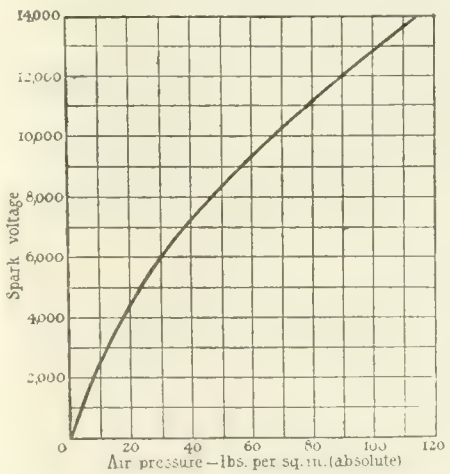
Traction

Advantages of Automatic Railway Substations.—CHARLES H. JONES.—The advantages of automatic over manually operated substations, according to experience on the North Shore & Milwaukee Railroad, are as follows: (1) Reduction in cost of substation operating labor; (2) reduction in power loss due to elimination of idle running time; (3) reduction in the size and length of feeders due to the increase in number of substations; (4) the alleviation of the electrolysis trouble in cities; (5) a substantial saving in substation building costs, and (6) increase in load factor on various machines.—*Electric Railway Journal*, Jan. 22, 1921.

Snow-Fighting Methods.—E. SEARS.—Snows of moderate depth—4 ft. to 5 ft. (1.2 m. to 1.5 m.) can easily be cleared by the wedge-type snowplow, but for deeper snows rotary plows are necessary. The performance of the electric locomotive is much more satisfactory than the steam locomotive, for the reason that it does not freeze.—*Electrical Journal*, January, 1921.

Installations, Systems and Appliances

Effect of Shunted Resistance, or Plug Leakage, on Sparking Performance of Electrical Ignition System.—G. E. BAIRSTO.—A series of tests were made to determine the effect of shunted resistance on the spark voltage of most of the leading types of electrical ignition systems. One of the limitations imposed on an electrical ignition system by the engine is that after a spark plug has run for some time it becomes a fairly good electrical conductor, owing to deposits of carbonized oil on the surface. Although the relation between the spark voltage and air pressure is not quite the same for all types of ignition systems and various magnitudes of leak, the curve shows a means for various systems and leaks, giving a typical relation.—London *Electrician*, Dec. 10, 1920.



DEPENDENCE OF SPARK VOLTAGE ON AIR PRESSURE

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

N. E. L. A. Convention to Be Held in Chicago, May 31 to June 3

ANNOUNCEMENT was made this week that the forty-fourth annual convention of the National Electric Light Association will be held in Chicago at the new Drake Hotel, May 31 to June 3, inclusive. While Hot Springs, Ark., had frequently been mentioned in connection with this year's convention, it was believed by President Martin J. Insull and the executive committee that because of the conditions attendant upon the reconstruction period it would be absolutely essential this year to hold the convention in a central place easily accessible from all parts of the country, and that geographically and from the point of view of transportation Chicago was the logical meeting place.

The Drake Hotel is at Lake Shore Drive and North Michigan Avenue, formerly called Lincoln Parkway. It is reputed to be the most modern hotel in the United States in every particular, and the N. E. L. A. convention will be the first to be held in the hotel following its completion. Further details of the convention plans will be announced later. It is expected that many important reports and papers will be presented, and men of national prominence will deliver addresses at the general sessions.

Favorable Money Rates to Rule for Well-Known Companies

THE flood of new financing has been loosed and millions in new securities are coming on the market. Other millions are scheduled. During the current week the investors had about $150,000,000 offered to them. These securities are coming from every direction—industrial, municipal, state, railroad, utility, oil, mining and foreign issues all forming part. For the most part the securities offered are long term. Six, 6½ and 7 per cents predominate, and issues of large nationally known properties are sold very close to par. The investment demand is still strong for issues of well-known companies. For issues of less well-known companies there is no demand, and salesmen have to go out and find the investor.

Such a situation has a very marked effect on electric light and power financing. Where well-known corporations pay a margin of four to six points to bankers and underwriters for disposing of an issue, less well-known companies will have to pay more. There are indications that, although the money market is easier in some ways, only the well-known companies will be able to obtain substantial reductions in the price of money. There is more money available for investment than there has been for two or three years, but there is more competition for that money.

Utilities without a national reputation and known only locally will undoubtedly find the best results this year in local financing. The large financial interests are not attracted by any except the best-known names, and there are reasons to believe that they will not engage in promoting little-known companies except at a margin of profit that is prohibitive.

New York to Test Water-Power Act in Courts

AUTHORITY to test the constitutionality of the Federal water-power act before the courts was given to the Attorney-General of New York State by the State Legislature in a resolution passed on Monday. Action will be brought to restrain the Federal Power Commission from exerting authority over power rights on New York boundary streams. This authority the state claims as its own.

New York State Will Require 3,500,000 Additional Hp. by 1930

A CONSERVATIVE estimate shows that the State of New York and the metropolitan district, which includes districts in New Jersey, will require an additional 3,500,000 hp. by 1930, according to a statement made by W. B. Parsons in his paper on "Heat, Light and Power for the Metropolitan District of New York," read before the American Society of Civil Engineers at New York on Wednesday evening of this week. The undeveloped water-power resources of the state practically available cannot be placed at more than 1,500,000 hp., so it is obvious that much of the power development that can be expected in the near future will be of the steam-electric type.

The problem of power development thus comes down to the utilization of the water-power resources to the fullest extent possible, Mr. Parsons said, and the transmission of such energy to the market centers of the state, including the metropolitan district.

The serious and widely extended differences in frequency constitute a big obstacle to serving a number of systems from a transmission line running through the state from the various developable water powers. There is now an installed horsepower of 700,000 at 60 cycles, 150,000 at 40 cycles and 1,950,000 at 25 cycles in the State of New York. In New York City 280,000 hp. is installed at 60 cycles, while the 25-cycle installations amount to 1,450,000 hp. In that portion of New Jersey included within the metropolitan area there is 250,000 hp. installed using 60-cycle current and 60,000 hp. using 25-cycle current.

It is on the metropolitan district that the burden of furnishing new installations will fall. Of the estimated 6,700,000 installed horsepower that should be in existence in 1931, 4,500,000 hp. will be found within a distance of 30 miles from the center of this district. The

hydro-electric transmission lines to the metropolitan district, varying in length from 100 miles, as would be the case from the Delaware River, to 250 miles from the Adirondack and more than 350 miles from the St. Lawrence and Niagara, present to the manager in the metropolitan district worries as well as advantages.

Great as are the potential water-power resources of New York, two things are obvious: (1) The amount is not in excess of actual requirements; (2) the objections to long-distance transmission will prevent the bringing of the whole of the supply to the metropolitan district from northern points. Here the demands for service are more exacting than in any other part of the state, and interruptions of service cannot be tolerated. To this end the distributing companies have assumed the burden of placing all their transmission lines underground.

Mr. Parsons pointed out that the water-power resources of New York could be developed along four different lines—first, the development of additional power at Niagara Falls; secondly, the St. Lawrence River development; third, the Delaware River, and, fourth, the streams lying wholly within the state.

Water Power Possibilities

The Niagara River has substantially 5,000,000 hp., which could be developed, but public sentiment would not permit this expensive utilization. The St. Lawrence River offers 500,000 hp. or 600,000 hp. along the New York boundary, or taking the whole river between Lake Ontario and Montreal perhaps 5,000,000 hp. Of the Niagara's power one-half would belong to Canada, and of the St. Lawrence power a certain amount, as will be fixed by international negotiations. The Delaware River probably would develop about 350,000 hp., of which 200,000 hp. might be secured by the State of New York. However, the State Conservation Commission claims but 40,000 hp. as being capable of development within the boundaries of New York State. In the streams lying wholly within the state there is a possible development of 1,000,000 hp.

Among the persons who discussed Colonel Parsons' paper were Farley Osgood, vice-president of the Public Service Electric Company of New Jersey; John W. Lieb, vice-president of the New York Edison Company; F. W. Smith, vice-president of the United Electric Light & Power Company; George Otis Smith, director U. S. Geological Survey. and W. S. Murray of the Super-Power Survey.

While Mr. Lieb classified the paper as an admirable survey, he expressed a doubt whether interconnection of electric systems in the Northeast Atlantic States will ever raise the load factor of the larger power plants appreciably, since the diversity factor of interconnected systems cannot be much greater than that of a large constituent like New York unless the load characteristics are entirely different. To assure reliable service Mr. Lieb contended that battery standby will always be necessary in New York and that any trunk line transmission should be of the most reliable double-circuit construction. Economies can be effected through interconnecting isolated plants and central stations, but several practical obstacles stand in the way. One of the best ways to increase load factor and hence economy, he said, is to develop battery charging loads.

F. W. Smith discussed the practicability of water power utilization in New York State and the possibilities of financing, referring particularly to objectionable features of water power regulations.

Federal Power Commission Appropriations

THE Senate has added the following amendment to the Federal Power Commission's item in the sundry civil bill: "For executive secretary, $5,000; chief clerk, $3,000; chief accountant, $3,000; accountant, $2,500; two assistant attorneys, at $2,500 each; clerks—one $1,400, one $1,200; civil engineers—one $2,400, one $2,100; hydraulic engineer, $2,400; electrical engineer, $2,400; mechanical engineer, $2,400; draftsmen—one $2,000, one $1,500; in all, $36,300."

The appropriation approved by the House of Representatives was in turn reduced to $80,000.

Southern California Edison Company Increases Dividends

AN EXTRA dividend of $1 per share of common stock in addition to the usual quarterly dividend of $1.75 has been declared by the Southern California Edison Company. This brings the common-stock rate up to 8 per cent and also will automatically cause the preferred-stock dividend rates to be increased to 8 per cent, as preferred stock participates with the common above 5 per cent.

This extra dividend, it is stated, is in a way a step toward the new "reward for efficiency" policy of the company, which has pending before the California Railroad Commission an application for authority to divide between the stockholders, the consumers and the employees those earnings which are due to increased efficiency in design and operation. In the month of January an order was handed down by the commission reducing the surcharges collected by the company from 27 per cent to 20 per cent, thereby granting the consumers a share in the results of greater economy.

Sees Solution of Trucking Problem in Use of Electric Vehicle

TRUCKING problems in the metropolitan district of New York and the part which the electric vehicle will play in their solution were discussed at the three hundred and eighty-ninth meeting of the New York Electrical Society on Wednesday evening, Feb. 9. William H. Onken, Jr., editor of the ELECTRICAL WORLD, speaking for James H. McGraw, president of the McGraw-Hill Company, on "The Electric Vehicle for City Delivery," brought out the fact that much time and money could be saved in handling freight at steamship piers and railroad terminals by the use of electric trucks. Deliveries of coal on short hauls can be made by these trucks at a cost approximately 60 per cent less than that of gasoline-driven trucks. The same saving holds true of the average of all other city deliveries.

The field for the electric truck has scarcely been touched, declared Arthur Williams, in discussing the "Electrotechnical Aspect of City Trucking." The amount of money paid out in the United States for secondary transportation, to which the electric truck is particularly adapted, he stated is sixteen times that of the country's total freight bill. Use of the electric truck to speed up the handling of commodities in congested city terminals and streets would effect an enormous saving.

J. J. Riordan, president of the United States Trucking Corporation, in describing the "Trucking Problem of New York," said electric industrial and commercial trucks would be the means of relieving traffic congestion.

Edison Pioneers Hold Annual Gathering at Inventor's Home

BY INVITATION of Mrs. Thomas Alva Edison the Edison Pioneers met yesterday in celebration of Edison's seventy-fourth birthday at "Glenmont," Llewellyn Park, West Orange, N. J., the inventor's home. This gathering took the place of the annual luncheon of the organization. A meeting took place, immediately after the arrival of the members, in a room placed at their disposal by Mrs. Edison, who served a buffet luncheon to them and the members of their families who accompanied them. A reception and special exercises followed. William J. Hammer is the president of the Edison Pioneers and T. Commerford Martin was chairman of the reception committee.

Kansas Would Separate Utility Regulation from Industrial Court

GOVERNOR ALLEN has recommended in a special message to the Kansas Legislature this week taking public utilities from the jurisdiction of the Court of Industrial Relations and creating a new utilities commission. A bill to that effect has been introduced into the Kansas Legislature. It contains a provision that in utility matters where labor is interested the judges of both courts shall sit. The effect of this provision, is is said, would be that in most of the really important utility cases the two courts would join, but the industrial court would be relieved of considering a multitude of small utility matters.

To Take Power of Removal of Utility Board from New Jersey Governor

THE New Jersey State Senate has passed a bill creating a state public utility commission of three members in place of the board of five members now authorized and extending the term of the commissioners to six years, with annual salary increased to $12,000 a year for each commissioner. The bill eliminates the feature of the existing law giving the Governor the power of removal for neglect of duty or misconduct and substitutes therefor trial by impeachment. The new measure has been sent to the House, where it seems likely of early passage. The proposed law is an aftermath of the controversy, still pending, between Governor Edwards and the present utility board, which officially has been removed from office, but pending decision by the Court of Appeals continues to function.

West Virginia Commission Being Officially Investigated

BILLS have been introduced into the West Virginia Legislature to abolish the Public Service Commission of the state. These bills have grown out of public dissatisfaction with increases allowed public utilities, especially the gas companies. No action has been taken on any of these bills, but on the insistence of the commission that its official acts be reviewed a committee has been named by the Legislature to inquire into the manner in which the commission has discharged its duties.

In addition to the bill to abolish the Public Service Commission measures have been introduced providing for the transfer of its activities to other bodies already in existence. However, it is regarded as being extremely doubtful whether favorable action will be taken upon any of these bills in the form in which they are introduced.

Indiana Engineers Support Utility Commission

THE abolition of the Indiana Public Service Commission and the re-establishment of the utility service rates in effect in 1913, as proposed in House Bill No. 75 in the Indiana Legislature, would be an act of economic retrogression which would entail loss and inconvenience to the people of the state and would throw a great many of the public utility companies into bankruptcy, was the sense of resolutions opposing the bill and passed by the Indianapolis-La Fayette Section of the American Institute of Electrical Engineers, the Indianapolis Chapter of the American Society of Mechanical Engineers and by the Indiana Engineering Society during the course of the forty-first annual convention of the Indiana Engineering Society in Indianapolis a short time ago.

California Commission Investigation Aims to Restore Public Confidence

EMPHATIC declaration has been given by State Senator John M. Inman, chairman of the legislative committee that is investigating the workings of the California Railroad Commission, that there exists no thought of attack on the integrity of the commission. It is the purpose of the committee, Mr. Inman said, to get the commission and the people into closer contact and "to bring to the people the confidence in this great body which it once had."

The occasion for this assurance was a hearing in San Francisco at which John J. Daily, assistant city attorney, asserted that the abolition of the commission would be a calamity and "the biggest crime ever attempted in the State."

Governor Small Appoints New Utility Commission for Illinois

SUSPENSE concerning the Illinois Public Utilities Commission situation was relieved by the announcement on Thursday of last week that Governor Small had appointed a new commission. The appointments are as follows: Chairman, Frank L. Smith, Dwight, Ill., retiring Congressman from the Bloomington district; Cicero J. Lindley, Greenville, a member of the Railroad and Warehouse Commission during the Tanner administration; Patrick H. Moynihan, South Chicago; Hal W. Trovillion, Herrin, and James F. Sullivan, Chicago. The old members of the commission still remaining will retire. It is rumored that there is considerable question whether Mr. Smith will accept the appointment.

United Engineering Society Elect Officers

AT THE annual meeting of the board of trustees of the United Engineering Society Jan. 27 the following officers were elected for the ensuing year: President, J. Vipond Davies; first vice-president, Calvert Townley; second vice-president, W. L. Saunders; secretary, Alfred D. Flinn; treasurer, Joseph Struthers; assistant treasurer, George H. Pegram.

European Market Will Grow with Power Development, Says F. L. Driver

DEVELOPMENT of the European market for electrical merchandise, including labor-saving devices, must naturally follow the greater extension of electric service, especially that derived from natural resources, according to Frank L. Driver, president of the Driver-Harris Company. Mr. Driver spent four months in Europe last spring, and upon his return to this country on Jan. 20 after spending a further period of two months abroad in the direction of his company's two manufacturing subsidiaries, one in England and the other in France, he was asked by the ELECTRICAL WORLD to outline his impressions of the fundamental economic conditions of Europe with especial reference to the socket-device market.

"Demand for labor-saving devices in Europe is growing," said Mr. Driver, "but not so fast as in the United States. There is not the variety of devices there that exists here, nor is there so much duplication of lines. The greatest use will undoubtedly come from those countries having abundant natural power resources, such as Switzerland and Italy. In England, where the average home does not now have electric service, development of the socket-device market must be slow, but it will follow the greater use of electricity which will come as the nation's power facilities are increased.

DEMAND FOR POPULAR-PRICED DEVICES

"European requirements call for a sturdy utility device to sell at a popular price to compete with similar lines made locally in a rather crude fashion. Trimmings, which add an element of price, are looked upon in Europe as luxuries. Furthermore, the average European, because of taxes and other onerous living conditions, has become more thrifty than ever before."

English labor, Mr. Driver pointed out, was engulfed in a wave of extravagant spending during the war and for a time afterward. Wages were decidedly greater, and the working classes simply "blew in" their money on luxuries that they had never been able to enjoy before the war. This desire for luxuries, however, Mr. Driver said, was not translated to any considerable degree into a greater use of electric service in the home. In France, according to Mr. Driver, the people are more thrifty and the spending wave was not so apparent.

In general Mr. Driver is inclined to take an optimistic view of the business situation both in England and France. He said that in his conversations with business men in those countries the opinion was freely expressed that changed conditions had to come sooner or later, and the general impression which he gathered was that the bottom of the depression had been reached.

"While I am confident that the European situation will work out favorably," Mr. Driver declared, "some steps must be taken by American financial interests to encourage it. Europe wants and needs our money. It wants us to establish business there and welcomes us with open arms. However, it must have extended credits, and we must find some methods for granting them. You can't ask individual firms to do it because of their inability to carry such a load singly. Nevertheless, there must be some credit link.

"If Europe can only secure raw materials, there are sufficient factory accommodations to work it up. The spirit of labor to work is splendid, only of course it must be directed. In England especially, where for a while the working class was on the brink of revolt, labor is now very steady. Wages are higher than before the war and in general in England and France are about half what they are in the United States."

When asked how the Russian situation was viewed abroad, Mr. Driver said that the impression he gained was that affairs would be allowed to drift until they found their level. There was no evidence, he added, of any desire on the part of European nations to trade with Russia, though perhaps Germany should be excepted.

Mr. Driver has been a student of European economic conditions and methods of doing business for a number of years. Back in 1910 his company, then the Driver-Harris Wire Company, established an agency in England and shipped goods over on order. This procedure was found to entail too much delay, and to obviate this goods were shipped on consignment, a practice which was followed until 1917, when the business had reached $300,000 or $400,000 annually. Then the next step of establishing an English manufacturing company followed, and, according to Mr. Driver, the results have fully justified the step. Raw materials are now sent from the United States to this factory for fabrication there. The English company, known as Driver, Drennan & Cooper, Ltd., now does all the melting to make castings and produces a line of nickel-chromium alloys in wire and sheet. The English company finds a market for resistance wire, cable, flat strip, pure nickel, copper-nickel alloys and castings not only in England but also in Italy, Switzerland, the Scandinavian countries, Spain and France.



FRANK L. DRIVER

Electricians' Strike Follows Wage Reduction

REDUCTION in wages of cable splicers from $8 to $7 per day, of linemen from $7 to $6 per day and of operators from $200 to $175 per month by the Great Western Power Company of California has been followed by a strike. The company says that less than half of its men have left, that its service has not been impaired and that new men are rapidly filling the places vacated.

The company claims that the increase of $1 per day granted last year was to compensate for increased living costs, which have now materially decreased. The company further states that the last increase put its wage rate above those generally in effect on neighboring systems. The strikers assert that last year the company received an increase in rates to compensate for the increases in wages, but that with this decrease in wages there has been no corresponding decrease in rates.

Senate Votes for Continuance of Muscle Shoals Work

THOSE who favor a continuance of the development work being done by the Government at Muscle Shoals on the Tennessee River are much encouraged by the action of the Senate Feb. 5, in the face of strong opposition, in upholding the committee on appropriations, which had inserted in the sundry civil bill an appropriation of $10,000,000 for the Wilson Dam. The committee on appropriations of the House declined to include the item in the bill, and an effort made on the floor to embody it failed by a small margin. There is some doubt whether the item can be retained in conference.

Senator Underwood stated that since expenditures are continuing each day there is every prospect that the full $17,000,000 at the disposal of the engineers will have been expended or obligated before any action is taken to discontinue the work. If Congress refuses to carry on the existing work, he declared, the next big rise of water in the Tennessee River will wash the Government's $17,000,000 down stream.

Senator Lenroot of Wisconsin, one of the most active opponents of any development at Muscle Shoals, predicted that neither the dam nor the nitrate plant will ever be used for the making of fertilizer. The Government, he said, will expend its $50,000,000 on this dam and "then we will have one customer, the Alabama Power Company, a corporation organized in Montreal and British-owned." When the dam is completed, Senator Lenroot asserted, he expects the Alabama Power Company to offer the Government $10 per horsepower-year, which it will resell for $20. The Government either would have to accept that proposition or expend an additional $29,000,000 for a distribution system. He thought that the Government would accept the Alabama Power Company's offer.

Conferees Approve Provision for Higher Patent Office Salaries

CONFEREES of the Senate and the House have approved the Patent Office bill providing for the higher scale of salaries authorized by the House and including the provision that the Federal Trade Commission administer patents taken out by government employees. Opposition to the adoption of the conference report is anticipated because of this latter provision. It is fully expected, however, that the bill will become a law as approved by the conferees.

The increase in the salary scale at the Patent Office was regarded as an urgent necessity. The efficiency of the whole service is menaced because properly qualified examiners cannot be attracted by the present scale of salaries. At present out of the ninety-four examiners employed in the Patent Office fifty-six are temporary employees because the Civil Service Commission cannot obtain an eligible list.

Enthusiastic Electric Vehicle Luncheon



WHAT was probably the largest single gathering ever held to sing the praises of electric transportation occurred on Feb. 2 when between two and three hundred sat down to luncheon at the Hotel Astor in New York to celebrate the first electric vehicle show, then in its first week. Speeches as reported in last week's ELECTRICAL WORLD on page 333 were made by former Governor Alfred E. Smith, now president of New York City's largest trucking company; William H. Onken, Jr., editor of ELECTRICAL WORLD, who spoke for James H. McGraw, president of the McGraw-Hill Company; Robert E. M. Cowie, vice-president of the American Railway Express Company, and Arthur Williams, general commercial manager of the New York Edison Company and under whose guidance the show is being conducted.

Hortonia Company Quickly Rebuilding Damaged Station

RECONSTRUCTION of the Otter Creek hydro-electric station of the Hortonia Power Company at Middlebury, Vt., is proceeding rapidly after its recent serious damage by fire, according to advices from I. M. Frost of Rutland, Vt., vice-president of the company. The station structure, switchboard and coils of generating and exciter equipment were destroyed on Jan. 15 at 9 a.m. In the afternoon clearing of the ruins was begun, orders were placed by telephone with the General Electric Company for a new switchboard, and repair men were promptly mobilized to remove the damaged coils. The station structure was scheduled for completion in the first week of February, and it is hoped to have at least one of the three units in operation turning out 1,000 kw. by Feb. 20.

Martin Insull Voices Necessity of Publicity

PUBLIC utility business ceases to become a natural monopoly when those in charge of the operating companies go into the markets of the world for money, President Martin Insull of the National Electric Light Association declared before the New England Geographic Division at Boston on Jan. 26, when he emphasized the vital importance of publicity in making the problems and the service attainments and possibilities of the electric light and power industry clear to the people. The speaker emphasized the importance of bringing home to local publics the high percentage of good service rendered them. He declared that good service cannot go ahead of increased rates. Service and reasonable rates go together, but without reasonable rates good service cannot be kept up.

The publicity campaign of the national association, the speaker said, should be supplemented by the spoken word of the central-station man in the communities which he serves. As a general proposition the American people judge fairly when all the facts are given to them. "Let us give them the facts and not permit them to be dependent upon the information handed them by demagogues," said Mr. Insull. The speaker briefly outlined the immense importance of public utility service from the social and industrial standpoint, picturing the disasters which would be entailed by its cessation. Things like this, he said, should be brought home to the public in all parts of the country, and the magnitude of the investment required to serve the public should be made clearer. A single strike by the operators of a small independent telephone company near Chicago caused five deaths and one disastrous fire, Mr. Insull said, in illustrating the point.

All that can be obtained under regulation, he continued, is a fair return upon the investment. Regulation by competition is economic waste. Mr. Insull said that he was a strong believer in regulation, but that the industry needs a flexible regulation which can change rates as conditions require.

During his address President Insull touched upon the value of interconnection, stating it has not made any great profit for the investor, but has given the small community the same facilities as are available in the city. Interconnection has literally made two blades of grass grow where one grew before. Only 60 miles of transmission line remain to be built in order to tie together St. Paul, Chicago and Indiana companies. Only a 30-mile gap remains between Indianapolis and Louisville via the Keokuk transmission line.

Worcester Company Reduces Rates

ONE cent per kilowatt-hour will be taken off the residential lighting, heating and cooking rates of the Worcester (Mass.) Electric Light Company on bills rendered on and after March 1. These rates, declared F. H. Smith, assistant general manager, are to be put into effect in spite of the fact that the company has a six months' supply of coal on hand purchased at higher costs than the present market demands. The maximum rate will drop from 9 cents to 8 cents per kilowatt-hour under the new schedule, or only ½ cent above the rate in vogue last fall, from which the advance to 9 cents took place. Notwithstanding the business recession, the diversity of loads carried by the company has enabled its earnings to be well kept up, and only a moderate falling off in energy output has been experienced.

"Coal Clause" Disapproved by Michigan Commission

GROWING disfavor on the part of public service commissions for rate schedules that go up and down in ratio with the varying price of coal was exemplified at Hancock, Mich., a week or two ago, when the Michigan Public Utilities Commission barred out the "coal clause" contained in the rates of the Houghton County Electric Light Company, a Stone & Webster Company. In announcing the attitude of the commission in this regard Chairman Sherman T. Handy said:

"We believe that the coal-clause charge is not a good thing for the company. We do not believe it is a good thing for the community. I do not care how honest a company may be—so long as it is left in its power to fix the rates by the so-called coal-clause charge there is bound to be some criticism and some charges of dishonesty. No public utility can afford a situation of that kind. A public utility to be completely successful must in addition to having a complete plant have the complete confidence of the community. That is the only asset it has. We regret that there is any feeling in Houghton County between the company and the users. We believe that anything which will tend to restore the confidence of the public in the utility would be a good thing. We believe that this coal clause should not be further considered; that we should direct our attention from now on to what will be a proper rate, eliminating the coal clause charge."

Detroit Edison Will Offer Stock to Local Investors

COMMON stock amounting to 20 per cent of the total stock of the company outstanding is soon to be offered to local investors by the Detroit Edison Company, according to the annual report for 1920, made by President Alex Dow, who says that the present stockholders of the company have responded satisfactorily to the company's recent invitation to waive their rights of subscription to the proposed new issue. At the end of 1920, more than half of the company's outstanding stock was held by residents of Michigan.

Wisconsin Metermen's School a Success

FROM Jan. 31 to Feb. 4 an electrical metermen's school was held at the electrical engineering laboratories of the University of Wisconsin under the auspices of the university extension division and the College of Engineering with the co-operation of the Wisconsin Railroad Commission and the Wisconsin Electrical Association. Eighty-one men, representing more than fifty utilities of the state, were registered for the course. The manufacturers of watt-hour meters each had one or more men present who assisted both by lectures and by personal instruction.

Those taking the course received instruction in specific problems of installing, testing and the maintenance of the different kinds and types of meters both with and without transformers. The lectures covered such subjects as electrical units and measurements, principles of watt-hour meters, meter constants, meter adjustments and instrument transformers. In the laboratories the men installed, tested and adjusted the meters according to specific directions. The course was so successful that most of the men expressed a desire to have it repeated next year.

Federal Reserve Board Sees Turn for the Better in General Business

IN ANALYZING the reports of its member banks on general business conditions during the month of January, the Federal Reserve Board makes the following statement:

"The business developments during the month of January have shown a slight but unmistakable turn toward a better state of affairs. At some plants where considerable numbers of men have been unemployed industrial operations have been resumed in whole or in part. The Bureau of Labor, however, reports a total of 3,473,466 unemployed for the country as a whole. Prices in many lines have gone no lower than the level which had been established at the close of 1920. Banking conditions have materially improved, partly through the steadier and more rapid movement of agricultural products to market and partly through the more rapid liquidation of paper already held by member banks. As a result the reserve ratio of the Federal Reserve System has risen to 49 per cent at the last reporting date in the month (Jan. 28). Member bank conditions also show improvement in liquidity and increasing strength. Failures have been relatively fewer. There are signs of a distinct improvement in certain branches of the textile trades, while retailers are now beginning to buy much more freely and actively than heretofore owing to the depletion of the stocks on their shelves. Transportation supply has been fairly equalized with demand, and there is now little or no delay of goods going from producer to consumer. Farm products, although fluctuating more or less widely, have maintained themselves at prices substantially equivalent to those established during December. There has been little or no gain in export trade conditions, but preparations for the placing of export financing upon more satisfactory basis were believed to lay the foundation for a distinct improvement of the outlook. Retail prices have shown during the month of January a much greater tendency to reflect the changes that had already occurred in wholesale prices. While, therefore, it cannot be said that very material alteration of fundamental conditions has occurred, enough progress has been made to give assurance of a steady movement toward sounder conditions in business."

Oklahoma Gas & Electric Retires Underlying Securities

FOR the purpose of retiring underlying bonds and notes and the payment of floating debt incurred for extensions and additions to its property the Oklahoma Gas & Electric Company offered this week a six-million-dollar issue of twenty-year first and refunding mortgage 7.5 per cent gold bonds at a price to yield the investor about 8 per cent. This issue, together with the issue of $2,500,000 bond-secured 8 per cent convertible gold notes reported in the ELECTRICAL WORLD last week, will provide funds for wiping out the closed mortgages of all underlying properties.

Permanent Financing Plan Proposed for San Joaquin Company

BECAUSE of the large increase of business and the increased activity in construction work undertaken by the San Joaquin Light & Power Corporation, Fresno, Cal., in the past few years, the company is contemplating increasing its capitalization from $25,000,000 to $150,000,000. It is proposed to increase the total authorized stock issue, divided into three classes of stock which are now authorized and outstanding, without any change in the characteristics of any class of the stock. Provision will also be made for the issuance of bonds. It is believed by the officials of the company that these plans will provide a financial structure sufficiently flexible to meet the varying money-market conditions. While the increased capitalization is being authorized at this time, the additional stocks and bonds will not be issued until the money is actually needed to pay for new work done and only as earnings justify their issuance.

Detroit Edison's 1920 Earnings Did Not Keep Pace with Demand

GROSS revenue of $21,990,351, expenses totaling $17,456,658 and net income, after paying interest on funded and unfunded debt, of $2,070,936 are shown by the annual report of President Alex Dow to the stockholders of the Detroit Edison Company for 1920, which has just been issued. In each case the figures are approximately $5,500,000 above the corresponding ones for 1919. Well over a billion kilowatt-hours was generated in 1920, an increase of nearly 15 per cent. Although the demand reached a maximum, earnings did not increase in proportion. This was due to three causes—operating during different periods—the railroad strike of April, which interfered with the company's coal supply and forced a suspension of service for a week or two to "non-essential" industries; the slow delivery of equipment ordered in good time, which forced a curtailment of output from May to October, and the industrial depressions which caused a slump in demand in November and December, just after a third new turbine had afforded the much-needed increase in generating equipment.

The operating ratio was the highest in the history of the company, being 77.6 per cent. In 1919 the figure was 68.9. It was 67.2 per cent in 1918, 63.8

in 1917 and 54.5 in 1916. The causes, the report says, are obvious—wage rates above the high figure of 1919, no opportunity until late in the year to make the replacements needed to improve production efficiency, the several periods of reduced output recited, but, far above all other causes, the excessive prices charged for coal and the poor quality of the coal purchased at excessive prices.

The company is still paying the highest wages it has ever paid, and no horizontal reduction is expedient or possible, though wages in certain classes will be lower. The rate schedule as it stands is proportionate to the prices for coal which the company expects to prevail in 1921.

For the first time in the history of the company the profit and loss account shows a reduction of surplus, which now stands at $1,653,687, as compared with $2,659,758 a year ago.

Mr. Dow concludes with an expression of optimism as regards 1921, based on the disappearance of the company's mechanical difficulties, the rate increases accorded to it and its sound foundation of general and permanent public service.

Hearings on Calder Coal Bill to Be Continued

HEARINGS on the Calder coal regulation bill continued much longer than was contemplated originally. The complexity of the problem was so impressed on the committee that the plan to limit the hearings to three days was abandoned. At this writing it seems very probable that the bill will be reported favorably to the Senate within the next few days. It is admitted, however, that it will be amended in important particulars.

With the extension of the hearings the possibility of passing the legislation at this session of Congress has grown materially less. The bill is certain to provoke extended discussion.

No Serious Objections to Tyler Report on Great Falls Development

LITTLE opposition to the Tyler report on Great Falls developed at the hearing conducted by the Federal Power Commission Feb. 1. The fact that the important interests concerned interposed no objections and showed no tendency to challenge any phase of the report is regarded as significant. Another important development at the hearing was the emphasis given to the advisability of treating the water-supply problem of the District of Columbia as a separate project.

The Secretary of War, in opening the hearing, made a plea for the early development of the power at Great Falls as well as at every other available site in the country. He expressed the opinion that the demand for power in the District of Columbia and the adjacent areas of Virginia and Maryland is so great that there is no likelihood of putting a large steam plant in Washington out of business.

J. H. Leavering, an independent engineer, representing no special interest, suggested that the Chain Bridge dam could be made 150 ft. high and would result in important economies. He has a plan for development which would cost less money, he says, and would insure the delivery of power in Washington at 3 mills per kilowatt-hour.

Col. Charles W. Kutz, the engineer commissioner of the District of Columbia, stated that the District commissioners believe that the report is entirely reasonable and the project capable of effective accomplishment. He pointed out, however, the desirability of keeping separate the federal project of developing the power and the District problem of obtaining a water supply.

William F. Ham, president of the Potomac Electric Power Company, inquired of the commission whether the Great Falls project is a part of the superpower plan which is recommended by the United States Geological Survey. He urged that all possible notice be given of the government's plans so that his company shall not expand wastefully its large steam plant.

Malicious Cartoon Reflecting on Water Power Development



THE CARTOON adjoining was published in the *Saturday Evening Post* of Jan. 29 and has created a sensation among the electric light and power people. It would be uncomplimentary to print the remarks emanating from the operators of hydro-electric systems, particularly those seeking permits for further development under the water power act. Not only is the cartoon malicious in their opinion because it will make it so much harder to finance water-power projects, but it is absolutely false in its portrayal. The water-power licensees, they claim, have no designs on the national parks whatsoever. Lumbermen, miners, and others, they say, may mar the natural beauties of our forests and parks, but the electrical engineers will not. Electricity, they claim, is the expounder of beauty, not its desecrator.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrifying the Liverpool Docks.—Progress is being made on the project to electrify the docks at Liverpool, England. In the case of the Hornby dock all the main cables have been laid, a generating station has been built and the installation of machinery and wiring of sheds is well advanced. Contracts have also been placed for the electrification of the Gladstone dock.

Total Horsepower of Electric Central Stations in United States.—A recent tabulation of the horsepower of electric central-station plants in this country gives the following figures: Steam engines, 1,781,000; steam turbines, 9,635,000; waterwheels, 3,377,000; gas and oil engines, 207,000; boilers, 3,895,000. Adding to this 19,050,000 hp. for electric generators, a total of almost 38,000,000 hp. results.

Accuracy of Electric Meters in Greater New York.—In the first ten months of 1920 the Public Service Commission, First District, New York State, which has jurisdiction over the public utilities of Greater New York, tested on complaint 700 electric meters. Of these 145 were found to be fast and 65 slow. Of the fast meters nine were from 4 to 10 per cent inaccurate and one was more than 20 per cent wrong. Of the slow meters three were from 4 to 10 per cent inaccurate and one was more than 30 per cent wrong.

A Sicilian Hydro-Electric Project.—Near Palermo, Sicily, according to a newspaper printed in that island, great hydro-electric works are being constructed by an Italian firm. The main reservoir will entail the submersion of more than 1,150 square miles. A waterfall of 1,580 ft. will be induced, which will be used for actuating three groups of alternating-current turbines, each rated at 3,500 kw. The plant, which it is hoped to have in full working order by 1922, will have an output of 16,000,000 kw.-hr. a year, which will be used for irrigation and industrial purposes.

Electrical Unloading in China.—If there were any place left in the world where the manual way of doing things would be cheaper than the electrical one would think that it would be China, with its overabundant supply of the cheapest labor. Yet a British member of the Engineering Society of China, writing in the London *Electrician*, describes how 3,000 tons of ore, limestone, coal and coke are daily being unloaded from the boats of the Han-Yeh-Ping Iron & Coal Corporation at Yangtze River docks by electrically operated grab buckets. The plant was erected by native labor under the direction of the English engineer, and when the latter left China 270,000 tons of material had been unloaded without an accident of any kind. The corporation, said to be the largest industrial company in China, is under native management and its $60,000,000 of stock is owned by Chinamen.

Electrical Accidents in Central Stations and on Systems of New York City.—Fifteen fatal accidents and thirteen others involving grave injuries to individuals occurred in the power houses and on the distribution systems of New York City electric light and power companies in the ten months ended Oct. 31, 1920, according to the Public Service Commission, First District. Total accidents of every degree of seriousness were 5,768, of which 4,951 were to employees and 817 to others.

Three-Million-Dollar Southern Corporation to Build Electric Plants.—A three-million-dollar corporation, the Union Power Company, organized at Shreveport, La., will, a dispatch to the *Manufacturers' Record* says, construct a number of large electrical plants in the Monroe (La.) gas field for the distribution of electricity for lighting and power purposes over north Louisiana, southern Arkansas and possibly points in Texas and Mississippi. The company, which is said to be amply financed, has acquired title to the natural-gas rights in thousands of acres and will begin immediately to construct gas-pipe lines and electric plants.

Work on Arkansas Hydro-Electric Project Soon to Start.—Work will begin on the dam for the hydro-electric power plant on the White River, above Cotter, Ark., just as soon as the drill can be set, according to a correspondent of the *Manufacturers' Record*, and a chamber of commerce is being organized to promote the industrial development of a territory about 150 miles long by 20 miles wide, extending from Newport to Yellville. The manganese, zinc, lead, phosphate, glass-sands, tripoli, cement, marble, sandstone, oil and natural-gas industries are among those which the promoters of the scheme expect to see developed with the aid of electric power.

California Public Utility Security Issues in 1920.—During the twelve months ended Dec. 31, 1920, California utilities—steam and electric railroads, gas and electric companies, water companies, telephone and telegraph companies, warehouse and steamship companies and motor companies—filed with the commission applications to issue securities that aggregated $179,668,083. The commission approved applications to the extent of $152,119,927, denied applications totaling $250,500, dismissed requests aggregating $3,491,560, and on Dec. 31 had pending applications totaling $50,678,783. In the official summary of the commission gas and electric companies are grouped together, their total security issues amounting to $82,515,708, as compared with $56,095,461 in 1919.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New York Section, I. E. S.—At the meeting of this section of the Illuminating Engineering Society held Feb. 10 William V. Kelly gave a demonstration of the making of colored motion-picture films.

Akron Section, A. S. M. E.—C. Harold Berry of the Detroit Edison Company will speak on "The Heat Balance of a Power Station" before this section of the American Society of Mechanical Engineers on Friday, Feb. 25.

Iron and Steel Electrical Engineers.—"Methods Used to Insure Continuity of Service" will be the topic of E. D. Sibley of the Metropolitan Edison Company, Reading, Pa., who will read a paper before the Philadelphia Section, A. I. and S. E. E., on March 5.

Civil Engineers Hear Mr. Harper.—John Lyell Harper, vice-president and chief engineer Niagara Falls Power Company, addressed the American Society of Civil Engineers at New York City on Wednesday, Feb. 2, on "The Construction of the World's Largest Hydro-Electric Units."

Weather Forecasting to Be Discussed at Western Meeting.—Co-ordination of the efforts of various bodies to forecast weather conditions some months in advance will be attempted at a meeting to be held in the San Francisco Commercial Club rooms Feb. 18 under the auspices of the Technical Division of the National Electric Light Association. Prominent men from the Weather Bureau, the University of California and the electrical industry will address the meeting.

Coming Meetings of Electrical and Other Technical Societies

American Engineering Council—Syracuse, N. Y., Feb. 14. (See issue of Feb. 5, page 330.)

Association of Iron and Steel Electrical Engineers—Cleveland Section, Feb. 14; Birmingham Section, Feb. 19; Chicago Section, Feb. 19; Philadelphia Section, March 5.

New Mexico Electrical Association—Albuquerque, Feb. 14 and 15.

American Institute of Mining and Metallurgical Engineers—New York, Feb. 14-17.

A. I. E. E.—Midwinter convention, New York, Feb. 16-18. (For program see issue of Feb. 5, page 336.)

American Institute of Electrical Engineers—Chicago Section, Feb. 28; New York Section, March 11; Schenectady Section, March 18.

American Physical Society—New York Feb. 25 and 26.

Associated Manufacturers of Electrical Supplies—New York, March 15.

Wisconsin Electrical Association—Milwaukee, March 23 and 24.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Necessity of Co-operation Between Company and Patrons. — Urging the need for co-operation between central-station companies and their patrons in small communities, the Montana Public Service Commission, instead of granting increased rates to the Eastern Montana Light & Power Company at Wibaux, recommended the establishment of dusk-to-dawn instead of twenty-four-hour service and held the case open for a period of thirty days to allow the company and its consumers to come to an agreement on the period of operation.

Powers of North Dakota Commission. —The North Dakota Board of Railroad Commissioners possesses, it has asserted, full authority to exercise the police power of the state with reference to rate making, even where maximum rates may have been agreed upon in charters or franchises. This authority is in no wise limited by the provision of the utilities law providing for approval of a sliding scale of rates. The statutory power of municipalities in North Dakota to regulate rates of utilities by ordinance does not give an implied power to the municipalities to make binding contracts fixing rates.

Deposits to Cover Cost of Service Connections Prohibited.—The Public Service Commission of Pennsylvania has ordered the Eastern Pennsylvania Light, Heat & Power Company to desist from the practice of requiring deposits to cover the costs of making service connections, holding that electric lighting and power companies are not justified in demanding that a prospective consumer supply capital for the labor and material required to make such a connection and that they are sufficiently protected by the right accorded them to require a deposit from the customer to secure payment for electrical energy delivered.

Georgia Commission's Views on Rate Fixing.—In a decision granting increased electric light and power rates, gas rates and street-railway fares to the Georgia Railway & Power Company, the Georgia Railroad Commission declared it to be unfair to the public to prescribe rates exclusively upon a basis of value determined by the cost of reproduction new at a time when such cost is abnormally inflated. The commission did not make a special allowance for going-concern value or for good will, but took into consideration the added value in the physical properties themselves attaching because of their assembly, unification, adaptation and utilization in the purposes for which as a whole they were designed. The mere fact that a utility is operating under temporary emergency rates is no reason, the commission held, why it should not make a second emergency application if the conditions have so changed that existing rates are not sufficient. Rates should not be such as in themselves would supply new capital, but such as to justify capital investments in competition with other business ventures. Losses or inadequate returns in one department of a utility should not be saddled upon another department. The commission found a return of 6 per cent too low and indorsed rates designed to yield 8 per cent.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Free Service to Municipalities Condemned.—A provision in a franchise requiring an electric company to furnish electricity for lighting city buildings free of charge should be eliminated, the North Dakota Board of Railroad Commissioners has declared, since the expense of such service should be borne by all citizens benefiting therefrom and not entirely by the consumers of electrical energy. The rate for street lighting, the commission holds, may reasonably be lower than general lighting rates where a considerable portion of the evening and night load of the electric company is made up from the energy supplied for such street-lighting purposes.

Proposed 70 to 300 per Cent Increase in Municipal Power Rates Unreasonable.—In arranging an increased rate schedule for the municipal electric plant at Kiel, Wis., the Railroad Commission of that state found that under existing conditions an increase of 60 per cent was necessary, but disapproved as neither reasonable nor practicable the suggested power schedule, under which the rate for energy used under the first step would have been increased about 70 per cent, that under the second step 140 per cent, under the third step 200 per cent, and the excess between 200 per cent and 300 per cent. Under these proposed rates power customers using more than 250 kw.-hr. a month would have paid more for their energy than if purchased under the lighting schedule.

Contract Offending Interest of General Public Disallowed.—In dismissing an appeal for a rehearing of a case brought by consumers against the Pine Grove Light, Heat & Power Company, the commission having at the original hearing refused to sustain contract rates superseded by a new tariff, the Public Service Commission of Pennsylvania found from the testimony that complainant uses 80 per cent of respondent's output, for which the company receives 42 per cent of its gross receipts, and that the operating expense to furnish energy to complainant is 30 per cent less than for the rest of the service. The commission held that while a contract establishing field rates for a determinate period is some evidence of the reasonableness of the rates so fixed, under the conditions and limitations present in respondent's business, the contract in this case, if permitted to remain in effect, would offend against the interest of the general public, since the burden of the increase would be placed wholly on 58 per cent of the business.

Service Connection Charges. — In passing upon a new rule of the New Jersey Public Service Electric Company requiring the cost of service connections to be borne by the customer, the New Jersey Board of Public Utility Commissioners refused a change in the rule as to the former free limit and also held that where charges are permissible they should not be fixed sums but based on actual cost of materials and labor.

Satisfactory Service Essential Factor in Rate Adjustments.—Granting a revised schedule of electric rates to the Heppner Light & Water Company, serving Heppner, Lexington and Ione in place of the previous "inadequate, unfair and unjustly discriminatory" tariff, the Public Service Commission of Oregon insisted that more satisfactory service must be provided and recommended the immediate installation of a voltage regulator at the generating plant. For trouble due to the interference of shade trees with the transmission lines the commission held the company not responsible where there was no alternative economical location and suggested that it was the duty of the municipalities to remedy this condition by ordinance. An adequate minimum charge for large consumers under the commercial lighting schedule was provided. Increases granted were based in large part on the greatly enhanced price of coal, the commission noting in regard to general conditions of business that "reports from all electric utilities have shown in general a relatively large and abnormal increase in business during 1919 and 1920."

Coal Clause as Applied to Special Service and to Supply from Hydro-Electric Source. — The International Railway Company opposed before the Public Service Commission of New York, Second District, on two grounds the application to its contract of a coal clause granted the Buffalo General Electric Company. One ground was that its contract was of a nature different from that of other customers of the electric company, being for a longer term and containing conditions favorable to the supplying company; the other ground was that the power furnished it was generated by hydro-electricity and was therefore not affected by the price of coal. The commission has ruled against the railway company on both points, holding as regards the first that the advantages to the electric company embodied in the contract between the two companies had already been compensated for by a lower rate than other customers paid, and as regards the second that there was no stipulation that the energy furnished was to be hydro-electric and that the electric company was free to generate it by steam if it saw fit, regardless of what may have been thought implied.

Operation Under Contract Ratifies Acceptance by Agent.—Determining an action for breach of contract brought by the city of Paragould, Ark., against the Arkansas Light & Power Company, the Supreme Court of Arkansas declared that where a power company for more than a year furnished power as called for by a contract with the city it thereby ratified the acceptance of such contract by its agent if he had no authority to make such ratification. (225 S. W. 435.)*

Public Service Company Cannot Be Compelled to Furnish Breakdown Service to Competitor.—The New York Court of Appeals, which is the state court of last resort, has unanimously affirmed the order of the Appellate Division of the Supreme Court, made March 19, 1920, in New York Edison Company vs. Public Service Commission, First District, and Acker, Merrall & Condit Company. This order supported the electric company in its contention that it could not be compelled to furnish breakdown service to a competitor. (For an account of this important case see ELECTRICAL WORLD, April 3, 1920, page 806, and June 5, 1920, page 1338.)

West Virginia Public Service Commission Ordered to Hear Case Affected by Federal Injunction.—The Public Service Commission of West Virginia having held itself inhibited from passing on a case (Kelley Axe Manufacturing Company vs. Public Service Commission) involving a dispute between an industrial and a natural-gas company because of an injunction awarded by the United States Supreme Court forbidding interference with interstate transportation of this fuel, the Supreme Court of Appeals of West Virginia has ordered the commission to hear and determine the case according to law, asserting that the injunction does not prohibit the commission from fulfilling the duties which it was created to discharge while it refrains from infringing on the United States Constitution. (105 S. E. 152.)

Powers of Municipalities and Public Service Commission.—A state can authorize a municipal corporation to establish by an inviolable contract the rates to be charged by a telephone company or other public service corporation for a definite term, not unreasonable in point of time, according to a decision of the Supreme Court of Appeals of Virginia in City of Richmond vs. Chesapeake & Potomac Telephone Company, and the effect of such contract is to suspend during its term the governmental power of regulating rates. The authority to make the contract must, however, clearly appear, and all doubts will be resolved in favor of the continuance of the power of the state. Where express power to fix rates is not so conferred on a municipality, the state may through the State Corporation Commission direct a public utility

* [illegible] refer to the volume and the right-hand numbers to the [illegible] System.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

to increase its rates above those fixed by its franchise and the municipality cannot maintain a constitutional objection on the ground of impairment of contract. Although a city has the statutory or constitutional right to prohibit the use of its streets by public service corporations, this alone is insufficient to confer express power to regulate rates by inviolable contract. (105 S. E. 127.)

Federal Court Holds Valuation of Property on Pre-War Costs to Be Confiscatory.—Granting an injunction to the St. Joseph Railway, Light, Heat & Power Company against the enforcement of street-railway and steam-heating rates prescribed by the Missouri Public Service Commission, the United States District Court for the Western District of Missouri declared that a valuation based on the original cost where that was ascertainable, and otherwise upon prices during the pre-war period, was not a reasonable method of fixing the valuation in view of the greatly increased costs since the war and of the greater rate of returns earned by other enterprises, and that rates based upon such a method of valuation were inadequate and virtually confiscatory. (268 Fed. 267.)

Federal Judge Sanctions 25 per Cent Profit on Gas.—The constitutionality of the 80-cent gas-rate statute having been successfully assailed by the Kings County Lighting Company, that company, finding itself free from legal prescription of its charges, raised its rates to $1.50 per 1,000 cu.ft. The Attorney-General and the Public Service Commission thereupon made a motion to vacate or modify the injunction, alleging that the new rate is excessive. In the United States District Court for the Southern District of New York Judge Hough orally dismissed the motion, concluding his opinion in these words: "I consider the word 'inequitable' in the present connection to mean something so obviously wrong that it shocks the conscience of a fairly decent man who happens to be the chancellor. I believe that at the present time and for a time in the future, concerning which I cannot venture even to form an opinion, the most favorably situated gas-making concern within the limits of the city of New York cannot reasonably expect to make and distribute gas and pay interest (at rates now ridiculously low) upon the money it has borrowed in the past for less than $1.20 per unit, and this gas company, I am sure, is by no manner of means the most favorably situated within the city's limits. I am also of the opinion that a 25 per cent profit (which is the difference between $1.20 and $1.50) is, as a profit on anything, not so grossly inequitable as to shock the conscience of a decent man."

Validity of Election Favoring Municipal Acquirement of Electric Plant Sustained.—The voters of Summerville, S. C., having indorsed a proposal for the purchase, repair and extension of an existing electric light plant, the Bank of Dorchester agreed to buy the entire issue of bonds made for this purpose, but subsequently refused, attacking their validity on three grounds—first, that the projects of purchase, repair and extension should have been separately voted on; second, that the rate of interest should have been stated; third, that the fact of there being an ice plant connected with the electric lighting plant affected the validity of the issue. In Commissioners of Public Works of Town of Summerville vs. Bank of Dorchester the Supreme Court of South Carolina found for the plaintiff and affirmed the entire legality of the election. (105 S. E. 32.)

Customers of Power Companies Contesting Rates Entitled to Copies of Others' Contracts.—In determining an appeal from an order made in Salisbury & Spencer Railway Company vs. Southern Power Company (see ELECTRICAL WORLD, May 29, 1920, page 1284), in which it was held that the defendant should be compelled to furnish electrical energy to the plaintiff and other companies without unjust discrimination, the order in question being one requiring the defendant to furnish to the plaintiffs copies of certain specified contracts which it is claimed the defendant had made with other customers under substantially similar conditions, the Supreme Court of North Carolina affirmed the order, laying down the law as follows: (1) The petition by plaintiffs for such an order in suit for mandamus was proper; (2) the power of the court to prevent rate discrimination is inherent and independent of the law establishing the Corporation Commission and of the statutory law; (3) the Corporation Commission cannot authorize an electric power company to discriminate between consumers and such discrimination can be corrected by mandamus whether or not it results from a contract imposed by the power company, for while the court will not fix rates it will review the commission's findings if unjust discrimination is authorized; (4) contracts made by defendant power company with other customers establishing the fact that it is selling energy to them under substantially the same conditions at a less price than it is charging plaintiffs are material, and plaintiffs are entitled to have copies of such contracts brought into court; (5) no interference is implied with the right of the power company to apply to the Corporation Commission to fix the rates it shall be permitted to charge all consumers receiving such service. (105 S. E. 28.)

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

D. H. Redinger, assistant resident engineer in charge of construction work on the Big Creek hydro-electric project of the Southern California Edison Company, has been spending a few weeks



D. H. REDINGER

in the East on a combined pleasure and business trip. He has spent some time at the plant of the William Cramp & Sons Ship & Engine Building Company inspecting the waterwheels being built for the Big Creek extensions and the plant of M. W. Kellogg Company, which is furnishing piping for the job. Mr. Redinger has been connected with the Southern California Edison Company since the spring of 1916. He was born at Lawrence, Kan., Jan. 20, 1884, and was graduated from Kansas University with the degree of C.E. in 1911. His first work was in the Alaska coal fields in charge of an investigation party under M. S. Hibbard of the United States Land Office. He then joined the engineering staff of Stone & Webster, and was engaged on the original construction work at Big Creek in 1912 and 1914. In 1914 he was engaged in the federal Reclamation Service as field engineer in charge of irrigation work in the Salt River Valley, Arizona. From the fall of 1915 to the spring of 1916 he was a member of the California State Highway Commission at San Luis Obispo. This position he resigned to take up his present duties.

Melvin H. Coulston of New York has been appointed Commissioner of Patents by President Wilson. Mr. Coulston was formerly First Assistant Commissioner of Patents.

E. C. Rutz of Chicago has been appointed director of the Department of Public Utilities of the city of Kalamazoo, Mich. Mr. Rutz was electrical engineer for the Commissioners of Lincoln Park, Chicago, until 1913, when he resigned and joined the staff of the Woodmansee-Davidson Engineering Company, consulting engineers of Chicago. He left this company to take up his duties in Kalamazoo on Feb. 1.

George L. Hoxie has been engaged by the Southern California Edison Company as research engineer to make investigations of power resources and their conservation and most effective utilization. Dr. Hoxie was graduated from Cornell University as mechanical engineer in 1892 and later received the degrees of M.M.E. and Ph.D. from the same institution. The next ten years were spent in university work, his first permanent business connection being with Westinghouse, Church, Kerr & Company of New York. In 1905 he opened offices in New York City as a consulting engineer, and he has followed his profession continuously since that time. His counsel and services have been employed by public utility corporations and private enterprises throughout the country in engineering and operating matters. His connection with the Edison organization will per-



GEORGE L. HOXIE

mit him to continue his professional activities. Dr. Hoxie has closed his New York office.

Ernst Fredrik Werner Alexanderson, who has been elected president of the Institute of Radio Engineers, is chief engineer of the Radio Corporation of America and consulting engineer of the General Electric Company. Mr. Alexanderson was born in Upsala, Sweden, Jan. 25, 1878, and received his technical education at the Royal Institute of Technology of Stockholm, Sweden, and at Berlin, Germany. He entered the service of the C. & O. Electric Company in 1901 and joined the engineering staff of the General Electric Company one year later. During the last eighteen years Mr. Alexanderson has been closely identified with development work on large alternators and high-frequency apparatus. He originated the development of the magnetic amplifier and was the first to introduce



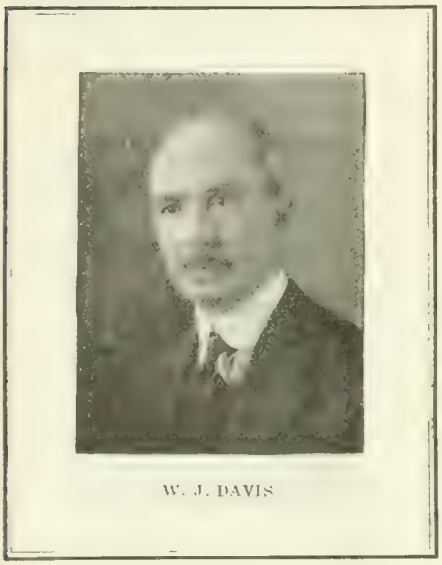
E. F. W. ALEXANDERSON

iron into high-frequency circuits. In May, 1915, Mr. Alexanderson was in contact with Mr. Marconi in this country, with the result that the large radio-frequency alternator and magnetic amplifier for raido-telegraphic work, as designed by Mr. Alexanderson, was installed in the Marconi company's station at New Brunswick, N. J., and has since been adopted by the Radio Corporation of America for its chain of worldwide wireless stations. Mr. Alexanderson holds a number of United States patents. He is a member of the American Institute of Electrical Engineers, and he is also author of a number of papers which have been presented before various technical societies.

Francis J. Chesterman, chief engineer of the Bell Telephone Company of Pennsylvania, Philadelphia, gave an interesting talk on the subject of "Translating Thought by Electricity" before the local Rotary Club at the Bellevue-Stratford Hotel recently.

Dr. Robert B. Owens, secretary of the Franklin Institute of Philadelphia, his many friends will be glad to hear, is now on the road to recovery from eye trouble, from which he has been suffering for several weeks. It will still be some weeks, however, before Dr. Owens will be able fully to engage in his duties at the institute.

W. J. Davis, Pacific Coast engineer of the General Electric Company, has been transferred to the International General Electric Company and will soon leave for London and later for South Africa, where he will remain about one year studying the proposed electrification of the present steam railroad between Capetown and Pietermaritzburg, a distance of approximately 800 miles. It is also proposed to electrify suburban lines from Pietermaritzburg to Natal and Durban. It is understood that electrical energy will be obtained from coal-fired steam stations. The changes are to increase the capacity of this im-



W. J. DAVIS

portant trunk line, which is now operating nearly up to the limit of its capacity. Sir William J. Hoy is general manager of the lines, which are owned and operated by the government. Mr. Davis states that electrification will defer double-tracking fifteen years. Mr. Davis was born in Louisville, Ky., in 1869 and after being graduated from the Rose Polytechnic Institute in 1892 spent three years in construction work, at which time he entered the employ of the General Electric Company at Schenectady in the students' course. In 1898 he was transferred from the special testing department, where he was then foreman, to the railway and traction engineering department. He remained in this department for ten years and during that time was engineer on some of the most notable early electrifications. Among these was the Albany & Hudson electrification. This was the first steam railroad to be electrified and also the first to use converters in railway work. Other electrification projects on which Mr. Davis was employed included the Central London, the London Underground, the New York Central, the Detroit River tunnels and the West Jersey & Seashore. The latter was notable in that 8 miles of line was double-tracked and electrified, a 6,000-kw. power house and converter station was built, nearly eighty cars were supplied and the line was put in operation in six months. Mr. Davis has been in his present position for eleven years.

J. M. Thompson, an attorney of Caldwell, Idaho, has been appointed to succeed A. L. Freehafer as president of the Idaho Public Utilities Commission.

Louis B. Fasset, for many years connected with the Northern New York Utilities, Inc., Watertown, N. Y., has been appointed superintendent of distribution, succeeding R. B. McGinnis.

Frederick A. Kolster, electrical engineer of the Bureau of Standards, in charge of the commercial radio development work, has resigned his position and is to be associated with the Federal Telegraph Company, San Francisco.

S. H. Heller has been appointed vice-president and general manager of the E. L. Uncapher Electric Company, Louisville, Ky., jobber of electrical supplies, to succeed M. H. Moies. Mr. Heller was formerly general manager of the Central Home Telephone Company of Louisville.

Harvey Pond, formerly advertising manager of the Arrow Electric Company, Hartford, Conn., manufacturer of wiring devices, has been promoted to the position of general sales manager of that company. Kenneth J. Owens succeeds Mr. Pond as advertising manager.

Stephen Q. Hayes, who is associated with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., in its switchboard engineering department, is en route to Australia in the interests of the company. Mr. Hayes will establish an office in the Queensland Building, 84 William Street, Melbourne, Australia, and will remain there for six months.

Frank A. Burr, who has been engaged in engineering work with the Narragansett Electric Lighting Company and the Brown & Sharpe Manufacturing Company, Providence, R. I., for the past year, has been appointed to the faculty of the Rhode Island State College to take the place of Prof. R. L. Wales, who is engaged in research work for the Bureau of Standards, Washington, D. C.

B. C. Jones has been appointed superintendent of the Pittsfield (Mass.) porcelain works of the General Electric Company. Mr. Jones entered the employ of the Pittsfield works of the company in 1908, being assigned to the cost section of the motor department and having charge of fan and power motors, lightning arresters, disconnecting switches, etc. In 1912 he was transferred to the manufacturing superintendent's office, specializing on costs, investigation, factory layouts and equipment. During the war he traveled extensively in behalf of the conversion and provision of works for the production of war material under the company's responsibility, having general charge of this work. About a year ago he was made an assistant manufacturing superintendent at Pittsfield. He will report to C. C. Chasney, manager of the Pittsfield works, in his new post.

Dr. R. C. Rodgers, who was recently appointed assistant secretary of the Illuminating Engineering Society, served for fifteen years in the department of physics of Cornell University, from which university he was graduated in 1905 with the degree of M.E., obtaining later, through advanced work, the degrees of M.A. and Ph.D. He has been particularly interested in photometry and illumination for some years past. Since the retirement of Dr. Edward L. Nichols as head of the physics department at Cornell he has been in charge of the work in the physics of photography, further de-



R. C. RODGERS

veloping the courses originated by Prof. G. S. Moler, who retired in 1917. Dr. Rodgers is a member of the American Physical Society, the American Association for Advancement of Science, the Optical Society of America, the American Institute of Electrical Engineers, the Illuminating Engineering Society, the Cornell Engineering Society and the honorary society of Sigma Xi. His duties with the Illuminating Engineering Society will be in the direction of promoting its interests and expanding its activities and influence. He will assist the chairmen of committees, where possible, in their work.

Obituary

Wilbert H. Doughty, a prominent contractor-dealer at Fall River, Mass., died at his residence in that city recently after a short illness. In July, 1920. Mr. Doughty retired from membership in the Doughty & Welch Electric Company, Inc., at Fall River. He was born at Brunswick, Me., about fifty-four years ago, and his earlier career included service as a traveling representative of the old Thomson-Houston Electric Company and the Thomson Electric Welding Company of Lynn, Mass. For a time he was in charge of the motor department of the Fall River Electric Light Company.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Aluminum Conductor Bookings Show Increase

CONTRARY to conditions existing last year in the aluminum field there is now sufficient capacity available, both raw material and mill, to place aluminum conductor production on a satisfactory basis. Less than a year ago there was little metal that could be turned over to conductor business, but with a decline in output in the automotive and other fields and an increase in orders for conductors there is now plenty of capacity at hand which it is expected will be devoted permanently to that trade.

There have recently been placed several orders of good size for aluminum conductor, and the outlook for the future is reported particularly bright. Ingot aluminum, 98 to 99 per cent virgin is quoted now at 28 cents a pound. With 14-cent copper the first cost of these two metals would be about on a par when it is considered that aluminum for equal conductivity weighs just under one-half what copper weighs.

Early Fan Orders Below Expectations

WITH 1921 production of large fans well on the way toward completion, contracts on the part of distributers are somewhat disappointing. True, there have been many orders placed with manufacturers, but at the same time a great many distributers have held off and say they will continue to do so for another month or so. The general unsettled conditions of business, although an upward trend is noticed; large stocks carried over and the fact of a price advance of up to 10 per cent over last year's prices are the reasons given for this hesitation.

The endeavor of the past few years on the part of the producers to encourage distributers to place their contracts early in the year, in order to get the best deliveries and to give manufacturers something in the line of orders to work on, began to bear fruit last year in a great many cases. But transportation tie-ups counteracted this measure. This year business conditions are hindering this early ordering.

As conditions stand now, fan prices will be about 10 per cent higher this season, although manufacturers are protecting the dealer against a drop in price. The facts of the case rest on production costs. The materials going into the fans were ordered at least by last summer, and production was started before a drop in both the price of materials and of labor became effective. Consequently the fans that will go on the market this year will have cost the producer more than they have at any other time.

There is a feeling among the trade, however, that these prices will be too high to suit the consumer and that sales will suffer. While it is generally thought by producers that sales this year will equal those of last year, a record year, there are some who feel that this question of price will have considerable effect. Production is going on on the basis of that of last year.

Stocks of fans among the trade vary. In the East stocks are large and advance ordering is light. Last season was not good fan weather there. Hence the hesitation in contracting. Stocks are fairly large in the Middle West, and there, too, ordering is light. The Pacific Coast is pretty well cleaned out. The South is always a good market, and stocks there are low. Consequently pretty fair orders have already been placed from that section.

As to types, it is thought that the 8-in. to 12-in. sizes will have an increased sale this year in proportion to other years and that the 16-in. will suffer somewhat. Much stress is being placed on the fan for residential uses, and this naturally caters to the smaller sizes. The smallest size has not been considered in this discussion, but will be taken care of at a later time.

Several manufacturers have already shipped quantities of stock to distributers, but these are resting quietly in the latters' warehouses, as the dealer buying is light.

An increased capacity is being devoted to the production of ceiling fans. The phenomenal run of these last year surprised the trade, and hold-over stocks are negligible. The same price advance has been applied to these.

Pole-Top Arrester Deliveries Ruling Short

LIGHTNING arresters of the pole-top type are responding to a fair movement already this year, especially in the Middle West. Some good orders have been going through in the far West and in the East too, and from the volume of inquiries coming in to manufacturers some nice buying should be in prospect.

In small quantities stocks can be tapped to supply orders on the 2,300-volt equipment, and from stock up to two and three weeks is quoted on other voltages and in large quantities. No price changes have been reported up to date. This is still a grave question with many central stations, and some are withholding purchases in expectation of a possible recession. It is known that many lines have been allowed to remain without lightning protection in the last few years and some have been put in without it.

Hopeful Year Seen in Washing Machine Industry

AT THE last meeting of the American Washing Machine Manufacturers' Association, Jan. 19 and 20, the general feeling prevailing among the members was that the washing machine industry was already beginning to come up out of the depths which all fabricated products have found themselves in during the last ninety days. This feeling of optimism, according to Enoch B. Seitz, the secretary, was based not on hopes but on substantial orders.

While recuperation was not expected to come fast, a steady improvement was looked for. The belief has been expressed that more intensive sales effort will be made by this industry than ever before and that the methods of merchandising will stand the most rigid inspection. The outlook for what is termed a wonderful year is predicted, starting slow but finishing stronger.

Pole-Line Hardware Manufacturers See Good Business Ahead

THE market for pole-line hardware is only fair from the standpoint of buying. The present month is usually a period of light buying, but though it is true some utilities are covering their spring needs the general demand is considerably less than normal. As far as prospects for good business go, however, the situation is very favorable, according to several manufacturers. Almost without exception producers express confidence that the contemplated extension of power lines by electric railways and central stations will result in heavy buying in the coming spring.

In accordance with this view some hardware producer

are going ahead with production, although on a curtailed basis, for the purpose of piling up reserve stocks. In one instance the value of surplus stocks now held at the factory amounts to half a million dollars. Other manufacturers have only recently caught up with back orders and so are not able to ship large quantities of other than standard material from stock. Deliveries, on the whole, are good, ranging from stock up to two or three weeks.

Prices have held steady since general decreases, ranging from 5 to 15 per cent, were made during the month of December and the early part of January. In some quarters still lower prices are expected, but in others the view is expressed that present quotations will hold steady.

Trade Pitfalls and Possibilities in the Orient

THERE are three major reasons why British and not American concerns have the great bulk of the electrical business in the Orient, and more particularly in China," according to F. K. Pinckney of the Macbeth-Evans Glass Company. In an interview with a representative of the ELECTRICAL WORLD, after a first-hand investigation of conditions in the Far East, Mr. Pinckney enumerated these reasons as follows: "First, Americans have not appreciated the great possibilities for electrical business in that part of the world; second, they have chosen unsuitable representatives, and, third, they have insisted on short-time credit when foreign competitors have been giving virtually as much credit as was necessary to get the business, which means anywhere from three to six months.

"Electric light," Mr. Pinckney continued, "is used extensively and lavishly in Japan, and its use is growing very rapidly in China. In Japan municipal hydro-electric plants are the rule, and the service is sold on a flat-rate basis as a natural sequence. In China, however, private companies supply most of the electric service from steam-driven generating stations, and the service is consequently metered.

"Glassware, such as it is; incandescent lamps all the way from Christmas-tree sizes to large gas-filled units, flashlight batteries and lamp sockets are manufactured in large quantities in Japan. Some of these products are being exported to this country, to China and elsewhere, but a Chinaman would not buy anything made in Japan if he could possibly get something else. Ultimately these and other electrical devices will probably be made in China, but that may be a long time off, and in the meantime the British are capitalizing the Chinese aversion to the Japanese product and are doing a large and increasing electrical business with the Celestial Empire.

"China should be a very fertile field for electric signs, because the Chinaman is a great believer in advertising and uses electric light very profusely.

"Both the Chinese and the Japanese are accustomed to cheap things, and that is what they want to buy. However, they will pay more for a better article when they are shown that the advantages outweigh the difference in price. That is now being demonstrated by the increasing demand for modern American glassware. One concern in Tokyo has up-to-date lighting demonstration rooms and employs an illuminating engineer, trained in America, to educate its salesmen.

"Europeans would lose the respect of the natives if the women attempted to do their own housework, so there does not seem to be much of a field for the essentially labor-saving electrical devices for the home. However, hollow ware, floor lamps, electrically operated phonographs, refrigerating machines, etc., should find ready sale among the European populations of the large cities. There is also a large field for electric fans, as the punkas, formerly used for cooling large assemblages, are rapidly being discarded.

"The meter requirements of China are growing rapidly, while both China and Japan are using a greater amount of insulated wire, wiring supplies, switches, motors, generators and central-station accessories. There is much more American apparatus to be found in Japan than in China, where, as previously stated, the British are getting most of the business. Throughout the Far East their bayonet-socket lamp remains the standard. The British have shown wise discrimination in trading through English or Chinese concerns. One of the Chinaman's characteristics is that it is against his principle to make an advance payment with an order or to pay for goods before they have been received."

Small Electrical Sheet Tonnages Being Booked

THERE is little activity in the electrical sheet market. In the first place manufacturers of motors, generators, transformers, etc., using electrical sheets are working on a much reduced schedule, as a whole, especially manufacturers of small motors. In the second place, these same manufacturers last summer and fall had to order their sheets well in advance and in pretty good volume in order to cover their needs in what might have turned out to be a very tight market.

But the break in demand came, and these stocks of sheets have not all been used up. Under the present feeling of uncertainty in the nation's industries manufacturers are not ordering in advance and current needs are relatively light. True, some tonnage is being booked, even in carload lots, but these large lots are few and far between. Small tonnages too are slipping through.

Prices of electrical sheets of various mills are on a par, and there is sufficient capacity available to supply most needs on short notice. There is a feeling among the mills, however, that business will pick up in March and show a much better tone.

The Metal Market Situation

POSSIBLY as a result of the proposed plan of the Copper Export Association, mentioned in last week's issue, to take 400,000,000 lb. of copper off the market by pooling it for export sales and issuing debentures at 8 per cent interest, which will be retired as the copper is sold, there is a firmer tone to the market. Prices in both the major and outside markets have advanced from ¼ cent to ½ cent over a week ago. This is a result not so much of increased domestic demand, as copper consumers in this country continue to hold off buying to see how things break, but of stronger buying interest from abroad.

Producers are generally asking 13 cents delivered for prompt and February shipments, 13¼ cents over March and 13½ cents for the second quarter. In the outside market prices have become firmer until they are generally ¼ cent per pound higher than producers'.

Outside of copper there is little or no change to metal prices this week. The market for lead is quiet but steady, little buying interest being shown. Tin is also inactive at present, following better inquiries a few days previously. The price of tin receded ¼ cent per pound the past week. Zinc presents a slightly steadier tone under a better demand, which may possibly be but temporary.

NEW YORK METAL MARKET PRICES

	—Feb. 1, 1921—	—Feb. 7, 1921—
Copper	£ s d	£ s d
London, standard spot	69 10 0	72 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.25	13.50
Electrolytic	12.75	13.00 13.25
Casting	12.37½	12.62½
Wire base	15.75	15.75
Lead, trust price	4.75	4.75
Antimony	5.25	5.25
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.50
Zinc, spot	5.50	5.50
Tin	33.00	32.75
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00 11.25	11.00 11.25
Brass, heavy	6.00 6.50	6.00 6.50
Brass, light	4.00 4.50	4.00 4.50
Lead, heavy	4.00 4.25	4.00 4.25
Zinc, old scrap	3.00 3.25	3.00 3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

STILL more evidence seems to be apparent this week of a better tone in the electrical market. Jobbers as a whole do not report substantial increases in volume of orders taken, but they do say that from the inquiries received they believe the trade is thinking better and feeling better. Resumption in building, especially residential building, is going on well in Seattle, but in other sections is quiet. However, a general feeling is prevalent that the volume will be quite satisfactory by May. Supply stocks are good for immediate needs, but there is little ordering for future business, regardless of the probability that a building boom would quickly reduce stocks to a low level.

NEW YORK

There seems no longer to be any doubt that the turn of the tide has been reached. From this time on conditions in the electrical trade in this territory should gradually improve. That appears to be the consensus of opinion among jobbers. Many of them cannot report any better actual sales, it is true. Some, on the other hand, are finding a larger total volume of orders. The common meeting ground is that the bottom point of buying has been reached. A generally improved tone, a feeling of optimism, a firmer basis is evident to the market. An increasing number of inquiries is reported, indicating that a good potential demand exists.

A reflection of this fact is found in the policy of several manufacturers of going ahead and producing goods for stock. Jobbers, however, are still ordering material only as they actually need it. Stocks consequently are held down to as low levels as possible to conform to the light demand which it seems must still exist for some time to come.

Collections in the metropolitan district, it seems, have been reported in rather more pessimistic vein than the actual average situation warrants. A representative collection would probably range close to sixty days, but the majority of jobbers state that in view of the care used in granting credit collections occasion little trouble.

Rubber-Covered Wire.—A few jobbers are making fairly good sales to industrials in small lots. The general demand is light, however, with stocks held as low as possible. Nominal quotations for No. 14 in 10,000-ft. lots this week range all the way from $7.75 to $9.50 per 1,000 ft.

Conduit.—Small orders are received in fair volume in some cases, but the market is quiet with adequate stocks on hand. In 2,500-ft. lots, ½ in. black varies from $70 to $79 per 1,000 ft. and 1 in. black from $137 to $155.

Flexible Armored Conductor.—Slight signs of a strengthening market are noted. Several jobbers report a fair volume of orders. The general policy is to replenish stock only as necessary. No. 14, two-wire double-strip, in 1,000 ft. quantities brings from $61 to $66 per 1,000 ft.

Cable Boxes.—W. A. Bonnell, New York City, announces a price reduction of 25 per cent on cable boxes, effective Feb. 5.

Tape.—Demand, on the whole, is quiet, the best report on sales being "fair." Stocks for the most part are not considered too large. Standard grades of friction tape range from 48 to 50 cents per pound, in 100-lb lots, and rubber tape from 42 to 50 cents.

Outlet Boxes.—Sales are light with very small quantities in stock. Some jobbers, in fact, are cleaned out.

Fans.—Very little buying has been done for the coming season in this district. Stocks held over from last year are large, and there is a feeling in the trade that prices announced last fall are rather high.

Lamps.—No falling off is reported in the good volume of sales that has been recorded to date this winter. Prompt shipments prevail, and stocks are generally full in all sizes. The Edison Lamp Works at Harrison, N. J., is back on a five-day week basis.

Porcelain.—Until further notice the American Jobbers' Supply Company announces that it will disregard the price increase of 10 per cent on knobs, tubes and cleats announced in last week's issue. The R. Thomas & Sons Company, East Liverpool, Ohio, has revised its price list on standard porcelain, effective Jan. 26. On some items the change is an increase, on others a decrease, the revision in both cases ranging from 5 to 10 per cent.

CHICAGO

Regardless of how poor other business is, the electrical line runs along with sufficient volume to prevent any real discouragement. Manufacturers and jobbers alike state that January billing reached a comfortable total and that, leaving the first half of 1920 out of consideration, business is very close to normal. An encouraging feature is that in many cases stocks have been well cleaned out, which will necessitate the placing of additional orders as rapidly as consuming demand develops. Close co-operation is found between manufacturer and jobber to the extent that in many cases jobbers' inventories are being submitted to the manufacturer for suggestions as to how heavily to order. This should insure sane business in the approaching season.

The worst feature remains in slow collections. Jobbers report sixty days or more as the average, and manufacturers in some cases are running behind that. Relief seems to be in sight, however, in that manufacturers with national distribution report conditions in the East as being better. This improvement, it is hoped, is traveling westward, as did the wave of depression last fall. In general, prices are firm, there being no quotable changes. Chicago building took a slight spurt this week, new permits amounting to $1,450,000 having been issued, two-thirds of this amount being in one large apartment building.

Motors.—Jobbers state that business has settled back as regards volume of orders to about where it was before the war and is confined almost wholly to replacements.

Fans. — Manufacturers anticipate rather light business in the approaching season as most jobbers and dealers, as a result of the cool summer last year, went into the winter with considerable stock on hand. The price element is a subject of much question, but no line on the future can be obtained.

Lamps. — Railroad buying, so great a feature a few months ago, has almost entirely disappeared. Domestic business continues good, and the trade feels that it will be better, as it is known that there are millions of empty sockets in the country. Undoubtedly the public's expectation of lower prices is acting as a drag. Prices are firm, and there is no indication that waiting will permit cheaper buying.

Fuses.—Fuse business is "going along." Stocks are full and orders can be filled on receipt. Prices so far remain firm. Reduction of industrial activity throughout the country has resulted in much less consumption of fuses, and this line will probably remain steady on a reduced level for some time.

Hollow Ware.—Manufacturers report that January was the best January in the history of the business with the exception of last year. Conservativism is the rule with jobbers, and they are consulting freely with manufacturers as to how large stocks they should carry. Retail dealers still have some stocks on hand.

Air Heaters.—Although the weather is mild in Chicago, some heaters are still being sold to supplement or take the place of furnaces. All elements of the trade report the past season to have exceeded expectations.

BOSTON

Slow improvement characterizes the trend of business, which continues spotty throughout New England. The Boston building strike has reduced buying in local jobbing circles, but industrial orders and public utility purchasing hold up fairly well. Collections are poor. Stocks are ample in nearly all lines except watt-hour meters, which are very scarce. Prices are firm except where the pressure of accumulated stocks has been strong enough to induce distributers to make cuts. Field men in jobbing organizations report a more hopeful outlook in local territory, and orders, while not heavy, are well distributed and numerous. Deliveries are satisfactory in most lines. New office-building construction is in prospect at Worcester, Mass., on sites recently swept by fires, and important hotel construction is scheduled for early advancement at Providence, R. I.

Meters.—Jobbers are unable to accumulate stocks of any real size. One of the largest houses was cleaned out Monday and was ordering meters on a fourteen weeks' delivery basis.

Fuses.—Prices are steady and stocks good. A leading distributer reports improvement in the sales of the last fortnight compared with any other of the last two months.

Tape. — Sluggish movement features the tape market. Prices are unsteady, but sales averaging around 50 cents per pound are common for ¾-in. black, in 100-lb. lots. Compound is selling around 42 cents to 45 cents in the above quantity. Stocks are large.

Insulators.—Buying is moderately good and stocks are fair. The 2,300-volt porcelains are selling around 14 cents to 18 cents according to quantity.

Flexible Armored Conductor.—Prices are steady, two-strip No. 14 selling at $67 per 1,000 ft. in 1,000-ft. lots. No trouble is experienced in getting this material by stock shipment.

Wire.—Prices are unstable in bare copper wire, the base ranging around 16½ to 17 cents on the average, with fluctuations of a cent or two on either side in extreme cases. Central stations are displaying more interest in the wire market. Weatherproof base Monday was about 18 cents, and rubber-covered No. 14 wire sold at $8.25 per 1,000 in 1,000-ft. lots.

Rigid Conduit.—A quiet market prevails for this material, with only nominal differences in prices against last week's figures. A leading house was putting out 1-in. black pipe in less than 2,500-lb. lots Monday at $164.55 per 1,000 ft., the galvanized selling at $174.85. The ½-in. black sold for $84.02 and galvanized at $89.12. Deliveries have been helped greatly by the mild winter.

Non-Metallic Flexible Conduit.—Unsteady prices are reported. In 1,000-ft. lots the ⅜-in. size was selling Monday as low as $22 per 1,000 ft., and the ½-in. size at $25. It was stated that these prices were set to meet cuts under close competition. Stocks are substantial and the demand is not very large.

Appliances.—The demand for washing machines shows improvement over the last two months of 1920, according to a leading distributer. Consistent campaigning is yielding returns. Cleaners are moving slowly and radiators are rather quiet, pending the advent of the between-season demand.

Cross-arms.—Stocks are reasonably satisfactory and buying has not as yet developed any spurt.

ST. LOUIS

Activity during the past week, according to reports from leading jobbers, has been decidedly spotty. With one large jobber reporting the week as one of the best in some time, sales of wiring supplies having increased noticeably, another jobber reports no improvement over the previous week and still another reports sales very low. It is difficult to discover any definite trend to the market. There is a generally hopeful feeling, however, in spite of the unsettled conditions. This is probably the result of a considerable number of inquiries from and, in the case of at least one jobber, a considerable number of sales to industrials. Practically no orders have been very large but they are steady, and the volume is being built up bit by bit.

In regard to the building situation, if all the construction now in the proposed stage is put under way between April and September, there will probably be as large a shortage of that line of supplies as there was during 1919. Actual building operations at present are negligible. Credit departments by dint of much hard work are maintaining collections around sixty days.

Fans.—Jobbers are beginning to sound out retailers on the coming season and are finding in a number of instances that dealers have carried over stocks from last year. In any case, they report, there are few dealers who will be willing to tie up much capital in fan stocks, most of them preferring to buy as fast as consumer demand develops. The increase in the price of fans over last season will also tend to keep dealers from buying heavily.

Lightning Arresters.—Inquiry is very lively, and sales have improved considerably. This may be traced to the desire of central stations to prepare for the maintenance work that will come in the spring. Deliveries have improved somewhat, from eight to ten weeks being promised locally.

Fittings.—Flexible-armored-conductor fittings are in fair demand, and jobbers have ample stocks. Jobbers are having no difficulty in obtaining all they want and are quoting at $7 per 100.

Ranges.—Little effort is being made to push range sales, and several jobbers are carrying large stocks. It is felt that present prices are too high to permit very heavy sales.

Lamps.—Lamp sales continue strong. Jobbers estimate them as slightly below those of last year, but the difference is not nearly so large as that observed in other items. Stocks are complete. The type C street-lighting lamp is in good supply, and jobbers are moving them steadily.

Rigid Conduit.—The market for rigid conduit is practically non-existent, almost all the wiring work being outside, but prices are holding well. Representative quotations are $77 per 1,000 ft. of the ½-in. black and $150 per 1,000 ft. of the 1-in. black. Supplies are heavy.

Wire.—Increased activity is noticeable here, much to the relief of some jobbers who have been carrying large stocks. The orders are generally small, running from 1,000 ft. to 5,000 ft. individually, but enough of these small orders were billed during the week to make up a satisfying total. The demand is coming mainly from industrials, with very few orders from contractor-dealers. Prices are about the same, No. 14 rubber-covered being quoted between $8 and $8.50 per 1,000 ft., with other wire prices in line.

Farm-Lighting Plants.—Demand has not quickened as yet, but intensive sales campaigns are being figured on for the spring. Stocks are generally large.

ATLANTA

Reports continue to be received of the reopening of industrial plants throughout the section, the textile industry in particular showing a considerable reawakening. This will, of course, naturally stimulate retail trade in all lines and should materially improve general conditions. Reports are current that the retailers expect a resumption of trade within the next thirty days and are placing orders in anticipation of this event. Jobbers are lending considerable assistance to retailers in sales promotion work, such as laying out selling campaigns for various classes of electrical merchandising. One of the principal jobbers reports his wholesale business approximately 25 per cent below that of December, though slow improvement is expected. Building activities throughout the section remain sluggish in spite of low price of materials and low labor rates. The building permits for Atlanta for the month of January number 189, valued at $586,909. This inactivity of building is causing the market for electrical building material to continue slow, as retailers and contractors are unable to anticipate their spring demands.

Local bank clearings are off 30 per cent, and collections

on the average are the worst they have been for the past several months.

Heating Devices.—This line has not recovered its volume of holiday trade, though in the aggregate jobbers report material moving satisfactorily. For the first time in several months stocks are reported in good shape with shipments coming through regularly.

Pole-Line Hardware.—The movement in this line is reported on the increase, with stocks and shipments in satisfactory shape. Prices were reduced on this item several weeks ago and possibly served to stimulate the demand. Prices, cross-arm braces, lots 100 to 500, 20-in., $13.49; 26-in., $17.50; 30-in., $20.15 per 100. Lag screws, ½ in. x 4½ in., $5.63 per 100. Through bolts, ⅝ in. x 12 in., $15.47.

Industrial Lighting Equipment.—There is little activity in this line, buyers purchasing only for very necessary requirements. A reduction in price seems to be demanded by the trade. Stocks are in good shape, but jobbers report no expectations of revival in demand before the early spring.

Fans.—Several of the jobbing firms have begun to close contracts for fan deliveries. Shipments to local stocks are being received and forwarded to retailers in the southern part of this section.

Flexible Armored Conductor.—The continued high price of conduit is stimulating the sales of this line, which was sluggish for so long. Jobbers report orders coming through fairly satisfactorily, while a price advance of 10 per cent has just been announced. Stocks are from good to heavy throughout the territory.

Porcelain.—Jobbers are skeptical on the possibility of a 20 per cent price advance. Stocks are in fair shape and moving satisfactorily, with shipments still somewhat slow.

Washing Machines.—Little or no activity is reported in the washing-machine market, sales having fallen to a minimum. All jobbers have heavy stocks on hand, though they expect to be able to reduce them by active sales campaigns in the next few weeks.

Vacuum Cleaners.—Steady sales are noticed, especially in the larger centers, though demand for a price reduction by consumers is becoming more pronounced.

Sewing Machines.—Few orders are being received, and most jobbers report themselves overstocked.

SAN FRANCISCO

A stronger note of optimism and better business distinguished the opening week of February. Building operations are still dropping, but the encouraging feature is the better buying morale of the public.

The value of the building permits issued in the principal California cities during January, 1921, is as follows: San Francisco, $1,246,808; Oakland, $546,239; Los Angeles, $3,096,579; San Diego, $499,342; Fresno, $341,550. The value of the building permits issued during January, 1920, was as follows: San Francisco, $1,636,268; Oakland, $548,693; Los Angeles, $4,186,266; San Diego, $277,280; Fresno, $875,540. These cities are typical of their different sections. The big increase in San Diego's building is no doubt caused by the increased prosperity of the district with additional railway service and through extensive building opreations by the United States government. On Feb. 1 400 linemen of the Great Western Power Company struck because of a wage reduction, but company officials say that only a few more than 100 are out now. The building trades unions of San Francisco recently signed an agreement with the employers providing that future wage differences shall be submitted to a board of arbitration, which seems to indicate a definite end to future disastrous strikes.

Sewing Machines.—Sewing machines have recently dropped in price, the standard portable vibrating models now retailing in the neighborhood of $60. Sales are better, and it is noticeable that dealers are now carrying a greater variety both of models and makes in their regular stocks.

Electric Ranges.—Although range sales are quiet, power men are predicting big sales within the next few months because of the increased power ready for distribution. Prices are now on a quantity basis. The average family-size range retails for about $220 and costs the dealer approximately $175 in single lots or $160 in lots of three with the privilege of assortment with other sizes.

Ironing Machines.—An enhanced interest in ironers is noticeable, with the demand veering to machines whose rolls are of a greater diameter. The 46-in. seems to be quite popular now.

SEATTLE—PORTLAND

Building construction in Seattle, particularly residences since the first of the year has shown steady improvement and this improvement naturally is redounding to the benefit of electrical jobbers, supply houses and contractor-dealers. The action of the master builders' association in reducing wages 20 per cent, effective Feb. 1, coupled with decreasing costs of building material, are bound to stimulate new construction. It is the consensus of opinion that prospective builders have decided that costs of building have dropped as far as they will go, that the bottom has been reached and that now is the time to build.

Prices along all lines of electrical materials are holding. Quite recently there has been some price cutting on socket heaters and certain hollow-ware appliances by retailers who overstocked for Christmas trade. Stocks along all lines are reported in excellent condition, and shipments are coming through in an entirely satisfactory manner. Sales are quickening perceptibly and are slightly in excess of those of last year for the same period. Collections are reported fair to medium and improving slightly. About 50 per cent of lumber mills are operating, some on a three-day-week basis, and logging camps are beginning to resume. Wages are being cut in every line of industry.

Portland manufacturers report that business continues about the same as in the past two weeks. Collections are very poor. Stocks are improving and manufacturers are still behind in orders but are rapidly gaining. Inquiries regarding new projects are appreciably increasing and the future looks very bright. Portland jobbers report business fair and collections worse, if possible, than they have been. Prices continue on a downward trend, recent drops being noted in conduit, loom, wire, etc. Dealers report business slower, with cash sales only fair and charge accounts about the same in number but less in quantity. Contractors in this section state that business is not very active but that the immediate future looks bright. There is a great deal of activity in building permits at this time.

SALT LAKE CITY—DENVER

There is a general impression that business is gradually emerging from the condition of inactivity and depression, but the change to a new status is slow. The retail market is a little livelier than it was a month ago, with dealers showing a stronger tendency to place orders for business a month or two ahead. The credit situation is still in a bad way, showing possibly a slight improvement. Conservatism in planning future merchandising operations is still the rule. There are rumors of big building projects that will get under way in early spring, much of which pertains to line construction. Fortunately there will be no scarcity of stocks when the resumption of building begins. Jobbers are beginning an active campaign to get dealers to stock for the spring trade in vacuum cleaners.

Washing Machines.—Apparently a point of price transition has been reached and dealers are looking forward to a general decline. One of the largest American manufacturers has announced a reduction of $5 on a dolly type of washer. The demand is good and stocks more than ample to supply the trade.

Vacuum Cleaners.—Prospects point to a big spring consumer demand, and dealers are preparing accordingly. No price easing has been noted. The general notion prevails that manufacturers mean to hold up the price and increase their advertising campaigns. Many of the best-known cleaners can be purchased on time-payment plans, and this provision has a decided tendency to stimulate buying.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Robbins & Myers Brantford Plant in Operation

The Brantford (Ontario) plant of the Robbins & Myers Company has placed in production the company's 8-in. fan. Machinery is now being installed there to build the ½-hp. repulsion-induction motor and the polyphase motor line up to frame 202. This takes in polyphase motors up to and including 3 hp., 1,700 r.p.m., 60 cycles, and 2 hp., 1,400 r.p.m., 25 cycles.

Dodge Acquires Gray & Davis House-Lighting Unit

The sole ownership and manufacture of the house-lighting system formerly marketed by Gray & Davis, Inc., Cambridge, Mass., has come into the possession of H. C. Dodge, Inc., machinery manufacturer, Alger Street, Boston. This "D-Light" unit is now manufactured under conditions that permit of a larger volume of production than formerly, according to the new manufacturer, because it is built in a plant where the facilities are exclusively devoted to this one product. The company is producing on a volume basis this 350-watt, 32-42-volt set, and is in a position to expand its representation throughout the country.

Wage Reduction at Graton & Knight Plant

A reduction of about 20 per cent in the wages of all employees was placed in effect at the plant of the Graton & Knight Manufacturing Company, Worcester, Mass., on Jan. 31. L. L. Harr, vice-president, informed the ELECTRICAL WORLD that the step was necessary in order to continue to provide work for the employees. During the past half year this company has noted a marked tendency toward the purchase of belting for group-driven installations instead of a trend toward individual belt driving.

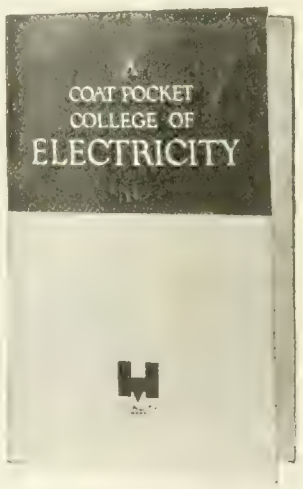
Question of Advertising Account in Receivership Claims

Exceptions have been filed in the Circuit Court at St. Louis to the report of the receivers of the Blue-Bird Washing Machine Company, disallowing the claim of the Gardner Advertising Company for $73,659.08. It is alleged that the receivers acted unlawfully in rejecting the claim, and that by so doing they seek to deprive the advertising company of its property and rights without due process of law, in violation of the federal and state constitutions. The court has been asked either to hear the claim or to refer it to a special master.

According to the exceptions, the claim is for advertising in various periodicals the product of the Blue-Bird Company and for preparation of the advertisements. These were placed by the Gardner company on contracts. The work was done prior to the receivership in May, 1920.

Edison Electric Appliance Starts Salesmanship School

To meet the new conditions arising from the pressure of competition and the awakened sense of thrift of the buying public, and to provide better and more intensive methods of selling,



PROSPECTUS GIVING SCOPE AND INTEREST OF COURSE IN SALESMANSHIP

the Edison Electric Appliance Company, 5600 West Taylor Street, Chicago, has launched a school of salesmanship. This school is for the use of all engaged in the selling of any kind of electrical appliances, says J. F. Roche, advertising manager of the company, and tuition is free. It covers the principles of salesmanship and advertising and the fundamentals of electricity and includes window trimming, store management, direct mail campaigns, and so on. Within the past two months 2,000 have enrolled, though very little publicity has been given to the school, and the company expects that the enrollment will be as high as 30,000 among its own dealers, central stations and jobbers. The scope and interest of the course is set forward in the prospectus, "A Coat-Pocket College of Electricity." John B. Mannion, formerly correspondence counselor of the La Salle Extension University, is supervisor.

Howell Motors Building for National Stock

In the belief that trade in the electrical industry will be picking up in strong volume before long, the Howell (Mich.) Electric Motors Company is going ahead with production. For the past two months the company has been stocking motors at its distribution points, which now number about twenty-three large cities. On the first of January two carloads of motors were shipped for Pacific Coast stock. Arrangements have just been completed for warehouse facilities in New York City, where a full line of motors will be carried too. This is the first time that the company has ever been able to accumulate large stocks at its district sales offices, as heretofore production facilities were always far behind the volume of new business. Since the first of the year, when the plant closed down for the annual taking of inventory, departments have been gradually opening up, until at present production is at about 40 per cent of capacity. This is double what it was last month. The selling organization has been gradually built up since the first of last September, and for the past two months the company reports that the results have spoken for themselves.

Carload Order of Line Hardware Shipped in Two Hours

As an instance of quick shipments now ruling the American Jobbers' Supply Company, New York City, shipped a carload of pole-line hardware on Monday of this week within two hours after the order was received at the factory. The carload was sent to one of the largest New England electrical jobbing houses, which is evidently confident of a strong revival of business in this line. The American company is optimistic as to the future, too, as its hardware factory not only has accumulated a very large surplus stock, but is continuing to produce for the purpose of further building up its reserve supply.

Locke Gets Order for 220-Kv. Insulator Units

An order for 45,000 units of suspension-type insulators, similar to the No. 5800 type, has been received by the Locke Insulator Manufacturing Company, Victor, N. Y., from the Southern California Edison Company, Los Angeles. They will be used on an experimental section of transmission line approximately 20 miles in length for operation at 220,000 volts. The Southern California Edison Company is at present operating at 150,000 volts with nine suspension insulator units per string. The special engineering features involved in the use of these insulators, such as the hardware, the grading shields and the number of units used per string, are being worked out now by the power company's engineers in conjunction with Prof. H. J. Ryan of Leland Stanford, Jr., University. Delivery of the 45,000 units is to

be made during the coming summer. The Locke company is running at full capacity but is still from four to six months behind on orders. The company expects that new business during the present year will be received in sufficient volume to absorb capacity.

Reductions Made in Industrial and Power Apparatus

Following recent wage cuts of 10 and 15 per cent, depending on the class of work affected, put into force at the Schenectady works of the General Electric Company, there has been a general reduction of 10 per cent, effective Feb. 8, on certain classes of the company's apparatus. The following are covered: Alternating and direct current industrial motors (including welding apparatus), switchboards, regulators, rotary converters, motor generator sets and generators of all descriptions except turbo generators. Power transformers and turbines did not change. These changes are in list price, not in discounts, and new lists are being published.

The same change has been made by the Westinghouse Electric & Manufacturing Company, effective Feb. 9, on alternating and direct current industrial motors and motor generators.

Underwriters' Laboratories Make Few Changes in 1920

The Underwriters' Laboratories, Inc. 207 East Ohio Street, Chicago, in a recent publication states that there have been submitted rather fewer new patterns of the more general types of wiring devices during the past year but that an increasing number and variety of special electrical appliances for use either in homes or in factories have received attention. The year has not been marked by any radical changes either in standards for appliances or in the general types of devices under investigation.

The Laboratories' standard for nonmetallic tubing has been revised and improved. New standards have been issued on asbestos-covered heater cords and on varnished-cloth-insulated wires and cables, and numerous minor changes have been made in other electrical standards. The important work on inspections of rubber-covered wires and cords has continued virtually as in previous years, and the only changes in specifications and standards have been in the recognition of varnished-cloth insulation and in certain new types as now authorized by the 1920 National Electrical Code.

Mulliner Brothers, 445 South Warren Street, Syracuse, N. Y., manufacturing service engineers, have published "Human Engineering," by Richard Mulliner, a textbook for manufacturers, engineers, executives, managers, superintendents or students of the human element in manufacturing and business engineering.

The C. L. Warrick Company, electric lamp specialist, announces that it is now in its new quarters at 112 West Forty-second Street, New York City, where it has much larger space.

The Cincinnati Artistic Wrought Iron Works, 2941 Eastern Avenue, Cincinnati, manufacturer of portable lamps, etc., has established new sales offices at 500 Fifth Avenue and 19 West Twenty-fifth Street, New York City, and at 17 West Wabash Avenue, Chicago.

The Cleveland Belting & Machinery Company, 1504-24 University Road, Cleveland, manufacturer of engines and boilers, generators, motors and belting, has enlarged its storage space by an addition 65 x 320 ft. The company says that its business is beginning to improve and expects it will continue to increase from now on.

The Hertner Electric & Manufacturing Company, 1905 West 114th Street, Cleveland, contemplates the construction of a one-story factory, to cost about $60,000.

The Maille Electric Company, Providence, R. I., has removed from 24 Garnet Street to Fountain and Dean Streets, where it has larger quarters.

The Corning Glass Works, Inc., Corning, N. Y., has made arrangements for an issue of $3,000,000 in capital stock, the proceeds to be used for general financing and for proposed plant extensions.

Leo Offenberg, Inc., has purchased the building at 390 Canal Street, New York City, and will occupy the store, basement and first two floors, comprising about 6,000 ft. of floor space. The company plans to conduct an electrical jobbing business, selling at wholesale only.

The Tubular Woven Wire Fabric Company, Pawtucket, R. I., has removed its New York office from 61 Broadway to 52 Vanderbilt Avenue. This change was made necessary because of the sale of "Duraduct" and "Duracord" having been combined under one sales organization. P. S. Klees has been engaged to take care of the combined sales in that territory.

The Clifton Manufacturing Company, Boston, has moved into offices in the new addition recently made to its plant at 63 Brockside Avenue. The portion of the old building made vacant by this change will be used for factory purposes. The company manufactures enamel and galvanized-steel conduits, insulating tapes and compounds and specialized rubber goods.

The Central Telephone & Electric Company, St. Louis, announces the removal of its headquarters from 310-12 North Eleventh Street to 2018-20 Locust Street, where it has much larger quarters.

The Thomas A. Edison Company, Inc., West Orange, N. J., has filed notice of increase in capital stock from $2,000,000 to $3,000,000.

The Maintenance Company, 417 Canal Street, New York City, electrical contracting engineer, has purchased the six-story loft building at 449-453 West Forty-second Street. The company, it is understood, will soon move into its news quarters.

The Air-Way Electric Appliance Corporation, Toledo, Ohio, has established a new factory branch office at 20 East Jackson Boulevard, Chicago, in charge of Leon Mayer, district sales manager. The company has made arrangements with the National Electric Heating Company, Ltd., 544 Queen Street East, Toronto, to act as its exclusive factory distributer for Canada. A. L. Hixson has been appointed district sales manager for the states of Indiana and Michigan. J. H. Maish is district sales manager of Kentucky and Ohio.

The Palmer Bee Company, Cameron Avenue and East Grand Boulevard, Detroit, is preparing plans for a four-story factory on Poland Avenue, to cost, including machinery, in excess of $350,000. The company manufactures elevating and conveying machinery.

The Warner Electric Company, Kalamazoo, Mich., manufacturer of electrical equipment, has filed notice of increase in capital stock from $14,000 to $50,000.

The Electrical Engineering Manufacturing Company, Pittsburgh, has acquired space 40 ft. x 160 ft. for a local plant in the building at 928-30 Penn Avenue.

The Dayton Fan & Motor Company, Dayton, Ohio, is planning to increase its capital stock from 22,500 shares, no par value, to 67,500 shares, no par value, the proceeds to be used to retire an issue of $118,000 of preferred stock and to furnish additional working capital.

Western Electric Company salesmen in the territory for which Salt Lake City is headquarters held their semi-annual conference in that city on Jan. 20, 21 and 22. James S. Walker, Jr., president of the Salt Lake Electrical Contractor-Dealers' Association, spoke before the meeting on the 21st, and in the evening a dinner was given at the Newhouse Hotel. Talks were also given by C. H. Talmage, manager of the Salt Lake branch, and by several manufacturers' representatives.

The Dayton Insulating Die Company, Dayton, Ohio, manufacturer of dies and molded insulation, has been authorized to increase its capital stock from $10,000 to $100,000.

The Rutenber Electric Company, Marion, Ind., has filed notice of increase in capital stock from $150,000 to $250,000.

The Advance Electric Company, 6315 Maple Avenue, St. Louis, has decided to hold in abeyance temporarily the erection of its proposed one-story addition, 50 ft. x 100 ft., for the manufacture of electrical specialties.

The Smith-Perry Electrical Company, Dallas, Tex., has filed notice of increase in capital stock from $60,300 to $100,000.

The El Paso Battery & Ignition Company, El Paso, Tex., has increased its capital stock from $15,000 to $30,000.

Foreign Trade Notes

RECENT FOREIGN ENGINEERING STANDARDS.—Copies of engineering standards issued in 1920 by foreign national standardizing bodies are on file with the American Engineering Standards Committee, 29 West Thirty-ninth Street, New York City, or photostatic copies of these standards can be furnished at a nominal cost. The publications of the British Engineering Standards Associations include: No. 94, specifications for watertight glands for electric cables; No. 97, specifications for watertight fittings for incandescent electric lamps, and No. 106, specifications for electrically heated cooking range.

THE EDISON SWAN ELECTRIC COMPANY, in its report for the year ended June 30, 1920, published in a recent issue of the London *Electrical Times*, shows a profit of £111,570 for the year. It states that extensive additions have been made to the lamp works, mainly to provide for the manufacture of gas-filled lamps, at a cost of £91,169. The arrangements made with the Philips Glowlamp Works of Eindhoven, Holland, is also mentioned. By this agreement the company has been able to obtain the co-operation of that firm at the company's works at Ponders End in the manufacture of all classes of electric lamps. Under the agreement a separate company has been formed, to be known as the Ediswan Lampworks, Ltd., for the entire manufacture of electric lamps for the company, the necessary capital being equally contributed by the Edison Swan company and the Philips company. The Edison Swan company has also made arrangements with the Sangamo Electric Company of the United States, and a company is being formed, the capital being subscribed by both firms, to manufacture meters at the Ponders End plant, buildings having been erected for the purpose at a cost of £25,000. Owing to the war, stocks of raw materials and manufactured goods have fallen very low. In order to increase these considerably, additional capital is necessary, and the shareholders are to be asked to sanction this. The issue is to be made as soon as the money market becomes more favorable.

DEMAND FOR SMALL MOTORS IN CANADA.—The demand for electrical appliances and accessories in Canada has been fairly good, particularly for small motors up to 1 hp. To meet this demand many manufacturers are now devoting special attention to the production of such motors.

NEW ZEALAND TO STANDARDIZE ELECTRIC DEVELOPMENT.—The New Zealand governent, it is reported, proposes to standardize the entire electric development of the Dominion on the standard three-phase, 50-cycle system. All new electric installations are to be made on this system, and several of the old plants are being changed to that system so as to be ready to take the government supply. The plans provide that the hydro-electric and steam-power plants are to be connected up on this system in each island when fully developed. The proposed hydro-electric developments in the North Island amount to 341,000 hp., with equal possibilities in the South Island. The cost of the North Island scheme is estimated at about $50,000,000 and that of the South Island plan at not much less.

WATER-POWER DEVELOPMENT IN SWITZERLAND.—Owing to the scarcity and high price of fuel in Switzerland plans have been hastened to utilize the water-power resources of the country. The maximum output of the power plants already existing near the rivers to be canalized amounts to 290,000 hp. By the erection of new plants and extensions to existing plants this will be increased by 1,450,000 hp. The hydraulic power to be obtained from rivers in the lower Alps is not included in these figures. Substantial progress has been made in the electrification of the Swiss railways, despite the high cost of materials and labor. It is estimated that the electrification will not be completed until 1923, and the cost is placed at approximately $150,000,000.

AMALGAMATION OF SIEMENS' INTERESTS WITH THE RHINE-ELBE UNION.—Arrangements for amalgamating the Siemens & Halske Electricitäts-Gesellschaft of Berlin and the other Siemens interests with the Rhein Elbe Union, one of Hugo Stinnes' trust creations, according to the London *Electrician*, have been approved by the shareholders of the Siemens-Halske Company. The capital stock of the [illegible] Company will be increased by 130,000,000 marks by the issue of 130,000,000 preferred and 4,000,000 ordinary shares. It is expected that this consolidation will make the company independent of market fluctuations in raw materials and increase the company's technical and commercial efficiency.

NEW EQUIPMENT FOR ELECTRIC PLANT AT VALLETTA, MALTA.—The manager of the waterworks and electric lighting plant, in a recent report, states that the present generating plant is inadequate and that there is an increasing demand for service not only from localities where mains are laid, but also from outlying centers such as Robato, Zebbug, Curmi, Hamrum, Zeitun and Paula, from which more than 600 applications have been received. Main extensions will not be undertaken before the generating station can meet the heavier demand. It is hoped to place the order for a new generator very soon so as to enable the department to put the new plant in service during 1921.

HYDRO-ELECTRIC DEVELOPMENT IN NEW ZEALAND.—The New Zealand Minister of Public Works in his annual report to Parliament has announced a progressive hydro-electric power development scheme to cover the next few years. The project consists of a complete high-tension transmission system in both the North Island and the South Island, connecting up the different hydro-electric power centers with the many electric power board districts. The government proposes to construct only the hydro-electric stations and main transmission lines and substations from which the energy will be sold in bulk to the local power boards for distribution to the consumers. Under the proposed plan the local organizations will be solely responsible for the distribution of the power for private use.

New Apparatus and Publications

INSULATING MATERIALS.—The Mica Insulator Company, Schenectady, N. Y., has issued catalog No. 85, covering its electrical insulating materials.

HOME LIGHTING PLANTS.—Fairbanks, Morse & Company, 30 Church Street, New York City, has issued bulletin H-248, describing the "One and a Half" and the "Three" home light plants manufactured by the company.

CONTROL.—"Development of Electricity in the Merchant Marine" is the title of publication No. 890, recently issued by The Cutler-Hammer Manufacturing Company, Milwaukee.

ELECTRIC CRANES AND HOISTS.—The Northern Engineering Works, Detroit, has issued general catalog No. 28, covering its electric traveling cranes, hoisting machinery, etc.

DIMMER SET.—The Cutler-Hammer Manufacturing Company, Milwaukee, has developed a portable dimmer box for traveling theatrical companies.

INSTRUMENTS. — The Westinghouse Electric & Manufacturing Company, has developed the type SX switchboard ammeters and voltmeters.

FURNACE.—The Majestic Electric Development Company, San Francisco, is marketing a little electric furnace of 100-watt capacity for dentists and those engaged in similar occupations.

SOCKET.—A new medium-base lighting reflector socket, catalog No. 4235, of the Bryant Electric Company, Bridgeport, Conn., is on the market.

STARTER.—A new inclosed automatic alternating-current motor starter is being marketed by the Cutler-Hammer Manufacturing Company, Milwaukee.

POWER-LINE RACK. — The France Foundry & Machine Company, Toledo, Ohio, has developed a portable power-line rack.

OUTLET BOX.—A new octagon-type outlet box for reinforced concrete construction has been put out by the Adapti Company, Cleveland, which is described in bulletin No. 106 G.

BATTERY HANDLE.—A lead-coated wire-type handle for storage batteries, No. 7-A, is a new product of the Mueller Electric Company, Cleveland.

PULVERIZED COAL.—Catalog No. 72 on "Pulverized Coal Equipment" has just been issued by the Fuller-Lehigh Company, Fullerton, Pa.

CONDUCTORS.—"Aluminum Electrical Conductors" is being distributed by the Aluminum Company of America, Pittsburgh, Pa.

HYDRAULIC VALVE.—The Larner-Johnson, Valve & Engineering Company, Philadelphia, has issued bulletin No. 2, descriptive of the Johnson hydraulic valve and differential surge tank.

LIGHTNING ARRESTER.—A vacuum-type lightning arrester for telegraph, telephone and signal circuits has been placed on the market by E. Jacobus, 79 Orange Street, Newark, N. J.

BATTERY TESTER.—The "Mac" storage-cell tester, catalog No. 25, has been put on the market by Metric Appliance Corporation, One Hundred and Thirty-third Street and Willow Avenue, New York City.

RADIATOR.—The Electric Heating & Manufacturing Company, Seattle, Wash., has developed an electric radiator in sizes from 600 watts to 10,000 watts.

New Incorporations

THE REIMERS ELECTRIC APPLIANCE COMPANY, New York City, has been incorporated by W. K. Tavender, D. Koppen and A. E. Reimers, 513 West Fiftieth Street, New York City. The company is capitalized at $60,000 and proposes to manufacture electrical equipment.

C. & H. MENZER, INC., New York City, has been chartered with a capital stock of $35,000 to manufacture electrical equipment and devices. The incorporators are C. Menzer, C. B. Bentz and W. A. Van Ness.

THE THOMPSON-DEGLER COMPANY, Clarksburg, W. Va., has been incorporated with a capital stock of $25,000 to manufacture electrical equipment. The incorporators are F. M. Thompson and H. M. Degler, both of Clarksburg, and L. F. Chalfant, Shinnston.

THE BILT-RITE EQUIPMENT COMPANY, Worcester, Mass., has been chartered with a capital stock of $150,000 to manufacture machine tools and electrical equipment. The officers are: Charles J. Jernberg, president, and Joseph T. Lord, 324 Highland Street, treasurer.

METZ & BOWLES, INC., 219 East Main Street, Clinton, Ill., has been incorporated by Herman and M. R. Metz and Edward J. Bowles. The company is capitalized at $25,000 and proposes to manufacture electrical equipment and metal products.

THE STANDARD ELECTRIC & SUPPLY COMPANY, Baltimore, has been incorporated with a capital stock of $50,000 to manufacture electrical supplies and equipment. The incorporators are Cheston M. Valentine, Chilton Ellett and John E. Martin, St. James Apartment, Center and Charles Streets.

THE AMERICOLITE COMPANY, New York City, has been incorporated by P. G. Moore, Jr., H. P. Whidden and R. M. Beard. The company is capitalized at $250,000 and proposes to manufacture electrical fixtures.

THE THORNTON TRANSFORMER COMPANY, New York City, has been incorporated by W. Brewster, H. C. Smith and G. A. Thornton, 30 Church Street. The company is capitalized at $50,000 and proposes to manufacture electrical transformer equipment and other products.

THE O-B ELECTRIC VEHICLES, INC., Brooklyn, N. Y., has been incorporated with a capital stock of $500,000 to manufacture electric automobiles and parts. The incorporators are: W. H. Bloom, W. J. Bergold and T. F. Baumann, 307 East Ninetieth Street, New York City.

THE SECURITY FIRE ALARM COMPANY, New York City, has been incorporated by L. Barone, L. Grasso and A. Forte, 300 East 122d Street. The company is capitalized at $100,000 and proposes to manufacture electrically operated alarm systems.

THE METER SERVICE CORPORATION, New York City, has been incorporated with a capital stock of $25,000 to manufacture electrical instruments and equipment. The incorporators are F. W. Douglas, S. A. Gafvert and C. E. Scobal, 1790 Broadway.

THE CENTRAL ELECTRICAL & HARDWARE COMPANY, Newark, N. J., has been incorporated by Francis Gonzalez and William C. Daly. The company is capitalized at $50,000 and proposes to manufacture electrical equipment and hardware specialties. Magne Kjellesvig, 539 Central Avenue, represents the company.

THE IDEAL ELECTRIC MANUFACTURING COMPANY, Newark, N. J., has been incorporated with a capital stock of $50,000 to manufacture electrical appliances and devices. The incorporators are August and Joseph A. Harth, August Weimert, Jr., and Otto A. Stiefel, 156 Market Street.

THE EATON ELECTRIC FURNACE COMPANY, Taunton Mass., has been incorporated under the laws of the state of Massachusetts with a capital stock of $95,000. Hary B. Eaton, 3 Prospect Street, Taunton, is president and treasurer.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 18, 1921)

1,365,898. TELEPHONE APPARATUS; Henry C. Egerton, Passaic, N. J. App. filed Jan. 8, 1918. Loud-speaking receiver.

1,365,926. RADIO INTERFERENCE PREVENTER; Tyng M. Libby, Tacoma, Wash. App. filed Oct. 21, 1919. For counteracting effect of interfering signals.

1,365,965. MAGNETIC SEPARATING APPARATUS; Charles G. Buchanan, Roseville, N. J. App. filed June 12, 1918. Pulley.

1,365,966. MAGNETIC PULLEY; Charles G. Buchanan, Newark, N. J. App. filed May 4, 1920. Separation apparatus.

1,365,972. TESTING ATTACHMENT FOR SPARK PLUGS; John E. Finn, Brooklyn, N. Y. App. filed Nov. 1, 1919. Variable gap.

1,365,977. RADIOTELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed June 18, 1917. Arc radio transmitters.

1,365,978. ELECTRICAL IMMERSION HEATER; Albert J. Gallager, New York, N. Y. App. filed Oct. 18, 1919. Non-corrosive insulating material.

1,365,988. BATTERY HAND-LAMP; Carl Hambuechen, Belleville, Ill. App. filed Aug. 26, 1916. Improved switch.

1,366,010. ELECTRIC ACCUMULATOR; Emmanuel Lemaire, Mons, Belgium. App. filed June 9, 1918. High capacity with small volume.

1,366,024. CALL-REGISTERING ATTACHMENT FOR TELEPHONES; Abraham Reubenstone, New York, N. Y. App. filed June 11, 1919. To prevent overcharges.

1,366,057. APPARATUS FOR CONVERTING ALTERNATING ELECTRIC CURRENTS INTO DIRECT CURRENTS AND VICE VERSA; John E. Calverley and William E. Highfield, Preston, England. App. filed March 26, 1920. Transformers and commutators.

1,366,069. MEANS FOR PREVENTING OFFSET IN PRINTING; James E. Doyle, Cleveland, Ohio. App. filed Aug. 17, 1918. Preventing offset and static electricity.

1,366,070. STORAGE BATTERY; John M. Friss, Racine, Wis. App. filed March 5, 1920. To prevent plates coming into contact.

1,366,073. ELECTRODE-ADJUSTING MEANS; Charles W. Harper, Chicago, Ill. App. filed April 29, 1920. Electrical furnace.

1,366,078. METHOD OF LOCATING FAULTY SUSPENSION INSULATORS ON LIVE-WIRE TRANSMISSION LINES; Tomlinson F. Johnson, Jr., Atlanta, Ga. App. filed March 16, 1918. By intensity of arc from insulator cap to metal point on an insulated pole.

1,366,084. PORTABLE HAND LAMP; Harry M. Koretzky, Brooklyn, N. Y. App. filed Aug. 5, 1919. Simple arrangement.

1,366,090. SEPARATOR FOR ELECTROLYTIC CELLS; Isaac H. Levin, New York, N. Y. App. filed April 21, 1919. Electrolyte permitted to circulate freely.

1,366,093. ELECTRIC LIGHT CLUSTER; Harold C. Noe, East Orange, N. J. App. filed May 20, 1920. For table lamps, etc.

1,366,095. VOLTAIC CELL AND ELECTRODE; Frederick R. Parker, Chicago, Ill. App. filed May 8, 1916.

1,366,108. VALVE WELDING; Fred H. Wobig, Detroit, Mich. App. filed March 6, 1920. Eliminates counter-boring.

1,366,141. CONTROL SYSTEM AND APPARATUS; Charles C. Whittaker, Pittsburgh, Pa. App. filed Feb. 13, 1920. Electric locomotives.

1,366,142. MINE TROLLEY; Robert G. Wilson, Davis, W. Va. App. filed Jan. 21 1920. Readily reversible.

1,366,160. ROTARY SPARK GAP; August J. Kloneck, New York, N. Y. App. filed May 8, 1916. High frequency.

1,366,189. REELING DEVICE; Frank A. Klohs, Mansfield, Ohio. App. filed March 28, 1919. Trolley retriever.

1,366,191. DRY-CELL BATTERY; Harry M. Koretzky and Boris H. Teitelbaum, Brooklyn, N. Y. App. filed Dec. 17, 1919. Compact form.

1,366,196. ELECTRIC HAIR SINGER; Joseph P. McMahon, New York, N. Y. App. filed Jan. 30, 1920. Electrically heated wire.

1,366,198. REELING DEVICE; Samuel S. Matthews, Mansfield, Ohio. App. filed April 9, 1919. Trolley retriever.

1,366,199. REELING DEVICE; Samuel S. Matthews, Mansfield, Ohio. App. filed April 9, 1919. Trolley retriever.

1,366,215. SUPPLEMENTARY POWER PLANT FOR ELECTRIC CENTRALS; Johannes K. Ruths, Djursholm, Sweden. App. filed Aug. 5, 1916. Reserve generator for instant connection to load.

1,366,222. IGNITION MAGNETO FOR INTERNAL-COMBUSTION ENGINES; Ettore Viani, Milan, Italy. App. filed Aug. 19, 1919. Timing conveniently adjusted.

1,366,223. STORAGE BATTERY; Ralph W. Wales, Auburndale, Mass. App. filed Feb. 24, 1920. Improved separator.

1,366,231. STERLIZABLE CAUTERY; William A. Winter, East Orange, N. J. App. filed Sept. 8, 1917. Surgical instrument.

1,366,246. ELECTRIC SOCKET BOX; Abraham Cooper, Brooklyn, N. Y. App. filed April 7, 1919. For classification plugs, markers and signal lamps.

1,366,257. MEANS FOR MOUNTING ELECTRODES EMPLOYED IN THE PREVENTION OF CORROSION IN STEAM BOILERS, CONDENSERS AND LIKE STRUCTURES; Arthur S. Gush, Edinburgh, Scotland. App. filed Nov. 26, 1919. Insulating bushing.

1,366,263. SPEED-LIMITING DEVICE; James B. Replogle, Detroit, Mich. App. filed Dec. 16, 1918. For automotive vehicles.

1,366,298. DRY BATTERY; Boris H. Teitelbaum, Brooklyn, N. Y. App. filed Dec. 3, 1919. Valve to allow escape of ammonia.

1,366,311. PRODUCTION OF HIGH-FREQUENCY OSCILLATIONS; Fulton Cutting, Tuxedo Park, N. Y. App. filed June 26, 1918. Wireless telegraphy.

(Issued Jan. 25, 1921)

1,366,352. PROPELLING AND BRAKING MEANS FOR TRAVELING CRANES AND CARRIAGES; Melvin B. Benson, Superior, Wis. App. filed Oct. 28, 1918.

1,366,378. TROLLEY WHEEL AND HARP; William R. Gillies, Chicago, Ill. App. filed Nov. 20, 1919. Removable rim.

1,366,395. RECTIFIER; Oscar M. Leich, Genoa, Ill. App. filed March 24, 1919. Vibratory.

1,366,404. ELECTRODE; Archibald J. MacDougall, Toronto, Ontario, Canada. App. filed July 2, 1919. Electrolytic apparatus.

1,366,410. TRANSMITTER; Marshall R. Myers, Afton, Ia. App. filed Dec. 22, 1919. Wireless.

1,366,411. THERMIONIC TRANSLATING DEVICE; Alexander McL. Nicolson, New York, N. Y. App. filed Feb. 19, 1916. Vacuum tube.

1,366,414. MEANS FOR AND METHOD OF MEASURING WEAK CURRENTS; Harold S. Osborne and William H. Martin, New York, N. Y. App. filed Feb. 26, 1917. In telephone circuits.

1,366,416. SIGNALING SYSTEM; Harry Pfannenstiehl, East Orange, N. J. App. filed June 18, 1917. Printing telegraph.

1,366,423. COMPOSITE RINGER; Roy B. Shanck, Kingston, N. Y. App. filed May 21, 1919. Telephone and telegraph.

1,366,446. METHOD OF AND APPARATUS FOR THE REPRODUCTION OF SOUNDS AND MOTIONS; Lee A. Collins, Louisville, Ky. App. filed May 26, 1917. Simultaneous reproduction of sound and picture.

1,366,452. VAPOR RECTIFIER FOR HIGH-POTENTIAL CURRENTS; George W. Heimrod, Hanover, Germany. App. filed June 3, 1914. High potential.

1,366,457. APPARATUS FOR CALCINING CARBON FOR ELECTRODES; William Hoopes, Pittsburgh, Pa. App. filed May 20, 1919. To produce coke of high grade.

1,366,458. METHOD OF CALCINING CARBON FOR ELECTRODES; William Hoopes, Pittsburgh, Pa. App. filed May 20, 1919. To produce coke of high quality.

1,366,461. FLASHLIGHT; Gustaf I. Johnson, Malden, Mass. App. filed Oct. 23, 1919. Manually generates current.

1,366,475. APPARATUS FOR THE PRODUCTION OF ALTERNATING CURRENTS; John L. Milton, Cleveland, Ohio. App. filed Jan. 30, 1909. For ignition.

1,366,478. POWER SYSTEM; William Morrison, Chicago, Ill. App. filed Sept. 7, 1916. Automobile.

1,366,480. ELECTRIC IRON; Jose A. Ocabalda, New York, N. Y. App. filed Oct. 7, 1919. Circuit opens short time after releasing handle.

1,366,489. PROCESS OF MAKING NEGATIVE ELECTRODES FOR ELECTRIC ACCUMULATORS; Adolfo Pouchain, Turin, Italy. App. filed Sept. 18, 1919. Plate coated with zinc.

1,366,490. NEGATIVE PLATE FOR ELECTRIC ACCUMULATORS; Adolfo Pouchain, Turin, Italy. App. filed June 22, 1920. Zinc plate reinforced by metal of high conductivity.

1,366,491. MANUFACTURE OF NEGATIVE PLATES FOR ELECTRIC ACCUMULATORS; Adolfo Pouchain, Turin, Italy. App. filed June 22, 1920. Two amalgamated zinc plates mounted on opposite faces of rigid material.

1,366,519. ELECTRIC HEATER; Samuel M. Carmean and James H. Carmean, Kansas City, Mo. App. filed March 13, 1920. Fan throws out hot air.

1,366,525. CORE STRUCTORE FOR DYNAMOS; William W. Dean, Rochester, N. Y. App. filed Aug. 4, 1916. Core in extended contact with the pole pieces.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

ROCKINGHAM, VT. —In connection with a proposed three-story dormitory the Vermont Academy, Saxtons River, Rockingham, plans to erect a 50-ft. x 50-ft. power house. The total cost will be about $100,000.

AMESBURY, MASS. — The Amesbury Electric Light Company has applied to the Department of Public Utilities for permission to issue stock for $60,000 to be used for extensions to its property.

BOSTON, MASS. —Plans have been filed by the John West Thread Company, 1312 Columbia Road, for improvements and alterations to its power house.

FRANKLIN, MASS. —The Union Light & Power Company has petitioned the Department of Public Utilities for permission to issue additional capital stock to the amount of $150,000. According to E. S. Hamblen, general manager, the new capital is needed for improvements and extensions to the plant.

PROVIDENCE, R. I. The Narragansett Electric Lighting Company has filed plans for the construction of a three-story power house on Elm Street.

Middle Atlantic States

LE ROY, N. Y. —The Le Roy Hydraulic Electric Gas Company, having recently installed equipment at its plant for increased capacity, is considering the extension of its electric lines northward on the Lake Street Road. This extension would provide energy for light and power for Fort Hill, Stone Church and adjoining vicinity.

MECHANICSVILLE, N. Y. The Half Moon Light, Heat & Power Company has increased its capital from $200,000 to $300,000 for proposed expansion.

NEW YORK, N. Y. The Knickerbocker Ice Company, 481-99 West 184th Street, contemplates the installation of considerable electrical and mechanical equipment in the proposed addition to its ice manufacturing plant.

BELVIDERE, N. J. Plans are under way by New York and Eastern capitalists, represented by P. T. Brady of the Westinghouse Electric and Manufacturing Company, for the development of a large power project on the Delaware River, including the construction of several reservoirs and dams. Four applications have been filed with the Federal Power Commission, and upon grant of federal consent work will be started immediately. The central electric power plant, using both steam and water power, which will probably be erected at Belvidere, is designed to generate 300,000 hp., though at first only half that power will be available. Twelve local and supplementary power houses will be erected along the Delaware Valley line at Hankins, Narrowsburg, Barryville, Mongaup, Eastbranch, N. Y., and Dingman's Ferry and Bushkill

Pa. More than $1,000,000 has been expended for sites, surveys, plans and initial contracts. The total cost is estimated at about $100,000,000.

ELIZABETH, N. J.—The Bethlehem Shipbuilding Company, Front Street, has tentative plans under way for the construction of proposed additions and installation of electrical and mechanical equipment. The total cost is approximated at $1,000,000.

ERIE, PA.—The City Council has been petitioned for the installation of an ornamental lighting system on Peach Street from Fifteenth to Twenty-sixth Street. Mr. Eichhorn is street director.

MASONTOWN, PA.—The power house at the Patrick mine of the Nicholson Coal Company, it is reported, has been damaged by fire, causing a loss of about $25,000. It is understood that the power plant will be rebuilt.

MOUNT CARMEL, PA.—Plans have been approved by the Borough Council for the installation of a fire-alarm system.

FREDERICK, MD.—Plans are under way by the Nicodemus Ice Cream Company for the erection of a power house in connection with a three-story manufacturing plant. H. O. Nicodemus is president.

HAMPSTEAD, MD.—Bids are being received by the Carroll County School Board, Court House, Westminster, for the construction of a three-story electric light plant.

NORFOLK, VA.—An appropriation of $18,000,000 has been arranged by the Norfolk & Western Railway for extensions and improvements. Plans include the construction of a new power plant, general repair shops for locomotive work and the installation of electrical equipment, to cost about $1,000,000. Other installations of electrically operated machinery will also be made.

RICHMOND, VA.—Liggett & Myers, 212 Fifth Avenue, New York City, plan to install a turbine engine in connection with the generation of electricity at their new factory in Richmond.

FREMONT, OHIO.—The city officials contemplate changing the entire lighting system when the present contract expires this year.

GLENDALE, OHIO.—The village officials contemplate the electrification of the local water-works at a cost of about $30,000. Energy will be obtained from the Union Gas & Electric Company, Fourth and Plum Streets, Cincinnati.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company will make improvements this year which will cost about $200,000. Plans include construction work, betterments to the distribution system and installation of automatic voltage regulators. C. I. Weaver is general manager.

WAPAKONETA, OHIO.—At a recent election bonds to the amount of $110,000 were voted for rebuilding the municipal light plant.

HAZARD, KY.—The Hazard Light & Power Company plans to make improvements this year at a cost of about $15,000. New equipment will be required.

DELPHI, IND.—The Farmers' Co-operative Packing Company contemplates the erection of a packing plant, power house, etc., to cost about $500,000.

FRANKFORT, IND.—Specifications have been prepared and bids will soon be received for the erection of a municipal light and power plant and the installation of equipment including turbines, condensers, boilers, etc. The cost is estimated at about $275,000. J. D. Lyon, Union Central Building, Cincinnati, Ohio, is engineer.

RICHMOND, IND.—The city officials have had specifications prepared for a 5,000-kw. alternating-current light plant to cost about $175,000. A centrifugal pump, coal and ash handling equipment, meters, etc., will be installed at a cost of $50,000. J. D. Lyon, Union Central Building, Cincinnati, Ohio, is engineer.

GALESBURG, ILL.—The Board of Local Improvements is considering the installation of an ornamental lighting system on Jefferson Street.

BELOIT, WIS.—The County Board has granted the Beloit Water, Gas & Electric Company permission to extend its line to the township of Turtle.

EXCELSIOR SPRINGS, MO.—The Excelsior Springs Water, Gas & Electric Company plans to erect a transmission line to Liberty.

WARRENSBURG, MO.—The city officials contemplate the erection of a 12-mile distribution system in the city and an 8-mile transmission line outside. F. L. Wilcox, Syndicate Trust Building, St. Louis, is consulting engineer.

CASTLEWOOD, S. D.—A special election will be held Feb. 15 to submit to the voters a proposition to issue $18,000 in bonds for the installation of a municipal light plant.

OSCEOLA, NEB.—The City Council has requested an estimate on a municipal light plant.

WALES, TENN.—The International Agricultural Corporation contemplates the electrification of its plant at a cost of more than $300,000. Electric motors and considerable electrically operated equipment will be installed at this plant for fertilizer production. Plans also include the erection of 20 miles of 6,600-volt transmission line and a step-down transformer station. J. A. Barr, Mount Pleasant, is engineer.

MONROE, LA.—The Union Power Company, St. Cloud, Minn., contemplates the erection of an electric plant in the Monroe gas fields.

DUNCAN, OKLA.—An election will be held soon for the purpose of submitting to the voters the proposal to issue bonds for the establishment of a light and power plant.

DALLAS, TEX.—The Board of Commissioners has granted the Dallas Power & Light Company permission to install three new power feeders at its East Dallas substation and three at its main station. The cost is estimated at $12,553.

MEMPHIS, TEX.—The city officials have purchased a light and ice plant and contemplate enlargements.

SOUTH BEND, TEX.—The Prairie Pipe Line Company is having plans prepared for a new electrically operated pumping plant to cost about $45,000.



CONSTRUCTION WORK ON NEW STEAM STATION AND GAS PLANT AT ASTORIA BY PHOENIX UTILITY COMPANY FOR PACIFIC POWER & LIGHT COMPANY

North Central States

ADA, MICH.—H. G. D. Nutting, an engineer at Grand Rapids, has been granted permit for the construction of a 24-ft. dam capable of developing about 1,000 hp.

HOUGHTON, MICH.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the erection of a radio building at this place.

PELLSTON, MICH.—The Cheboygan Electric Light & Power Company's dam, near Pellston, will be entirely rebuilt. Plans include the installation of waterwheels and electric generating equipment for control by means of electric energy from substation at Pellston. The present plant at the dam will be discarded.

TRAVERSE CITY, MICH.—An election will be held April 4 for the purpose of submitting to the voters a proposition to issue $250,000 in bonds for the installation of a hydro-electric plant. Mr. Moffatt is city clerk.

CLEVELAND, OHIO.—Bids will be received by the Board of Education until Feb. 28 for furnishing electric wiring, fixtures and reflectors for Mayflower, St. Clair and Dunham Schools. W. R. McCormack, East 84th Street and Rockwell Avenue, is architect.

Southern States

GAFFEY, S. C.—The Cherokee County Home contemplates the installation of a light and water system.

PUNTA GORDA, FLA.—The installation of a street-lighting system at this place is contemplated.

Pacific and Mountain States

PRIEST RAPIDS, WASH. At a recent conference attended by residents of Portland, Spokane, Seattle and several other places the proposition to erect the Priest Rapids dam and develop a large power plant was approved. Colonel Schultz represented the war department.

SEATTLE, WASH.—The Board of Public Works will receive bids until Feb. 18 for furnishing electrical equipment, including two 35,000-hp. generators, exciters, etc., for the Skagit River project. The cost is estimated at about $1,000,000.

DUARTE, CAL.—The Jewish Consumptive Relief Association contemplates the erection of hospital buildings and a power plant to cost about $100,000. F. H. Wallis, 507 Title Insurance Building, Los Angeles, is architect.

LODI, CAL.—The installation of additional equipment at the municipal light plant to cost about $20,000 is under consideration.

LOMPOC, CAL.—The San Joaquin Light & Power Company, Fresno, plans to extend its line to this section.

SACRAMENTO, CAL.—A report approving plans for the Iron Canyon irrigation project and prepared by the United States Reclamation Service and the State Engineering Department was submitted at a recent meeting of the Sacramento Valley Development Association. Plans include the construction of a hydro-electric plant and also a dam to impound water sufficient to irrigate 225,000 acres of land at a cost of $15,000,000. The total estimated cost is $37,577,932. W. F. McClure is state engineer.

BOISE, IDAHO.—The City Council has applied to the Federal Power Commission for permission to erect a 75-ft. dam on the north fork of the Payette River and to develop 12,000 hp. for municipal use.

PROVO, UTAH.—The Kecler Electric Light Company, recently incorporated for $5,000, plans to operate an electric light and power line in the vicinity of Salem and Spanish Fork. J. A. Walter is president and director.

SALT LAKE CITY, UTAH.—R. H. Lehman of Salt Lake City has filed application with the state engineer for the diversion of 20 sec.-ft. of water from Salina Creek in Sevier County. The development of 600 hp. for a coal mine in Salina Canyon is contemplated.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company has applied to the Federal Power Commission for permission to erect a 250-ft. dam on the Green River in southeastern Utah. The construction of an 8,000-hp. plant is also proposed for serving power in the vicinity of Salt Lake City and parts of Wyoming

TRENTON, UTAH.—The Utah Power & Light Company, Salt Lake City, has been granted a certificate of convenience and necessity to construct, operate and maintain a light and power system in and adjoining the town of Trenton.

Canada

GALT, ONT.—The Hydro-Electric Commission is considering the establishment of a hydro-electric system in Galt similar to the one in Chatham

Electrical World

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Chicago Chosen for N. E. L. A. Convention

BY A HAPPY decision the next convention of the National Electric Light Association will be held in Chicago. This augurs well for a large attendance and a successful meeting, for Chicago knows how to do things and its slogan "I will" typifies its spirit. To electric light and power men Chicago is particularly interesting because it is the abode of the industry's chief counsel and guide, Samuel Insull, and because it possesses some of the largest and most efficient steam-electric generating stations in the world. Were that all, it would be enough, but space does not permit the enumeration of the city's other assets. Volumes have been written on them, and material for fresh volumes is forthcoming daily. A visit to Chicago at any time will amply repay one, and the electric light convention is an added recompense. Managers, engineers and commercial agents should make it a point, therefore, not to overlook the week beginning May 29.

Customer Ownership and Public Opinion

CUSTOMER ownership of public utility securities develops a new sense of responsibility among the users of service, and if it is long continued it will greatly benefit operating managements by reflex action. The closer the relationship between public and company the better. Acquisition of property has a sobering influence upon radicalism, and in a community where the savings of citizens are invested in the local utility the chances of fair treatment are multiplied and the likelihood of serious disputes is reduced. It will be interesting to watch the course of proposed radical legislation in communities where the customer-ownership idea gains headway. Participation in the business of a local utility through investment in its shares bodes ill to the demagogue whose success in the past has so often been based upon appeals to ignorance and indifference in districts holding false notions or no ideas at all about local utilities. In addition alert managers will do well not to overlook the opportunities for taking their local investors into their confidence about company affairs. The educational possibilities are little less than wonderful. Worth-while "tips" to those in operating charge may often come from very humble sources. But most important of all is the opportunity for that contact between company and customer which contains so much potential good. The mighty force of public opinion is being harnessed for the mutual benefit of utilities and their patrons where customer ownership is treated as something beyond the mere speculative buying and selling of an interest in the property. If this great movement continues to develop, it will not be long before it will be credited with a vast amount of constructive influence on popular thinking about utility corporations, and new faces will appear at commission hearings in popular support of company policies.

Search for Economy Should Not Be Curtailed

THE conclusion reached from studying the tendencies of the day that a general effort toward economy exists. Operating companies are trying to reduce their overhead and underground costs, both as to construction and as to operation, without impairing service. It is more than an attitude forced by lack of money; it is a healthy consequence of the general extravagance of the last few years. That which has been accomplished so far only shows what a very small part of the actual possibilities have been investigated. The danger therefore is that, blinded by this desire for economy, investigations, searches, analyses, all of which represent expenditures, will be stopped for the sake of saving a few dollars and the infinitely larger savings that such work makes possible be lost. Further, this work must be done with thorough engineering application and judgment, which also represent expenditures, in order that it shall not be necessary to retrace steps. Those who will consider with unbiased mind what engineering effort has accomplished so far cannot but encourage investments of relatively small funds that hold unlimited promises of economy for the future.

What Are Utility Property "Values"?

DO UTILITY property values depend on current market prices of the component parts, or is there some other basis that will represent values in a more nearly correct light? Arguments for present-day or market values as a basis for rate making have met with favor in court decisions. These arguments are apparently founded on the theory on which merchandise stocks, which depend for their revenue-producing ability on the sale of the individual items to the customer, are valued. Whether the cases are parallel is an undecided question. Manufacturing plants are put together with labor and material purchased in open market to produce a salable product. The value of the plant as a manufacturing establishment depends to some extent on the market value of its parts, but its ultimate value is chiefly determined by the skill with which the parts are assembled and operated to turn out the factory product. If the product can be turned out at a low cost and the organization as a whole is efficient, the value of the assembled plant is enhanced by the profit on the sale of goods. If the assembly is unskillful, the management incompetent and the owner must face a competitive

market, he is at a disadvantage that will ultimately make it impossible to dispose of the product, and his plant speedily sinks in value to the price of the salvage that can be had. In a business field where free competition exists economic forces provide the penalty for incompetence or errors in judgment, and equally they reward efficiency.

The elimination of competition in utility operation by the establishment of commission regulation does not relieve the industry from the effects of incompetence or bad judgment or the necessity of reward for efficiency, nor does it change the fundamental basis of plant values. Commission regulation is designed to do constructively certain things that, because of conditions, competitive effort either will not do or will accomplish through a destructive process. The ultimate result, however, must be that which is obtained in the business field. If this reasoning be sound, a utility property may be considered as a manufacturing plant into the value of which the market prices of labor and material to construct enter as a factor. The price of its product will vary with conditions that bear little relation to the pure physical plant except as to its efficiency of production. The primary factor in property values that does bear a vital relation to the price of its product is the skill with which the physical and commercial components have been assembled and managed to give service. It therefore follows that in one form or another skill must be rewarded in proportion to its efficiency or the organization penalized for its incompetence. Whether the present trend of court decisions on the question of values will clear or becloud the issues is a matter of moment to public utilities. Serious study of the problem of what really constitutes value in a utility property is needed.

Procedure that Simplifies the Lighting Problem

EFFECTIVE lighting can be evaluated best by the results determined after it has been installed. No matter how carefully the design may be conceived and executed, unless all the factors are considered and taken care of the results may not be satisfactory to the user. These sometimes intangible, or at least unforeseen, details have caused many of the unsatisfactory layouts for lighting in industrial plants. That this has been true is not a reflection on the designer, but rather goes to show that lighting perfection can come only through experience. As the development of the art proceeds, no doubt new factors will still arise which will have to be considered in order to gain the fullest efficiency in the use of artificial illumination.

In this issue E. A. Anderson shows how it is possible to take up the subject of lighting design in four logical steps and almost automatically to allow for the many variable factors. A new term, called the "room index," enters into this method. This room index takes into consideration the length and width of the room, as well as the mounting height of the lighting unit above the working plane, so as to make it possible to turn to the various types of lighting units and by a consideration of the reflection factor of the walls determine accurately the coefficient of utilization. This work is not the result of theory or empirical formulas, but comes through long observation and study by the staff of the National Lamp Works.

While this method does not entirely eliminate the possibility of further and careful consideration, particularly in cases of special lighting, where the psychological and physiological effects must be considered, it is sufficiently comprehensive for most practical work. The greatest merit of the plan is that it is easily understood and when put into effect will certainly give results far more accurate than the methods by which most lighting installations have been designed in the past.

To See Ourselves as Others See Us

A RECENT number of the *Electrician* of London contained an interesting report on American electrical practice by S. L. Pearce of the Manchester Electricity Department, who was sent to this country to make a careful study of operating conditions in the larger plants with a view of getting a conspective notion of recent American practice. Those who know Mr. Pearce realize that a very keen intelligence and sharp pair of eyes have been fixed on the way we do things and that his recorded conclusions are correspondingly valuable. Perhaps the most surprising of his notes is that which suggests that steam-turbine practice in this country is less advanced than in England and that, comparing the best plants in each country, ours show the lower operating efficiencies. We should like fuller details on this matter before passing judgment, but our offhand inclination would be to ascribe the difference to the rapid changes that have taken place in American operating conditions during the war, and particularly to the rapid increase in costs of machinery, which have not always tended toward producing equipment of the highest possible efficiency irrespective of first cost. If this view of the situation be correct, it should rapidly be remedied under stress of the high costs of fuel still maintained and the removal of the abnormal requirements brought about by war loads. The same general conditions probably account, as Mr. Pearce evidently realizes, for the difference in boiler practice which forces American units to a considerably higher rating than is usual in British practice, by reason of the effect of high investment costs.

A number of other differences in practice noted are more or less the result of chance, like the considerable variation in engineering voltages of somewhat higher periodicity and the general use of overhead rather than underground lines in American practice. It is self-evident that with the widespread distribution from urban plants common in this country, as compared with the more compact areas served by most British plants, the use of overhead service whenever possible is an economic necessity and there is no considerable probability of our changing to underground distribution on any such scale as is attempted abroad. A curious variation in practice, however, is found and emphasized by Mr. Pearce with respect to the service pressures of supply, where American practice runs to just about one-half of the figures found in the typical English, or for that matter over-seas, plant. This is virtually the only country of importance which does not freely use incandescent lamps and other apparatus of intimate distribution at from 220 volts to 250 volts. What this means in distribution losses or distribution cost, according to whether we take one horn of the dilemma or the other, is too evident to require comment. The causes of this particular difference, which runs exactly counter

to the general bold trend of American engineering, are somewhat complicated. The long-established custom of lamp renewals free or at moderate cost—a custom only gradually being discontinued—has been one powerful influence at work, and the close relations between central stations and lamp manufacturers have been another. In addition, the very large number of motors and appliances already standardized and in use affords strong reason for hesitating at so radical a change as that from a 110-volt to a 220-volt service. It is probably safe to say, however, that if one could start *de novo* with a big urban plant, a secondary system at 110 volts would receive no more consideration than a primary system at 1,000 volts.

Despite the criticisms referred to and some other minor ones which Mr. Pearce makes, he has freely to admit that in the big American plants the cost of electrical energy is not only relatively but often actually cheaper than in England. We may slip up in details of practice occasionally, but in the large items of efficient operation a very high rank must be accorded to our central stations. Particularly is this true of interconnection, co-ordinated working covering in some cases, as Mr. Pearce notes, areas nearly as large as the whole of England. His estimate of American practice leaves us, on the whole, much to be proud of, albeit it brings sharply to our notice some details which from their very familiarity to us can best be seen by a sharp-eyed outsider.

Electrical Inspectors Seek Co-operation

APPOINTMENT by the Western Association of Electrical Inspectors of an industrial and an associate member to its executive committee is a commendable move in the direction of co-operation in the inspection field. This is done under the revised articles of association adopted at the recent Detroit meeting. When it is realized that these two committee members are from a group that has no vote in the open sessions of the association the significance of the action becomes more apparent. The feeling between the men called upon to handle the work of inspecting electric installations and those intrusted with the duty of installing and operating them has not always been of the pleasantest character, largely because there has been more or less lack of understanding of the functions of the various inspection organizations in their relations with the other branches of the industry. Fortunately that lack of understanding has been rapidly disappearing in the last few years and is being replaced by a feeling that all are a part of the same industry and that any apparent conflict of interest is due to a lack of co-ordination of the different fields of activity. The result is a better understanding in the electrical field of the functions of the inspector, and the inspector, on the other hand, is appreciating more and more the difficulties under which the work he must deal with is done.

It is regrettable that the spirit of the discussion at Detroit when the article providing for the representation came up for consideration cannot be imparted to every public utility and industrial man whose work is affected by inspection bureaus. The purpose of the move is to give the other branches of the industry vitally interested an opportunity to make their needs known, and to provide another method whereby hasty and ill-considered action can be halted and a thorough discussion on the part of all interested brought about before the action has gone so far that it is difficult to recall and that severe criticism has arisen. The association is endeavoring to provide every safeguard against unwise action. Its move should be met in the spirit in which it has been taken, and all branches of the industry should lend help to give it success.

Increasing Maximum Working Voltages in Cables

THE maximum stress on the insulation of high-voltage cables as at present manufactured is well below the dielectric strength of the principal ingredients used. All high-class fluid insulating compounds in the pure state have dielectric strength higher than that of a gas, and yet the maximum permissible stresses in cables are lower than the dielectric strength of air. This anomalous situation is caused by the difficulty of securing a homogeneous structure and the elimination of voids, or gas bubbles, in all types of built-up insulation. These gas pockets develop ionization at relatively low voltages, resulting ultimately in destruction of the insulation. The condition is well known in armature coils, and in cables is further complicated by the requirement of mechanical flexibility. At present the dielectric strength of the insulating material has relatively little weight in determining the total thickness of insulation in a cable for a given service. This is further emphasized by the fact that no consideration has yet been given to the increased stress on the insulation due to stranding of the conductor. It is well known that stranding a conductor in air materially increases the stress at the surface.

Recent research in this field and further knowledge of the facts are causing cable designers to look forward to the time when the dielectric strength of pure material may be more nearly approached as the limit of permissible stress, and so to increase permissible cable voltages. In the January number of the A. I. E. E. *Journal*, Messrs. Davis and Simons present a valuable survey of the present situation in the matter of cable design. Tables are given for determining the maximum insulation stress arising in single and three-conductor cables in terms of their dimensions. An analysis is also given leading to the determination of the minimum value of maximum stress for a triplex cable of given outside diameter and to the conclusion that this minimum value of stress will be attained when the conductor diameter equals the core diameter divided by 5.94.

Cable designers are apparently not in complete accord as to the present maximum permissible stress, the authors referred to proposing 25 kv. per centimeter, while other well-known engineers propose 19.5 kv. per centimeter. Using these two figures and the analysis developed, the authors of the paper have computed the maximum safe working voltages which may be used on several types of cables of core diameters from 2½ in. to 3½ in. (6.3 cm. to 8.9 cm.), as limited by the size of underground duct. The results of this analysis indicate a maximum voltage of about 34 kv. for a cable with core diameter of 3½ in. and maximum insulation strength of 25 kv. per centimeter. It is also proposed that the Hochstader triplex cable, in which the insulation of each conductor is wrapped with copper foil, may eventually operate at a stress of 40 kv. per centimeter. On this basis 50,000 volts is proposed for this type of cable.



Michael Idvorsky Pupin

Who this week received the Edison medal, the greatest honor the electrical industry has to offer, for his work in mathematical physics and its application to the electrical transmission of intelligence

IT IS seldom that one man does so many great things for one branch of science as Prof. M. I. Pupin has accomplished for the art of communication. In both wired and wireless work his discoveries have been of fundamental importance. But for his discovery of the loading coil the use of the telephone would still be restricted to comparatively short distances. Through the economy in wire effected thereby many millions of dollars have been saved. His early work in electrical resonance resulted in the use of tuned circuits for selective receiving of signals. This principle of tuning has had a profound effect on the wider use of the wireless. A further refinement in the wireless art contributed by Professor Pupin is the polarized electrolytic-cell method of rectifying both low-frequency and high-frequency oscillations to make them detectable by direct-current instrument. He has of late years been engaged in perfecting a method for eliminating the effects of static on radio waves, and one of his more recent contributions has been the so-called negative resistance compensator. In 1917 he presented to the United States government the use of his invention decreasing static interference.

Professor Pupin, who this week received the Edison medal, which was awarded to him by the American Institute of Electrical Engineers "for work in mathematical physics and its application to the electrical transmission of intelligence," was born of Serbian parents in Idvor, Banat, Hungary, Oct. 14, 1858. He came to the United States in 1874 and after five years of hard manual work had saved enough money to enter Columbia College, from which he was graduated in 1883 with high honors. He took post-graduate work in physics and mathematics at the University of Cambridge, England, and the University of Berlin, Germany. In 1889 he returned to Columbia University and with Prof F. B. Crocker started the electrical engineering department at Columbia as instructor in mathematical physics. Professor Pupin has remained at Columbia ever since and now occupies the chair of electromechanics, besides being director of the Phœnix Research Laboratory of the university. For his researches he has received many honors, including the Herbert prize in physics from the French Academy and the Carson gold medal from the Franklin Institute. He is a member of numerous technical societies, in some of which he has taken a prominent administrative part.

During the war he served on several war-work committees, including a government committee for submarine detection with headquarters at New London, Conn., where he and his staff developed a method for detecting submarines at rest and determining their exact position. The further development of this work is now in the hands of the United States Navy

Higher Temperatures in Cable Insulation

Low-Tension Cables Were Subjected to Intermittent Tests at Excessive Loads with Little Damage to Insulation—Higher Temperature Limits Are Recommended Based Upon Load Factor

A STRONG plea for higher temperature limits in low-tension paper-insulated cables was made by Philip Torchio, chief electrical engineer of the New York Edison Company, in a paper, entitled "Permissible Operating Temperatures of Impregnated Paper Insulation in Which Dielectric Stress Is Low," read this week at the mid-winter convention of the American Institute of Electrical Engineers. He emphasized the point that while in machinery the 105-deg. allowable limit is reached for long periods of time in the operation of the apparatus, on the other hand, low-tension cables, as commonly used in large distributing systems, are not subjected to the maximum temperature except for short periods of time each day, so that in such cases the 105 deg. C. for the low-tension cable is, in his opinion, immeasurably safer than 105 deg. for machinery. The author believed that the limiting temperature should be a function of the load factor (average load to yearly maximum) under which the apparatus is to operate, so that if the apparatus, either cable or machinery, is to operate for long hours at full load, the limiting temperature should not exceed say 90 deg. C., while, on the other hand, if the cable or machinery is to operate for a short time at heavy load and then be subjected to a long period of cooling, the limiting temperature for the peak loads should be raised and the 105-deg. limit should be standardized.

After a considerable review of the work of the British Engineering Standard Committee in 1905 and later work by Steinmetz and Lamme,* Mr. Torchio took up reasons advanced for low temperature limits used for low-tension cables. The principal reasons given for having adopted a temperature lower than 105 deg. C. for class A insulation in electrical machinery are: (1) that the compound, when warm, may leave the paper on the top of the cable and collect in the bottom, (2) that cables are often removed for reinstallation, and if the paper has become brittle, it will crack inside the lead sheath. Another reason advocated is that the expansion and contraction of long lengths of large size lead-covered cables may cause cracking of the lead sheath at sharp bends in manholes.

When Higher Temperature Is Considered Safe

The author then submitted evidence which he considers conclusive that 100 deg. C. to 110 deg. C. is safe and standard practice in large subway and distributing systems. This evidence consists of (1) results from observations obtained by wide and close scrutiny of the physical and electrical conditions of all the low-tension cables of a large electric power company, the New York Edison Company, and (2) results of special tests carried out by engineers and laboratory men.

In this system heavier loads were carried by the cable than previously in the period of the winter of 1919, when some serious short circuits occurred among the low-tension cable feeders.

Results of physical inspection show that a number of 1,000,000-circ.mil concentric cables, in congested banks of ducts, had their sheaths cracked near the edge of the ducts and at sharp bends in manholes. The movement of the cables due to expansion and contraction was impeded. These cracks extended to the insulation, leaving an open path for moisture and water to reach the copper and causing local short circuit. But it was noted with interest that the cable insulation was unimpaired a few feet from the crack or burn-out. Extensive tests were made on a series of four 278-ft. (85 m.) lengths of 1,000,000-circ.mil concentric cables which had been installed in ducts between manholes, connected in series, with bends and splices to simulate actual conditions. The object was to determine loads, temperatures and expansion of cables at which the sheaths would crack if the cables were subjected to specified cycles of eight-hour load and sixteen-hour no-load for periods extending over two months. Temperatures of sheaths were taken by thermocouples and the inner copper temperatures calculated, using the Atkinson constant of thermal resistivity of 354, which had been independently checked and appeared to be approximately correct. In Fig. 1 are given the maximum temperatures for lead sheath and inner copper for the different thermocouple locations at a 1,250-amp. load. For one typical location it appears that the insulation withstood the temperatures specified in Table I.

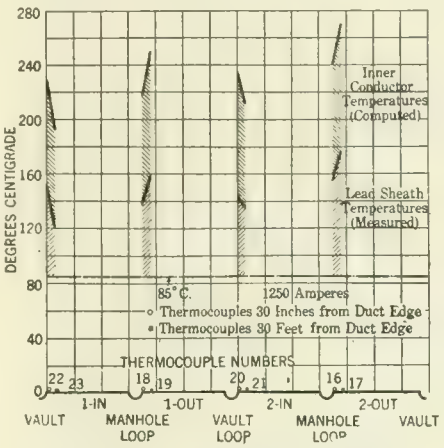


FIG. 1—EXCESSIVE TEMPERATURES AT WHICH 1,000,000-CIRC.MIL CONCENTRIC CABLES WERE TESTED

TABLE I—TIME SUMMARY OF HIGH TEMPERATURE TESTS

Inner Conductor Temperature, Deg C.	Hours	Remarks
Less than 85	73	Hours of tests with current on —exclusive of hours of cooling with current off
85 -90	13	
90 100	26	
100—110	37	
110—125	88	
125 -150	36	
Over 150	169	
Total duration of test periods	442	

The sample of cable at this location showed its insulation to be in good condition, the inner insulation being darkened and of considerably reduced tensile strength

*"Temperature and Electrical Insulation," *A.I.E.E. Proceedings*, Vol. XXXII, 1913.

but yet in perfect condition for indefinite service, according to Mr. Torchio, notwithstanding the fact that the insulation operated at a temperature of over 110 deg. C. for 293 hours, of over 125 deg. for 205 hours and of over 150 deg. for 169 hours.

With the enormously high temperatures to which the cable was subjected, only 20 ft. (6 m.) of one length out of 1,112 ft. (340 m.) of cable had the insulation destroyed. The four lengths were removed from the ducts and reeled and rereeled in some instances twice, and after this handling the cable lengths were subjected to regular factory voltage and insulation tests, with the results shown in Table II.

TABLE II—RESULTS OF VOLTAGE AND INSULATION TESTS ON CABLES

Section	No. of Times Re-reeled	Voltage Tests Five-Minute Application Inner to Outer and Lead	Outer to Inner and Lead	Insulation Test Megohms per Mile Inner to Outer and Lead	Outer to Inner and Lead
1 in	1	5 400	5,900	460	184
1 out	2	5,400	*	770	...
		5,500	5,700	703	289
2 in	1	5,500	6,600	100	56
2 out	2	5,400	5,800	520	105

* Broke down 12 ft. from the end near hub of reel after two minutes at 6,000 volts. Remaining portion retested with results in second line "1 out."

The insulation of the cable which withstood for 169 hours temperatures of over 150 deg. C. must, according to Mr. Torchio, have been immeasurably more affected than if the temperature had been limited to 105 deg. C. for many years of service during the winter peaks. Mr. Torchio stated that large systems with a substantial number of cables have been operated for the last twenty years at loads producing temperatures of 100 deg. to 110 deg. C. during the winter peaks, which proved that these seasonal temperatures for periods of peak loads had not impaired the cable insulation for occasional withdrawal and reinstallation.

The hardening of oil in the insulation which takes place when temperatures of 100 deg. C. and over are sustained continuously will either not take place at temperatures of 105 deg. C. applied only for a short time for certain periods of the year, or if any hardening takes place, the process will extend over periods exceeding fifteen or twenty years. At the ends of these periods it is improbable that any substantial amount of such cable would be reinstalled, if removed; but if the lead sheath is intact, the tests on the sample cables which have been submitted to almost destructive temperatures have shown that the cable can still be reeled and rereeled without destroying its efficiency as regards both dielectric strength and insulation resistance. In practice, he believed, the aging and deterioration of the lead sheath due to chemical action, electrolysis and similar causes will be the paramount factor in the life of low-tension cables.

Sheath Cracking Due to Handling

The difficulties caused by lead sheaths cracking in large-sized cables are essentially problems of careful installation and handling of the cable. In the heavy load tests just described no cracking was produced under the extraordinarily severe conditions of temperatures which gave expansions as large as 8 in. (20 cm.) in 278 ft. (85 m.). In practice, with 105 deg. C. temperatures, the expansions in the lead sheaths would only be 3¼ in. (68.3 cm.).

The assertion has been made that the compound might distill or vaporize at temperatures of above 100 deg. C. An exhaustive investigation was made by the New York Edison Company to determine the effect of temperature on cable impregnating materials. The results of laboratory tests carried out by the Electrical Testing Laboratories indicated that the mineral compound gave the first drop of distillate at 205 deg. C. A supplementary investigation was made to determine if the compounds would distill any appreciable amount at temperatures below 200 deg. C. when exposed to these temperatures for long periods of time. No distillate, however, was obtained for either mineral or resin compounds after the temperature had been maintained successively at temperatures of 115, 130, 145 and 160 deg. C. for three days. Similar results were obtained when the temperature was maintained at 180 deg. and 200 deg. C. for twenty-four and thirty-six hours.

Before making the final recommendations the author brought out the point that the operator must carefully study the temperatures under which the cables will operate when placed in subway ducts, especially when the trunk lines contain many ducts and cables in one bank. The paramount importance of carefully surveying the ambient temperature conditions in ducts is shown in Fig. 2, giving the relative allowable losses for a given temperature rise on each cable with different duct arrangements. In the figure the losses in a bank of two by two ducts are assumed as 100 per cent, giving a standard for comparison.

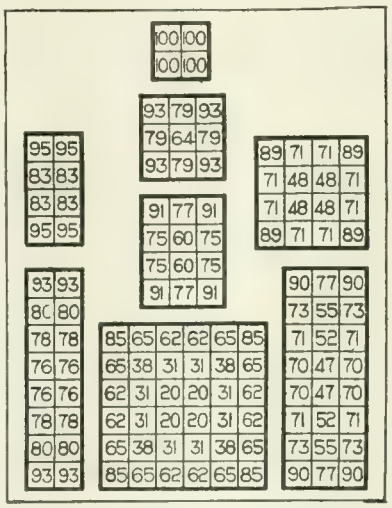


FIG. 2—PERMISSIBLE ENERGY LOSSES FOR VARIOUS DUCT POSITIONS FOR SAME TEMPERATURE RISE

Overload Ratings Are Proposed

In consideration of the foregoing data, including the Steinmetz and Lamme report, the British Engineering Standards Committee tests and the surveys of large operating companies, Mr. Torchio held that the permissible operating temperatures of impregnated paper insulation, in which dielectric stress is low, should be a function of the load factor at which the cable operates. The load factor for cables used in systems of distribution is intended to be the ratio between the yearly average load and the maximum load on the cable. He considered it certain that a load factor of say 33 per cent with seasonal winter peaks and correspondingly smaller maximum loads for the rest of the year would produce an average temperature on the cable considerably below 85 deg. C., so that a limit of say 105 deg. C. at peaks for 33 per cent load factors is safer than 85 deg. C. continuously, as allowed by the present A. I. E. E. rules. The proposed plan corresponds with the established practice of rating electrical apparatus at a temperature rise of say 40 deg. C. for continuous loads and from 55 deg. to 65 deg. C. for two or three hours' overload. Machinery so designed has given excellent service for the last twenty-five years.

The following temperature limits were offered for impregnated-paper, low-tension cables as functions of are load factor of the cable:

105 deg. C. for load factors around 33 per cent.
95 deg. C. for load factors around 50 per cent.
90 deg. C. for load factors over 66 per cent.

Temperature limits might perhaps be presented in a more general form by working back from the load factors to corresponding values of rise of temperature allowable for normal loads and overloads for specified hours, but Mr. Torchio preferred to use the load factors, as they are fundamental in the determination of the most economical current density in cables.

Australian Steam Station with a Rating of 125,000 Kw.

Will Burn 50-Cent Coal—All Electrical Equipment to Be Outdoors—132,000-Volt Transmission Line to Melbourne Will Have Five Towers per Mile

CONSTRUCTION of a 125,000-kw. steam plant 112 miles (180 km.) from Melbourne, Australia, will be immediately started, upon the closing of tenders on March 31, and the letting of contracts for the apparatus. The complete project includes the opening of extensive coal fields adjacent to the generating station site, the construction of a generating plant containing five units, each rated at 25,000 kw., the building of a total of 1,800 miles (2,900 km.) of 132,000-volt transmission line and the construction of three terminal substations.

At the present time the city of Melbourne has one 22,000-kw. steam station operated by the City Council, one 22,000-kw. steam station operated by a private company and one 78,000-kw. steam station operated by the state government. The latter is for supplying the railways. The new project is to be built and operated by the electricity commissioners of the government of Victoria and will sell energy in bulk to the present distribution utilities and also in the surrounding districts. No secondary distribution will be undertaken by the electricity commissioners.

Coal for the new station, which will be known as Morwell, will be obtained from fields immediately surrounding the power house. In 1 sq.mile (2 sq.km.) of these coal fields there is sufficient coal to operate the new power house for 150 years. There are 60 sq.miles (153.4 sq.km.) of these coal beds in the vicinity of this steam station. The coal bears an overburden of 33 ft. (10 m.) and the seam is 273 ft. (83 m.) thick. The coal will be mined by stripping and can be delivered to the power house at a cost of approximately 50 cents a ton. As the cost of fuel will be so low, no economizers are planned for the station.

A river alongside the power house will supply condensing water, but the flow of this river will place a limit on the size of the station unless use is made of spray cooling ponds.

The boiler plant and engine room are to be placed in one building. A second building will house the control apparatus and offices. Between the latter building and the generating station proper will be the 400-volt auxiliary transformers, the 400-volt buses and switch gear. Beyond the control building will be the main 11,000-volt low-tension buses, the step-up transformers, the high-tension switches and the 132,000-volt high-tension buses. The generators will operate at 50 cycles, 11,000 volts. Single-phase transformers rated at 9,260 kva. will step up the voltage to 132,000 volts for transmission.

The transmission line will consist of two two-circuit steel-tower lines having the towers spaced from 1,056 ft. to 1,500 ft. (322 m. to 457 m.). Dead-end towers will be placed 7 miles to 10 miles (11 km. to 16 km.) apart, and semi-anchor towers will be placed about every mile (1.6 km.). This rather long spacing between towers has been selected for the purpose of reducing the number of insulators to be used on the line, and it has been determined to be the most economical spacing for this particular installation. The three wires of one circuit will be placed in a vertical position with 11 ft. (3.35 m.) between conductors.

PARTICULARS OF 132,000-VOLT LINE

The climatic conditions are very favorable indeed. No high elevations whatever are encountered, and there is no fog, sleet or snow and comparatively little lightning. Seven suspension units will be used in suspension strings and eight units in dead ends. The line is designed for the use of an overhead ground wire on each tower line. A telephone line will be constructed on a separate pole line. At each of the terminal substations there will be two 15,000-kva. synchronous condensers which will be connected on 6,600-volt tertiary delta windings on the main step-down transformers. At the generating station end the transformers are to be connected delta-star with the neutral grounded. At the terminal stations end the transformers will be connected star-star and the neutral grounded through resistance. The terminal-station transformers will step down the voltage from 120,000 to 22,000 volts for distribution. The transmission lines will be operated at the constant voltage of 132,000 volts at the generating station and 120,000 volts at the terminal substation. Each line is designed for an economical capacity of 25,000 kw. By an interlocking of the line and tie switches at the terminal stations, should one transmission line fail the tie switch between the high-tension sides of the step-down transformers will immediately close, thereby placing the two 15,000-kva. synchronous condensers on the one remaining line, which will permit it to transmit 42,500 kw. at the same voltage drop as with 25,000 kw. transmitted and one 15,000-kva. synchronous condenser operating on it. With the two condensers operating on one line, 50,000 kw. may be transmitted over this line by raising the transmission-line voltage at the generating station 5 per cent, from 132,000 volts to 138,000 volts. Under these conditions the transmission-line voltage at the terminal station will be 120,000 volts, as normally.

The terminal substations will be separated 8 miles (12.8 km.). Two of the transmission circuits will enter each terminal substation. It was found that the least expense would be to utilize three terminal stations rather than to have the four transmission lines enter one station and make the entire distribution by underground cables operating at 22,000 volts. The cost per mile of the transmission line will be approximately $15,000, while underground cable for the same carrying capacity would cost $300,000 per mile. There are to be nine substations in Melbourne. There will be approximately 80 miles (128 km.) of 22,000-volt underground cable in the city interconnecting the nine substations.

Table I—Recommended Standards of Illumination

	Foot-Candles	
	Recommended	Under Some Conditions
Auditorium church	3	2 4
Armory, public hall	5	3 6
School—class room, study room, library	8	5 10
Store:		
Show window	10 70	
First-floor department, shop on bright street corner	10	6–12
Other clothing, dry goods, haberdashery, millinery, jewelry, etc	8	5 10
Other drug, grocery, meat, bakery, book, florist, furniture, lunch room, confectionery, etc	6	4– 8
Office:		
Private general	10	6 12
Drafting room	15	10 20
Industrial:		
Aisles, stairways, passageways and corridors	2	1– 2
Assembling:		
Rough	5	3 6
Medium	8	5 10
Fine	10	6 12
Extra fine	10–50	
Bakeries	8	5 10
Boilers, engine rooms and power houses:		
Boilers, coal and ash handling, storage-battery rooms	3	2 4
Auxiliary equipment, oil switches and transformers	5	3– 6
Switchboards, engines, generators, blowers, compressors	6	4 8
Candy making	8	5 10
Canning and preserving	8	5–10
Chemical works:		
Hand furnaces, boiling tanks, stationary driers, stationary or gravity crystallizing	3	2 4
Mechanical furnaces, generators and stills, mechanical driers, evaporators, filtration, mechanical crystallizing, bleaching	4	3– 6
Tanks for cooking, extractors, percolators, nitrators, electrolytic cells	6	4 8
Clay products and cements:		
Grinding, filter presses, kiln rooms	3	2– 4
Molding, pressing, cleaning and trimming	5	3– 6
Enameling	6	4 8
Coloring and glazing	10	6 12
Cloth products:		
Light goods	10	6 12
Dark goods	15	10–20
Dairy products	6	4– 8
Electric manufacturing:		
Storage battery, molding of grids	6	4– 8
Coil and armature winding, mica working, insulating processes	10	6–12
Elevator, freight and passenger	5	3– 6
Forge shops and welding:		
Rough forging	6	4– 8
Fine forging and welding	10	6–12
Foundries:		
Charging floor, tumbling, cleaning, pouring and shaking out	5	3– 6
Rough molding and core making	6	4– 8
Fine molding and core making	10	6–12
Glass works:		
Mix and furnace rooms, casting and lehr	5	3– 6
Grinding, glass blowing machines, cutting glass to size, silvering	8	5–10
Fine grinding, polishing, beveling, inspecting, etching and decorating	10	6–12
Glass cutting (cut glass), inspecting fine	10–50	
Glove manufacturing:		
Light goods:		
Cutting, pressing, knitting	8	5 10
Sorting, stitching, trimming and inspecting	10	6–12
Dark goods:		
Cutting, pressing, knitting	10	6–12
Sorting, stitching, trimming and inspecting	10–50	
Hat manufacturing:		
Dyeing, stiffening, braiding, cleaning and refining:		
Light	6	4– 8
Dark	10	6–12
Forming, sizing, pouncing, flanging, finishing and ironing:		
Light	8	5 10
Dark	10	6–12
Sewing:		
Light	10	6–12
Dark	10–50	
Ice making:		
Engine and compressor room	6	4 8
Inspecting:		
Rough	6	4– 8
Medium	10	6–12
Fine	15	10–20
Extra fine	10–50	
Jewelry and watch manufacturing	10 50	
Laundries and dry cleaning	8	5–10
Leather manufacturing:		
Vats	3	2 4
Cleaning, tanning and stretching	4	3– 6
Cutting, fleshing and stuffing	6	4– 8
Finishing and scarfing	10	6–12
Leather working:		
Pressing and winding:		
Light	8	5–10
Dark	10	6 12
Grading, matching, cutting, scarfing, sewing:		
Light	10	6–12
Dark	10 50	
Locker rooms	4	2– 4

	Foot-Candles	
	Recommended	Under Some Conditions
Machine shops:		
Rough bench and machine work	6	4– 8
Medium bench and machine work, ordinary automatic machines, rough grinding, medium buffing and polishing	10	6–12
Fine bench and machine work, fine automatic machines, medium grinding, fine buffing and polishing	12	8–16
Extra fine bench and machine work, grinding (fine work)	10 50	
Meat packing:		
Slaughtering	5	3– 6
Cleaning, cutting, cooking, grinding, canning and packing	8	5–10
Milling and grain foods:		
Cleaning, grinding or rolling	5	3– 6
Baking or roasting	8	5–10
Packing:		
Rough	4	3– 6
Medium	6	4– 8
Fine	10	6–12
Paint manufacturing	6	4– 8
Paint shops:		
Dipping, spraying, firing	5	3– 6
Rubbing, ordinary hand painting and finishing	8	5–10
Fine hand painting and finishing	10	6–12
Extra-fine hand painting and finishing (automobile bodies, piano cases, etc.)	15	10–50
Paper-box manufacturing:		
Light	6	4– 8
Dark	8	5–10
Paper manufacturing:		
Beaters, machine grinding	4	3– 6
Calendering	6	4– 8
Finishing, cutting and trimming	8	6–12
Plating	5	3 6
Polishing and burnishing	8	5 10
Printing industries:		
Matrixing and casting, miscellaneous machines, presses	8	5–10
Proofreading, lithographing, electrotyping	10	6–12
Linotype, monotype, typesetting, imposing stone, engraving	10–50	
Receiving and shipping	4	3– 6
Rubber manufacturing and products:		
Calendars, compounding mills, fabric preparation, stock cutting, tubing machines, solid-tire operations, mechanical goods building, vulcanizing	8	5 10
Bead building, pneumatic tire building and finishing, inner tube operation, mechanical goods, trimming, treading	10	6–12
Sheet metal works:		
Miscellaneous machines, ordinary bench work, Punches, presses, shears, stamps, welders, spinning, fine bench work	8	5–10
	10	6–12
Shoe manufacturing:		
Hand turning, miscellaneous bench and machine work	8	5–10
Inspecting and sorting raw material, cutting, lasting and welding (light)	10	6–12
Inspecting and sorting raw material, cutting, stitching (dark)	10 50	
Soap manufacturing:		
Kettle houses, cutting, soap chip and powder	5	3-6
Stamping, wrapping and packing, filling and packing soap powder	6	4-8
Steel and iron mills, bar, sheet and wire products:		
Soaking pits and reheating furnaces	2	1– 2
Charging and casting floors	3	2– 4
Muck and heavy rolling, shearing, rough by gage, pickling and cleaning	4	3– 6
Automatic machines, rod, light and cold rolling, wire drawing, shearing, fine by line	6	4– 8
Store and stock rooms:		
Rough	3	2– 4
Medium	6	4– 8
Fine	8	5–10
Structural steel fabrication	6	4– 8
Textile mills:		
(Cotton)		
Opening and lapping, carding, drawing frame roving, dyeing	4	3– 6
Spooling, spinning, drawing in, warping, weaving, quilling, inspecting, knitting, slashing	8	5–10
(Silk)		
Winding, throwing, dyeing	8	5–10
Quilling, warping, weaving and finishing:		
Light goods	8	5–10
Dark goods	10	6–12
(Woolen)		
Carding, picking, washing and combing	4	3– 6
Twisting and dyeing	6	4- 8
Drawing in, warping:		
Light goods	6	4– 8
Dark goods	10	6 12
Weaving		
Light goods	8	5 10
Dark goods	12	8–16
Knitting machines	10	6–12
Tobacco products	8	5–10
Toilet and wash rooms	4	3– 6
Wood working:		
Rough sawing and bench work	5	3– 6
Sizing, planing, rough sanding, medium machine and bench work, gluing, veneering, cooperage	8	5–10
Fine and bench and machine working, fine sanding and finishing	10	6–12

(Accompanying "Illumination Design Simplified," page 417)

Illumination Design Simplified

Planning a System Is Divided Into Four Main Steps — Reflecting Equipment Selected on the Basis of Seven Comparative Factors—Room Index a New Key by Which Variable Factors May Be Allowed For

By EARL A. ANDERSON
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MODERN LIGHTING DESIGN INVOLVES A CONSIDERATION OF ALL FACTORS TO INSURE A SUCCESSFUL INSTALLATION

IN THE design of modern commercial and industrial lighting systems a large number of variable factors must be considered, such as choice of reflecting equipment, allowable spacing, the coefficients of utilization in different sizes and types of interiors, depreciation factor, etc., if the quantity and quality of the illumination desired is to be obtained. To take into account all of these important factors has seemed so complicated a task that many designers still adhere to rule-of-thumb methods which are likely to result in unsatisfactory installations, especially where the conditions depart from the ordinary. With a view to simplifying the work of accurately laying out lighting systems, the data in this article have been compiled. Through their use it is possible to plan a system meeting all the modern requirements and taking into consideration all of the factors in such a way that allowance will be made for varying types of installation.

To arrive at a logical solution of the lighting problem the design may be divided into four principal steps:

1. The decision as to the foot-candles of illumination required.
2. The selection of a lighting unit best adapted to the particular requirements.
3. The determination of outlet locations, mounting height and number of lighting units required.
4. The selection of the proper size of lamp to provide the foot-candles desired.

There has been such a rapid advance in lighting standards, almost from month to month, that intensity tables are obsolescent before they are published. In Table I, however, a list of foot-candle values is presented corresponding to present standards for different classes of industrial operations, offices, stores, etc.

The desirable illumination varies rather widely, depending on the conditions in any particular installation, such as accuracy of the operation and fineness of detail to be observed, the color of goods worked on or handled, and, in the case of stores, the advertising value resulting from the attractiveness of a well-lighted interior. The foot-candle values recommended in the table are the minimum to be adhered to if fully satisfactory lighting is to be assured. Under particular conditions considerably higher illumination is often desirable.

SELECTION OF LIGHTING UNITS VERY IMPORTANT

The selection of the type of lighting unit depends not only upon the requirements of the work, but in some cases upon the construction of the room and the color of ceiling and walls. For example, semi-indirect and totally indirect lighting are unsuited to rooms with very dark ceilings. It is important to specify the type of lamp to be used, since, for example, as shown in Fig. 1, bowl-enameled lamps used in open reflectors, such as RLM standard domes, form a lighting unit much superior from the standpoint of glare, reflected glare and shadows to clear lamp units of the same type. In general, clear gas-filled tungsten lamps (type C) should not be used in open reflectors where the mounting height is less than 20 ft. (6 m.).

Factors other than those listed in Fig. 1 may enter

Direct Lighting-SOURCES 5 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING $7\frac{1}{2}$ FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 6 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH—FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 9 FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 7 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH—FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING $10\frac{1}{2}$ FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 8 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH—FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 12 FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 10 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH—FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 15 FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 14 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 21 FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 20 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 30 FEET ABOVE WORK PLANE

Direct Lighting-SOURCES 30 FEET ABOVE WORK PLANE

ROOM WIDTH	ROOM LENGTH—FEET																			
	10	12	14	16	18	20	24	30	35	40	50	60	70	80	100	120	140	170	200
8																			
10																			
12																			
14																			
16																			
18																			
20																			
24																			
30																			
35																			
40																			
50																			
60																			
70																			
80																			
100																			
120																			

Semi and Indirect Lighting-CEILING 45 FEET ABOVE WORK PLANE

TABLE II—ROOM INDEX FOR FINDING COEFFICIENT OF UTILIZATION FROM FIG. 2

into the choice of the lighting unit in certain instances. For example, in stores, offices and other public installations decorative effect is often an important item. The charts rate the various types of units comparatively to serve as a basis for judgment of the adaptability of a unit for a particular class of installation.

In the selection of the reflecting equipment for a lighting system seven fundamentals must be taken into account, namely:

1. *Illumination on Horizontal Surfaces.*—This is a prime requisite in offices, drafting rooms and those shops where the problem is to provide the best illumination for sustained vision of flat surfaces on the horizontal or slightly oblique planes in which papers, books and other flat objects are usually examined.

2. *Illumination on Vertical Surfaces.*—Such illumination in the case of work or machine parts is fully as important as the lighting of the surface in the horizontal plane. In a consideration of the amount of light necessary for factory illumination the criterion must be the intensity on all working surfaces, whether vertical, horizontal or oblique.

3. *Favorable Appearance of Lighted Room.*—Reference under this head is only to the general or casual effect produced by the complete system, and it is not intended to rate the unit as to satisfaction from the standpoint of good vision or freeedom from eye fatigue.

4. *Direct Glare.*—The most frequent and serious cause of bad lighting. It results, among other things, from unshaded or inadequately shaded light sources located within the field of vision, or from too great contrast between the bright light source and a dark background or adjacent surfaces. Glare should be avoided by the use of proper reflecting and diffusing equipment.

5. *Reflected Glare.*—Reflected glare from a polished working surface is particularly annoying because of the necessity of directing the eyes toward those surfaces, and further because the eyes are by nature especially sensitive to light rays from below. The harmful effects of this specular reflection can be minimized by properly shielding from below or diffusing the source.

6. *Shadows.*—Differences in brightness of surfaces are essential in observing objects in their three dimensions but are of little or no value in the observation of flat surfaces. Where shadows are desirable they should be soft and luminous, not so sharp and dense as to confuse the object with its shadow.

7. *Maintenance.*—Maintenance depends upon contour of reflector, construction of fixture and condition of ceiling. The rating is based upon the likelihood of breakage, the labor involved in maintaining the units at comparable degrees of efficiency, and the indication given of need of cleaning.

Relative importance of the foregoing criteria should be very carefully weighed with respect to the particular problem at hand. For instance, in an office the points would rank thus in importance: (1) Direct glare; (2) reflected glare; (3) shadows; (4) efficiency based upon illumination on horizontal; (5) main-

	LIGHTING UNIT		EFFICIENCY BASED UPON ILLUMINATION ON HORIZONTAL	EFFICIENCY BASED UPON ILLUMINATION ON VERTICAL	FAVORABLE APPEARANCE OF LIGHTED ROOM	DIRECT GLARE	REFLECTED GLARE	SHADOWS	MAINTENANCE
1	R L M DOME		A+	B+	C+	C	D	C+	A+
2	R L M DOME		A−	B	B	B+	B	B+	A−
3	GLASS TOP DOME		B	C+	A−	A−	B	B+	B
4	DEEP BOWL		B+	B−	C	C+	D	C	A
5	DEEP BOWL		B	C+	C	B	C+	C+	B+
6	FLAT CONE		B	C+	C+	C+	D	C	B+
7	FLAT CONE		B	B	C	D	D	C	A+
8	LIGHT DENSITY OPAL		B+	B	B+	C+	D	B−	B
9	LIGHT DENSITY OPAL		B	B−	A−	B−	B−	B+	B−
10	DENSE OPAL		A+	B+	B+	B	D	C+	A−
11	DENSE OPAL		B+	B−	A−	B+	B−	B	B
12	MIRRORED GLASS		A	B	C	C+	D	C	A−
13	MIRRORED GLASS		B	C+	C	B−	C	C+	B−
14	PRISMATIC INDUSTRIAL		A+	A−	B+	C+	D	C+	B−

	LIGHTING UNIT		EFFICIENCY BASED UPON ILLUMINATION ON HORIZONTAL	EFFICIENCY BASED UPON ILLUMINATION ON VERTICAL	FAVORABLE APPEARANCE OF LIGHTED ROOM	DIRECT GLARE	REFLECTED GLARE	SHADOWS	MAINTENANCE
15	DIFFUSING GLOBE		B−	B−	A	B−	B	B+	B+
16	ONE PIECE OPAL		B	B	A	B	B	B+	A−
17	DIFFUSING GLOBE		B	B	B+	B	B	B+	B+
18	SEMI-INDIRECTING		B	B	A	B	B	B+	B−
19	SEMI-INDIRECTING		B	B	A	A	A−	A−	C+
20	TWO PIECE GLASS		B	B	A	B+	B+	A−	B
21	ONE PIECE GLASS		B	B	A	B+	B+	A−	A−
22	LIGHT OPAL		B−	C+	A	B+	B+	A−	C
23	DENSE OPAL		C+	C	A	A+	A	A+	C
24	ENAMELED METAL REFLECTOR		B−	C	A	A	B+	B+	C
25	ENAMELED METAL REFLECTOR		C+	C	A	A+	A	A	C
26	CLEAR TOP ENCLOSED		C+	C	A	A+	A	A	B
27	MIRRORED INDIRECT		C+	C	B+*	A+	A	A+	C
28	ENAMELED METAL INDIRECT		C	C	B+	A+	A	A+	C

*For Luminous Bowl Type Rate A.

FIG. 1—REFLECTOR EQUIPMENT MAY BE SELECTED ON A BASIS OF CHARACTERISTICS

DIRECT LIGHTING PORCELAIN ENAMEL REFLECTORS

	Color Reflection Factor: Ceiling	Walls	Very Light (70%)			Fairly Light (50%)			Fairly Dark (30%)	
			Fairly Light (50%)	Fairly Dark (30%)	Very Dark (10%)	Fairly Light (50%)	Fairly Dark (30%)	Very Dark (10%)	Fairly Dark (30%)	Very Dark (10%)
	Reflector Type	Room Index	**COEFFICIENTS OF UTILIZATION**							
1	D L H Dome, Clear Lamp	0.6	.34	.29	.24	.34	.29	.24	.28	.24
		0.8	.42	.38	.34	.42	.37	.33	.37	.33
		1.0	.46	.43	.39	.45	.42	.39	.42	.39
		1.25	.50	.47	.43	.49	.46	.43	.45	.42
		1.5	.53	.50	.46	.52	.49	.46	.48	.45
	90° to 180° - 85%	2.0	.58	.55	.51	.57	.54	.51	.53	.51
		2.5	.62	.59	.56	.61	.58	.56	.58	.56
		3.0	.64	.61	.58	.63	.60	.58	.60	.58
		4.0	.67	.65	.63	.66	.64	.62	.63	.61
	0° to 90° - 40%	5.0	.69	.67	.65	.67	.66	.64	.65	.63
2	D L H Dome, Bowl Enameled Lamp	0.6	.32	.28	.25	.32	.28	.25	.27	.25
		0.8	.40	.36	.34	.39	.35	.33	.35	.33
		1.0	.43	.39	.37	.42	.39	.37	.39	.37
		1.25	.46	.43	.41	.45	.43	.41	.43	.41
		1.5	.48	.45	.43	.47	.45	.43	.45	.43
	90° to 180° - 85%	2.0	.52	.50	.48	.51	.49	.47	.49	.47
		2.5	.56	.54	.52	.55	.53	.51	.53	.51
		3.0	.57	.55	.53	.56	.54	.52	.54	.52
		4.0	.60	.58	.56	.59	.57	.55	.57	.55
	0° to 90° - 40%	5.0	.61	.59	.57	.60	.58	.57	.58	.56
3	Glass Top Dome, Bowl Enameled Lamp	0.6	.28	.25	.22	.27	.24	.22	.23	.21
		0.8	.34	.31	.29	.33	.30	.28	.30	.28
		1.0	.36	.35	.33	.36	.34	.32	.33	.32
		1.25	.41	.38	.36	.39	.37	.35	.36	.35
		1.5	.43	.40	.38	.41	.39	.37	.38	.37
	90° to 180° - 85%	2.0	.47	.44	.42	.45	.43	.41	.41	.40
		2.5	.50	.47	.45	.48	.46	.44	.44	.43
		3.0	.51	.49	.47	.49	.47	.46	.46	.45
		4.0	.53	.51	.50	.51	.49	.48	.48	.47
	0° to 90° - 40%	5.0	.55	.53	.51	.52	.50	.49	.49	.48
4	Deep Bowl, Clear Lamp	0.6	.31	.26	.23	.30	.26	.23	.25	.23
		0.8	.36	.34	.31	.37	.34	.31	.33	.31
		1.0	.41	.38	.35	.41	.38	.35	.37	.35
		1.25	.44	.41	.38	.44	.41	.38	.40	.38
		1.5	.47	.44	.41	.46	.43	.41	.43	.41
	90° to 180° - 85%	2.0	.51	.48	.45	.50	.47	.45	.47	.45
		2.5	.54	.51	.49	.53	.51	.49	.51	.49
		3.0	.56	.54	.51	.55	.53	.51	.53	.51
		4.0	.58	.56	.54	.57	.55	.54	.55	.53
	0° to 90° - 40%	5.0	.60	.58	.56	.58	.57	.55	.56	.55
5	Deep Bowl, Bowl Enameled Lamp	0.6	.29	.26	.23	.29	.26	.23	.25	.23
		0.8	.35	.33	.31	.35	.32	.30	.32	.30
		1.0	.38	.36	.34	.38	.36	.34	.35	.34
		1.25	.41	.39	.37	.41	.39	.37	.38	.37
		1.5	.44	.41	.39	.43	.41	.39	.40	.39
	90° to 180° - 85%	2.0	.47	.45	.43	.46	.44	.43	.43	.43
		2.5	.50	.48	.46	.49	.47	.46	.46	.46
		3.0	.51	.49	.47	.50	.48	.47	.47	.47
		4.0	.53	.51	.50	.52	.50	.49	.49	.49
	0° to 90° - 40%	5.0	.54	.52	.51	.53	.51	.50	.50	.49
6	Flat Cone, Standard Bowl, Clear Lamp	0.6	.27	.23	.21	.26	.23	.21	.23	.21
		0.8	.32	.30	.28	.32	.29	.27	.29	.27
		1.0	.35	.33	.31	.35	.33	.31	.32	.31
		1.25	.38	.36	.34	.37	.36	.34	.35	.34
		1.5	.40	.38	.36	.39	.37	.36	.37	.36
	90° to 180°	2.0	.43	.41	.39	.42	.41	.39	.40	.39
		2.5	.46	.44	.42	.42	.43	.42	.43	.42
		3.0	.47	.45	.43	.46	.44	.43	.44	.43
		4.0	.49	.47	.46	.48	.46	.45	.46	.45
	0° to 90° - 54°	5.0	.50	.48	.47	.49	.47	.46	.47	.46
7	Flat Cone, Clear Lamp	0.6	.26	.20	.16	.26	.19	.16	.19	.16
		0.8	.32	.26	.22	.32	.26	.22	.26	.22
		1.0	.36	.30	.26	.36	.30	.26	.30	.26
		1.25	.41	.35	.30	.39	.34	.30	.33	.30
		1.5	.44	.38	.33	.42	.37	.33	.36	.33
	90° to 180° - 0%	2.0	.50	.44	.38	.48	.43	.38	.42	.38
		2.5	.54	.48	.42	.52	.47	.42	.46	.42
		3.0	.57	.51	.46	.55	.50	.45	.49	.45
		4.0	.62	.56	.51	.60	.54	.50	.53	.50
	0° to 90° - 74°	5.0	.65	.60	.54	.62	.56	.53	.55	.53

DIRECT LIGHTING ENCLOSING AND SEMI-ENCLOSING UNITS

	Color Reflection Factor: Ceiling	Walls	Very Light (70%)			Fairly Light (50%)			Fairly Dark (30%)	
			Fairly Light (50%)	Fairly Dark (30%)	Very Dark (10%)	Fairly Light (50%)	Fairly Dark (30%)	Very Dark (10%)	Fairly Dark (30%)	Very Dark (10%)
	Reflector Type	Room Index	**COEFFICIENTS OF UTILIZATION**							
15	Diffusing Globe, Light Opal	0.6	.18	.13	.10	.16	.12	.10	.10	.09
		0.8	.22	.17	.14	.20	.16	.13	.14	.12
		1.0	.26	.21	.18	.23	.19	.16	.17	.14
		1.25	.29	.24	.21	.26	.22	.19	.19	.16
		1.5	.32	.27	.23	.29	.24	.21	.22	.19
	90° to 180° - 85%	2.0	.37	.32	.28	.32	.28	.25	.25	.22
		2.5	.40	.35	.31	.35	.31	.28	.28	.25
		3.0	.43	.38	.34	.38	.33	.30	.30	.27
		4.0	.47	.42	.38	.41	.37	.34	.33	.31
	0° to 90° - 40%	5.0	.49	.45	.41	.43	.39	.36	.34	.33
16	One Piece Opal, Flattened Reflecting Top	0.6	.22	.17	.14	.20	.16	.13	.14	.12
		0.8	.27	.22	.19	.25	.21	.18	.19	.17
		1.0	.31	.26	.23	.28	.24	.21	.22	.19
		1.25	.35	.30	.26	.31	.27	.24	.25	.22
		1.5	.38	.33	.29	.34	.30	.27	.27	.24
	90° to 180° - 85%	2.0	.42	.38	.33	.38	.34	.31	.31	.28
		2.5	.46	.41	.37	.41	.37	.34	.34	.31
		3.0	.49	.45	.40	.43	.39	.36	.36	.33
		4.0	.53	.48	.44	.47	.43	.40	.38	.36
	0° to 90° - 40%	5.0	.55	.51	.47	.49	.45	.42	.40	.38
17	Diffusing Globe, Large Metal Reflector	0.6	.22	.17	.14	.22	.17	.14	.17	.14
		0.8	.28	.23	.20	.27	.23	.19	.23	.19
		1.0	.31	.26	.23	.31	.26	.23	.26	.23
		1.25	.34	.30	.26	.33	.29	.26	.29	.26
		1.5	.36	.32	.29	.36	.32	.28	.31	.28
	90° to 180° - 85%	2.0	.41	.37	.33	.40	.36	.33	.35	.32
		2.5	.44	.41	.37	.43	.40	.37	.39	.36
		3.0	.47	.43	.39	.45	.42	.39	.41	.39
		4.0	.50	.47	.43	.48	.45	.43	.44	.42
	0° to 90° - 40%	5.0	.52	.49	.45	.50	.47	.44	.46	.44
18	Semi-Enclosing Mica Reflector	0.6	.22	.17	.13	.21	.16	.13	.15	.13
		0.8	.28	.22	.19	.26	.21	.18	.21	.18
		1.0	.31	.26	.23	.30	.25	.22	.24	.21
		1.25	.35	.30	.26	.32	.28	.25	.27	.24
		1.5	.38	.33	.28	.36	.31	.27	.30	.26
	90° to 90° - 20%	2.0	.43	.38	.33	.40	.36	.32	.34	.30
		2.5	.46	.41	.37	.44	.39	.36	.37	.34
		3.0	.49	.44	.40	.46	.42	.38	.40	.37
		4.0	.54	.49	.44	.50	.45	.42	.43	.40
	0° to 90° - 56°	5.0	.56	.51	.47	.52	.47	.45	.44	.43
19	Semi-Enclosing Comp. Reflector	0.6	.24	.18	.14	.23	.18	.14	.17	.14
		0.8	.30	.24	.21	.29	.24	.20	.23	.20
		1.0	.34	.29	.25	.32	.28	.24	.27	.24
		1.25	.37	.32	.28	.35	.31	.27	.30	.27
		1.5	.39	.35	.31	.38	.34	.30	.32	.29
	90° to 180° - 15°	2.0	.44	.40	.35	.42	.38	.34	.37	.34
		2.5	.48	.44	.39	.46	.42	.38	.41	.38
		3.0	.50	.46	.42	.48	.44	.41	.43	.40
		4.0	.55	.51	.47	.53	.49	.45	.46	.44
	0° to 90° - 60°	5.0	.57	.53	.49	.54	.50	.47	.48	.46
20	Two Piece Glass, Opal Reflector and Enameled Bowl	0.6	.22	.17	.14	.21	.17	.14	.16	.14
		0.8	.27	.23	.20	.26	.22	.19	.22	.19
		1.0	.30	.26	.23	.29	.26	.23	.25	.22
		1.25	.33	.29	.26	.32	.28	.26	.29	.25
		1.5	.36	.32	.29	.35	.31	.28	.31	.27
	90° to 180° - 12°	2.0	.41	.37	.33	.39	.35	.32	.34	.31
		2.5	.44	.40	.36	.42	.38	.35	.37	.35
		3.0	.46	.42	.38	.44	.40	.37	.39	.37
		4.0	.49	.45	.42	.47	.43	.41	.42	.40
	0° to 90° - 53°	5.0	.51	.48	.44	.48	.45	.43	.43	.41
21	One Piece Glass, Enameled Reflector and Bowl	0.6	.22	.17	.14	.21	.16	.14	.15	.14
		0.8	.27	.23	.20	.26	.22	.19	.20	.18
		1.0	.30	.26	.23	.29	.25	.22	.23	.21
		1.25	.34	.30	.26	.32	.28	.25	.26	.24
		1.5	.37	.33	.29	.34	.30	.27	.28	.26
	90° to 180° - 22°	2.0	.41	.37	.33	.38	.34	.31	.32	.30
		2.5	.44	.40	.36	.41	.38	.35	.35	.33
		3.0	.47	.43	.39	.43	.40	.37	.37	.35
		4.0	.51	.47	.43	.47	.44	.41	.41	.39
	0° to 90° - 50°	5.0	.53	.49	.45	.48	.45	.42	.42	.40

DIRECT LIGHTING OPEN GLASS REFLECTORS

8	Light Density Opal, Clear Lamp	0.6	.26	.21	.17	.24	.19	.16	.18	.15
		0.8	.32	.27	.23	.30	.25	.22	.24	.21
		1.0	.36	.31	.27	.34	.29	.26	.27	.24
		1.25	.40	.35	.31	.37	.32	.29	.30	.27
		1.5	.43	.38	.34	.40	.35	.32	.32	.30
	90° to 180° - 11%	2.0	.49	.44	.39	.45	.40	.37	.37	.34
		2.5	.53	.48	.44	.49	.44	.41	.40	.38
		3.0	.56	.51	.47	.51	.46	.43	.42	.40
		4.0	.60	.55	.51	.55	.50	.47	.46	.44
	0° to 90° - 54°	5.0	.62	.58	.54	.57	.53	.50	.48	.46
9	Light Density Opal, Bowl Enameled Lamp	0.6	.22	.17	.14	.20	.16	.13	.14	.12
		0.8	.27	.22	.19	.25	.21	.18	.19	.16
		1.0	.31	.26	.23	.28	.24	.21	.22	.19
		1.25	.35	.30	.26	.31	.27	.24	.24	.22
		1.5	.38	.33	.29	.34	.30	.26	.27	.24
	90° to 180° - 85%	2.0	.43	.38	.34	.38	.34	.31	.30	.28
		2.5	.47	.42	.38	.42	.38	.34	.34	.31
		3.0	.49	.44	.40	.44	.40	.37	.36	.33
		4.0	.53	.49	.45	.48	.44	.41	.39	.37
	0° to 90° - 45°	5.0	.56	.52	.48	.50	.46	.43	.40	.39
10	Dense Opal, Clear Lamp	0.6	.32	.27	.23	.31	.26	.22	.25	.22
		0.8	.40	.35	.31	.38	.34	.31	.33	.30
		1.0	.44	.39	.36	.42	.38	.35	.37	.35
		1.25	.47	.43	.40	.45	.42	.39	.40	.38
		1.5	.51	.47	.43	.47	.45	.42	.43	.41
		2.0	.56	.52	.48	.54	.50	.47	.48	.46
		2.5	.60	.56	.53	.57	.54	.52	.52	.50
		3.0	.62	.59	.56	.60	.57	.54	.55	.53
		4.0	.66	.63	.60	.63	.61	.58	.58	.56
		5.0	.69	.65	.62	.65	.63	.59	.60	.58
11	Dense Opal, Bowl Enameled Lamp	0.6	.29	.24	.20	.28	.23	.20	.22	.20
		0.8	.35	.30	.28	.34	.29	.27	.28	.27
		1.0	.39	.35	.32	.38	.34	.31	.32	.30
		1.25	.43	.39	.36	.41	.38	.35	.36	.34
		1.5	.46	.42	.39	.44	.40	.37	.38	.36
		2.0	.51	.47	.44	.48	.45	.42	.43	.41
		2.5	.55	.51	.48	.52	.49	.46	.47	.45
		3.0	.58	.54	.50	.54	.51	.48	.48	.46
		4.0	.63	.59	.56	.59	.56	.53	.53	.51
		5.0	.67	.63	.60	.63	.60	.57	.57	.55
12	Mirrored Glass, Clear Lamp	0.6	.26	.22	.19	.25	.22	.19	.21	.18
		0.8	.32	.27	.24	.31	.26	.24	.25	.23
		1.0	.36	.32	.29	.34	.32	.28	.29	.27
		1.25	.40	.36	.33	.38	.35	.32	.33	.31
		1.5	.43	.40	.36	.41	.38	.35	.36	.34
		2.0	.48	.44	.41	.45	.42	.39	.40	.38
		2.5	.52	.48	.45	.48	.45	.42	.43	.41
		3.0	.54	.51	.48	.51	.48	.45	.46	.44
		4.0	.57	.54	.51	.54	.51	.48	.48	.47
		5.0	.60	.58	.55	.56	.54	.51	.51	.49
13	Mirrored Glass, Bowl Enameled Lamp	0.6	.26	.22	.19	.25	.22	.19	.21	.18
		0.8	.32	.27	.24	.31	.26	.24	.25	.23
		1.0	.36	.32	.29	.34	.32	.28	.29	.27
		1.25	.40	.36	.33	.37	.35	.32	.33	.31
		1.5	.43	.40	.36	.41	.38	.35	.36	.34
		2.0	.48	.44	.41	.45	.42	.39	.40	.38
		2.5	.52	.48	.45	.48	.45	.42	.43	.41
		3.0	.54	.51	.48	.51	.48	.45	.46	.44
		4.0	.57	.54	.51	.54	.51	.48	.48	.47
		5.0	.60	.58	.55	.56	.54	.51	.51	.49
14	Prismatic Industrial, Clear Lamp	0.6	.33	.26	.21	.31	.25	.21	.24	.20
		0.8	.41	.35	.30	.39	.33	.29	.32	.29
		1.0	.46	.40	.35	.43	.39	.34	.37	.33
		1.25	.50	.44	.40	.47	.42	.38	.40	.37
		1.5	.52	.48	.43	.50	.45	.42	.43	.40
	90° to 180° - 0%	2.0	.58	.54	.49	.56	.51	.47	.49	.46
		2.5	.63	.59	.54	.60	.56	.53	.54	.50
		3.0	.66	.62	.58	.63	.59	.56	.56	.54
		4.0	.71	.67	.63	.67	.63	.61	.60	.58
		5.0	.74	.70	.66	.69	.65	.63	.62	.60

SEMI-INDIRECT AND INDIRECT LIGHTING UNITS

22	Light Opal	0.6	.18	.14	.11	.15	.12	.09	.09	.07
		0.8	.22	.18	.15	.19	.15	.12	.12	.10
		1.0	.26	.22	.18	.22	.18	.15	.14	.12
		1.25	.30	.25	.22	.25	.21	.18	.16	.14
		1.5	.33	.28	.24	.27	.23	.20	.18	.16
	90° to 180° - 0%	2.0	.38	.33	.29	.31	.27	.24	.21	.19
		2.5	.41	.36	.32	.34	.30	.27	.24	.22
		3.0	.44	.39	.35	.36	.32	.29	.25	.23
		4.0	.49	.44	.40	.40	.36	.33	.28	.26
	0° to 90° - 5%	5.0	.51	.46	.42	.42	.38	.35	.29	.28
23	Dense Opal, over Light Opal and Bowl Enameled Lamp	0.6	.16	.13	.11	.12	.10	.08	.07	.06
		0.8	.20	.17	.15	.16	.13	.11	.09	.08
		1.0	.23	.20	.17	.18	.15	.13	.10	.09
		1.25	.27	.23	.20	.21	.18	.16	.12	.11
		1.5	.29	.26	.22	.23	.19	.17	.13	.12
	90° to 180° - 0%	2.0	.33	.29	.26	.26	.22	.20	.15	.14
		2.5	.36	.32	.29	.28	.25	.23	.17	.16
		3.0	.39	.35	.32	.29	.27	.25	.18	.17
		4.0	.43	.39	.36	.32	.30	.28	.20	.19
	0° to 90° - 5%	5.0	.45	.41	.38	.34	.32	.30	.22	.20
24	Enameled Metal Reflector Open Glass Bottom	0.6	.18	.15	.13	.14	.12	.11	.09	.08
		0.8	.22	.19	.17	.18	.16	.14	.12	.11
		1.0	.25	.22	.20	.20	.18	.16	.14	.13
		1.25	.29	.25	.22	.23	.21	.19	.15	.15
		1.5	.31	.28	.25	.25	.22	.20	.17	.16
	90° to 180° - 61%	2.0	.34	.31	.29	.28	.25	.23	.19	.18
		2.5	.37	.34	.32	.30	.28	.26	.21	.20
		3.0	.39	.36	.34	.31	.29	.27	.21	.20
		4.0	.43	.40	.38	.34	.32	.30	.23	.22
	0° to 90° - 14%	5.0	.45	.42	.40	.36	.34	.32	.25	.23
25	Bowl Enameled Lamp	0.6	.16	.13	.11	.12	.10	.08	.07	.06
		0.8	.19	.16	.14	.15	.13	.11	.08	.08
		1.0	.22	.19	.17	.17	.15	.13	.10	.09
		1.25	.25	.22	.19	.20	.17	.15	.11	.10
		1.5	.27	.24	.21	.21	.18	.16	.12	.11
	90° to 180° - 0%	2.0	.31	.28	.25	.24	.21	.19	.14	.13
		2.5	.34	.31	.28	.25	.23	.22	.15	.15
		3.0	.36	.33	.31	.27	.25	.23	.16	.15
		4.0	.40	.37	.34	.29	.28	.26	.18	.17
	0° to 90° - 0%	5.0	.41	.38	.37	.31	.29	.28	.19	.18
26	Clear Top Enclosed	0.6	.16	.12	.10	.13	.10	.08	.07	.06
		0.8	.20	.17	.16	.17	.13	.11	.10	.09
		1.0	.23	.19	.16	.19	.15	.13	.12	.10
		1.25	.26	.22	.19	.21	.18	.15	.14	.12
		1.5	.29	.25	.21	.24	.20	.17	.15	.13
		2.0	.32	.28	.25	.26	.23	.20	.18	.16
		2.5	.36	.31	.28	.29	.26	.23	.20	.18
		3.0	.38	.34	.31	.31	.28	.25	.22	.20
		4.0	.42	.38	.35	.34	.31	.29	.24	.22
		5.0	.44	.40	.37	.36	.33	.31	.25	.24
27	Mirrored Indirect	0.6	.15	.12	.10	.11	.09	.07	.05	.04
		0.8	.18	.15	.13	.13	.11	.09	.07	.06
		1.0	.22	.19	.16	.15	.13	.11	.08	.07
		1.25	.25	.22	.19	.18	.15	.13	.09	.08
		1.5	.27	.24	.21	.20	.17	.15	.10	.09
	90° to 180° - 0%	2.0	.30	.27	.25	.22	.19	.17	.11	.10
		2.5	.34	.31	.28	.24	.22	.20	.13	.12
		3.0	.36	.33	.30	.26	.24	.22	.14	.13
		4.0	.40	.37	.34	.28	.26	.24	.15	.14
	0° to 90° - 0%	5.0	.42	.39	.37	.30	.28	.26	.17	.15
28	Enameled Metal Indirect	0.6	.14	.11	.10	.10	.08	.07	.04	.04
		0.8	.17	.14	.13	.13	.10	.09	.06	.05
		1.0	.20	.17	.15	.14	.12	.10	.07	.06
		1.25	.23	.20	.17	.17	.14	.13	.08	.07
		1.5	.25	.22	.19	.18	.15	.14	.09	.08
	90° to 180° - 34%	2.0	.28	.25	.23	.21	.18	.16	.10	.10
		2.5	.31	.28	.26	.22	.20	.18	.12	.11
		3.0	.33	.30	.28	.24	.22	.20	.13	.12
		4.0	.37	.34	.32	.26	.24	.22	.14	.13
	0° to 90° - 0%	5.0	.39	.36	.34	.28	.26	.24	.15	.14

FIG. 2—UTILIZATION FACTORS MUST BE CONSIDERED IF THE INSTALLATION IS TO GIVE SATISFACTORY SERVICE

tenance; (6) vertical illumination. On the other hand, where lamps are to be hung above a crane in a foundry the order of importance would be: (1) Efficiency based upon illumination on horizontal; (2) vertical illumination; (3) maintenance; (4) shadows; (5) direct glare; (6) reflected glare.

In Fig. 1 the highest rating given is *A*+, denoting excellence, while *D*, the lowest, indicates that units so rated in that particular will very likely prove unsatisfactory in an installation where this factor is important. The ratings *B* and *C*, while indicating a result not equal to *A*, are decidedly superior to rating *D*. In other words, a rating *B*, *C*+ or *C* in certain respects does not disqualify a unit provided that in the essential requirements of a given location the unit is rated *A* or *B*+.

A+, *A*, *A*— } Excellent; *B*+, *B*, *B*— } Good; *C*+, *C*, *C*— } Fair; *D*—Very Bad

Determining Outlets, Mounting Height and Number of Units

Having solved the first two steps of the illumination problem, the third point in the design—that of determining the details of arrangement—comes up. One way to handle this is to make a diagram of the floor. If the units are of semi-indirect or totally indirect type, measure the ceiling height of the room and refer to Table II for the permissible spacing of units and preferred suspension distance of lighting units corresponding to this ceiling height.

TABLE II—SPACING AND MOUNTING HEIGHT FOR LIGHTING UNITS

Mounting Height of Unit*	Permissible Distance Between Outlets	Permissible Distance Between Outlets and Side Walls: In Usual Locations Where Aisles and Storage Are Next to Wall	Permissible Distance Between Outlets and Side Walls: In Offices or Where Work Benches Are Not Next to Wall	Suspension Distance, Indirect Units, Ceiling to Top of Reflector†
4	6	3	2	1
5	7½	3¾	2½	1¼
6	9	4½	3	1½
7	10½	5	3½	1¾
8	12	6	4	2
9	13½	6¾	4½	2¼
10	15	7½	5	2½
11	16½	8	5½	2¾
12	18	9	6	3
13	19½	9¾	6½	3¼
14	21	10½	7	3½
15	22½	11	7½	3¾
16	24	12	8	4
18	27	13½	9	4½
20	30	15	10	5
22	33	16½	11	5½
24	36	18	12	6
27	40½	20	13½	6¾
30	45	22½	15	7½
35	52½	26	17½	8¾
40	60	30	20	10

* Note that the permissible distance between outlets depends upon the height of the light source above the work, not above the floor. In offices, the work plane corresponds to the desk tops, usually 2½ ft. above the floor; in factories, the work plane will often be 3½ or 4 ft. above the floor. Note that in the case of semi- and totally-indirect lighting units, the figures in this column are the height of the ceiling above the work.

† Suspension distances are based on best distribution of light and efficiency of utilization for standard units. In some installations other considerations may require a different suspension distance.

If the units are direct-lighting type, determine the mounting height and refer to Table II for the permissible spacing corresponding to this mounting height. If the units are mounted as close to the ceiling as possible (a minimum allowance of one foot is usually necessary to provide for the drop of the reflector from the ceiling), a wider spacing is permissible and fewer units are therefore necessary for an even distribution of light. Considerations of shadows, the appearance and arrangement of work may make a lesser mounting height desirable even though a closer spacing of outlets would be needed to keep the same uniformity of illumination. Ordinarily lamps should not be mounted less than 10 ft. (3 m.) above the floor unless a low ceiling makes it necessary.

Outlets Are Located Symmetrically If Possible

Having determined the permissible spacing, proceed to locate the outlets on the diagram of the floor, placing the units as nearly symmetrically as possible without appreciably exceeding the permissible spacing for a uniform illumination. At a greater height, a spacing closer than that in Table II results in greater freedom from shadows, but increases the number of units required and makes the installation cost more. If a spacing somewhat closer than the permissible value is adopted, as is often the case, it is allowable, though not necessary, to refer back to Table II and select a lower mounting height corresponding to the new spacing. As shown in Table II, the distance between the outside row of outlets and the wall should not exceed one-half the spacing distance, and for office spaces, or where work is carried on at benches or machines near the wall, this distance should be approximately one-third the spacing distance.

The average area per outlet is found from the floor area of the room and the number of outlets located on the diagram as follows: Area in square feet per outlet equals the total floor area in square feet divided by the number of outlets in room.

The necessary lumen output for the lamp in each outlet of the system may be found directly from the following formula:

$$\text{Lamp lumens per outlet} = \frac{\text{foot-candles} \times \text{depreciation factor}}{\text{coefficient of utilization}} \times \text{area in sq.ft. per outlet}$$

In this formula

Foot-candles = illumination decided upon

Depreciation factor = safety factor or allowance for depreciation due to aging of lamps, dirt, dust and deterioration of reflecting value of walls. Use 1.30 for fairly clean locations. Use 1.50 for dirty locations or where cleaning is infrequent.

Area = area in square feet per outlet.

Coefficient of utilization = proportion of the generated light from the lamps which reaches the plane of work. The coefficient of utilization for the installation is determined as outlined below:

Determining Coefficient of Utilization

Fig. 2 shows that the coefficient of utilization varies according to the type of fixture, the color of the walls and ceiling and the proportions of the room or "room index." From Table III find the room index corresponding most nearly to the dimensions of the installation; then the coefficient of utilization for the installation of the type of lighting unit selected will be found from Fig. 2 in the proper column of wall and ceiling color opposite the correct room index.

Solving the formula above, after substituting the proper values for foot-candles, depreciation factor, coefficient of utilization and the area per outlet, gives the lamp lumens necessary per outlet.

To find the wattage of lamp required, refer to Table IV, which lists the lumen output rating for lamps. Locate in this table the size of lamp of the desired type which most nearly meets the requirement of lumen

output. When the lamp lumens required fall nearly midway between the two sizes, choose the larger rather than the smaller, unless it is certain that the less illumination from the smaller will suffice.

Solving a Typical Problem

In order to give a more definite and practical idea of how this method of illuminating design is used, the layout for a typical factory room as shown in the headpiece of this article may be followed out. The floor plan of the factory space to be lighted is 60 ft. x 120 ft. (18 m. x 36 m.), with a height from floor to room trusses of 12 ft. (4.2 m.). The roof is of sawtooth construction and the walls and upper structure are painted a medium color. A considerable amount of dark material is kept stacked along the walls of

TABLE IV—LUMEN OUTPUT OF TUNGSTEN-FILAMENT LAMPS
(Subject to change without notice)

Size of Lamp in Watts	110-125-Volt Standard Lighting Service			220-250-Volt	
	Type C	Type B	Daylight	Type C	Type B
10	....	75	.....	.....	...
15	....	125	.....	.....	...
25	....	226	.....	.....	191
40	....	372	.....	.....	...
50	450*	480	.....	.....	442
60	....	575	.....	.....	...
75	865	...	600	.....	...
100	1,260	...	875	995	945
150	2,040	...	1,400	.....	...
200	3,100	...	2,000	2,520	...
300	4,840	...	3,360	4,100	...
500	8,750	...	5,600	7,850	...
750	13,900	...	.....	.....	...
1,000	19,300	...	.....	17,500	...

* White.

the room which will have an effect in the lighting design. The work carried on is the assembly of sewing-machine heads.

The four steps in the design are worked out as follows:

1. *Foot-Candle Illumination.*—From Table I, 8 foot-candles is recommended for assembly, medium grade.

2. *Type of Lighting Unit.*—Consulting the guide to the selection of reflecting equipment of Fig. 1, unit No. 2, the RLM dome with bowl-enameled lamp is selected, based on efficiency and favorable showing from the standpoint of glare, reflected glare, shadows and maintenance.

3. *Location of Outlets, Mounting Height and Number of Units.*—The height of the benches, and therefore the plane of work, is 3½ ft. above the floor. The maximum mounting height of the lamps above the floor is 11 ft. (12 ft. height from floor to truss less 1 ft. allowed for reflector drops). Hence maximum mounting height of units above plane of work is 11 ft. (3.3 m.) less 3½ ft. (1.1 m.), or 7½ ft. (2.3 m.)

From Table III of spacing-mounting height, a 7½-ft. (2.3-m.) mounting height above plane for direct-lighting units is found to indicate a permissible spacing of approximately 11 ft., and since the section of the room near the walls consists of aisles and storage, 5½ ft. (1.7 m.) may be allowed for the distance between the last row of outlets and the side walls.

The floor plan of the room shows that a 10-ft. (3-m.) spacing each way, with outside units 5 ft. (1.6 m.) from walls, would make a symmetrical layout in the 20-ft. x 30-ft. (6-m. x 9.1-m.) bays, and this plan is therefore adopted. Outlet locations for the entire space are marked on the plan, and seventy-two are found to be required. The area in square feet per outlet equals the total floor area in square feet divided by the number of outlets in room (7,200 ÷ 72 = 100).

4. *Lamp Size.*—Lamp lumens per outlet =

$$\frac{\text{foot-candles} \times \text{depreciation factor}}{\text{coefficient of utilization}} \times \text{area in sq.ft. per outlet}$$

Area in square feet per outlet = 100; foot-candles = 8; depreciation factor = 1.30.

To Find Coefficient Utilization.—From the room index (Table II), in a room 60 ft. x 120 ft., where the mounting height of direct-lighting units above plane of work is 7 ft., the room index is 5.0, or in the same room where the mounting height is 8 ft. the room index is 4.0. Either value might be used for the room index with equal accuracy as to the result, but 4.0 is more conservative.

Referring to Fig. 2, coefficients of utilization, for RLM dome bowl-enameled lamps in a location with a room index of 4.0 and where the ceiling and walls are fairly dark, the coefficient of utilization is found to be 0.57. Hence lamp lumens required per outlet = [(8 × 1.30) × 100] ÷ 0.57 = 1,824.

From Table IV a 150-watt Mazda C lamp giving 2,040 lumens is found most nearly to meet the requirements. The actual service illumination using this lamp will, of course, be slightly greater than originally designed for, or (2,040 ÷ 1,824) × 8 = 8.9 foot-candles.

Building Transmission Lines Vs. Paying Freight on Coal

Determining Factors Are Fixed Charges of Line, Freight Charges on Fuel and Relative Thermal Efficiencies and Construction Costs of the Two Plants

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THE difficulties of transportation, coupled with rising freight rates, bring forcibly to mind the advisability of generating power at the mine and transmitting it to the market, thus eliminating the haulage of a considerable tonnage of fuel and consequently reducing the congestion of freight traffic. The engineer is therefore more and more likely to be called upon to answer the question "Can we or can we not afford to generate at the mine and transmit to the market?"

There are three questions which must be answered to solve the problem: (1) Will the production efficiencies of plants at the mine and at the market be equal? This includes generating efficiency as well as transmission efficiency. (2) Can the plants be built for equal costs per kilowatt of rating? (3) Will the fixed charges on the line be less, equal to or greater than the freight charges on the fuel? The last question is usually the most important. Often it may be settled by comparing the estimated cost of constructing the line with cost of transmission justifiable at the existing freight rate.

The following method of determining the justifiable cost of transmission may be found convenient: First, set up the probable fuel requirements in pounds per kilowatt-hour for the type of plant likely to be built for annual load factors of 50, 75 and 100 per cent (line *c* in the table on page 423). Next, calculate the kilowatt-hours per kilowatt of peak load for each load factor and the corresponding annual fuel requirements (*d*). Then figure the freight charges on the coal required to generate one kilowatt-year. Freight

charges are shown in the accompanying table for an assumed plant and with freight rates varying from $1 to $2 by 25-cent increments. In order to find at what rate the freight charges may be capitalized it is necessary to determine the fixed charges on the proposed transmission-line investment which will equal the freight charges. The figures assigned must, of course, be based on the company's own experience. Assume the following: Cost of money, 9 per cent; taxes, 2 per cent; maintenance, 6 per cent, and deferred upkeep, 3 per cent, giving total fixed charges of 20 per cent. Letting this 20 per cent of the cost of the line equal the freight charges, the total cost of the line may be figured. This cost of transmission line per kilowatt of peak load for the various load factors and freight rates assumed is shown at the bottom of the table (*g*). The curves show graphically the results secured by these calculations.

Knowing the maximum amount which should be spent on lines the next step is to calculate the size of lines required and to make an estimate covering their cost. This should include the cost of step-up and step-down equipment, protective apparatus, spare circuits, etc. This figure divided by the safe capacity of the plant (one unit not operating) gives the cost per kilowatt of peak load. For purpose of illustration assume that this resulted in a cost of $30 per installed kilowatt. Draw a horizontal line through this point on the chart and it will intersect the cost curves plotted. If the freight rate for coal delivered to the market is $1.50 per ton it is obvious that in order to offset this freight rate the plant at the mine must be operated at an annual load factor of not less than 52 per cent, at which point the actual and justifiable cost lines intersect. If a better annual load factor can be maintained economies will accrue. If the freight rate were only 75 cents per ton it can be seen that even at an annual load factor of 100 per cent it would be cheaper to haul the fuel.

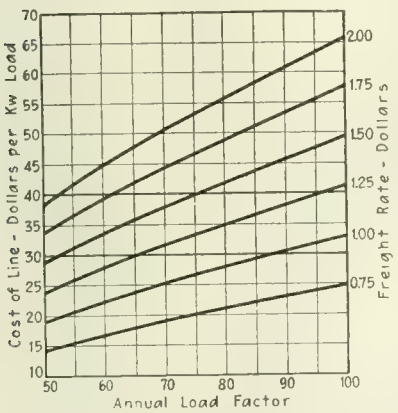


CHART TO BALANCE COST OF TRANSMISSION LINE FROM MINE AGAINST COST OF SHIPPING COAL

Reverting now to question 1, assume that because of natural facilities a plant at the market could be operated with a higher average vacuum and therefore a better thermal efficiency than a similar plant at the mine. For instance, assume a fuel economy of only 2 lb. (0.9 kg.) of coal per kilowatt-hour at 50 per cent load factor instead of 1.75 lb. (0.8 kg.). Then additional fuel per kilowatt-year to the amount of 1,095 lb. (496 kg.) would be required. If a coal cost of $6 delivered at the mine plant is assumed this extra fuel adds $3.29 to the cost of a kilowatt-year, and the freight charge of $5.75 (based on $1.50 per ton) should be reduced by that amount before capitalizing. The figures assumed would therefore decrease the allowable transmission line cost to $12.30 per kilowatt, and it would be impossible to justify a mine plant.

Similarly referring to question 2, if the cost of a plant at the mine is greater per kilowatt (transmission-line equipment excluded), then this additional cost per kilowatt should be added to the cost of the transmission line as computed before plotting on the chart. For instance, if this cost at the mine were found to be $10 per kilowatt in excess it would be equivalent to a transmission line cost of $40 instead of $30. In this case an annual load factor of 75 per cent would have to be maintained at the mine plant to break even.

In the above discussion annual transmission losses have been neglected. If the answer to question 3 shows a reasonable leeway, calculations should then be made for various percentage losses resulting from transmission at different load factors.

The added fuel required to supply the losses may be treated from the point of view of kilowatt-hours delivered as equivalent to a decreased thermal efficiency at the mine plant; that is, an increase in pounds of coal required per kilowatt-hour, and calculations made as outlined under question 1, where plant conditions, instead of line losses, are assumed as being responsible for decreased fuel economy.

If reasonable leeway still exists, further studies should be made to determine whether either of the conditions outlined in questions 1 and 2 would affect the final result. It is believed that this method of attacking the problems will eliminate many lengthy and laborious calculations.

INVESTMENT IN TRANSMISSION LINE JUSTIFIED TO AVOID PAYING FREIGHT ON COAL

(a) Annual load factor, per cent	50	75	100
(b) Average daily load factor, per cent	67	84	100
(c) Coal per kilowatt-hour, lb	1.75	1.62	1.50
(d) Annual output per kilowatt of plant, kw.-hr	4,380	6,570	8,760
(e) Fuel per kilowatt-year, lb	7,665	10,645	13,140
(f) Annual freight charges per kilowatt-year:			
Freight Rate per Ton:			
$1.00	$3.83	$5.32	$6.57
1.25	4.79	6.65	8.21
1.50	5.75	7.98	9.86
1.75	6.71	9.31	11.50
2.00	7.67	10.64	13.14
(g) Justified cost of transmission line per peak kw.*:			
Freight Rate per Ton:			
$1.00	19.15	26.60	32.85
1.25	23.95	33.25	41.05
1.50	28.75	39.90	49.30
1.75	33.55	46.55	57.50
2.00	38.35	53.20	65.70

* Fixed charges assumed as 20 per cent, made up of: Cost of money, 9 per cent; taxes, 2 per cent; maintenance, 6 per cent, and deferred upkeep, 3 per cent.

WHEN notable achievements are referred to in America, the moralist often remarks: "Anybody can do the same if he is made of the right kind of stuff." The scientific fact is that people are made of the right kind of stuff, and human beings do have this passion for achievement. But how to release this creative power, how to give this passion an adequate constructive expression is the problem. How shall we begin? By the enactment of legislation? By reform at the top? By waiting for absolute justice to be arrived at between employer and employee? I have no desire to check any effort of the kind, but the practical achievements have historically worked out from the other direction. The most vital place to begin, it seems to me, is with the individual worker's first approach to industry. How far and how fast can we go in transforming the factory into a real school, in which opportunity shall succeed opportunity for each worker to give expression to his passion to accomplish something, where all shall learn things by doing things, and learn as many things and as important things as each individual is capable of accomplishing?—CHARLES P. STEINMETZ.



Reduced Handling Costs Shown by Contrast

THE Appalachian Corporation of New Orleans, La., reduced the cost of handling cotton seed meal from 58 cents to 15 cents per ton by the use of the tiering machine shown above. The hand truck shown below was replaced by platform electric trucks, allowing one man to handle twenty-five 100-lb. sacks in less time than the three men could handle six sacks. To the engineer in charge of production these illustrations suggest an interesting study both in the selection of the proper apparatus and its operation afterward

Unit Basis for Wholesale and Retail Rates

Factors Influencing Make-Up of Rates—They May Be Based on Segregated Wholesale Rate Plan—Method of Apportioning Costs Indicated—Application to Definite Case

By N. A. KEMMISH
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THE central-station industry has always been able to ascertain accurately the revenues received from the various classes of business and to tell fairly well what the combined total costs for all classes of business have been. When it tries, however, to obtain accurate costs of serving the various classes of business it is at a loss. It is equally at a loss when it attempts to apportion the total revenue required to each of the various classes of business, because costs are not known. The result has been the development of a wonderful system of guessing, and since all companies and all individuals cannot, and will not guess alike, all sorts of rates with no more resemblance between them than the individuals who made them have been developed. The greatest need at the moment is an accurate and uniform system of accounting that will make a proper segregation of costs between the different classes of business. Great progress has been made, but the goal is still a long way off. Greater progress can be made if a few fundamental principles are adopted and allowed to govern accounting systems and methods of procedure. The unit plan hereafter described is an attempt to develop a system capable of application by an isolated plant in a small town or by any combination of towns and transmission lines. There are two general schemes that can be employed, as follows: First—Any group can be divided into three main

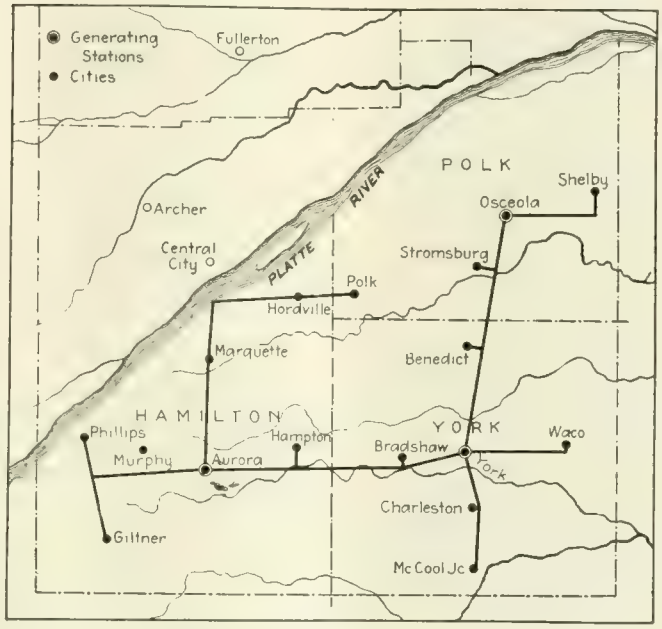


FIG. 1—THIS NEBRASKA SYSTEM USES A UNIT SYSTEM OF WHOLESALE AND RETAIL RATES

UNIT SYSTEM WHOLESALE AND RETAIL RATES AS DEVELOPED FOR A GROUP OF NEBRASKA OPERATING PROPERTIES

RETAIL RATES

Total Kw.-Hr. Used per Month by Entire City	*Average Monthly Consumption, Kw.-Hr.		†Lighting Rates (in Cents)					†Power Rates (in Cents)									†Electric Range Rates (in Cents)					‡Average Wholesale Rate, Cents per Kw.-Hr.
			Minimum Lighting Bill	Kw.-Hr. Consumption per Month				Minimum Power Bill	Kw.-Hr. Consumption per Month								Minimum Stove Bill	Kw.-Hr Consumption per Month				
				First 30	Next 30	Next 30	Over 90		First 50	Next 100	Next 150	Next 200	Next 500	Next 500	Next 500	Next 1,000	Over 3,000		First 100	Next 100	Next 100	Over 300	
0-2,000	R—Hordville	1,081	$1.50	22	19	18	15	$3.50	16	13	12	11½	11	10.8	10.7	10.6	10.5	$2.00	11	10	9	8½	$0.10
	R—McCool	1,463																					
	R—Waco	1,537																					
2,000–10,000	W—Benedict	2,810	1.50	20	17	14	13	3.50	15	12	11	10½	10	9 8	9.7	9 6	9 5	2.00	10	9	8	7½	.0815
	R—Marquette	2,915																					
	W—Bradshaw	3,818																					
	W—Polk	4,285																					
	W—Giltner(est.)	5,000																					
	W—Hampton	5,124																					
	R—Shelby	7,012																					
10,000–25,000	R—Stromberg	19,012	1.25	18	15	12	11	3.00	13	10	9	8½	8	7.8	7.7	7.6	7.5	1.50	8	7	6	5½	.0666
	R—Osceola	20,926																					
25,000–75,000	R—Aurora	o1,571	1.25	16	13	10	9	3.00	11	8	7	6½	6	5.8	5.7	5.6	5.5	1.50	7	6	5½	5	.0566
75,000–150,000	R—York	106,295	1.25	14	11	8	7	3.00	10	7	6	5½	5	4.8	4.7	4.6	4.5	1.50	6	5½	5	4½	.0499

*Showing location in sliding scale of various towns. R = places in which company does retailing. W = places in which company does wholesaling, city doing retailing.

†10 per cent discount in lighting rates if paid in ten days from date of bill; power rates net; range rates net.

‡Wholesale Rates.—Minimum bill, $125 per month; first 2,000 kw.-hr., used per month, 10 cents; next 3,000 kw.-hr., 8 cents; next 5,000 kw.-hr., 7½ cents; next 10,000 kw.-hr., 6½ cents; next 15,000 kw.-hr., 5½ cents; next 25,000 kw.-hr. 5 cents; next 40,000 kw.-hr. 4½ cents; next 50,000 kw.-hr. 4¼ cents; over 150,000 kw.-hr., special rate. These rates are based on coal at $6 per ton of 2,000 lb. at the power plant, York, Neb. Should the average price of coal at this plant increase or decrease over the base of $6 per ton, then the above rates will be increased or decreased at the rate of $0.0020 (two-tenths cent) per kilowatt-hour for each 10-cent raise or decrease in the price of coal per ton. The above rates are based on an average load factor of 30 per cent. Should maximum demand be shown by occasional readings to be over 1/216 of the total number of kilowatt-hours used per month the electric company may at its discretion add such additional charges as are necessary to pay the overhead charges on the additional equipment necessary to supply.

divisions, namely, generation, transmission and distribution. Each would be a complete unit in itself, the transmission company buying its energy where it can at the lowest possible rate and selling it in turn to the various towns and wholesale consumers within reach of its lines. This is a decided departure from present practice and may be the best method to apply to the super-power systems as they develop. A disadvantage is that the smaller power plants would be squeezed out by the larger ones and that the whole system would suffer in case of transmission-line trouble because of lack of standby plants.

Second—The power plants and transmission lines might be considered as one complete system from which energy would be wholesaled to the various distribution

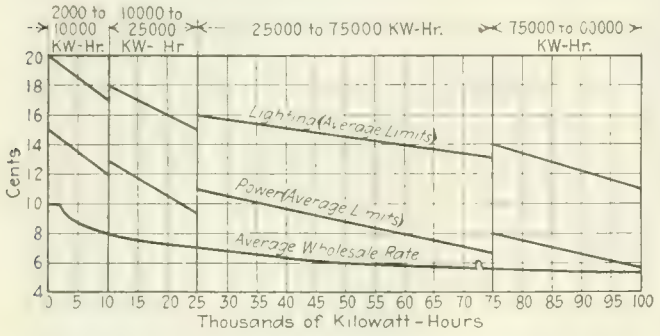


FIG. 2—UNIT RATE SCHEME IN WHICH THE RETAIL RATES ARE BUILT UP ON A SEGREGATED WHOLESALE RATE AS A BASE

The lighting and power rate curves indicate the maximum and minimum average rates. The average rates for each group are taken from the calculations for the curves in Fig. 3 and 4, and the curves indicate the relation of the average retail and wholesale rates for the assumed consumption in those figures. The groupings on which the wholesale and retail rates are based are expressed in kilowatt-hours consumption per month.

systems reached by its lines. These systems could be either single communities or secondary transmission systems, the main generation and transmission system in the latter case using extremely high voltage and covering a large area. This system would be concerned only in obtaining a rate for its service that would pay its operating and fixed charges and a fair profit on the business. The rate structure for the distribution service would be an independent problem and based on the service rendered by the distribution company.

In building the rate structure for the entire service the following are suggested as vital factors in a correct solution:

1. Total cost equals operating expenses plus overhead expense.

2. Gross revenue equals operating expenses plus overhead expense.

3. Operating expense must include all necessary and legitimate expenses falling under this head, including taxes, bad debts, etc.; also a reserve for renewals and contingencies and interest on current obligations.

4. Overhead expense includes a fair return for the use of capital and for enterprise in developing and carrying on the business, in which the following must be considered:

(a) The net income must never be less than the prevailing rate of interest on similar risk investments, in order that capital may be freely and continuously attracted to the enterprise.

(b) Efficiency and good service must be recognized by allowing a reasonable profit, in which the degree of efficiency is recognized by an increasing profit based on efficient management.

Gross earnings to provide total cost as defined in the foregoing should be apportioned among the various classes of service in accordance with their combined and individual "value of service" as follows:

1. When conditions are the same, rates to different groups of consumers or classes therein should be the same.

2. No rate should be below bare cost, and every rate should include a fair return on any investment added or used exclusively for that group or class of consumers.

3. Rates must be such that as many groups or individual consumers as possible may be served at the lowest practicable rates and yet a fair return on the investment be earned.

4. No rate can be above the "value of service" to the consumer.

5. Consumers whose circumstances are alike should pay the same rates, but it is not necessary that those whose circumstances are unlike should be asked to pay the same percentage on jointly used investment. Customers who are asked to pay a smaller return should be of a character whose presence on the system will help to lower the cost of service to consumers of all classes.

Classification of Rates

1. Wholesale. The rates applied to communities where the energy is resold at retail or to consumers whose requirements are such as to class them with such communities. A common wholesale sliding-scale rate can be applied to the various communities or groups served. It should be based on the combined group value of service. It can also be employed to arrive at a proportion to be used in apportioning the revenues required among the users of service. These wholesale rates must provide revenue to pay all operating and overhead expenses apportioned to each class of service.

2. Retail. The distribution of energy may or may not be done by the wholesaler. In any event it may be considered as a separate problem. The rates for each group of consumers must be based on the same principles as the wholesale rates and return a revenue

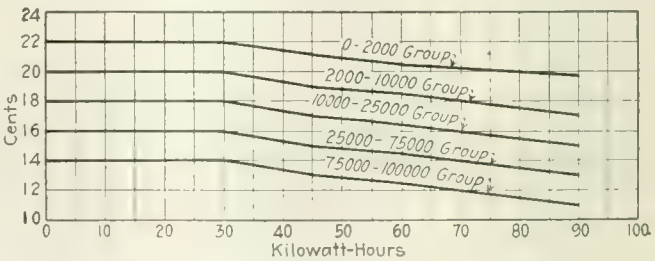


FIG. 3—AVERAGE LIGHTING RATES FOR VARIOUS OPERATING GROUPS

Minimum bills are omitted from consideration. See the table on page 425 for these minimums.

sufficient to pay all expenses apportioned to each class of consumer.

3. Types and forms of rates. These will vary with every system because of varying conditions and need not be discussed here. In any specific case the type best suited will usually suggest itself.

Policies to Be Followed in Rate Making

1. The United States Supreme Court holds that a rate-regulating body cannot compel a public utility to furnish service at a rate that merely returns the increment cost of the service; also that when a rate-regulating body undertakes to establish a rate for a given

class of service, the costs pertaining to that class of service must first be determined and assigned thereto, and that overhead and general expenses must be fairly apportioned between that class and all other classes.

2. Rates need not be uniform for all classes of service or localities. The same rate of profit is not required on different classes of service. Reasonable adjustments may be made as between classifications taking into consideration varying costs, competition and economic value of the service.

3. No body of consumers should be served at a loss and thereby be a burden to other classes.

4. All consumers can enjoy lower rates whenever the utility serves all possible consumers in a given territory.

5. The larger the consumer the lower the cost, especially when long hours' use of maximum demand at off-peak is attained.

6. A segregated wholesale plan is sound.

Methods Employed in Rate Study

In the discussion so far it will be seen that "total cost" and "gross revenue" are used as synonymous terms. In order to arrive at the individual's proportion of this total it is necessary to begin at the top and work down. The serious fault in the past has been the attempt to go from the total business down to the individual at one jump. The total business has been considered as made up of individual consumers rather than of different-sized groups of individual consumers in different localities and under different conditions, as they actually are. Proceeding from this viewpoint, they may then be thought of as minor groups depending on the larger ones, and so on down until finally the individual is reached as simply a part of a minor group or classification. Consumers should first be grouped geographically and costs apportioned on this basis. These costs must then be subdivided among the smaller groups or classes, and so on until the individual is reached and dealt with according to his location and the class to which he belongs.

A consumer or group of consumers will not take service if it costs much more than they can produce it for themselves. This cost to produce may be used as the measure of individual or group "value of service."

The "total cost" should then be apportioned among the geographical groups so that each group pays in proportion to its "value of service." This gives a combination of "costs" and "value of service" that is desirable. The larger groups should then be apportioned in the same way and the operation continued until the individual is reached. The total local class cost among individuals in the various classes should then be apportioned on the individual's "value of service."

This method gives the individual the benefit of class grouping and also the benefit of combining all classes in a given locality into one group, and as locality groups are combined he receives additional benefit.

Continuous Cost Check

To illustrate, we have three steam-electric generating stations located in three towns and owned by the company doing the retailing in the three places. (See Fig. 1.) The three plants feed into a system owned by another company, and they serve fourteen towns and villages in all. Energy is also purchased by the transmission company from an outside source. Each of the three generating plants handles central-station heating, and the expense of the heating service is kept separate as far as possible. All plant-operating expenses incurred in producing electric energy are charged against the cost of producing energy for the entire system. All the energy produced by the three plants is also charged against the entire system, as is the purchased energy. To this total is added the operating expense of the transmission system. This is called the production cost for the entire system. To this the overhead expense of the power plants and transmission lines is added. The next problem is to apportion this "total cost" among the fourteen towns in an equitable manner. All towns are treated alike, no allowance being made for the presence

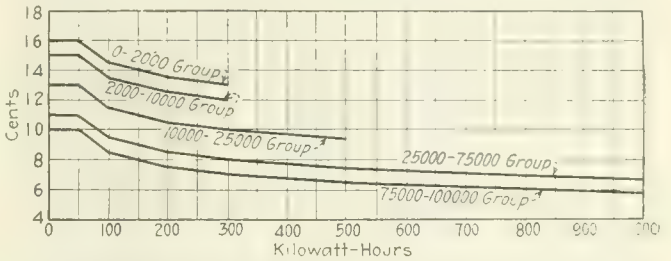


FIG. 4—AVERAGE POWER RATES FOR VARIOUS OPERATING GROUPS
Minimum bills are omitted from consideration. See the table for these minimums.

of a generating plant in a town. A common wholesale sliding scale rate for all towns, such as that in the table on page 425 (or we could use instead a ratio or percentage), based on the town's "value of service," is applied to the total energy used by each town on the system. The sum of all these values divided into the value for any particular town gives that town's proportion of the "total cost" each month. The wholesale sliding-scale rate, based on the town's "value of service," is used primarily as a factor to arrive at the proportion of the "total cost" for any given town. It is immaterial what figures are used in the rate to obtain this proportion so long as they are based on the value of service to that particular community. Since the plants in three towns are owned by the local distribution company, each generating town is credited each month on its wholesale power bill with the amount of plant overhead expense charged into the system each month. This is in the nature of a rental to the transmission system and necessary to get the total power-plant charges into transmission costs. Each town therefore stands its correct share of all expense. These cities and villages are patrons of the power plants and transmission lines, just as much as the individual consumers are the patrons of the distribution systems.

The general plan of charging a common wholesale sliding-scale rate to towns of all sizes within a given group, and retail rates based on the average wholesale rate to each town, proves reasonable and popular with the individual consumer. It stops all arguments between towns, since both wholesale and retail rates are the same in towns of the same size or using the same amount of energy within the same group. The larger the town or the more energy used by any town, the lower will be the wholesale and retail rates.

An example of a rate schedule built up on the foregoing plans is that in Fig. 2, in which the relation of the retail lighting and power rates to the wholesale rate for various groupings is shown. Figs. 3 and 4 show the average retail rates for power and lighting for various assumed consumptions. The curves omit consideration of minimum rates, which are shown in the schedules in the table I.

Readers' Views and Comments

Italian Electrical Industries Show Rapid and Continuing Growth

To the Editor of the ELECTRICAL WORLD:

SIR: The Italian industries underwent a strong development during the war, but long before 1914 great strides had been made which have never been properly appreciated by the outside world. According to a census taken at the end of 1910, there existed in Italy no fewer than 243,000 industrial establishments, with a rating of 1,570,000 hp., giving employment to 2,300,000 men. This was an increase of 34 per cent over the census of 1901.

Leading in industrial life was Lombardy, with 41,030 plants, followed next by Piedmont with 26,336, Tuscany with 22,558 and Venice with 20,900.

According to statistical returns by the Department of Commerce, the following capital has been invested in new industries in Italy during the period from 1915 to 1918: 1915, 79,000,000 lire; 1916, 235,700,000 lire; 1917, 1,288,479,000 lire; and in the year 1918, 2,949,000,000 lire.

The consumption of electric power is perhaps the best measurement of the development of Italian industry. The respective figures (in thousands of kilowatts) are: 1911-12, 17,968,257; 1913-14, 23,119,303; 1917-18, 33,915,890.

Like Switzerland, Italy is trying its best to become independent of foreign coal by means of electrifying the state railways. At the present time the entire electric railway lines in Italy have a total length of only 350 km. (218 miles), and the only great line for the electrification of which preliminary technical and financial steps have been taken so far is that of Modane-Turin-Genoa.

In 1919 the largest capital—435,000,000 lire—was invested in mechanical and metallurgical industries. The great Italian banks supported this movement in a most liberal way. The result is that Italy is today much less dependent upon foreign importation. The chemical industry especially has undergone the greatest changes, though it is as yet doubtful whether the electrotechnical industry will be able to supply the requirements of the home market.

One of the highest Italian authorities on technical questions, Professor Beluzzo of the Milan Polytechnic Institute, recently said, in a speech at Milan, that Italy was bound to develop by all available means the electric resources of the country. Numerous concessions for the utilization of electric power have been asked and granted of late. At present there is only 1,000,000 hp. of electrical energy developed in the country, while more than 5,000,000 hp. is available.

Another industry which did not exist before the war has since made considerable progress—that of the manufacture of magnets and sparking devices for internal-combustion motors. This industry has meanwhile assumed such proportions that it not only supplies the entire home market but also ships considerable quantities abroad. Furthermore, the manufacture of electric accumulators, which largely increased during the war, is making steady progress, thanks to the existence of lead-ore deposits in a great many parts of the Italian peninsula.

A great drawback, however, in the development of the Italian industries is the fact that the country has to import almost every class of raw materials, including coal, foundry iron and, to a very large extent, even ore.

Münsinger-Berne, Switzerland. HENRY L. GEISSEL.

Improving Power Factor by the Use of Induction Motors

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the comments by Quentin Graham appearing in the ELECTRICAL WORLD of Jan. 15, page 149, may we say that we did not aim to extol the induction motor synchronously operated as superior to a motor of synchronous design, but rather to demonstrate the complete feasibility of such operation where starting loads are moderate, running loads not in excess of rating and a wound-rotor machine available? These conditions are not found simultaneously in all motor applications, but perhaps they exist in enough to warrant giving publicity to the satisfactory synchronous operation of induction motors of ratings less than those available in lines of synchronous motors. In regard to Mr. Graham's statement that 100 per cent of magnetizing ampere-turns are required for stable synchronous operation, our article shows that it is quite possible to obtain this, without exceeding heating limitations, owing to the absence of induced rotor currents.

Yale University, New Haven, Conn. RUSSELL G. WARNER. A. E. KNOWLTON.

More Testimony that Causes of Fires Are Not Accurately Reported

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with much interest the article on page 277 of the Jan. 29 issue of the ELECTRICAL WORLD under the title "Society for Electrical Development Attacks Fire Underwriters' Figures." I should like to say that from my own experience I know that in many cases the contention that fires result from electric wires is "all bunk." I put in one year's time in a fire department and was always present when the cause of each fire in our district was looked for. The first procedure was to see whether the house or building was wired, and if it was, the cause of the fire was set down as "crossed wires." These reports, I suppose, came to the attention of the insurance companies. I know of one instance reported as crossed wires when the house was not wired. In another instance there was a 3-in. hole in the chimney and the fire had done some damage around the chimney but was not near the electric wires. I told this to the captain, but the cause of the fire was reported as "crossed wires."

I am convinced that in 98 per cent of the fires attributed to crossed wires the cause given is guesswork. It is safe to say that crossed wires did it, since few persons know that the average wire will hold a closed contact and blow the fuse without throwing sparks. I believe cigarettes cause 90 per cent of our fires. I have known within the last three years of three fires in the factory in which I am employed started by cigarettes.

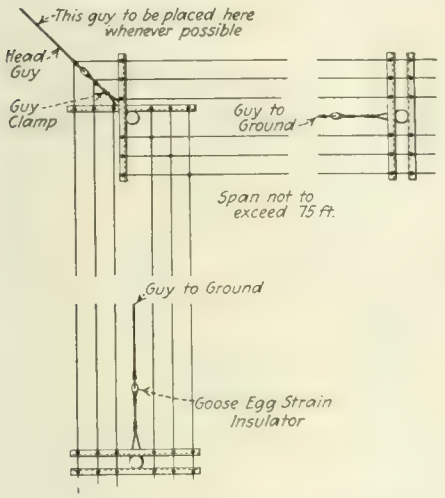
Chicago, Ill. A READER.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Making Better Line Corners

DOUBLE-ARMING corner poles helps to make pole lines look "sloppy" and makes them dangerous to work on. The accompanying drawing shows a neat corner that provides ample working space if cross-arms having at least 30-in. pole-pin spacing are used. The line strains are taken on the adjacent poles by double-arming and guying. The spans around the corner can be shortened and slacked to ease the strain. The corner-pole guy will carry only a small strain if the work is done properly. Where heavy leads are involved special cross-arms of heavier cross-section are preferable to double arms because of the cleaner corner poles which the single-arm construction gives.



A LINE CORNER THAT PROVIDES AMPLE WORKING SPACE AND SAFETY TO LINEMEN

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Percentage of CO_2 Is Not Final Test of Good Combustion

MANY power-plant engineers do not place much confidence in CO_2 readings and make it a rule never to allow the CO_2 present to exceed 10 to 12 per cent or even 8 to 10 per cent. Under these conditions there is likely to be a waste of fuel due to the avoidable escape of sensible heat up the chimney. In contrast with these there are authorities who claim that there is no danger of having combustible gases escape unconsumed before CO_2 reaches a point above 15 per cent.

The fact of the matter is that combustible gases may appear with any percentage of CO_2, and dependence on CO_2 records alone is therefore decidedly misleading. It is quite possible to have large volumes of combustible gases (CO, CH_4 and H_2) present simultaneously with a low percentage of CO_2 as well as a high percentage of CO_2. For example, if the fire in one part of the furnace is very thick or dirty, CO would be generated in that part and escape unburned because not enough air would be going through. If, at the same time, there is an air hole in another part, air would rush through unused. Under these conditions CO would be present at the same time that a low CO_2 reading indicated excess air.

The percentage of CO_2 for economical combustion may vary considerably from time to time in the same furnace with the rate of combustion, method of firing, thickness of the fire bed, distribution and character of the fuel, draft, formation of ashes, dirt and clinkers, and many other influences which are subject to irregular variations and which have a decided effect upon the completeness and efficiency of combustion with any given air supply.

Generally speaking, low CO_2 indicates excess air, but it may also indicate that the air is poorly mixed, giving rise to a simultaneous formation of CO. It is therefore not desirable to attempt to secure a high percentage of CO_2 by cutting down the draft alone. A high percentage of CO_2 can be obtained with practically any draft, so long as it has the proper relation to the fuel-bed resistance. On the other hand, the losses due to the formation of combustible gases which are allowed to escape up the chimney without being burned are frequently much greater than the losses due to excess volumes of air, because it is quite possible to reach a very high percentage of CO_2 while simultaneously producing large volumes of combustible gases.

Insufficient air supply is the most general cause of the presence of CO in the stack. CO may, however, be present owing to the poor design of the furnaces, improper methods of firing, the coal being of a character not adapted to the equipment with which it is burned, poor mixing of the combustible gases with the air, and low furnace temperature which causes gases to be cooled below the ignition point before combustion is complete.

Mono Corporation of America, New York City. OLOF RODHE, Chief Engineer.

Standardized Meter Test Board Speeds Up Laboratory Testing

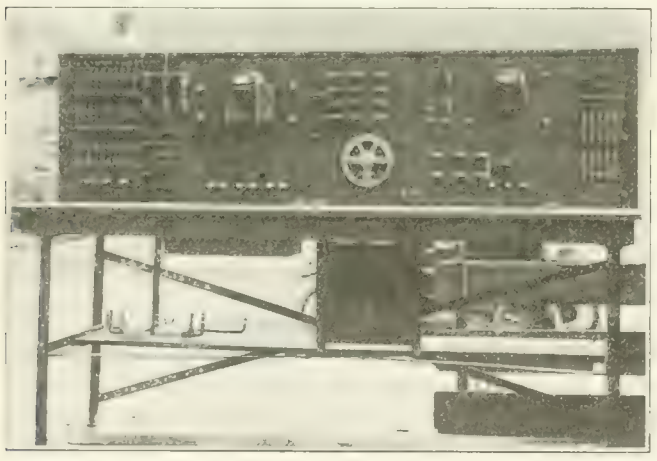
A BOARD for quickly testing watt-hour meters in the laboratories in outlying districts of the Southern California Edison Company has been evolved after several years of trial. This board was designed for applying the necessary testing loads to meters of various current and potential ratings with a minimum of time spent in changing connections. It consists of two sections, for polyphase and single-phase meters respectively. Current is supplied from an open-delta bank of transformers wound for 110 volts on the high-tension side and 11 volts on the low-tension side. Loading the meters by low-voltage current not only saves energy but makes possible the use of small iron-wire coils for loading, with a wide range of combinations.

Compartments are provided in the front shelf for the rotating standard meters used in testing. These standards are started and stopped by telegraph keys connected in their potential circuits—a convenience which will be appreciated by testers using the more cumbersome pendent-type switches generally employed for this purpose.

The single-phase board, on the right, has a current control switch on the left of the meter and two double-throw switches on the right for the potential leads. By the use of these switches it is possible to obtain either 110 volts or 220 volts in phase with the current or leading it 60 deg., the latter method being used for adjusting meters at 50 per cent power factor. Any desired combination of loads is obtained by the single-pole switches, the lower row of which controls the light-load resistors and the upper row the heavy load. With these switches set as required by the meter size, transition from light to heavy load is quickly effected by operating the double-pole, double-throw switch on the left.

This switch also automatically cuts in the light-load or heavy-load coil of the standard meter, making it impossible to burn out the small-capacity coil by throwing the heavy load on it.

The polyphase board, on the left, is arranged for testing with a balanced three-phase load at any power factor. Three similar groups of resistances are provided, connected in closed delta, and controlled by the single-pole switches at the left of the panel. Any power factor from 0 to 100 per cent is obtained by a phase shifter in the potential circuit. This is installed behind the board, the rotor being connected to a graduated dial on the front of the panel. A four-pole double-throw switch transposes the phase connections of the meter elements so that the meter may be calibrated on both phase rotations. Owing to the use of low-voltage current for the series coils it is, of course, necessary to disconnect the potential coils at the points where they are joined to the series terminals and to excite them separately if these coils are tied together according to the practice followed by some companies. However, if the meter has independent connections to potential and current coils no changes are necessary.

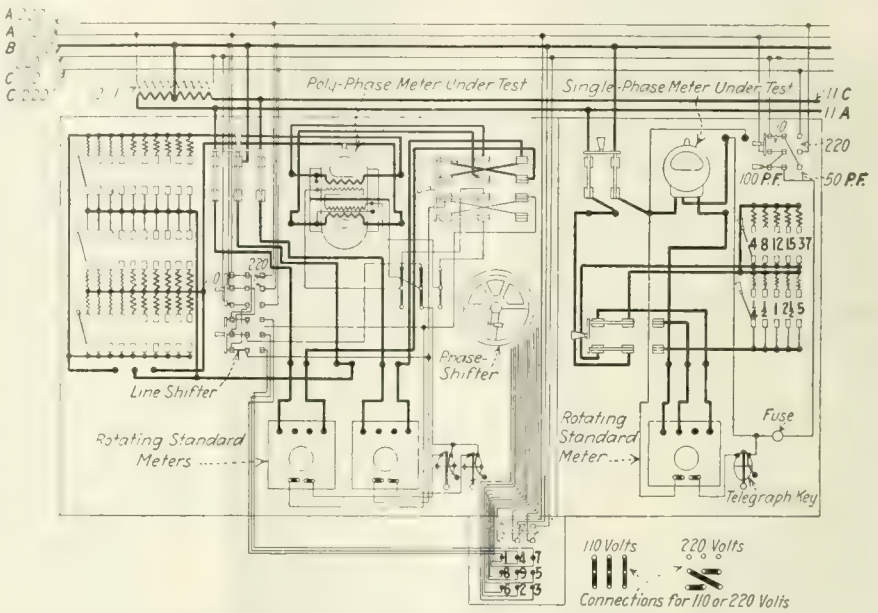


THIS METER-TESTING BOARD IS DESIGNED FOR BOTH SINGLE AND POLYPHASE METERS

Halbert R. Thomas,
Meter and Testing Department.
Southern California Edison Company,
Los Angeles, Cal.

Authority and Duties of the Load Dispatcher

As a load dispatcher is constantly in communication with all parts of a system, he should have complete authority in directing operation in normal or emergency conditions. The dispatcher should direct the loading of all plants as well as of the individual units. Except in cases of emergency, no machines should be started up or shut down without his orders. He should be furnished with curves or other data showing the proper loading point on all machines to obtain maximum efficiency. He should at all times have knowledge of the available kilowatt-hours in storage reservoirs, and no water should be taken from ponds or flumes without his orders. There should be gaging stations showing both rainfall and second-feet flow conveniently located throughout the system with telephone connection to the dispatching office.



METER TEST BOARD WIRED TO PREVENT POSSIBILITY OF BURNING OUT STANDARD METERS

The switching of all lines should be handled by the load dispatcher. In case it is decided to de-energize certain lines for repairs, notice should be given to the dispatcher, who should investigate the load conditions and when necessary take the matter up with the customers whose service would be interfered with and decide whether or not the work can be done. No apparatus or part of the station equipment, such as transformers, generators and oil switches, should be taken out for repairs or dismantled without the knowledge of the dispatcher. Where work is to be done the dispatcher should issue to each station where switching is necessary the proper clearance order, and all such orders given by telephone should be repeated to avoid any possibility of a misunderstanding.

In the event of transmission-line trouble the dispatcher should handle the sectionalizing and testing of the lines. He should send out patrolmen or repairmen to make temporary or permanent repairs. All employees, irrespective of departments, are subject to call from the load dispatcher in case of an emergency. If trouble occurs and the dispatching office cannot be communicated with, the sectionalizing and testing of the lines should be carried out according to a prearranged schedule.

A complete log recording all operating details should be kept. A copy of power-house logs should be sent to the dispatcher, who should compile certain records pertaining to the amount of power generated and to the class of service. The dispatcher's log should show the number of kilowatt-hours generated at each station every hour, and from those readings the daily system load curve sould be made. The amount of water added to or taken from storage reservoirs should be recorded each day. Detailed reports of the line troubles should be kept, and from these a monthly report of the interruptions to custoners should be made out.

A copy of all periodic reports covering the inspection of equipment should be sent to the dispatcher. In case these reports show any apparatus in need of attention, he should take the matter up with the proper authorities with the view of having the condition remedied.

Wherever possible the load dispatcher's office should of course be at or near the center of distribution. Private telephone lines should be maintained between the dispatching office and all stations, and as often as possible there should be connections to the Bell telephone lines as well. The dispatcher should have telephone connection with patrolmen living along the transmission right-of-way in order that these patrolmen may be notified immediately following a case of trouble in their territory. In the dispatching office there should be displayed a map or dummy board carrying a layout of the system and showing the position of every line and switch. The immediate operation of the system can be conveniently followed by a color scheme of plugs or lights.

M. M. RODDEY,
Superintendent of Operation.

Tennessee Power Co.
Cleveland, Tenn.

Securing Good Parallel Operation of Alternators

FOR satisfactory operation of alternators in parallel the chief requirements are: (1) Equal average speed of engine; this means rather heavy flywheels and good valve setting. (2) Fairly sluggish governors which will not respond too quickly to slight changes of load. (3) Some means to choke out any "pumping," such as solid pole shoes, or copper dampers if the poles are laminated. (4) Speed drop from no load to full load the same in each engine, otherwise they will not divide the load properly. Requirements Nos. 1 and 3 must be taken care of by the manufacturer, but Nos. 2 and 4 can be adjusted after installation.

If the engine regulation is too "close"—that is, if speed does not drop appreciably as load comes on—good parallel operation is impossible. Suppose, for example that two engines driving generators in parallel ran at exactly the same speed at full load as at no load. There would then be no tendency for either to "get out from under" when load came on and thus give part of the load to the other machine. Consequently the load might go to either one and not be divided between them. When paralleling a slow-speed unit with a high-speed unit it is almost always found that the high-speed machine tends to take the load away from the low-speed unit, particularly on sudden load increases. This is because the high-speed machine is usually quicker to govern. If this is objectionable, it can be overcome by placing dash-pots on the governor of the high-speed machine to make it more sluggish.

Trouble from pumping is likely to occur if either engine shows unequal indicator cards for the two ends of the cylinder. Such poor adjustment causes uneven speed of rotation and can be remedied by proper setting of the valve gear.

The only way to make each machine take and hold its share of the load is to make the engines hold up speed equally. Little or nothing can be accomplished by juggling the field rheostats. Increasing the field strength of a direct-current machine makes it take load, but this is not true of an alternator. Increasing the field strength makes the alternator generate more voltage, but the extra voltage is used in circulating wattless current through the stator windings of both machines. Hence the ammeter readings will change but the wattmeters will not. To reduce the wattless current between the two machines to a minimum their field should be so adjusted that the two machines give the same voltage at no load. A few trials will show just where the rheostats should be set for regular service conditions.

If cross-current or pumping action is troublesome on two machines having separate exciters, it is well to parallel the exciters or excite both alternators from one exciter. Connecting together two rotors in this way causes them to act as dampers on each other and helps considerably to kill any "swinging" of the load.

JAMES DIXON.

Reliance Electric & Engineering Company,
Cleveland, Ohio.

Cost Estimate for 66-Kv. Spur Line $6,630 per Mile

BASED on extended construction experience, the New England Power Company, Worcester, Mass., recently prepared the accompanying estimate of cost for building 3.06 miles of a 66,000-volt branch line on a 100-ft. right-of-way in the Pepperell district of northern Massachusetts, using steel wishbone cross-arms, wooden poles, No. 2 copper wire and four-disk and five-disk suspension insulators. The poles are set twenty-eight to the mile. These values represent what a line would cost in December, 1920.

ESTIMATED COST OF 66,000-VOLT BRANCH LINE
Costs for December, 1920.
Line has twenty-eight wood poles per mile.

Clearing	$2,140
Pole erection	3,160
Haulage and handling	518
Power wire	2,550
Power insulators and hardware	4,650
Crossarms and fittings	1,565
Stringing power wire	622
Telephone circuit (on poles)	1,460
Special work	1,132
Right-of-way	2,560
Total	$20,357
Per mile	6,630

It will be noted from the table that of the total cost, which averages $6,630 per mile of line, the cost of insulators and hardware for the power circuit amounts to 23 per cent, while the power wire amounts to 12.5 per cent and the cross-arms with their fittings cost almost 8 per cent. The second largest item is that of the poles and their erection, which amounts to 15.5 per cent.

C. R. OLIVER,
Construction Engineer.

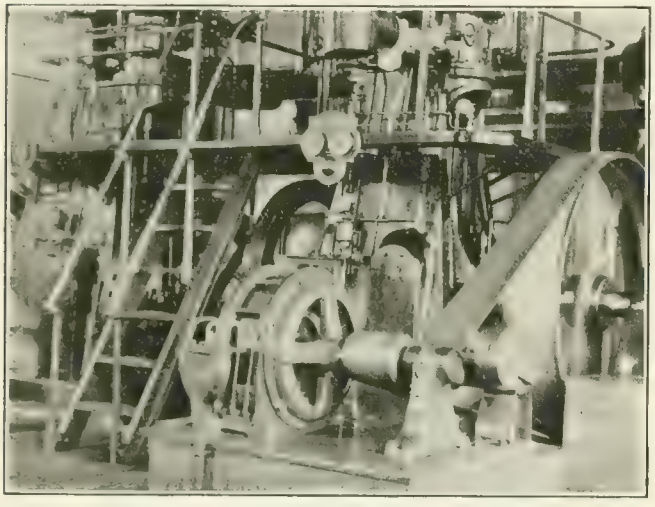
New England Power Company,
Worcester, Mass.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Motor Drive for Compressor Takes Little Space

THE three-phase motor driving an ammonia compressor in a refrigerating plant on Cape Cod, Mass., takes very little floor area. It drives through a short wide belt with idler adjustment. This mounting renders the motor unusually accessible and provides a flexible



COMPACTNESS AND ACCESSIBILITY COMBINED IN THIS COMPRESSOR DRIVE

drive from a pulley of small diameter to a pulley virtually as large as the compressor flywheel. The motor is mounted on a low platform, allowing very short wiring connections from a vertical pot-heat connected with the conduit system of the plant. EUGENE CARPENTER.
Cape & Vineyard Lighting Company,
Falmouth, Miss.

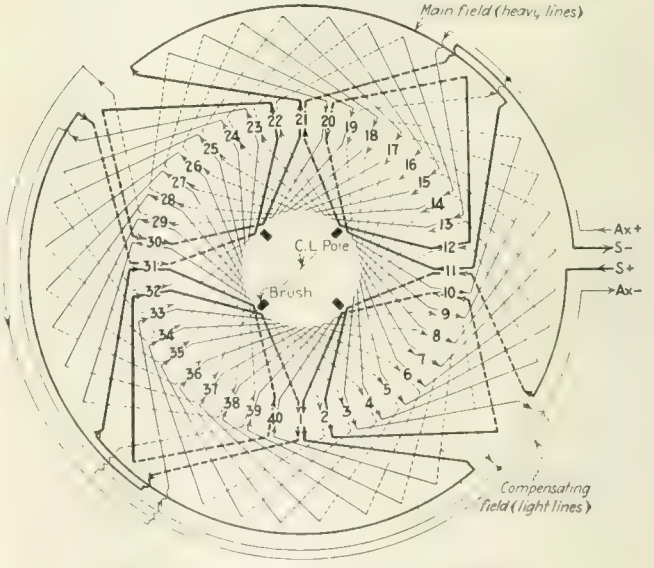
Overheating of Improperly Connected Series Alternating-Current Motor

TROUBLE on a series motor with a field winding in slots similar to the stator of an induction motor and with non-shifting brushes recently came to the writer's attention. This motor had been rewound, and when an attempt was made to start it the motor sparked at the brushes and the armature winding heated excessively. An investigation revealed that the stator winding had been put on in the wrong position without regard for the position of the brushes.

The motor is a single-phase, series commutating motor for 150 volts alternating current or 300 volts direct current. It is used to drive a blower that ventilates the main motors on an electric locomotive. The stator or field is similar in construction to the stator of an induction motor—*i.e.*, laminated, with partly closed overhanging slots, evenly distributed around the periphery. The armature is lap-wound and is virtually the same as any direct-current armature. The motor has four brush arms rigidly fixed to the front bearing bracket, and these arms cannot be shifted.

The stator had forty slots and forty two-layer diamond-shaped coils with two turns of $\frac{1}{16}$-in. x $\frac{1}{2}$-in. bare copper strap per coil, each individual turn being insulated, so that one strap could be threaded in at a time. The pitch was 1 and 10. The coils were connected up into two separate windings, the main field or torque winding and the auxiliary or compensating winding, as shown in the drawing, the heavy lines representing the main field and the light lines the compensating winding.

In stripping the motor no attention had been paid to the location of the slots containing the main coils, or to the slots in which the outside leads were taken off the coils. When the winder put the coils back he had not tried to get the coils in the proper position as regards the brushes. In order to see if this had resulted in placing the winding in the wrong position, the main winding was traced out and marked with chalk, then the front end bracket was put on. It was found, as suspected, that the brushes were not on the center lines of the main poles where they should have been. Further to check this theory of shifted brushes the proper main coils were marked off; then the bolts were removed and the front bracket was rotated until the



CORRECT CONNECTION FOR A SINGLE-PHASE, SERIES COMMUTATING MOTOR

Four-pole motor for 150 volts alternating current or 300 volts direct current. Has forty slots and forty coils of two turns each (only one is shown). Full lines represent top half of coil, dotted lines bottom half. Pitch is 1 and 10. Center line of brushes should pass through center line of slots 6-16-26-36.

brushes were brought on the center lines of the existing poles as marked. The bracket was then held in place with "C" clamps, and when current was applied the motor ran correctly on both alternating current and direct current.

Accordingly the motor was reconnected as shown in the diagram with the center line of each main pole passing through a brush. The mistake the winder had made in connecting up was to use the bottom lead in slot 14 for "S+" instead of the bottom lead in slot 11 as shown. As the rest of the winding was picked up in proper order, the finished winding was four slots out of line, which had the effect of shifting the main poles 27 mechanical degrees. The brushes should be set on the center lines of slots 6-16-26-36, which are also the center lines of the main or torque poles. Instead, the winder had the pole center lines on slots 9-19-29-39, which brought coils short-circuited by the brushes into an active field. Consequently these coils had large currents induced in them and caused the heating and sparking experienced.

This experience points out the lesson that when rewinding motor stators of the single-phase type the slots in which are the coils containing leads to outside connections should be marked with a steel stamp and a drawing made showing the layout and number and the location of the leads, so that the winding can be put back in the proper position.

A. C. ROE.

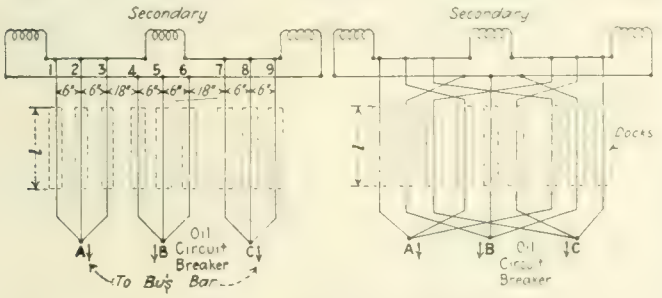
Detroit, Mich.

Current Unbalance in Furnace Leads Reduced with Reactors

A CASE of current unbalance in the secondaries of furnace transformers was solved by the writer through the use of laminated iron reactors having a high permeability. It was not possible to use any of the ordinary methods of transposition or interlacing of these bus cables.

The installation consists of two banks of transformers, each bank made up of three 2,500-kva. single-phase transformers; secondary, delta; primary, delta; primary, 44,000 volts; secondary, 2,200 volts; 60 cycles. The two banks operate in parallel, and with 75 per cent full load the cables on the secondary side of the transformers connecting the low-tension bus as shown in the wiring diagram became dangerously hot.

The size of each cable is 750,000 circ.mil.; that is, the total for each phase is 2,250,000 circ.mil, which should be of ample capacity without any undue heating for the particular load requirements. As can be seen in the wiring diagram each cable has a separate 3-in.

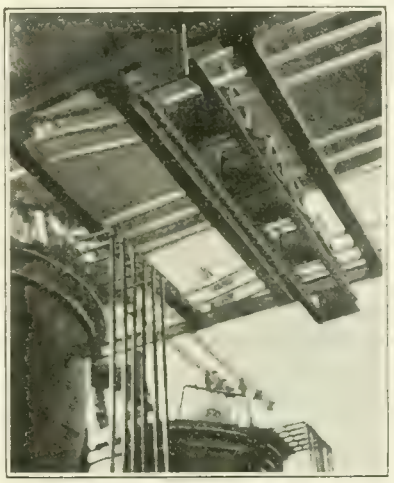


EXCESSIVE HEATING MAY RESULT FROM UNBALANCE IN FURNACE TRANSFORMER SECONDARIES

On the left is shown an installation which gave trouble from heating in cables 3, 4, 6 and 7. On the right is a method of transposition which would have eliminated this unbalance. This method was not feasible because of construction difficulties.

fiber duct. Centers are 6 in. apart, and each phase is 18 in. from the next. The length of the cables from the busbar to the transformers is approximately 75 ft.

At first some thought was given to transpose the cables, which would have virtually neutralized the inductive effects, making the application ideal had it not been that constructional difficulties made this virtually impossible, the distance being too short for a transposition. When a transposition is feasible it should be within each phase group of the conductors so that each conductor will have an equal impedance and there will be no excessive heating in any one of the conductors. The aim is to have each cable of the group kept in the same average relative position over the run, and if this condition is obtained, then each cable will take an equal current and there will be no excessive heating. A scheme was drawn up, as shown in the wiring diagram, whereby the leads would be interlaced. In this way the inductance of the leads would be kept at a minimum because of the subtractive effects of the mutual inductance of adjacent cables of opposite polarity. Because of this the resulting inductance of a negative cable with a positive cable placed on both sides of it would be considerably reduced by the mutual inductance subtracting from its self-inductance. The degree to which the current could be made to distribute equally among the parallel conductors depends upon the extent that the interlacing makes the circuit symmetrical. By referring to the diagrammatic layout it will be noted that the ducts are 6 in. apart, center to center, and in the same plane. If these ducts had been arranged in three sets, each set forming an equilateral triangle, and the ducts instead of being 6 in. apart had been placed side by side, the mutual induction would have been materially lessened.



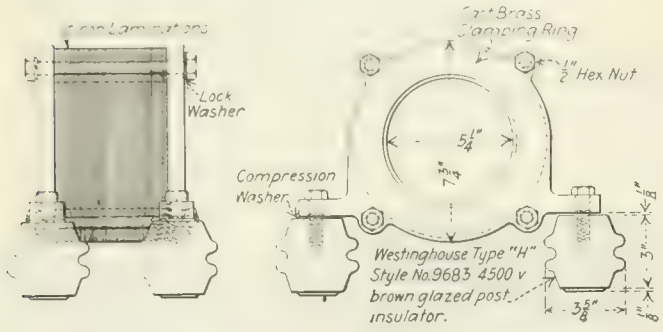
REACTORS WERE LOCATED MIDWAY BETWEEN TRANSFORMERS AND POINT WHERE CABLES ENTER DUCTS

In this case all of the above methods would have been impossible to adopt, so that an alternative scheme had to be thought of, which was the introduction of reactances in the cables taking more than their proper proportion of current. This was accomplished by surrounding the cables over a given length with laminated iron having a very high permeability. The method has been successfully used in different installations to balance the voltage applied to rotary converters. The principal objection to it is that the balance is obtained by increasing the total reactance of the system, which in some cases would be very objectionable. Applying reactors to the cables induces a counter-emf. in the cable which is proportional to the current flow and the length of the core of the reactor.

This counter-emf. is directly opposed to the flow of current, and its function is to oppose part of the main flow of current and increase the flow through the cables that before were only partly loaded. By examining the sketch which illustrates the general construction of the reactor it can readily be seen that the designer has been very liberal with the iron. This was done to insure that the iron should not be oversaturated when the cables were carrying full load; otherwise the effective reactance

would decrease greatly when the cables were carrying an overload. Obviously such a reactor as that described should be so designed that its entire working range will fall well below the knee of the saturation curve of the iron.

Calculating the cores from a basis of 700 amp., the ampere-turns in the reactor are 700 amp. × 1 turn = 700 ampere-turns. The circumference of the core is 20.4 in., or approximately 3.43 ampere-turns per inch of



REACTORS WHICH WERE BUILT AND USED TO DECREASE CURRENT FLOW IN UNBALANCED FURNACE CIRCUIT

core circumference. The flux density is therefore 37,100 maxwells per square inch. High-grade sheet iron such as was used can be readily operated at a density well over 100,000 maxwells per square inch. The iron is therefore operated well below the saturation point. As a factor of safety it was decided to leave ample room around the conductors for the dissipation of heat; consequently this increased the diameter of the core, there being virtually 2 in. clearance from the outside of the cable insulation to the core. By varnishing the laminations the iron losses, eddy currents and hysteresis were kept down to a minimum, and in fact they are negligible when compared with the total output of the transformer.

The accompanying figures will help to illustrate the effect of the reactors in bringing about a comparatively even current distribution in all the conductors.

CURRENT IN THE CABLES BEFORE INSTALLATION OF REACTORS

Phase A		Phase B		Phase C	
Cable	Amp.	Cable	Amp.	Cable	Amp
No. 1	617	No. 4	735	No. 7	670
No. 2	522	No. 5	556	No. 8	425
No. 3	778	No. 6	626	No. 9	708

CURRENT IN CABLES AFTER INSTALLATION OF REACTORS

Phase A		Phase B		Phase C	
Cable	Amp.	Cable	Amp.	Cable	Amp.
No. 1	669	No. 4	639	No. 7	660
No. 2	609	No. 5	639	No. 8	619
No. 3	639	No. 6	639	No. 9	638

From the table it will be seen that a perfect balance was obtained in phase *B*. This could also have been accomplished in phases *A* and *C* had two reactors been used as in phase *B*. Phases *A* and *C* were considered close enough for all practical purposes; that is, the cost of the extra reactors would not offset the gain brought about by having an absolutely even current distribution in all the cables in phases *A* and *B*.

The lengths of the different reactors to bring about the above results are as follows: Phase *A*, cable No. 3, 5¼ in. Phase *B*, cable No. 4, 2¾ in.; cable No. 6, 4½ in. Phase *C*, cable No. 7, 8½ in.

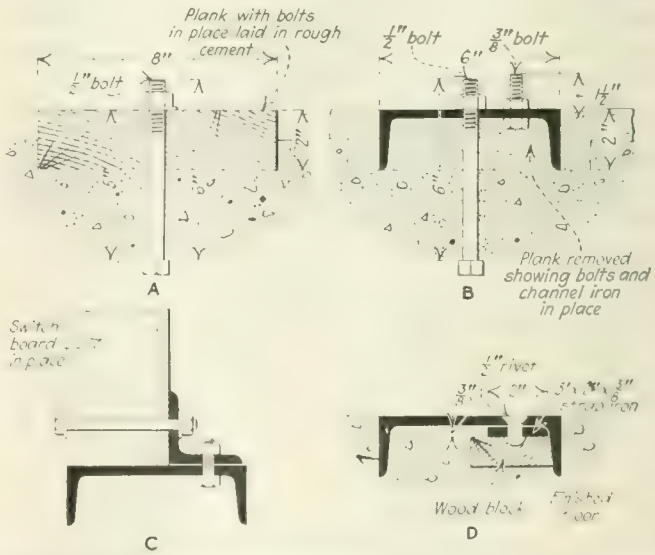
The photograph shows the installation of the reactors. They are mounted on a channel-iron rack hung under the cables midway between the transformers and where the cables enter the ducts. The reactors are insulated from ground with 4,400-volt post-type insulators.

Trail, British Columbia. R. H. N. Lockyer.

Secure Method of Mounting Switchboard

For securely fastening a channel iron to be used for the base of a switchboard on a concrete floor the writer has used the method illustrated in the accompanying drawing. This gives a very firm support to to the switchboard framework. The channel iron is held down by means of bolts inserted in the concrete floor. The bolts which hold the supporting feet for the switchboard may be inserted at the time of laying the floor or, by use of a special construction, may be inserted at any time afterward. The first step to be taken is to insert a plank 8 in. wide and 2 in. deep into the forms at the place where the switchboard is to be set. This plank has bolts through it and extending downward as shown at drawing *A*. These bolts are used to hold the channel iron in place. An 8-in. plank is selected if a 6-in. channel iron is to be used because it leaves a space on each side of the iron so that the iron may be wedged to one side or the other to correct any irregularities which are present in the iron. When the rough pouring of the floor has set, the plank is taken up and the channel is put into place after filling the slot in the floor with soft concrete so that the underside of the channel iron will be filled. The holding-down bolts are spaced so as to come directly in the center of a panel. They should not be placed farther than 4 ft. apart.

Before putting the channel iron in place ⅝-in. bolts are inserted in holes drilled at the places where the



DETAILS SHOWING HOW CHANNEL-IRON BASE FOR SWITCHBOARD IS FASTENED IN FLOOR

feet for supporting the switchboard will come, as shown in drawing *B*. In case it is not known exactly where the switchboard panels will be in the future, the construction as shown in *D*, may be used. In this case a strip of 2-in. x ⅜-in. iron is riveted to the inside of the channel before it is put in place. It is then put in place

with a piece of ⅞-in. board underneath this strip. When the location of the support for the board is determined upon, holes may be drilled through the channel iron and the ⅜-in. strip, and these holes may be tapped to receive the bolts which will hold down the feet of the switchboard support. The addition of this strip of ⅜-in. iron makes the section sufficiently thick to support the switchboard. With the channel iron alone the section would be rather thin. The wood strip underneath allows the drill to pass through the iron without cutting into the concrete.

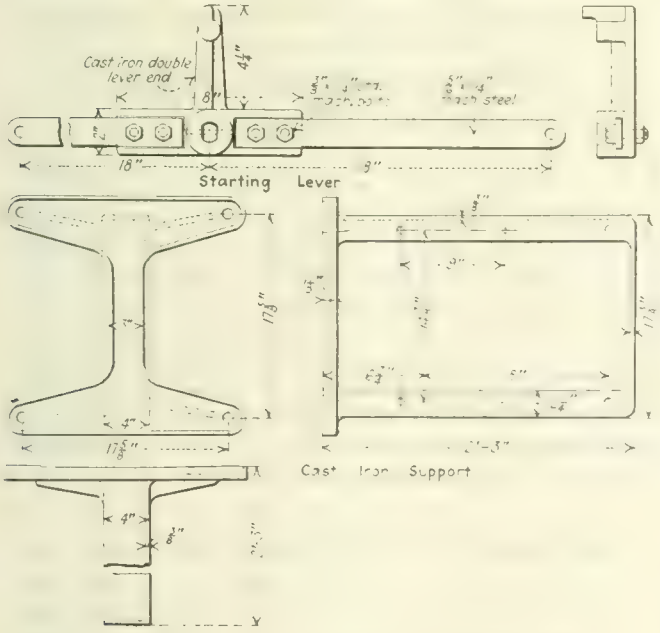
JOHN F. HANLEY.

Lawrence, Mass.

Ceiling Mounting for Large Compensators

IN ORDER to save space compensators are mounted in the ceiling in the factories of the Dayton Engineering Laboratories Company, Dayton, Ohio. The supports are made in two sizes, respectively, for motors of 30 hp. to 100 hp. rating and motors of up to 25 hp. rating.

A drawing of the size used for motors of from 30 hp. to 100 hp. is shown here. The support is a cast-iron bracket, 2 ft. 3 in. long, drilled to be fastened to the ceiling and with holes for bolting on the compensator. In order that the motor may be started up from the floor, a special lever is made which is attached on to the shaft where the ordinary starting lever is fastened. This lever is moved by chains which hang down within reach of the operator on the floor. A third chain is



CAST-IRON CEILING SUPPORTS FOR COMPENSATORS OF 30 HP. TO 100 HP.

attached to the latch of the compensator for tripping it out when it is desired to stop the motor.

Mounting a compensator on the ceiling in this manner not only saves working space but it also eliminates runs of conduit from the ceiling down to the compensator if it is installed at the usual height on a wall or column of the building.

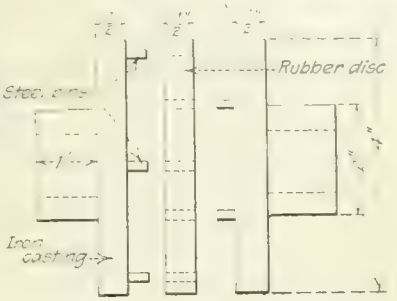
A description of the mounting for motors not over 25 hp. will be given in a later issue.

H. L. BURNS,
Chief Electrician.

Dayton (Ohio) Engineering Laboratories Company.

Flexible Coupling Built at Small Expense

A CONVENIENT and inexpensive coupling of home-made design, as illustrated herewith, is used in the plant of the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The size required for a 2-hp. motor - generator drive cost approximately $3. The coupling is composed of three disks, two of which are iron castings and the third a rubber disk. Steel pins countersunk and headed over are provided as shown for the iron disk, the rubber disk furnishing a seating member for the pins. The arrangement is flexible, and when the intermediate disk is worn the replacement of it is a small matter.



FLEXIBLE COUPLING MADE FOR A 2-HP. MOTOR DRIVE

WALTER B. ATCHINSON,
Electrical Engineer.

Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Causes of Commutation Troubles

THERE are two common conditions of sparking—first, general sparking, in which the commutator is equally bad all around and the fault is probably in the field or the brush rigging, and, second, local sparking, which is usually due to a rough commutator or armature fault.

In a case of general sparking first examine the field for short-circuited or reversed field coils, check the mechanical centering by measuring the air gap and make electrical balance test. The amount of voltage variation between various pairs of brush arms, when the machine is running separately excited, should not be more than 5 per cent; otherwise there is a good chance of sparking. In two-circuit windings one bad pole does not affect the commutation to a great extent.

If all of these points are good, the sparking may be due to the fact that the field is not "stiff" enough; that is, the neutral shifts with load changes, owing to the armature current affecting the shunt field. The machine can be stiffened in this respect by trimming off the pole shoes to increase the space between them. This method can be applied when there is a non-sparking point for any load. Such adjustments are best made by the manufacturer before the machine is shipped.

The second cause for general bad commutation is that the sparking constants of the machine are bad on account of faulty design or manufacture. In this case commutation must be forced by putting on special brushes. The laminated metal brush was invented to take care of this kind of sparking. Machines as made at present are not liable to require such treatment. It is sometimes hard to distinguish between general sparking and local sparking. Whenever a bad spot shows up in test it is customary to mark the bars by a prick punch at the front ends. Then, if the bad spot shows up again at the same place, after smoothing the commutator, the inference is that the trouble is a local one and may be due to bad soldering or some such reason. A shifting bad spot which travels around the com-

mutator with rotation indicates general trouble and not local trouble.

Graphite brushes will not pick up copper. A carbon brush which picks up copper in little flakes or spots is sure to pit, because the current density will be greater through the flake of copper than through the surrounding carbon which heats the carbon underneath the flake. On account of overheating, the resistance of this section of the carbon decreases and allows still more current to pass. This causes a red-hot spot on the face of the brush, which makes a pit.

A slight prickly sparking on the face of the commutator is one of the earliest and surest signs of high mica. High mica results from inability of brushes to wear the mica as fast as the copper, or from operating with sparking, as on heavy overloads. In high-speed machines violent sparking may be caused by high mica. To prevent this trouble machines with soft brushes should have the mica undercut. High mica cannot be removed by sandpapering. Stoning with a sandstone or carborundum block is necessary. If undercutting is objectionable, owing to dirty surroundings or other reasons, high mica may be kept down by a few hard gritty brushes, scattered over the commutator.

Before investigating local sparking it is necessary to get the commutator in first-class condition and then note the condition of the commutator after short runs, say of one hour. Notice whether any particular bars show marks. Local sparking is generally due to commutator faults, such as loose commutators or bad soldering. Commutator bars are held by two different actions—barrel-stave action and end holding. These must both be good. Poorly soldered joints usually cause a hollow to be eaten out at the bad spot, and this spot travels with rotation so that other spots will start. One spot may be the cause of several others. The travel cannot be stopped by undercutting, but the defective joint must be made good. A completely open-circuited coil burns out the mica between the two bars to which its ends are connected. A reversed coil has the same effect, only very much worse. A short circuit causes the bars at the short circuit to become high.

Other causes of black spots are engine shaft throw, eccentric commutator and imperfect centering of armature in field. Sometimes where shaft throw cannot be eliminated a change to a livelier type of brush holder will enable the brushes to stay with the commutator and thus cure the trouble.

JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Inspection Form for Large Motors

IN MAINTAINING large motors, say of 50-hp. rating and over, the prevention of service troubles warrants a degree of thoroughness in inspection records that would hardly be justified in dealing with small motor units. An example of a form for large-motor inspection is shown. It is 11 in. x 17 in. in size and fits a loose-leaf binder. At the top is a data space about 3½ in. high, filled out in this case for a 25-hp. motor with auto-starter and covering entries giving essential facts about the motor rating, number, etc., with drive particulars. Below are checking spaces for recording inspections.

MOTOR INSPECTION SHEET

PLANT

LOCATION #3 Bldg Roof #2 LOCATION No DR-4- Middle Cab FACTORY No MAKE Westinghouse STYLE No. 160818

SERIAL No 1594183 TYPE CS H P 25 VOLTS 440 AMPS 296 PHASE 3 CYCLES 60 R. P. M. 1160

STARTER Westinghouse Auto H P 20-30 AMPS VOLTS 440 STYLE No 192523 FACTORY No

RELAY Westinghouse RANGE 40 AMPS TO 80 AMPS. #151643A FACTORY No. CUT-OUTS AMPS. VOLTS

CONTROLLER

MOTOR PULLEY Rockwood DIA 7" FACE 10" BORE 2 3/8" MAIN LINE PULLEY Iron DIA 19" FACE 9" MAIN LINE SHAFT LENGTH DIA

	MOTOR										STARTER			CONTROLLER		FUEL	FRICTION	COMMENTS	
DATE	AIR GAP				OIL			ROTOR	BEARINGS		AUTO		OPEN	CONTACTS		LOAD	LOAD		INSPECTED BY
	Top	Bottom	Right	Left	Front End	Pulley End	Changed	Slip Rings	Brushes	Inside	Outside	Relay Amp	Neutrals	Fused Amp	Drum	Fingers	K. W.	K. W.		
												50								

MUCH INFORMATION REGARDING A LARGE MOTOR MAY BE KEPT ON THIS SHEET

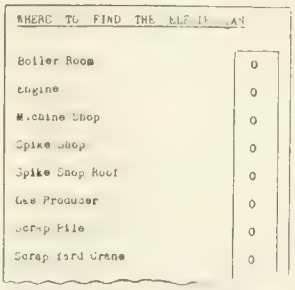
Below are checking spaces for recording inspections.

Westinghouse Electric & Mfg. Co., R. P. KING,
East Springfield (Mass.) Works. Works Engineer.

Charts to Solve Power-Factor Correction Problems

IN THE article on raising power factor by means of a synchronous condenser in the ELECTRICAL WORLD of Jan. 8, page 101, some errors occurred which should be obvious but may lead to confusion. In the small type in the middle of the page under example III, the solution of the problem should read: "Follow OLD POWER-FACTOR line (Chart 2), etc." Problem IV should read as follows: "IV. To determine total kva. supplied with condenser at zero power factor carrying no mechanical load: Follow ORIGINAL LOAD ordinate (Chart 2) to CONDENSER KVA. circle (Chart 1) and from intersection trace circle to TOTAL KVA. scale (Chart 2).

Peg Board to Tell Where Electrician Is



PEG IN HOLE TELLS WHERE ELECTRICIAN HAS GONE

IN ORDER to let those who are seeking the electrician in an industrial plant know where he is at any time, a board such as that shown in the drawing, on which are listed the names of the different departments of the plant, with a peg opposite each department, has proved a great saver of time. The names of the departments can be typewritten on a piece of paper, which is then pasted upon a 3-in. board, and the holes are drilled in this board.

Jersey City, N. J. A. E. VERNEY.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

A System for Handling Customers' Orders with Speed and Efficiency

By Charles A. Collier
Assistant to General Sales Manager Georgia Railway & Power Company, Atlanta, Ga.

In the issue of the Electrical World for March 27, 1920, page 740, a method devised by the writer for handling customers' orders by the Georgia Railway & Power Company's contract order department was described in detail. This system made use of forms with carbon copies. The copies were used for departmental instruction and work sheets, one form of application being used for gas orders and another form for electric orders. The system as then described, while far ahead of the one that it superseded, had its limitations and defects, the principal ones being the limited number of legible copies, errors in deciphering the handwriting on the copies and the fact that separate applications had to be written for gas and electric service.

Subsequent to the adoption of the system referred to the gas order and meter division was merged with the electric division of the company. This merger opened up the possibility of a combination gas and electric order. A great deal of thought and study was given to the subject with the idea of improving the method in the following respects:

(1) Speed in handling, (2) legibility, (3) accuracy, (4) simplicity, and (5) reduction in the number of forms and cost of printing and stationery. This study led to the adoption of the revised system now in use. It differs from the system described several months ago principally in the mechanical make-up of the master copy and the copies of the line orders made therefrom. The routine, filing and consolidation of orders and so forth are identical with the methods followed under the carbon-copy system. The master copy shown in Fig. 2 is printed on one side in hectograph ink. The agreement and the place for the customer's signature are on the reverse side. This master copy is inserted in an ordinary typewriter, equipped with copying ribbon and keyboard carrying only capital Gothic letters. A young woman clerk fills it in with the information furnished by the customer which is necessary for all departments concerned. The customer then receives the copy for signature, the agreement covering the furnishing of service, rates and so forth being on the reverse side of the master copy. A credit card is then made on the typewriter, after which the master copy is sent to the credit department for "O.K." Upon being "O.K.'d" it is returned to the contract order department, where a boy runs the master copy through a "Ditto" jelly-pad duplicating machine, making the requisite number of copies on properly colored sheets. The sheets before being run through the machine are in blank, except for the word "original," which is printed on one copy. The color scheme is designed to reduce the possibility of errors, all electrical orders being reproduced on canary-colored sheets, all straight gas orders on blue sheets and all "prepay" gas orders on pink sheets.

The master copy is routed to the bookkeeping depart-

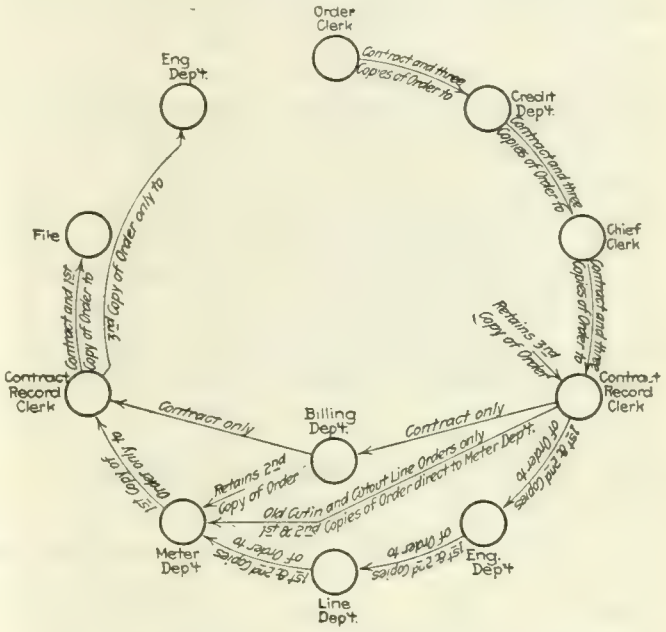


FIG. 1—ROUTINE FOR HANDLING NEW CUT-IN, OLD CUT-IN AND CUT-OUT LINE ORDERS

ment, where it is entered in the consumers' ledger, gas and electrical sheets being consolidated, and is then returned to the contract order clerk. The line orders, of which there are sufficient copies for all departments interested, are released simultaneously with the forwarding of the master copy to the bookkeeping department. The original line order is checked by each department through which it passes, and each department takes and keeps for its record one of the copies accompanying the original. When the original line order is complete and finally returned to the contract record department gas and electric orders are consolidated with the master copy and filed.

Reference to Fig. 4 will give a clearer conception of the number of orders and other details. A street card is also made from the master copy at the same time as the line order and is filed alphabetically and numerically by streets, so that the order clerk has constantly at her elbow a list of all locations that have been cut in. As a customer moves out of and another moves into the same location the old card is destroyed, the new card showing both the present and the former occupant.

The cut-out order is similar in mechanical arrangement to the cut-in order, the same color scheme being maintained; but the order itself is made only half as large as the cut-in order, thereby eliminating the possibility of mistaking a cut-in for a cut-out order, or vice

versa. The mechanical layout of the application is such that when it is folded three times and the cut-out order twice all the information necessary for filing and so forth appears on the face of the order, and it is only necessary to reverse the sheet to get the customer's signature and the rate that is applicable. All sheets are punched before printing so as to fit a standard board file.

The ability to furnish quickly and economically legible copies of the original order in quantities sufficient to enable all departments to retain a copy for their records has eliminated a card index in the contract record department, one in the engineering department, one in the gas shop and a ledger system in the line department, together with the labor, stationery and so forth that were heretofore necessary for these various different records.

In case of a new cut-in the engineering department uses the back of the line department's copy for a sketch of the construction necessary, so that this copy serves the purpose not only of an order but an instruction sheet and permanent record of the work done by that department as well. This system has not only eliminated the necessity of making card indexes in the departments referred to above but has also provided a check whereby, if the original and all copies of the order but the one held by the contract record clerk are lost, virtually no delay in giving the customer service results. It has also eliminated a large number of mistakes caused by careless handwriting, illegibility and so forth, in addition to having speeded up handling customers' orders in the ratio of nearly two to one.

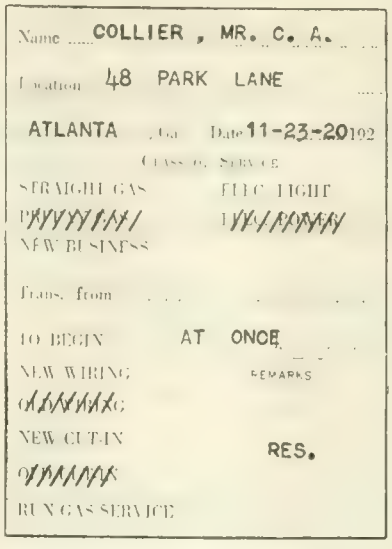

Name COLLIER , MR. C. A.
Location 48 PARK LANE
ATLANTA Ga. Date 11-23-20 192
Class of Service
STRAIGHT GAS ELEC. LIGHT
P XXXXXXXX E XXXXXXXX
NEW BUSINESS
Trans. from
TO BEGIN AT ONCE
NEW WIRING REMARKS
O XXXXXXX
NEW CUT-IN RES.
O XXXXXXX
RUN GAS SERVICE

FIG. 3—RECORD FOR CARD FILE
Upper right-hand corner of master copy impression taken on jelly pad duplicating machine.

This revised system was put to its first real test during the moving period last fall, when 360 applications were taken by three order clerks in a working day of seven hours and a half and the majority of the orders were in the hands of the respective departments by 10 a.m. of the following day. The value of the present method of handling is best appreciated when it is understood that the number of employees required for the operation of the contract order and contract record department is five less than was necessary a year ago., although the number of customers

CUT-IN LINE ORDER

GAS DEPARTMENT

Meter Set 192

Company's No. .....

Maker's No. .....

Size .....

Index .....

Work Completed

..... 192 ..

(Signed)

Remarks:

ELECTRIC DEPARTMENT

Construction Dept.

Power Ser. Con. ..... 192 ....

Light Ser. Con. ..... 192 ....

(Signed)

Meter Department

Power Meter Inst. 192

Light Meter Inst. ..... 192 .

(Signed)

CITY APPROVAL NUMBER

Light .....

Power .....

Remarks:

Name COLLIER ,MR. C.A.
Location 48 PARK LANE
ATLANTA Ga. Date 11-23-20 192
Class of Service
STRAIGHT GAS ELEC. LIGHT
P XXXXXXXX E XXXXXXXX
NEW BUSINESS
Trans. from
TO BEGIN AT ONCE
NEW WIRING REMARKS
O XXXXXXXX RES.
NEW CUT-IN
XXXXXXXX
RUN GAS SERVICE.

TK
No 8445

System A.C. Phase
CONNECTED LOAD.
40 - 50 Watt Eq
H. P
LEDGER ENTR'D
By
FOLIO CHK'D
By

FIG. 2—MASTER COPY OF ORDER PRINTED IN HECTOGRAPH INK

has been increased in the intervening period by 7,800, or 15 per cent.

The number of orders during this period have increased 16 per cent. In addition the new form has eliminated a great deal of lost motion and lost time—just how much it is impossible to estimate with accuracy,

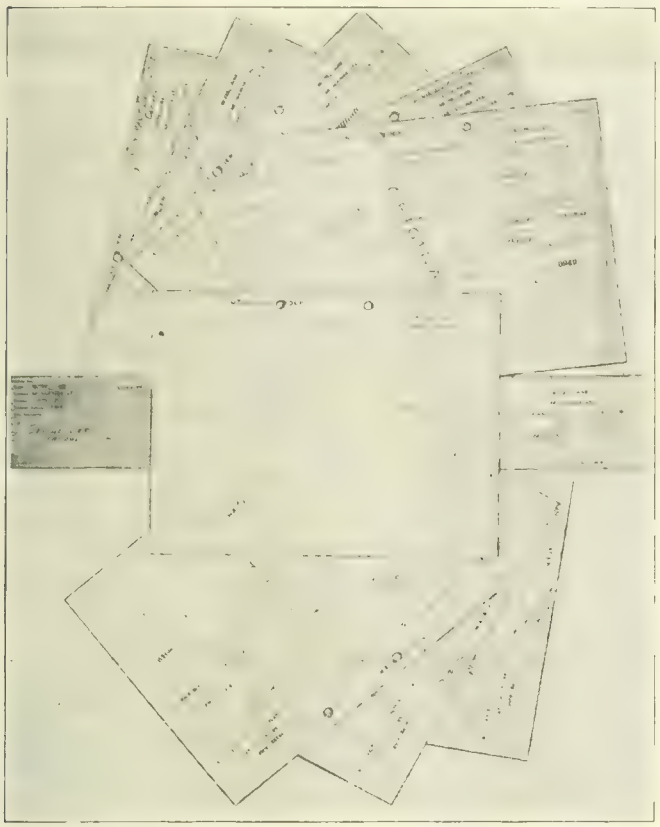


FIG. 4—COMPLETE SET OF COMBINATION GAS AND ELECTRIC ORDER SHEETS TAKEN FROM MASTER COPY

but more than was at first anticipated. In the other departments, besides speeding up their work, it has removed a fruitful source of friction between them and the contract order department caused by illegibility and errors in transcribing. Last, but not by any means least, it has given to the prospective customer a more businesslike impression of the company than he could possibly have obtained under the old form of accepting customers' applications.

Advertising Essential to Successful Merchandising

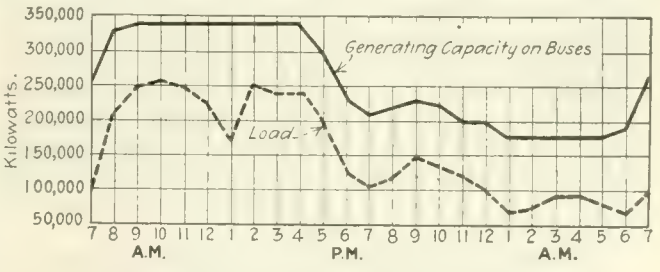
THAT one of the most essential factors in good merchandising practice is advertising was brought out in an investigation conducted by the merchandising committee of the Southeastern Section of the N. E. L. A. However, it found that very little effective advertising is being done, and that while a considerable sum of money is spent annually for this purpose, it is not being spent wisely and as a consequence results have not been all that could be desired. Some companies prefer local advertising, while others use almost every variety offered. Use of the show windows and local newspaper advertising were favored as being most desirable and productive of results.

An important factor which is overlooked by many companies is co-operation with electric sign manufacturers, who are always willing to furnish sketches and designs and will also send representatives to assist in selling the signs. In the opinion of the committee companies should carry on active sign campaigns, not only for the revenue derived from their sale and the consumption of energy but also with a view to improving the night appearance of city streets.

Summarizing the status of advertising as carried on by central stations, the report of the committee said: "Our investigations prove that, as a whole, our show windows and store interiors are not up to the standard of some of our competitors. This is a deplorable fact, as it is through these two mediums that we make the greatest appeal to the prospective purchaser. Our stores and show windows should be, without a doubt, the best lighted and most attractive in our locality. It is absolutely essential that we keep up with competition in advertising and that our stores should look their best at all times. The most essential points in producing interesting and profitable advertising may be enumerated as follows: (1) Originality, (2) artistic design, (3) consistency, (4) truthfulness."

Load Curve Shows Advantages of Interconnection

EIGHT of the principal electric service systems in New England are now interconnected, and the operating advantages of this arrangement are widely recognized. The accompanying diagram represents the combined twenty-four-hour load curve of these systems for Wednesday, June 16, 1920. The peak load of the period was 255,000 kw., occurring at 10 a.m., the evening peak, at 9 p.m., being 150,000 kw. The total generating capacity on the combined buses of these systems was 340,000 kw. at the peak and 230,000 kw. at 9 p.m. In the cases of four of the systems the reserve capacity on the buses during the forenoon peak was a smaller percentage of the local load than was the case with the combined system, and at the evening peak five systems had a smaller reserve capacity ratio than the combined systems. That is, interconnection enabled several of the companies to get along safely with less equipment on the bus than would have been feasible without the tie-in. The Edison Electric Illuminating Company of Boston, New England Power Company, Narragansett Electric Lighting Company of Providence, R. I., Turners Falls Power & Electric Company, Eastern Massachusetts



CONSOLIDATED LOAD AND CAPACITY CURVE OF EIGHT INTERCONNECTED SYSTEMS

Electric Company, Eastern Connecticut Power Company, Fall River Electric Light Company and United Electric Light Company of Springfield were interconnected when the curve was prepared. In four forenoon and three evening cases the reserve capacity on the local buses was less than 30 per cent of the load. The combined reserves as shown by the curves were 36 and 53.3 per cent respectively of the combined loads at the time of the morning and evening peaks.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Efficiency of High-Tension Transformers as Used for X-Ray Purposes.—REGINALD MORTON.—The author takes up the subject of a more efficient means of exciting X-ray tubes from the point of view of the physician and states that the essential need of the radiographer is a supply of X-rays having a high degree of actinism and with sufficient penetration to pass through the thickest parts of the body without serious loss of this actinism. A "soft" or low-resistance tube gives off very actinic rays which have only a low power of penetration. The penetration can be increased to a limited extent by raising the voltage of the current applied to the tube. The author then goes into a detailed discussion showing how these prime requirements may be met.—*Journal Institution Electrical Engineers*, London, August, 1920.

Generation, Transmission and Distribution

Electrical Development in Shanghai.—I. V. ROBINSON.—Some idea of the rapid growth of electrical supply systems in Shanghai is given in the following table:

Year	Plant Capacity, Kw.	Maximum Load on Generators, Kw.	Output, Kw.-hr.
1915	19,600	14,400	50,014,128
1916	19,600	19,167	62,402,478
1917	29,600	20,927	78,796,232
1918	31,600	22,012	86,543,469
1919	38,600	28,368	102,622,803

Details of the Riverside station in Shanghai show that this is a modern steam turbo-generator plant.—*Beama* (London), January, 1921.

Determining Transmission Characteristics of Alternating-Current Lines by Hyperbolic Charts.—BLONDEL and LAVANCHY.—In a long article, which forms a continuation of an earlier paper by Blondel on the same subject, the authors show in great detail how voltage and current distribution, change of phase relations along the line and transmission efficiency of long alternating-current lines may be computed by use of hyperbolic charts. The paper includes a great number of full-page tables, giving the numerical results for many practical examples worked out by this method.—*Revue Générale de l'Electricité*, Nov. 13 and 27, 1920.

Traction

New York and New Jersey Port and Harbor Development Commission.—A system of belt lines to make direct rail connections to the greater part of the waterfront of New York Harbor and a plan for building an underground "automatic-electric" freight subway loop system for distribution on Manhattan Island are the principal features in a plan proposed in this report for the solution of the New York port problem. The plan also proposes belt-line links in New Jersey, Brooklyn, Queens, Staten Island and the Bronx.—Report of the Commission, Jan. 24, 1921.

Chicago, Milwaukee & St. Paul Railway Electrification.—The electrified portion of this road now includes 647 miles (1,040 km.), including heavy grades in five mountain ranges. Comparative operating costs as between steam and electric locomotives are given in the article, as well as data on reliability of service. The table reproduced here gives the construction cost for 440 miles (700 km.) of electrification in 1914 to 1916.—*Engineering News-Record*, Dec. 2, 1920.

CONSTRUCTION COST FOR 440 MILES OF ELECTRIFICATION, 1914–1916; C., M. & ST. P.

	Average Cost per Route Mile	Average Unit Costs	Per Cent of Total Costs, Exclusive of Locomotives
Trolley system, complete	$8,390	.....	47.7
Transmission system, complete	2,360	.....	13.3
Transmission line, per mile	.....	$2,835	....
Substations, complete	6.050	.....	34.4
Substations, each	.....	189,400	....
Substation buildings	.....	38,400	....
Substation apparatus	.....	144,900	....
Operators' dwellings	.....	6,100	....
Miscellaneous: Right-of-way, change to electric lines, storehouses, minor apparatus at shops and roundhouses	265	.....	1.7
Engineering and administration, except for substations	514	.....	2.0
Road locomotives, delivered	.....	122,500	....
Switching locomotives, delivered	.....	37,700	....
Total per route mile (exclusive of locomotives)	17,579	.....	100.0

Installations, Systems and Appliances

Electric Welding.—The questions of what constitutes good judgment in the selection of arc-welding equipment and of the fundamentals of its efficient operation are considered in a symposium under four different discussions. The opening discussion, by A. A. Nims, deals with the salient points in the selection of welding equipment. C. J. Holslag discusses the voltage characteristics and fundamentals of alternating-current transformer-type welders. The operation of welding, with a very clear statement of the phenomena of the transition of metal from the electrode to the work, is treated by H. E. Dralle. He explains the chemical and physical changes which occur with the fusion process and describes the wide range of applications of arc welding. P. O. Noble discusses common sense in the selection and operation of arc-welding equipment, with notes on automatic welding.—*Journal Engineers' Club of Philadelphia*, January, 1921.

Slip Regulators Versus Notchbacks.—GORDON GAGE.—This paper covers primarily experience with a 1,500-hp., 35-deg.-rise wound-rotor induction motor connected by rope drive and spur gear reduction to eight sheet mills. From experience with both methods the author believes that the slip regulator has satisfactorily met all conditions; that it is more dependable, more simple, easier to adjust, and will limit the peaks more effectively than the notchback control. The operating costs and kilowatt-hour consumption are virtually the same for the two types.—*Association Iron and Steel Electrical Engineers*, December, 1920.

Emergency Ship's Lighting Set Rated at 25 Kw.—This set consists of a paraffin engine directly coupled to an electric generator and mounted on a cast-iron bedplate together with the fan and radiator and fuel tank. The engine, it is said, develops 50 hp. on paraffin and 60 hp. on petrol. The generator is capable of a maximum output of 30 kw.—London *Engineering*, Nov. 19, 1920.

Electrophysics and Magnetism

Calculation of the Amplification Constant of the Weagant Thermionic Vacuum Tube.—ALEXANDER MARCUS.—This tube has the control electrode on the outside and because of the presence of the glass wall amplification is not possible for constant grid potentials. By making some simplifying assumptions the author is able to develop a theoretical expression for the amplification constant which involves the dimensions of the tube and the resistivity of the glass wall. When this resistivity is either very high or very low the amplification is small. In the latter case it is shown to depend solely on the dimensions.—*Physical Review*, January, 1921.

Unilateral Conductivity of Tubes Having a Salt Electrode.—MASAMICHI KIMURA AND JUNICHIRO NAGAHATA.—Vacuum tubes having a salt electrode were found to have the property of rectifying high tension on the current, and the conditions of perfect rectification were examined. An explanation of the process of rectification is given in the article.—*Memoirs of the College of Science, Kyoto (Japan) Imperial University*, June, 1920.

Telegraphy, Telephony and Signals

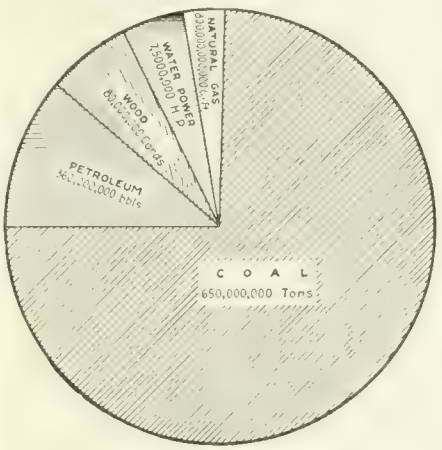
The Development of Thermionic Valves for Naval Uses.—B. S. GOSSLING.—The first four sections of this paper describe the introduction of valves into naval wireless-telegraph installations and the early work, experimental and theoretical, on the elucidation of their observed behavior. The article further deals with the principles of the numerical design of power valves, more particularly triodes, and with the rapid development in the manufacture of valves so designed. The investigation and improvement of small valves for use in reception, including both high-vacuum and gas-filled types, are briefly touched upon. Successive stages of approximation in the calculation of the characteristics of small valves with low operating voltages are illustrated, the final result of calculation indicating the degree of closeness with which the observed behavior of a high-vacuum valve can be accounted for in terms of known physical phenomena. The concluding section of the paper deals with the standardization of valves and their specification for quantity production.—*Journal Institution of Electrical Engineers*, London, August, 1920.

Impedance of Submarine Cables.—DOUGLAS C. GALL.—The writer finds that the measured impedance of the submarine cable differs in both magnitude and phase angle from the calculated value when such calculation is based upon cable constants of resistance and capacity measured by direct-current methods. This is shown by the change of phase angle with frequency. In general the angle is found to decrease with increasing frequency. Investigation into dielectric losses, the shielding effect of brass tape, armor and sea water and the effective increase in the resistance of the core resulting therefrom and its dependance upon potential current and frequency may permit of dealing with greater certainty with the behavior of new cables. But it is probable that variation in materials, complex secondary phenomena and reflection consequent upon the unavoidable jointing of different cable sizes of different constants would introduce ambiguous effects not amenable to exact calculation.—London *Electrician*, Dec. 24, 1920.

The Submarine's Wireless.—PHILIP R. COURSEY.—Heretofore it has been possible for the submarine to communicate by wireless only when riding on the surface of the water. In this case aërials would be erected on the deck. Recently, however, the development of the vacuum-tube amplifier has made it possible to receive messages from high-power stations and ships while the submarine is submerged. Data giving radius of communication for different conditions and showing that communication is not possible when the submarine is submerged to great depth are given in the article.—*Wireless World*, Nov. 27, 1920.

Miscellaneous

The Fuel Supply of the World.—L. P. BRECKENRIDGE.—Comprehensive data showing the world supply of fuel and the coal production in the principal countries having coal mines. An interesting chart shows the fuel consumption of the United States for one year. This chart is made up by the reduction of petroleum, wood and water power and natural gas to the coal equivalent of such fuel or energy. This chart shows what relatively small quantities of other fuels than coal are used in this country.—*Mechanical Engineering*, January, 1921.



ANNUAL CONSUMPTION OF FUELS IN THE UNITED STATES

Status of the Electric Steel Industry.—EDWIN F. CONE.—The statistics given show that the United States leads in output with 356 furnaces, a gain of 10 per cent in 1920. It is estimated that the number of electric furnaces in the steel industry in the entire world has reached 961.—*Iron Age*, Jan. 6, 1921.

ELECTRIC STEEL FURNACES IN THE UNITED STATES AND CANADA

Type	U. S., 1921	Canada, 1921	U. S. and Canada, 1921	U. S. and Canada, 1920	U. S. and Canada, 1919	U. S. and Canada, 1918	U. S. and Canada, 1917
Heroult	159	18	177	170	163	146	84
Snyder and Von Schlegell	52	2	54	49	48	35	22
Rennerfelt	17	0	17	18	13	13	13
Greaves-Etchells	23	2	25	18	11	12	0
Gronwall-Dixon	11	1	12	13	13	12	9
Ludlum	13	0	13	12	11	6	5
Girod	5	0	5	5	5	5	4
Booth	14	0	14	12	11	4	0
Moore*	22	2	24	20	12	4	0
Induction	3	0	3	3	3	3	3
Webb	2	0	2	2	2	2	0
Stassano	1	0	1	1	1	1	1
Greene	18	0	18	11	8	1	1
Vom Baur	5	0	5	4	2	0	0
Wile	0	0	0	0	0	1	1
Detroit	1	0	1	1	0	0	0
Volta	2	8	8	0	0	0	0
Special*	8	10	20	24	27	24	12
Total	356	43	399	363	330	269	155

* Estimated

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Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

BATTERIES, AUTOMOBILE, STARTING AND LIGHTING, PERFORMANCE TESTS.

A brief study has been made of the performance characteristics of certain makes of batteries in several types of cars. Performance curves showing the instantaneous demand on the battery when cranking the engine have been obtained by the use of an oscillograph. The initial values of current and voltage which cannot be obtained by ordinary indicating instruments are shown at the time of closing the starter switch. An interpretation of the oscillograph records shows that much additional information might be obtained by this method concerning the operation of the starter system and of the engine itself, and indicates the possibility of applying the method to the study of problems relating to lubrication, ignition, compression and distributer action. In addition an exact method is obtained for measuring the speed from one revolution to another. Since the results which so far attained are more suggestive than quantitative no printed data are yet available.—*Bureau of Standards, Washington, D. C.*

CORONA, MEASUREMENT OF SHORT-TIME INTERVALS IN.

In an investigation of the time interval of the corona discharge a fine membrane and an oscillograph have been used to measure the time elapsed from the beginning of the corona current and the corona pressure. The time interval for characteristic pressure has been found to be of the order of one-third of one second. A manometric flame has also been used, and the pulsations in the pressure of the corona tube when excited by a 60-cycle alternating current have been made visible by means of a rotating mirror. It has also been found that the increase in pressure varies along the radius from the wire to the tube.—*Charles S. Fazel, Urbana, Ill.* (N. B.—This is a contribution to a study of transient corona. Such corona is now proposed for a relief of overpotentials.)

LAMPS, INCANDESCENT, SPEED OF FLASHING.

In a study of incandescent lamps for use in daylight signaling it has been found that a simple function involving only steady current measurements of wattage, resistance and temperature in the neighborhood of the maximum temperature of a flash, together with the thermal capacity of the filament, will serve quite accurately in rating various lamps as to their flashing speeds.—*A. G. Worthing, Nela Research Laboratory, Cleveland, Ohio*

LIGHTING STREETS WITH TWO-LAMP UNITS.

An important development in street-lighting units is one which contains two lamps (in one type one of 1,000 cp. and one of 250 cp.), where by means of a relay in the casing of the fixture the 1,000-cp. lamp will be extinguished at midnight and the 250-cp. lamp lighted.—*A. I. E. E. Committee on Lighting and Illumination.*

RADIO, AIRPLANE LANDING SIGNALS.

At the request of the Air Mail Service of the Post Office Department the Bureau of Standards undertook to devise a method to enable an airplane to find its landing place in fog or in the dark. The method is a combination of radio and induction signals. By means of the radio direction finder the airplane steers its course to the general neighborhood of the landing field. The exact location of the landing field is then communicated to the airplane by magnetic induction from alternating current in a large coil on the landing field. The intensity of the signals falls off sharply, so that the position of the landing field is very accurately indicated to the airplane, beginning at about one kilometer from the coil.—*Radio Laboratory, Bureau of Standards, Washington, D. C.*

RECTIFIER, SILICON-CARBON CONTACT.

A four-element silicon-carbon rectifier as described by Hartsough (*Physical Review*, October, 1914) was applied to such alternating-current measurements as conductivity of electrolytes, coefficient of self-induction and coefficient of mutual induction. The rectifier in series with a D'Arsonval galvanometer takes the place of the telephone receiver or vibration galvanometer commonly used to indicate the alternating-current balance. With 2 volts to 6 volts at 60 cycles applied to the bridge arms, results have been obtained which are in good agreement with those derived by means of the older methods. Higher frequencies must be used with electrolytes to avoid polarization [illegible] *J. C. Jessen, Nebraska Wesleyan University, Lincoln, Neb.*

ROTARY CONVERTER, FLASH SUPPRESSOR FOR.

Extensive tests have been made on a flash suppressor which [illegible] actuated by the short-circuit current between the collector rings. This current reduces or kills the voltage on the commutator. The results of these tests have been reported in a recent number of the *A. I. E. E. Journal*, and they show that the flash suppressor will give ample protection from flashing as far as the alternating-current side of the converter is concerned. However, there are several problems connected with the application of the flash suppressor to synchronous converters, such as the increased duty on the collector rings, disturbance on the alternating-current supply system, and the machine falling out of step, which problems have not yet been worked out and which would form excellent subjects for research.—*Marvin W. Smith, Pittsburgh, Pa.*

SILK, DIELECTRIC CONSTANT OF.

When two dielectrics are electrified by contact and friction the one having the larger specific inductive capacity becomes positive. If this holds true with silk and other substances, then the dielectric constant of silk must be rather large. This suggested the measurement of this constant for silk. The usual condenser method was used. Since silk is not a continuous body several thicknesses were used, and from the weight of the silk, the total volume and the density of silk, the ratio of silk to air in this volume was determined and allowance made for the air spaces. The simple bridge method was used for the measurement of the capacity of the condenser having silk as a dielectric. The value of the dielectric constant in these experiments varied from 4.58 to 5.07.—*F. J. Rogers, Leland Stanford University, Cal.*

TELEPHONE SPEECH, ERRORS IN.

An extensive series of experiments on the source of errors in telephone communication indicates that the various sounds can be arranged quite definitely in the order of the number of errors for which they are responsible and that this order is dependent upon the reproduced volume of the sounds, so that certain letters are more often in error with a loud-talking receiver, and vice versa. The experiments also indicate that at average volume the errors due to the sounds *f* and *th* are greater than for all the other sounds together.—*Research Laboratories American Telephone & Telegraph Company and Western Electric Company, New York City.*

TONE GENERATOR.

A tone generator has been developed which produces sound by the use of a diaphragm in a magnetic field. The diaphragm is fastened between two pancake coils made up of annuli. A direct current is sent through the coils which are connected in opposition so as to develop a radial magnetic field in the diaphragm. An oscillating current from a vacuum-tube generator is sent through the diaphragm, setting up circular currents which react with the radial magnetic field to cause vibration of the diaphragm.—*C. W. Hewlett, Iowa City, Ia.* (N. B.—This is useful as tone standard in telephone and acoustic research.)

Suggestions for Research

CABLES, ALUMINUM STEEL-CORE, STRENGTH OF.

It is suggested that a determination be made of the strength of various sizes of stranded aluminum conductors with steel core, in order to establish the proportion in which the stress is divided between the aluminum and steel elements. Some engineers regard the steel core as carrying all the weight, while others seem to rely partly on the aluminum covering.—*D. W. Blakeslee, Pittsburgh, Pa.*

CONDUCTIVITY, THERMAL, OF SOLID DIELECTRICS.

It has been suggested that the thermal conductivity, k, of solid insulating materials is proportional to the product of the elasticity, E, and density, q, so that the ratio $(Eq)/k$ is constant for any material. This relationship is only roughly correct for optical glass (*Philosophical Magazine*, 1920, page 502), but the statement that the thermal conductivity increases with the density and with the elasticity seems to be approximately correct. Further research in this line is desired so as to determine a more definite relationship between the above-mentioned physical properties and thus to aid in finding better heat insulators and dielectrics of higher heat conductivity.—*Editorial Suggestion.* (N. B.—This is one of the problems in high-voltage alternators.)

INSULATORS.

Cracks occur in porcelain insulators usually in definite places—for example, near the metal cap. Would it be feasible to design an insulator which is split beforehand in such places, with the cracks filled with some insulating compound possessing flexibility?—*Editorial Suggestion.*

TEMPERATURE CONTROL, THEORY OF.

The development of temperature controllers for industrial processes is seriously handicapped by the lack of a theoretical treatment of the subject. Instruments for this purpose are at present capable of doing little more than closing one circuit when the temperature is high and another circuit when it is low. A mathematical treatment of the performance of a simple furnace under the action of various disturbances would be a material help in the practical work on temperature control.—*Leeds & Northrup Company, Philadelphia.*

TRANSFORMERS, INSTRUMENT TYPE, RATIO OF.

The development of a readily portable device for the determination of the ratio and phase angle of instrument transformers is needed. A device which would eliminate the necessity of delicate instruments would be advisable. Such a device would be valuable in checking the instrument transformers used on important loads without removing the transformers from service. H. S. Baker has developed a method for current transformers described in the *A.I.E.E. Proceedings* of September, 1918. A method for potential transformers is available, with modifications recommended by the Bureau of Standards, but there is no method embodied in a single instrument suitable for both current and potential transformers which is perfectly satisfactory for field use. Dr. Agnew of the Bureau of Standards has developed a method using watt-hour meters which may be applied to both current and potential transformers, but this method requires a standard transformer of the same ratio as the transformer under test and hence has serious limitations for the purpose indicated above.—*W. P. Dobson, Hydro-Electric Power Commission, Toronto, Ont.*

TURBO-GENERATOR UNITS, UNCOUPLING OF.

It is desired to develop a quick method of uncoupling the alternator from the turbine in turbo-generator units so that the generator may be used as a synchronous condenser to improve the power factor during such times as its output as a generator is not available.—*Prime Movers Committee, N. E. L. A.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

New Jersey Governor's Removal of Commission Is Upheld

BY A VOTE of seven to six the New Jersey Court of Errors and Appeals this week affirmed the Supreme Court's decision sustaining the judgment of ouster issued by Governor Edwards against the four members of the State Board of Public Utility Commissioners.

This action will leave the state without a board until the Senate either confirms a new board nominated by the Governor or the Legislature enacts a law creating a new commission. The lower house at once passed Senator Wadsworth's bill for a new board of three members at a salary of $12,000 a year each, the Governor to be without power of removal.

Final Water-Power Regulations Expected Before End of Month

THE remainder of the major regulations covering the administrative features of the water-power act, it is stated, will be promulgated before the end of February. The draft of these regulations was taken up for discussion last week by officials of the Federal Power Commission and representatives of outside interests. During the conference, which lasted two days, a great many changes were suggested. It became apparent early in the discussion that the views of the officials of the Federal Power Commission are greatly at variance with those of the representatives of the outside interests on some of the principal questions involved. Finally it became evident that no agreement could be reached immediately and it was decided to allow the matter to go over for a week, so that each interest might have an opportunity to revise its views in the hope that they could be brought more nearly into harmony.

The National Electric Light Association takes exception particularly to the draft of the regulation with regard to depreciation reserves and the establishment of a system of accounting. Objection was made to the provision requiring regular charges for depreciation of project property. The desirability of not making such charges until the project is well established was urged, since it would be helpful in tiding over the period of establishment and finding a market for the power.

The representatives of the N. E. L. A. questioned the advisability of adopting a system of accounting, suggesting that the commission should admit the type of accounting approved by the respective state commissions. Where such commissions have not been established it was suggested that the licensee be permitted to submit a system of accounting for the approval of the commission.

The question was taken up at the meeting of the commission on Feb. 14, and the commission approved the view of its chief accountant that regular depreciation reserves should be set up and maintained and that a uniform system of accounting should be established by the commission.

Switch Limitations and Cable Temperatures Features of A. I. E. E. Convention

CONSIDERABLE interest in oil circuit-breaker limitations was shown by the attendance of about 500 engineers at the opening meeting of the mid-winter convention of the American Institute of Electrical Engineers, held in New York this week. The convention was opened with an address from President Berresford. As announced in a previous issue of the ELECTRICAL WORLD, the papers of the evening were "Present-Day Practice Limitations of Oil Circuit Breakers," by H. R. Woodrow, and "High-Current Tests on High-Tension Circuit Breakers," by Philip Torchio. The paper by Mr. Torchio was particularly entertaining, being accompanied by motion pictures which showed the action of oil-switch parts when subjected to currents as high as 100,000 amp.

Thursday morning's session also attracted widespread interest. Six papers were presented expressing different ideas on maximum operating temperatures for paper-insulated cables. One of these is published quite fully in this issue, beginning on page 413. Features of the remaining papers and discussions at this convention will be published in next week's issue of the ELECTRICAL WORLD.

As usual, the dinner-dance at the Hotel Astor constituted the chief social function of the convention. On Friday evening Dr. M. I. Pupin was presented with the Edison medal for his contributions to electrical science. "Wave Transmission" was the subject of a lecture given by Dr. Pupin on this occasion.

Inspectors Working to Minimize Appliance Fire Hazards

A CAMPAIGN to minimize fire losses due to improper construction, installation and operation of electrical appliances is being developed by the Western Association of Electrical Inspectors. A circular to the electrical industry has been sent out in which a tentative list of the responsibilities of the manufacturer, the electrical contractor-dealer, the central station and the inspection bureau is presented for criticism and suggestion before use is made of the material contained therein.

The manufacturer's responsibility is viewed as the design of appliances to minimize the fire hazards, co-operation with the underwriters, furnishing of safety instruction with each appliance, and uniformity as far as possible in plugs, cords, general design and safety instructions. The contractor-dealer's responsibility is held to be for adequate wiring installations,

the handling of approved appliances only, educational work through architects and employees and consideration of public interest. Responsibility is placed on the central station for the education of the public through its employees in the proper installation and use of appliances and in co-operation with manufacturers, dealers and inspection bureaus. The central station, it is stated, should also use its facilities for the detection of unsafe devices and to promote the installation of adequate wiring. Responsibility for establishing uniform wiring and installation practices, adoption of proper municipal ordinances and periodic reinspection of installations lies with the inspection bureaus.

The advocacy of mains of No. 10 B. & S. gage wire or larger and of power circuits for appliances is suggested. A systematic publicity campaign, particularly just before the holiday season, should be carried on, and educational campaigns with the architect, with the contractor-dealer and with the central station are suggested.

It is intended after a thorough discussion to revise the circular and use it as a basis of action on the part of the association members to minimize appliance fire hazards. The circular has been sent out for discussion from the office of W. S. Boyd, the secretary, at 175 Jackson Boulevard, Chicago.

Two New Issues This Week Total $9,000,000

TWO new issues of electric light and power company securities totaling $9,000,000 were offered this week. One was of $8,000,000 Pennsylvania Power & Light Company first and refunding series A mortgage 7 per cent bonds, sold at a price to yield about 7.68 per cent. The proceeds of the sale of these bonds will be used to retire floating debt incurred for construction which has been completed and will also provide funds for additional construction.

The other issue was of $1,000,000 Idaho Power Company first lien and general mortgage series B 7 per cent gold bonds at a price yielding 7½ per cent. The funds from the sale of these bonds will be used for construction now under way, which includes additional capacity of 10,000 kw. and 115 miles of transmission lines.

Production and Distribution Problems Discussed by New York Association

THE problems of the small plant, the importance of close voltage regulation and several features of distribution were discussed at a meeting of the production and distribution sections of the Empire State Gas & Electric Association in Rochester, N. Y., Feb. 10 and 11. F. A. Dressler, Cortland County Traction Company, related the difficulties which are peculiar to the small plant. The necessity for close regulation of voltage in industrial plants was discussed and illustrated through examples by O. W. Bodler of the Eastman Kodak Company.

An interesting discussion on electrical department organization was entered by T. H. Yawger, Rochester Gas & Electric Corporation; A. C. Jordan, Elmira Water, Light & Railway Company; W. C. Blackwood, New York & Queens Electric Light & Power Company; H. W. Watt, Westchester Lighting Company, and W. C. Pearce, Syracuse Lighting Company. The advantages of aërial power cables were pointed out by F. A. Westbrook, Habirshaw Cable Company.

A demonstration of methods of locating defective insulators while in service was conducted by E. P. Peck, Utica Gas & Electric Company.

Other subjects discussed were reverse-power relays, preservative treatment of cross-arms, and policies regarding grounding and parallel operation of transformers, charges for service connections and control of long commercial circuits.

Portland Railway, Light & Power to Float Note Issue Through Employees

THE Portland (Ore.) Railway, Light & Power Company has placed on the market an issue of $1,000,000 in 8 per cent five-year gold notes dated March 1, 1921. These notes are the direct obligation of the company and will be issued in denominations of $100, $500 and $1,000, interest payable semi-annually. The notes will be callable on any interest date at a premium. An issue of $2,000,000 has been authorized, only $1,000,000 of which will be placed on the market at this time. The money will be expended during 1921 for improvements and betterments necessary to keep pace with the growth of the community. A feature of the sale is that it will be accomplished through the employees of the company instead of through bond houses as is customary. A special effort will be made to place as much of this paper in the hands of the company's customers as possible.

Further Development of Southern Company Hinges on Rate Increase

ERECTION by the Southern Power Company of an eight-million-dollar hydro-electric plant somewhere on the Catawba River, with Mountain Island as the probable site, is said to be contingent in large degree on the outcome of the company's rate case now pending before the Corporation Commission of North Carolina. This case is attracting much public attention owing to the attitude of the company, which has been a great factor in the industrial development of the state and the sister commonwealth of South Carolina. It is estimated that 4,500,000 cotton-mill spindles in mills scattered through the Carolinas get their power from the Southern Power system and that twenty-six cities and towns in North Carolina alone are lighted by energy developed by the system, while street cars in Charlotte and other cities derive their power from the same source.

All the energy that can be developed by the existing North Carolina plants of the company is, it is said, either in actual use or contracted for, and an additional supply of 30,000 hp. will soon be demanded. If it is not forthcoming from hydro-electric sources industrial companies will be forced to erect steam plants, with greatly increased production costs as the inevitable result.

Officials of the company are quoted as saying that once the rate matter is settled, there will be nothing to hinder the start of the projected new plant, which would have a capacity of 60,000 kw. and be completed in two years. Without an increase in rates enabling the company to pay the market price for capital officials doubt the possibility of going ahead.

Michigan Organizes Utility Information Committee

THE Michigan Committee on Public Utility Information has been organized with H. H. Tinkham, an experienced newspaper man of Ann Arbor, in active charge. The headquarters will be at Ann Arbor. With the organization of this committee there are such bodies actively at work in all four states in the Great Lakes Section National Electric Light Association.

A meeting of the officers and committee chairman of the Great Lakes Section was held in Chicago on Feb. 9, at which the formal organization of the section work was discussed and plans were made for future activities.

Atlanta Engineers Advocate Law to Regulate Practice

INDORSEMENT has been given by the Atlanta (Ga.) Chapter of the American Association of Engineers to a bill to regulate the practice of professional engineering, architecture and land surveying which it is intended to introduce into the Georgia State Legislature. This proposed law is said to follow closely one proposed by the Engineering Council. Copies have been sent to all members of national engineering societies in the state with the request that each society appoint two members to meet with the committee from the American Association of engineers and agree upon the terms of the bill. A joint committee will be functioning to this end within sixty days, and an effort will be made to have the measure supported in Georgia serve as a model for all the states. H. H. White, an Atlanta sales engineer, is chairman of the license law committee of the American Association of Engineers.

Recommends Tyler Plan for Great Falls Development

THE Federal Power Commission has sent a communication to the President of the Senate and to the Speaker of the House of Representatives recommending that the work on the development of power at Great Falls, on the Potomac River, be undertaken at once in accordance with the report made by Major Max Tyler, Corps of Engineers, U. S. A.

"Our study of the situation satisfies us," says the communication, "that all the power so developed will find a ready market in the District of Columbia and the circumjacent territory to which it can be transmitted without disproportionate line loss or distribution system cost.

"The plan for the development of hydro-electric power from the Potomac has three great advantages: (1) It contemplates a serial development of which the several elements can be separately and consecutively undertaken, with the result that the power resources of the District will be augmented from time to time as the capacity of the District for the absorption of the power developed increases; (2) the suggested conservation of use of existing steam installations for the production of power makes it highly improbable that any substantial loss will accrue to those who have invested in steam power plants, and (3) the serial development of water power will render unnecessary extensive and costly additional steam power plant installations, which would be necessary unless existing power producing facilities are supplemented, as here suggested, by the early development of a large body of primary power from a dam erected near Chain Bridge."

Standard Insulators May Be Used on 220,000-Volt Lines, Says Frank G. Baum

TRANSMISSION at 220,000 volts is now assured, according to a statement made this week to the ELECTRICAL WORLD by Frank G. Baum, who asserted that he had now the solution to the insulation problem. Mr. Baum, who is consulting hydro-electric engineer for the Pacific Gas & Electric Company and under whose supervision the design of the Pit River development is being carried out, is now in the East inspecting most of the equipment for this project, but particularly with the object of working out the 220-kv. insulator manufacturing details.



FRANK G. BAUM

With Prof. Harris J. Ryan of Leland Stanford Junior University he has been conducting experiments on insulators working under a pressure of 220,000 volts and over, and with proper shielding of a type recently worked out experimentally he has demonstrated that standard insulators can be used at these higher voltages.

"However, engineers would be making a mistake," Mr. Baum asserted, "to go to these higher voltages just because they are higher. The economics of engineering development must play the heaviest part.

"This thought goes even further. In the great hydro-electric development of the country that is coming engineers must not be encouraged to build the highest dams, the largest plants, lines of the highest voltage, just because they are record-breaking. Conservatism and good economics must rule. Furthermore, engineers ought to be honest and make honest estimates—not a million-dollar estimate where it is known the job ultimately will cost two millions. If the engineers do not act conservatively and honestly, there will once more be hydro-electric failures and loss of public confidence.

"In the Pit River development we are going to transmit energy at 220,000 volts, not because it is a record, but because it costs less. At the lower voltages the regulation was poorer and more circuits were needed. We expect to transmit 150,000 kva. per circuit, each circuit having a cross-section of 500,000 circ.mil."

Another important problem on which Mr. Baum is working in connection with this development is that of close regulation of long high-tension lines. He stated that he is planning to secure on the Pit River lines practically uniform voltage and operation. From the plant to the first substation is 200 miles, and from this station to the second substation is 260 miles.

Electrical Sales Associates Organized in New England

FOLLOWING the recent "get-together" meeting of electrical men at the Boston City Club, a formal organization has been established under the name "Electrical Sales Associates of New England," planned to work along co-operative lines, including the leading branches of the industry leagued together for the upbuilding of trade and advancement of mutual interests. William Gould, 77 Franklin Street, Boston, was elected chairman; M. R. Griffeth, 84 State Street, Boston, treasurer, and Frank J. Allen, 10 High Street, Boston, secretary. This action crystallizes the establishment of the New England electrical league into a permanent organization, the plan having been launched in a broad way at the meeting above mentioned. Annual dues have been set at $5 per member. The single purpose of the organization, Secretary Allen informs the ELECTRICAL WORLD, is the "100 per cent electrification of New England."

The work of the associates will be conducted largely through committees, whose activities will embrace monthly sales effort, advertising, data supply, conferences and adjustments, each committee representing the central station, jobber, manufacturer and contractor. Four members per committee have been appointed. The membership and work to be covered by each are as follows:

Monthly Sales Effort Committee.—Frank J. Allen, chairman; H. W. Porter, J. E. Livor and D. E. Robinson. The duties of this committee are to make recommendations to the four branches of the industry regarding monthly sales efforts, making the number of recommendations large enough to enable local central stations and contractors to make their choice as to appliances upon which to concentrate. Information will be given to manufacturers and jobbers, who will back up the central stations and contractors with advertisements and displays, together with demonstrators, if required.

Advertising Committee.—W. F. Abely, chairman; R. E. Holden, D. C. Gidley and Harry Cole. The committee will supply central stations and contractors with suggestions on the advertising for newspapers, showrooms and windows that will tie in with the article to be featured in each month's sales. It is believed that this will save a large amount of waste of advertising material and insure contractors and central-station men advertising helps as needed.

Data Committee.—Charles B. Burleigh, chairman; V. M. F. Tallman, George H. Wahn and George B. Quinby. Data will be furnished by this committee as to prospective business, service of appliances and resultant household and commercial economies, revenue and merchandising profit, suggestions for sales and accounting figures on successful sales elsewhere, the committee to consider itself a general information bureau. Figures will also be sought from contractors and central stations as to past year's sales, taking these as a basis upon which to strive to attain a minimum increase of 25 per cent in 1921. These figures are to be sent out by the data committee every three months.

Conference Committee.—Fred H. Smith, chairman; H. M. Savage, S. B. Condit and J. E. Wilson. This committee is to keep itself and the associates informed as to activities of other associations in the electrical industry and to make plans to have a representative attend meetings and bring about a better feeling between the four branches of the industry by citing profitable results obtained in communities where there has been practical co-operation.

Adjustment Committee.—A. J. Hixon, chairman; F. S. Hardy, F. L. Ball and W. S. Davis. This committee will take care of interbranch complaints and criticisms, suggesting means for removing difficulties and offering constructive advice.

The organization committee, whose work led to the formation of the permanent body, consisted of George H. Cox, chairman; C. W. Halstead, Almon Foster and J. P. Coghlin.

Private Initiative Not Discouraged in Superpower Program

THE relation of the superpower plan to the old program, the rate of replacement of old units with new, the incentives that may induce interconnection of existing systems, and above all the means of safeguarding public interest without discouraging private initiative, are, it was brought out at the meeting of the advisory board on Feb. 18 with John Barton Payne, Secretary of the Interior, the broad subjects into which the work of the advisory board of the Superpower Survey is divided. This was the third session of the advisory board devoted to the discussion of the corporate and financial structure necessary to put the engineering project into effect. It is the intention of the advisory board to draw up a plan complete in its legal and financial details and in its corporate and intercorporate relations. Dr. George Otis Smith, the Director of the United States Geological Survey, under whose direction the Superpower Survey is being conducted, comments as follows on the progress of the work:

"Less than two-thirds of the time allotted to the superpower investigation has passed, yet the engineering data have been received in such completeness that tentative conclusions on some of the phases of the problem already are apparent. I am confident that the engineering report will be submitted on June 30 ready for publication.

"While no preliminary report is planned in advance of the complete report, there is no desire to withhold from the engineering public any facts of interest so far as they are determined. As Mr. Murray has stated, some of the conclusions tentatively arrived at thus far in the investigation are the ratio of both operating and production costs in large and small power units, the measure of fuel saving possible in central-station operation and the relative operating economy of the electric as compared with the steam locomotive. He also has commented upon the density of traffic as the determining factor in the economics of railroad electrification, stating that approximately only 6,000 miles of the 36,000 miles in the region under study have at present a sufficient density to warrant electrification.

"Mr. Flood, the engineer-secretary of the Superpower staff, has cited statistics showing the growing demand for electric power in industry, the machine power per industrial worker in the United States having reached 3½ hp., and has estimated an increase in the total power load of manufacturing industry in the superpower zone during the next decade from the present figure of less than 12,500,000,000 kw.-hr. to 19,000,000,000 kw.-hr. Expressed in coal saving, had the Superpower system of interconnected central stations been in operation last

year the economies over the present system of isolated plants, central stations, small as well as large, and steam locomotives would have effected a saving of 30,000,000 tons of steam coal, and by 1930 the Superpower system should require annually 53,000,000 tons less than the continuation of the present system.

"An important part of the engineering report will be a chronological statement of the Superpower program, setting forth the location of stations and transmission lines in the order of their requirement to supplement existing units. In both its engineering and financial aspects the Superpower undertaking can well be pictured as like the erection of a great railroad bridge replacing a smaller structure inadequate to carry the ever-increasing load. The plans of the new structure must be complete to the last detail and on a scale that fully provides for the future, but they must be executed with scrupulous attention to the one essential requirement of the present—there must be no interruption to traffic. The Superpower plan will be a constructive program with no destruction of present values nor tearing down before building up.

"Not less important than these engineering results already attained is the progress being made in the study of the economic, financial, social and legal phases of the Superpower system."

Supplementary Course on Public Utility Regulation for Yale Law School

NATHANIEL T. GUERNSEY, head of the law department of the American Telephone & Telegraph Company, New York, has accepted the invitation of the Yale University School of Law to deliver a series of lectures upon "Public Utility Regulation" at the school, supplementing the existing courses in public utilities legal affairs. From five to ten lectures will probably be given, and it is expected that by this means the student will gain the benefit of much broad practical experience in a field where there is a decided lack of properly trained lawyers. In commenting upon the announcement to a representative of the ELECTRICAL WORLD, Dean Swan emphasized the importance of adequate functioning on the part of public utilities in view of their great investment and essential relations to the nation's political, commercial and social machinery.

"The regulation of these utilities," he said, "has hardly passed beyond the experimental stage, and to be permanent it must be based upon a proper balancing of the interests of the portion of the public using the service and that portion which has made the investment necessary to it. In this work the coming generation of lawyers must play a very important part."

Candidates for Presidency of A. I. E. E.



WILLIAM MC CLELLAN



C. S. RUFFNER

DR. WILLIAM McCLELLAN is a consulting engineer with headquarters at Philadelphia, Pa. For the past two years he held the position of vice-president of the Cleveland (Ohio) Electric Illuminating Company. Previous to that he was for three years dean of the Wharton School of Finance and Commerce of the University of Pennsylvania and a member of the firm of McClellan & Campion, consulting engineers with offices in New York and Philadelphia. Dr. McClellan was graduated from the University of Pennsylvania in 1900 and in 1903 received the degree of Pd.D. For a time he was engineer in charge of construction of the Philadelphia Rapid Transit Company. In 1905 he was made supervising engineer for Westinghouse, Church, Kerr & Company on the Erie Railroad electrification and in 1907 became a member of the firm of McClellan & Campion. In 1911 he was appointed electrical engineer and chief of the division of light, heat and power of the New York Public Service Commission, Second District. In 1914 he was retained by the First District in the valuation of the New York Telephone Company's property, and he has served other large utility companies on rate matters and executive problems. Dr. McClellan joined the A. I. E. E. in 1902 and was elected a fellow in 1912. He has served as manager and vice-president and as chairman of important committees. He has fostered the idea of co-ordinating the work of engineering societies on national problems.

C. S. RUFFNER is vice-president and director of the North American Company with headquarters in New York City. Before coming to New York in 1918 Mr. Ruffner was vice-president and general manager of the Union Electric Light & Power Company of St. Louis, Mo., and president of the American Light & Power Company, St. Charles, Mo., the Commercial Telephone Company and the Arrow Engineering Company, all of which are North American subsidiaries. Mr. Ruffner was born in Chicago in 1880. In 1900 he was graduated from the University of Missouri with the degree of bachelor of science in electrical engineering. He started in engineering with the Telluride Power Company and Central Colorado Power Company and has enjoyed an unusual experience in large power transmission work. Since 1911 he has been associated in an executive-engineering capacity with subsidiaries of the North American Company. To Mr. Ruffner is due the credit for the design and erection of the 60,000-kw. substation at the St. Louis end of the 110,000-volt transmission line from the Keokuk hydro-electric development. In 1916 Mr. Ruffner was appointed an associate member of the Naval Consulting Board. He joined the A. I. E. E. in 1902 and was elected a fellow in 1912. He has served as manager of the Institute and vice-president and has been appointed chairman of the committee on economics of electric service and other technical committees.

Nomination ballots must reach secretary A. I. E. E., 33 West Thirty-ninth Street, New York, before March 1.

Details of the Southern California Edison's Six-Year Expansion Program

DECLARING that public convenience and necessity require the construction of certain reservoirs, conduits and power plants on the San Joaquin River and its tributary, Big Creek, in Fresno County, the California Railroad Commission has issued to the Southern California Edison Company a certificate under which it may proceed with its construction program calling for the expenditure of approximately $48,000,000 in the next six years. The completion of this work will add to the hydro-electric generating system of the company a capacity of 316,000 kw. and an annual output of 1,500,000,000 kw.-hr.

The principal items of construction included in the proposed development are as follows: (1) Florence Lake Reservoir of 43,000 acre-feet capacity, at the headwaters of San Joaquin River; (2) tunnel, 11 miles in length, connecting Florence Lake with Huntington Lake; (3) conduit from Huntington Lake to Shaver Lake; (4) a new hydro-electric generating station known as power house No. 1-a, above Shaver Lake; (5) Shaver Lake Reservoir of 138,000 acre-feet capacity on Stevenson Creek; (6) conduit from Shaver Lake Reservoir to a generating station to be known as power house No. 2-a; (7) a new hydro-electric generating station to be known as power house No. 2-a on Big Creek; (8) a third generating unit in present power house No. 1 on Big Creek; (9) enlargement of hydro-electric generating station known as power house No. 8.

To Unify Insulated-Wire Specifications

A CONFERENCE on the standardization of insulated wires and cables was held in New York Feb. 2 at the call of the American Engineering Standards Committee and was attended by representatives of fourteen national organizations. After a thorough discussion it was unanimously decided that "the unification of specifications for wires and cables for other than telephone and telegraph use should be undertaken under one general plan, covering substantially all the more important uses." It was agreed that work on the following subjects should be included: Conductors—quality, stranding, sizes; rubber insulation, varnished-cloth insulation, impregnated-paper insulation, magnet wire, including enamel, cotton, and silk insulation; fibrous coverings, including asbestos; sheaths, armor, and standard make-ups.

Nearly a dozen organizations now have important publications on the subject, and it was agreed that the proposed work should be a unification of the specifications and standards already in existence, rather than an attempt to formulate entirely new standards except in fields not already covered.

It was the consensus of opinion that, in order to promote export trade, it would be desirable to have all the American wire and cable standards assembled in a single book. This form of publication, while giving due credit to the participating organizations, would appear to foreign wire and cable purchasers as a complete book of American standards rather than as the standards of societies comparatively unknown abroad. This has been done in a very thorough way by the Germans and to a considerable extent by the British, thus placing Americans at a decided disadvantage in foreign trade. It was agreed that if such a book were prepared and given proper publicity in foreign countries, it would remove one of the greatest difficulties under which American manufacturers are now laboring in developing export trade.

The proposed work will be carried out under the Engineering Standards Committee.

Wisconsin Association Will Discuss Rate Factors

THE thirteenth annual convention of the Wisconsin Electrical Association will be held at the Hotel Pfister in Milwaukee on Wednesday and Thursday, March 23 and 24. An inspection trip to the Lakeside plant of the Milwaukee Electric Railway & Light Company is arranged for March 23, a special train leaving Broadway and Mason Streets at 9 a.m. The plant is the new powdered fuel installation put into service in December last and is of especial interest because of the use of that form of fuel. The first convention session, which is a joint meeting with the Wisconsin Gas Association, takes place Wednesday afternoon. The following program will be presented on Wednesday afternoon and Thursday:

WEDNESDAY AFTERNOON, MARCH 23

"Safety," by Charles B. Scott, N. E. L. A. national safety committee; "Public Utility Associations," by P. V. Prather, secretary Great Lakes Geographical Division, N. E. L. A.; "The Work of the Wisconsin Public Utilities Bureau," by Frantz Herwig, director; reports of standing committees—Rural-line extension, G. C. Neff, chairman; steam-road crossing, F. W. Walker, chairman; street-railway and interurban, B. W. Arnold, chairman; legislative, Harold L. Geisse, chairman; safety code advisory, A. J. Goedjen, chairman.

THURSDAY, MARCH 24, 9:30 A.M.

"Induction regulators," by Frank Hershey, General Electric Company; "Electrical Merchandising," by C. E. Michel, sales manager Union Electric Light & Power Company, St. Louis; symposium on one-man-car operation, B. W. Arnold, H. A. Mullett, R. M. Howard, Dudley Montgomery and C. R. Phenicie; "Street-Railway Rate Schedules," by W. H. Sawyer of the American Electric Railway Association; "Power Factor—Methods of Correction, Measurement and Application to Rates," by F. A. Coffin, sales manager Milwaukee Electric Railway & Light Company; "Customer's Demand as a Factor in Rate Making," by L. B. Andrus, American Public Utilities Company.

A joint convention banquet will be held on Wednesday, March 23, at 7 p.m., when the toastmaster will be N. J. Whelan and the speaker Edgar A. Guest.

New Units for Pennsylvania Water & Power Await Lower Prices

UNTIL such time as advantage can be taken of lower general construction costs the Pennsylvania Water & Power Company, according to its annual report for 1920, will defer major additions to the equipment of its plant. This action is taken in spite of the fact that the market for hydro-electric power has been for some time greatly in excess of the amount of energy obtainable for the company's development on the Susquehanna. Foundations are in place for two additional units the output of which could readily be absorbed at the present time.

There are other construction improvements which have been studied out and planned in part during the past few years which will also serve to increase the output of the system.

L. W. Wallace Elected Federation Secretary

ANNOUNCEMENT was made at the meeting on Monday of this week at Syracuse, N. Y., of the executive committee of the American Engineering Council of the Federated American Engineering Societies that Lawrence Wilkinson Wallace, consulting industrial engineer of Baltimore, had been elected seretary of the council. At the same meeting Herbert Hoover, chairman of the federation, spoke of the council's plan to investigate waste in industry.

"The whole basis of national progress, of an increased standard of living, of better human relations, indeed, of the advancement of civilization," said Mr. Hoover, "depends upon continuous improvement in productivity. While we assume that great advances in living standards are brought about by new and basic invention, yet in fact even a greater field of increasing standards lies in the steady elimination of wastes. The primary duty of organized society is to enlarge the lives and increase the standards of living of all the people—not of any special class whatever. We are therefore proposing to make a preliminary examination of the volume of waste in certain industries, the proportion of fault that lies in each field."



L. W. WALLACE
Newly elected secretary of federation

The largest area of waste, according to Mr. Hoover, lies in the long periods of slack production and non-employment due to the ebb and flow of economic tides between booms and slumps. Another variety of intermittent employment, and thus great waste, lies in certain industries now operating upon an unnecessarily wide seasonal fluctuation, as, for instance, the bituminous coal industry. The second largest area of waste in productivity, the speaker stated, is the eternal labor friction, strikes and lockouts. He was of the opinion that the whole employment relationship will yet have to be reorganized to find its solution. Mr. Hoover sees great promise in this field during the past two years. Yet another variety of loss, it was stated, lies in the unnecessarily faulty distribution of labor supply due to seasonal and shifting demands. An adequate national employment service was suggested as the first need in bringing about reduction of these wastes.

Probably the next largest fraction of waste in productivity, Mr. Hoover pointed out, lies in a too high degree of individualism in certain basic products and tools. In other words, a standardization of certain national utensils makes for economy in distribution, in operation and in repairs. By this he did not mean that individuality should be stamped out of manufacture or invention or decoration; he meant that basic sizes should be given to common and every-day things. Another type of waste was said to lie in the failure to advance industrial equipment. The Superpower Board, it was declared, will demonstrate the saving of 25,000,000 tons to 50,000,000 tons of coal annually by the electrification of the Eastern power supply.

"Nor do we believe it is necessary," said Mr. Hoover in conclusion, "to effect these things by the government. The spirit of co-operation that has been growing in our country during the last thirty years has already solved many things; it has standardized some things and is ripe for initiative toward co-operation of a widespread character.

Mr. Wallace, the newly appointed secretary, was born in Austin, Tex., Aug. 5, 1881, and was graduated from the Agricultural and Mechanical College of Texas in 1903 in mechanical engineering, and from Purdue in 1912 he received the degree of M. E. The years 1903 to 1906 were spent in special apprenticeship with the Santa Fé Railroad. Then he joined the Purdue faculty, becoming head of the department of railway and industrial management. Since that time he has been engaged in research and consulting work in railway mechanical engineering and factory management. At one time he was assistant general manager in charge of production for the Diamond Chrome & Manufacturing Company, Indianapolis. Mr. Wallace is now serving his third term as president of the Society of Industrial Engineers. He is a past-president of the Indiana Engineering Society, a member of the International Railway Fuel Association, Western Railway Club, Master Car Builders' Association, Academy of Political and Social Science and Western Efficiency Society. He is vice-chairman of the federation's committee on the elimination of industrial waste.

Extensive Development Hangs on West Virginia Water-Power Legislation

THAT the West Penn Power Company will resume the development of Cheat River started by the Kuhn interests in 1916 but abandoned is vouched for by C. P. Billings, manager of the Wheeling Traction Company, a subsidiary of the West Penn Power Company, provided that the present restrictions upon the water-power development of West Virginia are removed by the State Legislature. A bill has been introduced in both branches of the Legislature which would amend materially the existing water-power statute in accordance with the recommendation of Governor Cornwell in his biennial message to the Legislature. This bill, it is believed, will, if passed, safeguard the interests of the public and of the state and at the same time yield a large revenue through royalties from water-power development. One of the important provisions of the measure pending before the Legislature, as pointed out by Mr. Billings, is that relating to the payment of large royalties to the state which will accrue in direct proportion to the amount of development. Another important provision of the pending bill is one that would require the operating company to meet the demands for electrical energy in West Virginia before any power generated from water could be transported from the state.

Authentic information is to the effect that the West Penn Power Company, in connection with its proposal to continue water-power development on Cheat River, will expend in the neighborhood of $15,000,000 for the construction of dams and power plants.

Alexanderson Urges International Service for Radio Engineers

E. F. W. ALEXANDERSON, chief engineer of the Radio Corporation of America and newly elected president of the Institute of Radio Engineers, in his inaugural message to the membership in New York City recently, called attention to the international scope of the institute and to the important service which it can render in the allotment of wave lengths to the various nations for international use. Unfortunately Mr. Alexanderson, who had been called to Europe, was unable to be present. His message was read by George Clark, who took advantage of the opportunity to pay tribute to the character of Mr. Alexanderson as a man and as an engineer.

The meeting was presided over by Fulton Cutting, president of Cutting & Washington, newly elected vice-president of the institute. Mr. Cutting also read a paper on "Some Considerations of Efficiency in Radio Engineering." He showed that radio transmission, although low in energy efficiency, might be highly effective. The low energy efficiency of the various elements, however, offers an attractive field for development. Dr. A. N. Goldsmith, entering upon another term as secretary of the institute, amplified the remarks of Mr. Cutting. John V. L. Hogan, retiring president, also spoke on this theme.

Director Smith Answers National Coal Association Superpower Slander

AS A RESULT of statements published by the *Coal Review*, the official publication of the National Coal Association, Dr. George Otis Smith, the director of the United States Geological Survey, felt called upon to explain to a Senate committee that there is nothing sinister about the Superpower Survey which is being made in the Boston-Washington area. One of the statements published by the *Coal Review* is as follows:

"The big electrical utilities of the East are preparing to invade the coal producers' market to the extent of 30,000,000 tons a year, through the so-called superpower project. This mammoth project is being forwarded under the guise of conserving coal."

After quoting this and other extracts from the article Dr. Smith told the committee, which is considering the advisability of imposing certain federal regulations upon the coal industry, that the *Coal Review* was right in saying the superpower survey is being conducted under the "guise" of conserving coal. "That is the actual purpose of the investigation," said Dr. Smith, "and it seems to me that when private business introduces the question of the motive of a government bureau simply because Congress authorized the receipt of certain money from certain people it is an extraordinary proposition. These people are contributing—I do not know in what amounts and I do not care. The people who are supporting the Superpower Survey are the railroads, which are to be the consumers of power if we have electrification of the railroads; the public utilities, which are producers of power, and the electrical machinery people. Every one of those interests is parallel and is going in the same direction as the public's interest. If the public utilities can get power cheaper the state regulations provide that they must sell it cheaper.

"There is nothing that would be a greater calamity to this country than for the government to operate any business even one-half the size of the bituminous-coal industry. It is my unqualified opinion that government operation would be a disaster because it would increase the cost of coal. It would make for a very high cost, and the public would have to meet it both as consumers and as taxpayers. There should be some control of the industry. That regulation is absolutely necessary unless we are going to be controlled by the industry itself."

Hydraulic and Steam Relay Topics Presented to Boston Engineers

ABOUT 400 engineers met at the Boston City Club on Feb. 7 to listen to addresses by W. M. White, hydraulic engineer Allis-Chalmers Manufacturing Company, Milwaukee, and E. B. Powell, consulting engineer with Stone & Webster, Inc. Their respective subjects were "Recent Waterwheel Developments and Settings" and "The Design of the Steam Power Station for Hydraulic Relay." Members and guests of the Boston Sections of the A. I. E. E. and the A. S. M. E. and of the Boston Society of Civil Engineers participated in a banquet which closed the series of joint meetings held within the last few months by the three organizations. Emphasis was laid by the speakers upon the attainment of efficiency in the utilization of interconnected plants, recent improvements in settings and economic analyses of relay-plant design to fit classified conditions. Prof. C. M. Allen of the Worcester (Mass.) Polytechnic Institute and R. J. S. Pigott of the Crosby Steam Gauge & Valve Company, Boston, also spoke briefly upon plant efficiency. Elmer Smith, General Electric Company, Boston, chairman of the Boston Section, A. S. M. E., presided.

Importance of Utility Credit in Relieving Housing Shortage

PUBLIC utilities will require $852,500,000 to equip properly the 1,250,000 houses and apartments which this country now needs, Philip H. Gadsden, vice-president of the United Gas Improvement Company of Philadelphia, declared last week before the housing conference of the Chamber of Commerce of the United States.

"This is an astounding total to contemplate," said Mr. Gadsden, "even in a field of industry which has good credit. Unfortunately, the public utilities field is not blessed today with good credit, hence this problem becomes doubly difficult for the operators who must furnish public service to the people when these houses finally are built.

"There is no hope on earth of ever getting these needed extensions if the credit of public utilities is not restored. The shortest step toward restoration of credit is for regulatory bodies to permit public utilities to earn such a return on their investments as will attract new capital into the public utility securities field. Regulatory bodies must recognize the fact that many public utilities were carried to the brink of disaster by enormous costs during the war and that investment in their securities practically closed because of uncertainty of returns. If these facts are not recognized and rates regulated accordingly, needed extensions cannot be made.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

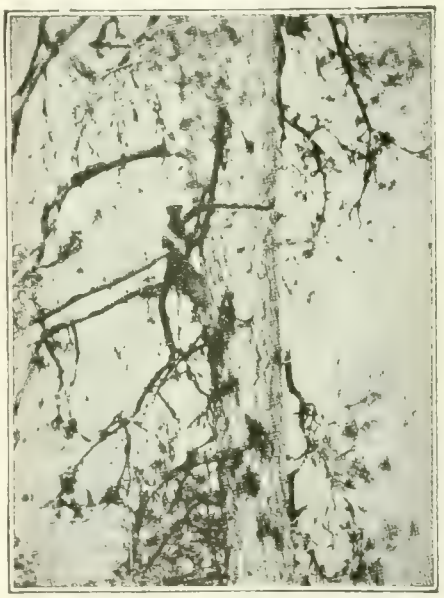
Central-Station Service for Munson Steamship Building.—A twenty-five-story office building is being erected on Wall Street, New York City, by the Munson Steamship Company, which operates a passenger service to South American ports. It was at first proposed to install a private electric plant, but careful estimates showed that about 25 per cent of the $55,500 a year that such a plant would have required for operating expenses could be saved by contracting with the New York Edison Company, without taking into consideration the large area of basement space thus released for other purposes.

Wireless in the Jungle.—The British government is now planning an all-British chain of wireless stations from Cape Town to Oxford, England. The chain will include the powerful station built by the Germans at Windhuk, Southwest Africa, which is reported to have sent messages directly to Berlin, a distance of more than 4,000 miles. A new station is to be erected at Nairobi, British East Africa, to receive the Windhuk messages. From there they will be relayed to Cairo and thence to Europe. The present transmission route, says the *Wireless Age*, includes a station at Kikondji, in the heart of the Belgian Congo and so remote from civilization that one wireless operator fell a victim to a hungry lion.

Human Curiosity and "Safety First."—The official publication of the Travelers' Insurance Company of Hartford, Conn., bears rather astonishing testimony to the predominance of curiosity over prudence as an actuating motive with human beings when it says: "We have directed attention to the hazard from fallen and dangling wires many times. There is a record of a case in which twenty-two persons stopped at the sight of a fallen wire, and of this number seventeen stepped forth and touched it. From their actions we might reasonably infer that these persons all knew that the wire might be dangerous, but apparently curiosity had a more compelling influence than either intelligence or ignorance."

Electricity in Turkey.—Up to 1908 electricity, it is said, was scarcely known in Turkey, the Sultan Abdul Hamid refusing all concessions for its introduction except for lighting some of the streets of Constantinople. After the revolution of that year the tramways were bought up by a German combination, which obtained authority to construct many new lines, to run trains over the new bridge between Galata and Stamboul and to operate the system by electricity. It also was to supply all Constantinople with electric light and power. Another large industrial company, organized in Belgium with capital from a number of European countries, received many concessions before the war. All these projects are at present in a state of chaos awaiting the final adjustment of the Near Eastern political situation.

Electrocuting the Pine Bark Beetle.—One of the greatest enemies to forest growth in Oregon has been the bark beetle which infests the pine trees of the state. Quite recently an onslaught has been made on this insect by electricity with the aid of the California-Oregon Power Company, which serves a population vitally interested in the timber industry, and under the direction of Prof. W. J. Chamberlain of the Oregon Agricultural College at Corvallis, who had demonstrated in his



laboratory that the larvæ, pupæ and adults of the beetle could be readily killed by being placed upon the surface of wet blotting paper through which 110 volts was passed. Professor Chamberlain selected as the scene of operations in the field a location near the Keno power station where beetle-infested trees and the electricity necessary for the experiments were both at hand. A temporary 11,000-volt line was run off from the main Keno line on the south side of the river for a distance of 400 ft., and at a point about a half-mile from the Keno power house another short line was run from the Keno line on the north side of the river. A beetle-infested tree was selected and the bark chipped away down to the zone between the bark and wood, where the sap runs. Chains were then put around the tree and the wires attached to them. In some of the tests a single chain was used and the circuit made by grounding the other wire. The exact degree of success attained is not announced, but the experiments are to be resumed in the spring.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

American Electrochemical Society.—The spring meeting of this society will be held at the Hotel Chalfonte, Atlantic City, N. J., on April 21-23.

National Safety Council.—The Engineering Section of the National Safety Council will meet in Philadelphia on Monday, Feb. 28, conjointly with the Philadelphia Section, A. S. M. E. The principal subjects for consideration will be dust explosions, crane overhoist limit stop, signals and signaling in industry, and relation of boiler accessories to safety.

New British Engineering Society.—The Newcomer Society has been formed in Great Britain to encourage the study of the history of engineering and industrial technology. The founders of the new association maintain that this field has been neglected and that the world does not appreciate how much it owes to the professional engineers. Members will be sought in all parts of the British Empire and in foreign countries as well.

March Meetings of A. I. and S. E. E.—Meetings of the various sections of the Association of Iron and Steel Electrical Engineers are scheduled for next month as follows: Philadelphia, March 5, "Methods Used to Insure Continuity of Service," by E. D. Sibley, Metropolitan Edison Company. Cleveland, March 14, "Electric Propulsion of Ships," by W. E. Thau, Westinghouse Electric & Manufacturing Company. Birmingham, March 19, "Power-House Operation," by J. G. Somerville; "General Plant Spares," by J. E. Sayers, and "Test on the Bennett Surge Arrester," by W. W. Corcoran. Chicago, March 22, "Control Equipment for Auxiliary Motors," by J. D. Wright, General Electric Company. The Birmingham Section meeting announced for tonight (Feb. 19) has been changed to Feb. 23.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Pittsburgh Section, Feb. 19; Chicago Section, Feb. 19; Birmingham Section, Feb. 23; Philadelphia Section, March 5; Cleveland Section, March 14.

American Physical Society—New York, Feb. 25 and 26.

Engineering Section, National Safety Council—Philadelphia, Feb. 28.

American Institute of Electrical Engineers—New York Section, March 11; Schenectady Section, March 18.

Associated Manufacturers of Electrical Supplies—New York, March 15.

Wisconsin Electrical Association—Milwaukee, March 23 and 24.

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Commission Rule on Discontinuance of Service for Non-Payment Sustained.—The California District Court of Appeal has determined, in Lane vs. Pacific Gas & Electric Company, that a rule of the Railroad Commission preventing companies from discontinuing service for non-payment of disputed bills for metered service, if consumer deposits the amount with the commission pending adjustment, applies to a bill for gas which a defective meter had failed to measure but which had been determined by test. The commission's rule, the court held, is not rendered void because of provisions of the public utilities act giving patrons of public utility companies a right of action for its illegal acts. (193 Pac. 589.)*

Lighting Company Not Estopped from Attacking Electric Rate by Accepting Gas Rate Named in Same Order.—Where customers of a company furnishing electricity and gas to the public file petition with the Public Service Commission for reduced electric rates, and the company files a petition for increased gas and electric rates, and the commission consolidates the hearings, making only one order, the company may accept the surcharge permitted temporarily on gas bills without surrendering its right to contest that part of the order granting the petition for a reduction in electric rates. This decision has been made by the Supreme Court of Indiana in a suit brought by the Valparaiso Lighting Company against the Public Service Commission of that state. (129 N. E. 13.)

Not Contributory Negligence to Fail to See Low Overhead Wire.—In Fagin vs. Benton Harbor-St. Joe Railway & Light Company the plaintiff recovered damages in the trial court for injuries received while passing under an improperly insulated electric wire at a summer park. This wire was alleged to have sagged to within five or six feet of the ground for several days. The Supreme Court of Michigan found that the questions of how far above the ground the wire was, whether the plaintiff deliberately seized it and whether the company had knowledge or should have had knowledge of its dangerous condition, all of which were disputed, were properly submitted to the jury for decision. The court explicitly refused to say that the plaintiff was guilty of contributory negligence merely because he failed to observe the wire, although it was broad daylight, holding that since pedestrians are infrequently interfered with by overhead objects they cannot be expected to be on the watch for them. (180 N. W. 490.)

Where Evidence in Damage Suit Shows Death from Electricity High Voltage Need Not Be Proved.—The Indiana Appellate Court has affirmed a verdict for the plaintiff in Wilder vs. Ayrshire Coal Company, where damages were sought for the death of a car coupler who came into contact with an uninsulated transmission wire strung above the spot where he had to work. The complaint alleged that this wire carried from 2,200 volts to 2,700 volts, but the company sought to prove that the voltage was only from 240 to 260 and to attribute the fatality to some other cause. The court held that maintenance of an uninsulated wire in such a place constituted negligence and that it was not necessary for the plaintiff to prove the allegation as to the exact voltage, the fatality speaking for itself and the facts being properly submitted for the decision of the jury. (129 N. E. 260.)

Protection from Confiscation.—In a suit brought by the Dallas Telephone Company against the city of Dallas, Tex., to establish its right to put into effect increased charges during the time—held by the company to be unduly protracted—that the city took to determine a new rate schedule, the United States District Court held that the company had the right "to put into effect and to collect from its patrons the proposed rates and to deal with its patrons independent of the city's rate-making power and the same as any business concern, not government-controlled, deals with its customers." The court so held because convinced that the existing rates were confiscatory, that irreparable loss and injury would result to the company if continued, and that the city had refused or failed to determine proper charges.

Boy Injured by Inadequately Safeguarded Wires in Lot Used as Playground Entitled to Damages.—Although boys playing on a vacant lot owned by a central-station company were technically trespassers, the facts that the lot was inadequately fenced, that it contained a pit filled with water which obviously served as an attraction to boys and that employees of the electric company knew of the habit of the lads to congregate there rendered the company responsibile for injuries incurred by contact with its apparatus. Thus holding, the Court of Appeals of Kentucky refused to overrule a verdict for $3,000 awarded to the plaintiff in Lunsford vs. Union Light, Heat & Power Company of Covington. The injured boy in this case had chased a frog from the pit to the company's transformers, about 10 ft. away, and, one of the planks protecting these transformers having been permitted to fall down, his hand had come into contact with imperfectly insulated high-tension wires. (225 S. W. 741.)

*This decision applies to the volume and page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Good Service Must Precede Rate Increases.—Before granting the Sea Cliff & Glen Cove Gas Company an increase in its rates beyond the amount fixed in its municipal franchise the New York Public Service Commission, Second District, required the company to improve its practice and to render service more nearly approaching the adequate standard contemplated by law.

Effect of Application to Discontinue Service.—Authorizing an increase in steam-heating rates for the Southern Illinois Light & Power Company in the city of Hillsboro, the Illinois Public Utilities Commission asserted that a utility cannot complain upon being required to operate its plant without out-of-pocket loss where it has petitioned for authority to discontinue service, thus indicating its willingness to forego earning interest on capital invested.

Adjustment of Increase Granted Municipal Plants as Between Electricity and Water.—Finding that the increases of 40 per cent in electric rates and 28 per cent in water rates asked by the city of Shawano would throw a disproportionate burden on consumers of electricity, the Wisconsin Railroad Commission altered the proposed rates so as to produce the same revenue with a smaller rate of increase for electricity and a much greater one for water, it having been shown that on the basis of six months' revenue 29 per cent and 106 per cent increase for electricity and water respectively would be necessary to produce the required income. The commission held 6 per cent to be a reasonable annual return for a municipally owned plant.

Municipal Regulation of Interior Wiring.—Complaint against the rules of the Commonwealth Edison Company concerning interior wiring having been made to the Public Utilities Commission of Illinois, the commission refused to order any modification of them inasmuch as they were designed to comply with restrictions promulgated by the city of Chicago. "Without expressing any opinion as to the reasonableness of rules and regulations which the city of Chicago has promulgated or may promulgate," the commission said, "the commission believes it would be dangerous practice to remove restrictions governing the installation of interior wiring, as it has been found hazardous to life and property to furnish electric service where the interior wiring does not conform to the rules and regulations of best practice."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

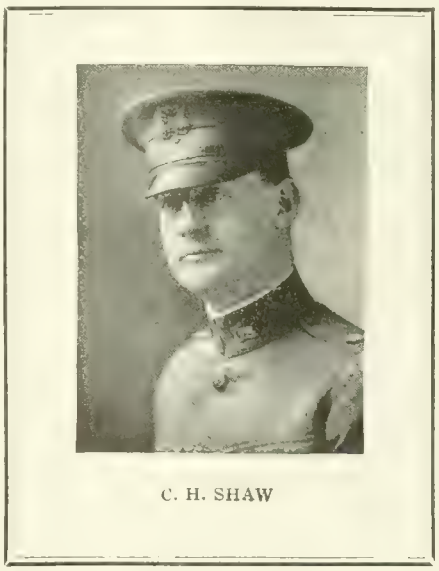
H. B. Gear of the Commonwealth Edison Company, Chicago, a pioneer in the development of overhead central-station distribution practices, has been advanced from the position of engineer



H. B. GEAR

of distribution to be assistant to Vice-president L. A. Ferguson. Mr. Gear joined the staff of the Chicago Edison Company as inspector of interior wiring in 1895, after graduation from Cornell with the class of that year, and he has been with that organization ever since. In 1898 the problem of consolidating the circuits of five companies which had been taken over on the south side of Chicago was assigned to him. There were at least two competitors nearly everywhere in the territory, and they operated at various voltages and frequencies. He revised the system of secondary distribution, merged and unified the primary distribution, and by 1900, when what is said to have been the first three-phase, four-wire generating station was installed, he had cut the entire southern district of the city over to three-phase, four-wire, 60-cycle, 2,300/4,000-volts. In March, 1900, Mr. Gear was called back to the head office with the title of general inspector in charge of the interior wiring inspection, the testing and lamp renewal departments and the engineering of alternating-current distribution. In 1911 the department was reorganized, the engineering of underground distribution was added and his title was changed to that of engineer of distribution. Between 1900 and 1911 the 4,000-volt distributing system was extended to all other parts of Chicago outside the direct-current district, the work being done under the direction of Mr. Gear. General standards of feeder sizes were established and the demands and diversity of various types of customers were determined. The first published data on diversity factor were given by Mr. Gear in a paper presented in 1910 before the American Institute of Electrical Engineers and the Western Society of Engineers. For this paper the Western Society of Engineers awarded Mr. Gear the Chanute medal. In the same year Mr. Gear and P. F. Williams published as joint authors the first edition of their book, "Electric Central-Station Distribution Systems," which was later revised and enlarged. Mr. Gear edited the distribution section of the Standard Handbook in 1915. He is a fellow of the American Institute of Electrical Engineers and has been a member of the Institute code committee for about ten years. He has also been chairman of the overhead-line committee and the inductive-interference committee of the National Electric Light Association.

Major Carroll H. Shaw, until recently consulting engineer with the firm of Jackson & Moreland, Boston, and before that on the commercial engineering staff of the New England Power Company, has been appointed engineer of the newly created distribution and installation department of the New York Edison Company. Prior to his connection with the New England company he was in charge of the New England district of the power section of the War Industries Board. Before entering government service he held several responsible engineering and executive positions with central-station companies in the Middle West.



C. H. SHAW

S. G. Rhodes, assistant to the vice-president of the New York Edison Company and engineer in charge of the meter and test departments, has been appointed general superintendent of a newly created distribution and installation department. This has resulted from the expansion of the company's system and the corresponding need of closer co-operation between several hitherto unrelated departments. The new department will carry on the activities of transmission, distribution, service, maintenance, meter setting and inspection, filling the gap between the generating stations, substations and customers' service switches. In addition



S. G. RHODES

to his newly assumed duties Mr. Rhodes will maintain his position as assistant to the vice-president and as engineer in charge of meters and tests. Starting with the company in 1891 as wireman, Mr. Rhodes has risen through the positions of foreman of the arc-light department, superintendent of that department and engineer of the meter and test departments. For a number of years he has served on various technical committees of the N. E. L. A., the A. I. E. E. and the I. E. S. In addition he has conducted a considerable amount of original investigation for the New York Edison Company on illumination, particularly in connection with street and park lighting. He is a fellow of the A. I. E. E.

George E. Tebbetts, formerly with the construction and engineering division of Stone & Webster, Boston, has resigned to become associated with the Roberts & Schaeffer Company, engineers and contractors, Chicago.

H. P. Broughton, manager of the Interstate Public Service Company, Kentland, Ind., has resigned to accept a position with the Indiana Service Corporation, Fort Wayne, Ind. Mr. Broughton succeeds Charles B. Hart as superintendent of the light and power department of the Indiana Service Corporation. Mr. Broughton was at one time assistant to F. S. Hunting, general manager of the Fort Wayne plant of the General Electric Company.

W. J. Gilson, superintendent of the Northern Division of the Houghton County Electric Company, Houghton, Mich., has resigned to become associated with the Adirondack Light & Power Corporation, Glens Falls, N. Y.

C. B. Hutchinson, formerly district manager of the San Pedro district of the Southern California Edison Company, Los Angeles, has been appointed manager of the newly formed Fullerton district. Mr. Hutchinson is succeeded by P. S. Minner.

R. C. McFadden, who has been district manager of the Long Beach district of the Southern California Edison Company, Los Angeles, has been transferred to the position of district manager of Oxnard district, succeeding C. E. Houston, now manager at Redondo.

P. S. Minner, acting district manager of the Southern California Edison Company at Redlands, has been promoted to the position of district manager of the San Pedro district, succeeding C. B. Hutchinson, who has been made manager of the Fullerton district.

Charles Hackel, who has been appointed chief engineer of the Trenton & Mercer County Traction Company, Trenton, N. J., to handle matters pertaining to power plant and electrical operations, was formerly connected with the Western Electric Company.

C. G. Hanna, local superintendent of the Wabash Valley Electric Company, Sullivan, Ind., has accepted a position with the same company at Clinton, Ind. Mr. Hanna is succeeded by John T. Kester, formerly manager of the Noblesville (Ind.) Heat, Light & Power Company.

C. H. Shepherd, electrical engineer for the Commissioners of Lincoln Park, Chicago, has resigned to become associated with the Bemis Company, engineer-accountant, in the same city. After graduation from the University of Wisconsin in electrical engineering he became associated with the Allis-Chalmers Manufacturing Company, later becoming chief operator of the Fisk Street station of the Commonwealth Edison Company. He resigned that position to take up the duties of chief operator of the electrical department, Commissioners of Lincoln Park, later becoming operating engineer for this department. Mr. Shepherd was then appointed chief layout engineer for the Department of Gas and Electricity of Chicago, having supervision over the design, layout and construction of all equipment of the municipal street lighting system. In 1914 Mr. Shepherd resigned to become electrical engineer in charge of the electrical department for the Commissioners of Lincoln Park and rebuilt the Lincoln Park power and lighting system. He has done considerable consulting work on power and lighting systems for the last eight years and will continue in this capacity with the Bemis Company, which is taking over industrial valuation and appraisal work, as well as general engineering and public utility cases.

A. E. Hogrebe has been appointed sales engineer for the Baltimore territory of the Champion Engineering Company, Kenton, Ohio, manufacturer of electric traveling cranes.

Eugene F. Fagan, formerly general superintendent of the Federal Electric Company and its subsidiaries, Chicago, is now associated with the Lyon Metallic Manufacturing Company, Aurora, Ill., as purchasing agent.

H. D. Randall, who was recently appointed district manager of the Denver office of the General Electric Company, has been connected with the electrical business for the last eighteen years. Born in 1881, he prepared for college at Groton School and was graduated from Amherst in 1902. The same year he entered the service of the Westinghouse Lamp Company, remaining until Jan. 1, 1904, when he went to Pittsburgh with the Westinghouse Electric & Manufacturing Company. After a year there he went



H. D. RANDALL

to Seattle, and on Aug. 1, 1907, he took charge of the Spokane office of the Westinghouse company, remaining there for a year and a half. In December, 1908, he entered the employ of the Allis-Chalmers Company as salesman of hydro-electric apparatus, with headquarters in Salt Lake City. Four years later Mr. Randall joined the sales organization of the General Electric Company at Salt Lake City. On Dec. 1, 1914, he was called to Schenectady to the power and mining department, but the following year returned to the Salt Lake City office as local manager, holding this position until Nov. 1 of last year, when he was made district manager of the Denver office. Since March 1, 1919, Mr. Randall has been president of the Capital Electric Company and the Butte Electric Supply Company of Salt Lake City.

Frank Lynch, for thirty-three years associated with the Commonwealth Edison Company, Chicago, has retired, because of ill health, as chief engineer of the Northwest station of that company. Mr. Lynch will serve the company in a consulting capacity.

S. W. Dudley, chief engineer of the Westinghouse Air Brake Company, East Pittsburgh, Pa., has resigned to become professor of mechanical engineering in the Sheffield Scientific School of Yale University.

F. C. Reed has been transferred to the Charleston (W. Va.) office of the Westinghouse Electric & Manufacturing Company. Mr. Reed was formerly in the industrial sales department of that company at East Pittsburgh, Pa.

William S. Higbie, 114 Liberty Street, New York City, electrical engineer, formerly with the Chile Exploration Company, has established an inspection and purchasing service for buyers of power equipment.

H. F. Brinckerhoff of the Charleston (W. Va.) office of the Westinghouse Electric & Manufacturing Company has recently been appointed manager of the supply division of the Philadelphia district office. F. C. Reed succeeds Mr. Brinckerhoff in the Charleston office.

Roy S. Nelson, formerly engineer of the power station of the Ponce (P. R.) Electric Company, has been transferred to the Eastern Texas Electric Company, Port Arthur, Tex., to become assistant chief engineer of the Port Arthur power station.

A. F. Chamberlain, manager of the New York office of the Robbins & Myers Company, Springfield, Ohio, who has been devoting part of his time to the supervision of the Canadian plant of the company at Brantford, Ontario, will once more give his entire time to the New York office.

B. C. Holst has joined the sales force of W. N. Matthews & Brother, manufacturers of Matthews patented specialties at St. Louis. Previous to this connection he was advertising manager and manager of the specialty department of the Northwestern Electric Equipment Company at St. Paul, Minn.

E. C. Ryder, who has been president of the Bangor (Me.) Railway & Electric Company for the past five years, has resigned to devote his time to the practice of law. Mr. Ryder is a prominent Maine attorney and has been general counsel in that state for the Canadian Pacific Railway and the Eastern Trust & Banking Company. He was born in Readfield, Me., in 1854 and attended Colby University. Mr. Ryder has been closely associated with the growth and development of the Bangor Railway & Electric Company.

Robert Reynolds Robertson, who has recently joined the staff of the Society for Electrical Development, was formerly associated with the Winchester company's retail store department. In that position he selected sites for the Winchester stores and assisted in the work of hiring and training personnel for the retail departments. Because of his experience in this work and as buyer for the specialties department for the chain of Winchester stores he brings to the society a knowledge of buying, retailing, displaying and advertising merchandise.

Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Export Copper Financing Full of Meaning to Electrical Industry

OF UNUSUAL interest to the electrical industry was the floating this week of a $40,000,000 loan by the Copper Export Association. This loan is secured primarily by 400,000,000 lb. or substantially two-thirds of all unsold refined copper on a basis of 10 cents per pound of copper.

There are a number of angles to this transaction which electrical manufacturers would do well to recognize. First, the copper producers are now furnished with a credit substantial enough to withstand a protracted period of non-buying. Second, it will now be possible to grant credits to foreign purchasers on much more favorable terms than formerly and thereby open this market for American copper. Third, there is effectively removed from the market the dangerous element of a heavy surplus stock.

It is reasonable to believe, therefore, that copper is as low today as it will be for a great many months. Furthermore, it would not be surprising to see copper go to considerably higher levels in the near future. Thirteen cents is really too low for electrolytic and, if present indications count for anything, any manufacturer who buys on a 14-cent basis or lower would be making no mistake. Wire producers especially ought to be able to find in the present copper market sufficient argument to convince electric light and power companies of the advisability of ordering for future requirements on the current copper base.

Ten per Cent Reduction on Distribution Transformers

DISTRIBUTION transformers were reduced 10 per cent in price by two of the leading manufacturers, the reduction becoming effective on Feb. 12 in one case and on Feb. 14 in the other. Current demand, while less of course than a few months ago, continues in good volume. One of the manufacturers in question still has considerable back orders on hand, though these are being overcome. Deliveries in this instance average about ninety days on 100-kv. to 150-kv. sizes. In the other case production has just about caught up with current business, and though the present stock is small, it includes virtually all sizes, so that shipments can be made from stock. The delivery situation, it is expected, will continue to improve.

Rigid-Conduit Buying Merely for Individual Jobs

WITH the construction market progressing at a very slow rate, as far as new jobs are concerned, the demand for rigid conduit is quiet. Manufacturers are receiving orders here and there and are making shipments in quick time, but these orders are virtually only to cover the needs of individual jobs as they come up.

Jobbers show no tendency whatever to stock. The buying on their part is just to replace little breaks in their stocks as small orders creep in here and there. Manufacturers, on the other hand, are continuing their production to care for needs which it seems will require filling within, say, the next three months. These stocks are not what can be called large stocks, because it is thought that the demand will really not become insistent during the first half of the year. Any amount of building that may be started in the very near future could not get to the conduit stage much before early fall.

Manufacturers are willing to fill orders now when they know what their production costs are and ship the pipe to jobbers for stock. It seems, however, they can hardly be expected to accept orders on long delivery, which they could not now make up, at the price that shall rule in the future, which might be lower than present costs would warrant.

Prices have been holding rather steady since January reductions, although all producers are not quoting on the same card.

Lower Prices on Pole-Line Hardware

FOLLOWING price reductions of 5 to 15 per cent on pole-line hardware that went into effect during December and early January, as mentioned in last week's issue, prices have further declined. General reductions on the entire line, ranging from 5 to 7½ per cent, were put into effect by leading manufacturers on Feb. 15. It is hoped that this reduction will have some effect upon consumers in the way of inducing them to buy, as until the present time demand has been very light. With the closer approach of spring, however, manufacturers are hopeful that the program of extensions on the part of utilities will result in a better market.

In anticipation of this producers are continuing production so as to accumulate reserve stocks. These have been rather low in the past, but should now build up in good shape. Deliveries are considered entirely favorable, being from stock in most instances. In others shipment is not longer than ten days to two weeks.

Slightly Better Orders for Flexible Armored Conductor

IN THE last two weeks there has been a slightly better run of ordering in the flexible armored conductor market. It is not necessary that all producers shall be able to check up this condition, but it is true in some cases. There has been no general increase in business in this material, however.

Jobbers still have good stocks of armored conductor, and in some quarters slight overstocks are being lowered through an interchange among the trade. Of course, this makes for a condition of stock throughout the jobbing industry which is more nearly commensurate with the demand at this time. But it isn't keeping price cutting a negative quantity. In some sections this condition makes the market very unstable.

Manufacturers, as a rule, are producing armored conductor to take care of a good spring demand—a demand which should come to realization much ahead of that for rigid conduit because of the length of time necessary to bring the different classes of building construction to the wiring point. A fair amount of residence and stone construction and alteration would very soon deplete jobbing stocks of armored conductor, and the result would be an eager volume of orders for large lots on quick delivery. The condition that would follow would probably be little different from that which has existed in the past when trade stocks have run out at about the same time. A higher price might not be unexpected.

Jobbers can get this conductor now at a rather low price, and some manufacturers are of the opinion that they are passing up a good investment by continuing to hold off

buying in the face of a summer demand which all sections of the country look forward to with considerable optimism. The jobbers, according to manufacturers, are cutting prices and at the same time declaring that there is no profit in sales of flexible armored conductor at present prices.

Shipments of steel strip can be made in two to three weeks, and some lots are coming through on present orders, There is not a great deal of this material being produced for stock, though, according to some mills.

Report of German Producers Shows High Labor

THE three large establishments forming the German Siemens-Schuckert organization have just published their annual report (September, 1919, to September, 1920). While other German industrial enterprises were able to pay high dividends—some of them up to 30 per cent and more—the great electrical works had to be satisfied with smaller earnings. It is even astonishing that in spite of the immense increase in working expenses, the high state taxes, high-priced raw materials, steadily increasing freight rates, numerous strikes, etc., the companies were nevertheless able to distribute a dividend for the shareholders.

To what extent the expenditure for wages and salaries has increased is best illustrated by the following figures: For two of the companies—Siemens-Halske, Ltd., and Siemens-Schuckert—the wages and salaries paid in millions of marks were: 1913 to 14, 70; 1918 to 19, 236; 1919 to 20, 479; 1920 to 21, about 1,000. The report of Siemens-Halske, Ltd., states that wages and salaries are still increasing.

The net earnings of the three companies and the dividends paid were as follows: Siemens-Halske, Ltd., 16,433,763 marks, of which 12 per cent was paid on the old capital of 63,000,000 marks and 6 per cent on the new capital of 63,000,000 marks. Siemens-Schuckert Company, 12,760,000 marks, 10 per cent; Schuckert Company, Nuremberg, 7,228,542 marks, 9 per cent. The report of Siemens-Halske, Ltd., further states that in spite of the difficult economical conditions, the exports have considerably increased, which is chiefly because of the great international demand for all kinds of electrical goods.

During the year under consideration the capital of Siemens-Halske, Ltd., was doubled and a 4½ per cent loan of 60,000,000 marks has been raised in order to meet the financial requirements of the company. The report concludes by stating that sufficient orders are booked and that sufficient raw material is at hand.

Schedule Material Manufacturers See No Chance of Lower Prices

SOME of the large manufacturers of schedule material report that within the past two or three weeks there has been a slight improvement in buying in their field. This increase is said to come from large electrical contractors who are anticipating a revival of the building industry. Supply jobbers, it seems, remain almost entirely out of the market. The latter are apparently satisfied with their present stocks, which in the East, for instance, are too large. In that section jobbers are replenishing their stocks from other jobbers, and in this way supplies are gradually being reduced. It will probably be some time, however, before the widespread policy of keeping down inventories will allow of very heavy orders being placed with manufacturers. The latter, despite the prevailing quietness of the market, remain confident that the year will yet record good sales.

Prices of schedule material remain unchanged, and the view is frequently heard in the trade that these prices must come down before orders will be placed. On the other hand, several large producers emphatically state that there is no possibility of any price reduction. In their opinion, cutting prices would not stimulate buying one iota, and furthermore, conditions do not warrant lower prices, they say. In this connection it is pointed out that schedule-material prices were not inflated previously, that stocks of high-priced material are on hand, and that wage reductions of 10 per cent that have generally gone into effect did not bring anywhere near a corresponding reduction in cost. The present light demand is in itself a production expense, since the cost per unit mounts as mass production decreases.

Manufacturers' stocks are not large, although they are sufficient to insure prompt deliveries. At present production is on a curtailed basis.

Little Improvement Seen in Insulation Field

LITTLE increase has been noted in the buying of fabric insulation and compounds, etc., during the year up to date. Although it is stated that the number of orders which manufacturers are receiving is about normal, at the same time the amount of each order is still disappointingly small. A normal number of bills are sent out each month, but for small figures. Factory production is down pretty near the 50 per cent mark.

Cotton webbings are moving slowly, although recent price decreases of about 18 per cent have been applied. There is some distributer stocking of this class of insulation, as it is thought the bottom price has been reached. Compounds for finishing insulated wires are moving fairly well and have increased in February over January. Dry-battery filler also is feeling a fair response in the buying market. Shellacs and varnishes are going slowly.

Varnished silk has little call at present, and its price has held steady since the revisions reported in January. Varnished-cambric tape and cloth are about 10 per cent lower than last quotations made the latter part of January, and the demand is not well sustained. There is little manufacturing for stocks beyond what is deemed necessary to supply immediate future needs. That is, no future production on a large scale is being attempted even with a good outlook for summer business.

The Metal Market Situation

DOMESTIC demand for copper remains light, and though large brass and wire drawing interests were reported to have been feeling out the market recently, there is no increase in actual orders. The statistical position of producers, however, is undoubtedly stronger than it has been for some time. The removal of 400,000,000 lb. of surplus copper from the market is bound to have a salutary effect upon the situation, especially as production is being curtailed. Copper prices are no higher, but at least it seems that the bottom of the depressed market has been reached. Even the small producers are showing no willingness to shade the price of 13 cents delivered at which copper for prompt February and March shipment is held. One-quarter cent more is asked over the second quarter. In the outside market little business is done as prices are fully a quarter cent higher than producers'.

Demand for tin remains light, a downward fluctuation of ¾ cent per lb. being recorded during the week. The market for zinc is quiet. The manufacturer's basic price of sheets was reduced 1 cent to 11 cents the past week.

NEW YORK METAL MARKET PRICES

	—Feb. 7 1921—	—Feb. 14 1921—
Copper	£ s d	£ s d
London, standard spot	72 0 0	71 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13.50	13.50
Electrolytic	13.00-13.25	13.00-13.25
Casting	12.67½	12.50
Wire bars	15.75	15.75
Lead, trust price	4.75	4.75
Antimony	5.25	5.25
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	11.50	11.00
Zinc, spot	5.50	5.37½
Tin	32.75	33.50
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11.00-11.25	11.00-11.25
Brass, heavy	6.00-6.50	6.00-6.50
Brass, light	4.00-4.50	4.00-4.50
Lead, heavy	4.00-4.25	4.00-4.12½
Zinc, old scrap	3.00-3.25	3.00-3.25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A SLIGHTLY better tone can be noticed in this week's market, but as before, no high spots in buying in any sections of the trade have appeared. Price drops of 10 per cent announced last week, applied to apparatus, motors, etc., have had little effect upon buying, it is reported from all over the country. It may be too early to expect a reaction and none has appeared. Stocks in general are sufficient for immediate needs, and no tendency is noted among manufacturers to produce for stock very far in advance, consequently it is with difficulty that some plants are running in sufficient volume to keep their forces intact. In fact, shorter hours or lower rates of pay, or both, have become more noticeable in the past two weeks.

Wire is moving slowly, but a little better than in January. Wiring materials are quiet. A rather inactive insulation market shows the state of production in the apparatus and motor line. Collections are holding their own, but financial conditions as a whole appear to be on a slightly higher level.

NEW YORK

The ups and downs of trade among jobbers continue, but on the whole there has been no further retrogression of the market, while, on the other hand, each week several jobbing houses report a slight improvement in business. These same firms may next week report the gain only temporary, as is often the case, but the general continuing trend of the industry is undoubtedly toward better times.

Very little material is being ordered from manufacturers. Jobbers are keeping their inventories low and will not order goods for stock until actual sales warrant this, it seems. Maintenance of present stock accounts for the greater part of the orders that jobbers are placing, and this is mostly taken care of by the interchange of stocks among themselves. Much hope is placed upon a return of the building industry in improving the electrical trade, but from inquiries made among jobbers it seems that contractors are as yet taking very little interest in the market.

No price reductions by manufacturers are reported this week except on pole-line hardware, as noted elsewhere.

Conduit.—Half-inch black is holding close to $70 per 1,000 ft., with shading down to $66 in 2,500-ft. quantities, although one large jobber has consistently quoted slightly more than $79. Galvanized brings from $72 to $79. Demand is not large, with ample stocks on hand.

Flexible Armored Conductor.—Jobbers are buying their cable from one another and so have reduced overstocks. No. 14 two-wire, double-strip brings from $61 to $65 per 1,000 ft., although one or two houses have held to higher prices.

Rubber-Covered Wire.—Stocks seem to be reduced to fairly normal levels. Such demand as is felt is mostly in small quantities. Most jobbers are holding No. 14 at $8 to $8.75 in 10,000-ft. lots, though prices of $7.50 and $7.75 are also quoted by large houses this week.

Tape.—Stocks of both friction and rubber are adequate but not considered too large. Demand is quiet on the whole, though some jobbers are making fairly good sales. The latter state they will not order except to maintain stock, and this is being done by buying from other jobbers. In 100-lb. lots the selling price for standard grades of friction ranges from 48 to 50 cents per pound, and for rubber from 45 to 50 cents. There are variations of a few cents each way.

Lamp Cord.—No. 18 twisted in 500-ft. quantities ranges in price from $17.50 to $22 per 1,000 ft. Demand is poor.

Non-Metallic Flexible Conduit.—Little call exists at present and the size of stocks varies considerably. For 1,000 ft. of $\frac{3}{8}$ in. jobbers ask from $22 to $24.50, and for $\frac{1}{2}$ in. from $24 to $27 per 1,000 ft.

Heating Appliances.—Sales in this territory have fallen to very low proportions. Stocks of hollow ware in several instances are considered much too large and jobbers report that they will order sparingly if at all. A standard 6-lb. iron listing at $8 is this week being offered at $4.98 by a large department store, and another well-known make is being sold as low as $4.50 by some of the small dealers. Many jobbers state that appliance prices are too high to attract the public.

CHICAGO

A canvass of the various factors reveals a spotty situation in that manufacturers selling direct to users report additional activity while jobbers seem to be a unit in stating that the quiet of past weeks is unchanged. Price reductions are noted in many lines, but are so recent as to render impossible any reportable reaction. Manufacturers are continuing operations on schedules which are greatly reduced.

The jobbing trade is permitting stocks to run down. There is widespread demand on the part of buyers for guaranteed prices. Jobbers feel that, such being the case, and with probabilities apparently favoring declines in many items in the near future, it is not asking too much to look to the manufacturers to carry a portion of the risk.

No appreciable change is noted in the general situation in other commercial lines. Department stores are continuing to feature reduced price sales, and industrial plants are operating either on part time or with greatly reduced forces. The announced re-employment of 2,000 shopmen laid off by one of the railroads several weeks ago has helped to cause a feeling of optimism.

Power Apparatus.—Several standard lines of motors and generators are reported reduced in price 10 per cent. This cut was effective on Feb. 7, and the effect on the trade cannot yet be noted. Manufacturers selling direct to the user report increased inquiry and sales on sizes ranging from 1 hp. to 50 hp., although jobbers state that no change is apparent.

Power Control Apparatus.—Circuit breakers, oil switches, lightning arresters, rheostats and similar apparatus of standard make are reduced 10 per cent. Demand is very light, and stocks of most items are sufficient to fill any probable requirements.

Transformers.—Distribution transformers have also been cut 10 per cent. The gradual increase of a buying movement in the agricultural district promises an increase of business in this item. Power transformers are reported in ample supply with demand weak.

Construction Tools.—A cut is recorded on shovels, "spoons" and similar tools of about 10 per cent. Stocks in jobbers' hands are running low, and any steady buying would throw orders back on manufacturers for immediate shipment. Jobbers are not stocking.

Line Hardware.—No increase in business is noted and opinion is freely expressed that another cut is due, owing to reduced costs of raw materials.

Tape.—Prices hold firm to former levels, and stocks, particularly on rubber, are running low. For some reason this item seems neglected by jobbers to a certain extent, none reporting any definite policy in regard to stock maintenance. The feeling is that in view of possible price changes manufacturers should assume their full share of stock-carrying risk.

Heating Appliances.—Business remains quiet. Jobbers' stocks are not at all heavy, and dealers are also running low. Opinion is expressed that price adjustments in this line will be slower than in any other.

BOSTON

Although trade is unevenly distributed as to volume in New England a better tone pervades the market. A prominent Connecticut jobber reports 25 per cent better business than in January, and in Rhode Island improved conditions are noted. Boston jobbers are much affected by the building trades strike, but some good outside business is coming in. Collections are sharply watched, and buying for stock is very conservatively done. Increased buying by central stations is noted in some localities. Prices of motors, control equipment, distribution transformers and considerable other apparatus were reduced last week by about 10 per cent by a number of leading manufacturers. Manufacturers are generally running considerably below their capacity.

Meters.—Production has still to overtake the demand. Prices are steady and stocks scanty.

Lamps.—An excellent winter's business is reported, one distributer stating that the demand has fallen off only 10 per cent this month. Manufacturing for stock is proceeding to some extent. One factory added about 300,000 finished lamps to its stores in January and is running on two-thirds time, curtailing type "B" production about 25 per cent and type "C" about 33 per cent.

Motors.—Several leading makers announced price reductions around 10 per cent on motor and control equipment last week. Back orders are still occupying some factories. Local stocks are improving in range and qualtity and competition is keen.

Tape.—Among eight leading New England jobbers three had normal stocks of friction tape Monday, four were below normal and one reported excess. Those carrying subnormal stocks ranged from an existing supply for one week to two months' business. Ordinarily two or three months' supply is carried. Several are buying on a hand-to-mouth basis, and small quantities are being bought more frequently than a few weeks ago. The demand is rather light, but is well distributed among central stations, contractors and industrial buyers. Compound is in good supply with one exception. A tendency toward purchasing the cheaper grades of tape is evident. Prices vary considerably, a fair range being 45 to 57 cents on black friction tape, according to quantity, compound running from about 40 cents to 50 cents per pound. In the cotton insulating-tape market a better feeling is reported. Raw material and labor are easier, but no marked wage reduction has been made as yet in a leading establishment whose prices have fallen from 200 to 100 per cent above pre-war figures. Deliveries are excellent, but buying is cautious.

Flexible Armored Conduit—No. 14 double-strip was selling Monday in Boston at $65 per 1,000 ft., with light demand and good stocks.

Wire.—Unsteady prices featured the wire market at the opening of the week. No. 14 rubber-covered sold for $8 to $10 per 1,000 ft., dependent on quantity and local stocks. Weatherproof and bare bases were about 18 cents and from 16½ to 17 cents respectively. The demand is not so active as usual.

Non-Metallic Flexible Conduit.—This material was steady Monday at $22 per 1,000 ft. in the $\frac{7}{32}$-in. size and $25 for the ¼-in. diameter. No difficulty in getting this product is known. The market is quiet.

ATLANTA

A slow revival of business activities continues, and business men in general are assuming a more optimistic attitude of mind in reference to the future. Manufacturing plants continue to announce schedules for reopening, and the retail trade is reported on the increase throughout the section. The local electrical contractors seem to be kept comfortably busy with repair work and some new construction and report the receipt of a good number of inquiries for estimates on building to be undertaken in the spring. The Sixth Federal Reserve District reports that building permits in the twenty-one principal Southern cities for December numbered 1,688, valued at $2,922,921, a sharp decrease under December of 1919.

Ceiling Fans.—No movement in this line is reported, though a price reduction from $72 to $64 list has just been announced. Stocks have been accumulated in anticipation of the season opening on about April 1.

Wire.—Popular sizes of both weatherproof and rubber-covered continue to move in reduced volume, though inquiries for heavy purchases are being received. Stocks throughout the section are in excellent shape, with rubber-covered on a 16-cent base and weatherproof on a 17-cent base.

Tape.—The tape market, both friction and rubber, is reported rather dull, with jobbers placing orders only for immediate requirements. Most firms state that no heavy orders will be placed under ninety days as all firms have stocks on hand in all varieties sufficient for thirty to sixty days. Jobbers are expecting sharp price reductions similar to those in other specialties containing cotton and rubber. The present quotation on weatherproof is 48 cents per pound.

Schedule Material.—Heavy stocks have been accumulated, and all companies report sales very slow.

Porcelain.—As predicted last week, porcelain prices have been advanced approximately 20 per cent. Knobs and tubes continue to move quite satisfactorily, and stocks in general are reported fair, no acute shortage of material being in evidence.

Industrial Motors.—Manufacturers announce price reductions of approximately 10 per cent in all sizes. Stocks are in fair shape and the market is somewhat sluggish.

Distribution Transformers. — Municipalities and small utilities are taking quite a respectable volume of the more popular sizes. Local stocks are in fair condition, and prices are reported steady.

Farm-Lighting Outfits.—An increasing interest is reported in this line, accounted for probably by a slight price reduction on the part of the manufacturers to both the retailer and consumer. Stocks are somewhat low with shipments quite satisfactory.

ST. LOUIS

Business seems slowly but surely to be getting under way once more, each succeeding week showing a slight increase over the previous one. While the revival is not startling by any means it does indicate that the pendulum has started to swing the other way. Retailers report the appliance business picking up considerably, an increase in sales of vacuum cleaners being particularly noticeable.

St. Louis engineers are preparing plans for several small municipal light plants which will go through in the spring if the municipal bond market improves by that time. The dearth of actual construction continues. Inquiries from industrials are still heavy, with sales improving. The railroads and utilities pursue their policy of buying lightly, but many inquiries are received from them. The non-employment situation has bettered, several large industrials opening up again on part time, their labor costs having been adjusted in the meantime. Collections average sixty days.

Switches.—The Department of Electrical Inspection of St. Louis has announced that only switches of the safety type will be passed hereafter. This ruling is modified by the explanation that any switch inclosed in a metal box and indicating externally whether the circuit is open or closed will be considered a safety switch. Jobbers' stocks of knife switches are not large, while, on the other hand, their supplies of safety switches are heavy. Demand for the safety switch has been slow.

Tape.—Jobbers here stock only the ¾-in. black friction and rubber tape to any extent, carrying as a rule about 5,000 lb. of that size to 100 lb. of any other size. Stocks are ample to take care of demand, which is fairly steady. Jobbers have been following the practice of ordering new supplies about once a month in order to keep fresh stock coming in, but their orders for several months to come will be smaller than formerly. Both the black friction and the rubber tape, ¾-in., are being quoted at 45 cents per pound.

Motors.—Movement is slow, though there are still a good number of inquiries coming in. Stocks are getting heavy, but there have been no price cuts to date.

Knobs and Tubes.—Jobbers' supplies are topheavy, and there have been a number of instances of price slashing in order to cut down stocks. Quotations vary, but all of them are below replacement prices. Quotations on "Nail-it" knobs range from $22.80 to $30 per 1,000. Jobbers are asking $11.50 per 1,000 for ⅞-in. x 3-in. tubes. Despite the price cuts demand has not been heavy.

Fuses.—There is a steady demand for fuses, but present stocks are capable of taking care of it for some time to come.

Wire.—A good number of small orders continues to be the rule, with very little change of any kind in the market. Rubber-covered No. 14 is quoted at $8 per 1,000 ft. Several jobbers report good orders from contractors in outlying sections of Missouri.

Sockets.—Jobbers continue to report business very dull. Stocks have become unwieldy, but prices are being held firmly.

Poles.—Demand has increased in the last few weeks, but it is not heavy enough to be a serious drain on stocks. Prices are holding up, though the opinion is that decrease in cost of production will reach the buyer soon.

SAN FRANCISCO

There seem to be indications that California is recovering from the prevalent feeling of business depression. Still the 1920 crops, while big, are unmarketed in many sections because of the efforts of the growers' association to hold up prices. There still exists the spirit of hand-to-mouth buying.

These factors, however, are becoming neutralized by the steadily improving morale of the buying public, and many dealers are even reporting better sales for January of this year than for January of last year.

Switch Boxes.—A 20 per cent drop is reported in the price of standard switch boxes for non-metallic flexible conduit, a representative type now selling for 22½ cents each in lots of 100. Local stocks are big.

Insulating Materials.—Various decreases in price have occurred in cotton tapes and the like and sales are quite slow.

Cross-Arms.—Local stocks are excellent in the face of declining construction. As a gage of local prices it may be noted that the 3¼-in. x 4¼-in., 10-ft. arms, are selling f.o.b. Coast cities in fairly large lots at $1.22 each, and the same arm in the 5-ft. length at 61 cents.

Rubber-Covered Wire.—No. 14 single-braid solid wire has dropped slightly and is now selling in coil lots for about $9.40 per 1,000 ft. It is reported that many contractors are now placing fairly large assorted orders on the assumption that the copper market is at its bottom level.

Water Heaters.—Not very long ago many range installations were held up because of the shortage of electric water heaters, the biggest demand being for the 5-kw. size, generally with a thermostat. The decline of sales effort has remedied this condition and produced stagnant stocks. Jobbers, however, are not worrying over this item at least, for the abundant additional power promised for the near future will intensify sales effort by all branches of the industry.

SEATTLE—PORTLAND

In the Seattle and Portland districts very little change is noted in conditions over those obtaining during the last few weeks. Sales along most lines are light, but are showing gradual improvement, especially among materials utilized in building. Appliance sales in Seattle are considerably ahead of the mark usually made during January and February, and from present indications there will be considerable building, both residence and business, in Seattle and Portland this year. If this proves true, the lumber industry should be materially benefited. There is a gradual decline in prices, but these reductions are not materially affecting sales. Stocks are in fine shape, and no difficulty is experienced in getting shipments from the East.

Manufacturers in the Portland territory report business rather quiet, but the future continues to look bright. Collections are fair, though somewhat slow, but it is not felt that this indicates any ultimate difficulty in realizing the full indebtedness eventually. Jobbers state that business is improving somewhat since the first of the year. Collections by jobbers are still poor; in fact, they show no indications for the better. Approaching liquidations are much in evidence among some of the smaller dealers, and the credit situation is quite strained. Dealers in the Seattle district report that there is a fair business with gradual improvement.

Electric Signs.—A slight drop in materials involved in electric sign construction and noticeable decreases in costs of installation have been instrumental in causing a movement of this merchandise. It is expected to reach considerable magnitude before the end of the year.

Meters.—An increase in demand is noted with increase in construction. Stocks are in much better condition and deliveries are coming through considerably better.

Rigid Conduit.—New construction, which has shown an appreciable increase since the first of the year, has increased the demand for this merchandise but stocks are more than adequate to care for demand. Prices are fluctuating.

Lamp Cord.—Demand shows slight increase, but stocks are ample and replenishments very easy to obtain. A recent drop in prices is noted.

Ranges.—Deliveries are coming through nicely from Eastern factories for spring and summer business, and from indications this year's sales will measure up favorably with those of 1920. Present sales are light in spite of recent reductions in price.

SALT LAKE CITY—DENVER

An Intermountain newspaper of reputable standing said in its latest weekly financial summary: "Many banks have entirely cleared their indebtedness with the Federal Reserve and are in excellent condition to meet the inevitable demands of the coming spring and summer for money to plant and work crops. The very favorable weather conditions during the present winter have meant very many thousands of dollars to the live-stock and agricultural industries. But the best indication of all is the state of mind in which the farmers and the business men are approaching their 1921 problems. People have recovered their courage and their determination. They have come to realize that because prices dropped was no reason to lose faith or to cease their efforts. On the contrary, they are now working harder, thinking more sanely and practicing a more wholesome economy and thrift than at any time before the high-price balloon began to collapse."

Tape.—The demand for tape in all grades is steady, although it is not moving in big volume. Auto accessory dealers and service stations and garages are big consumers of rubber tape, while the mines and industrial plants use large consignments of friction tape, especially of the better grades. The size of tape almost exclusively in demand is the standard ¾-in. There has been some inquiry for the 1-in. size, but not sufficient to make it worth while for jobbers to stock. Jobbers report ample stocks on hand to meet the present trade demands; the only suggestion of a shortage is in the cheaper grades of friction tapes. One big jobbing house has been under the necessity of picking up odd lots wherever they could be found to fill orders specifying immediate delivery. The price tendency on tape is decidedly downward. A 10 per cent reduction has already been announced to dealers and a new schedule sheet noting further decline is now being prepared by jobbers. The cheaper grade of friction tape is now quoted at 70 cents a pound and the best grade is quoted at $1.15. The price of rubber tape ranges from 75 cents to $1.50 a pound.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Southern Jobber Holds Optimistic Outlook

According to an announcement of the Piedmont Electric Company, Asheville, N. C., the company, in all its eighteen years of existence, does not recall entering a new year with such ambitious plans for the future and so much enthusiasm for carrying them through as in this new year. The business of the company in the past few months is reported to show a considerable increase over the corresponding period of a year ago. This is taken as a vote of confidence on its policy of sales.

Austin Machinery Company of Louisiana Incorporates

The Austin Machinery Company of Louisiana, Inc., 1020 Maison Blanche Building, New Orleans, has been incorporated under the laws of the State of Louisiana with $100,000 preferred stock and $200,000 common stock as sole distributer for Louisiana, Arkansas, Mississippi and Tennessee of the products of the Austin Machinery Corporation, manufacturer of contractors' equipment. This corporation, it is announced, will carry a full stock of machinery and spare parts for the requirements of municipalities and contractors of excavation, construction, irrigation and drainage projects.

Navy Specifications Issued for Mica and Batteries

The Bureau of Supplies and Accounts, Navy Department, Washington, has issued specifications 17J3, dated Nov. 1, 1920, on hard-rubber jars and hard and soft rubber parts (except separators) used in storage batteries of submarine boats; 17M5b, dated Dec. 1, 1920, superseding 17M5a of July 1, 1915, on mica and pressed-mica plate, and 17S6, dated Jan. 3, 1921, on separators, hard-rubber, for storage batteries for submarine boats.

International Clay Products Purchases Properties

Announcement is made that the International Clay Products Company, 31 Union Square, New York City, has recently purchased the entire properties, plant, equipment, coal, clay and shale mines of the Clermont Sewer Pipe Company of Pennsylvania and the Kesco Clay Products Company of New Jersey. The Clermont plant covers 400 acres of land and has an annual capacity of 10,000,000 duct feet of clay conduit. Both plants are reported to be operating at full capacity, and complete stocks are carried for prompt shipment. In addition the company carries cable hangers, conduit coupling rods and pick-up tools.

Edison Storage Battery Takes Optimistic Outlook

F. D. Fagan, recently appointed vice-president and general manager of the Edison Storage Battery Company, Orange, N. J., called in district managers from all over the United States and Canada for a conference with department heads and officials during the week of Jan. 31, at which time general policies for 1921 were outlined.

The tone of the convention was very optimistic concerning the big future awaiting the storage-battery business. One point in support of this view is the confidence exhibited by the New York Edison Company in its electric vehicle show, just completed. Optimism for the future of this business rests on a basis which the company thinks never was more concrete.



EDISON BATTERY DISTRICT MANAGERS GROUPED ABOUT THE "OLD MAN" AT THE FACTORY

Westinghouse Veteran Employees' Banquet Attended by 950 Persons

Nine hundred and fifty members of the Veteran Employees' Association of the Westinghouse Electric & Manufacturing Company attended the eighth annual banquet, held in Pittsburgh on the evening of Jan. 29. The association now includes in its membership more than 1,200 men and women. The speakers at the meeting were Col. H. G. Prout, who was long associated with George Westinghouse and who told of his association, and Dr. W. R. Farmer of the Western Theological Seminary. James McA. Duncan, manager of the Pittsburgh district office, was toastmaster. The new officers elected were: R. W. Patton, president; R. L. Wilson, vice-president, and C. W. Hutchinson, trustee.

Marine Equipment Manufacturers' Association Launched

Among the shipbuilders and manufacturers of marine equipment and supplies who were represented at a meeting in New York City on Jan. 28, at which time what was tentatively called the Marine Equipment Manufacturers' Association was formed, were the American Car & Foundry Company, American Engineering Company, American Steel Foundries, Brunswick Refrigerating Company, Charles Cory & Son Inc., Crane Company, Cutler-Hammer Manufacturing Company, Electro Dynamic Company, Fairbanks, Morse & Company, Gold Car Heating & Lighting Company, Griscom-Russell Company, International Nickel Company, Locomotive Superheater Company, Niles-Bement-Pond Company, Page Steel & Wire Company, Shepard Electric Crane & Hoist Company, C. H. Wheeler Manufacturing Company and the Westinghouse Electric & Manufacturing Company.

The objects of the association, as given out by its temporary president, Edward A. Simmons, *Marine Engineering*, Woolworth Building, New York City, are: To advance the interests of its members, to promote good will between those who buy and those who sell marine equipment and supplies, to promote and supervise exhibits, and to co-operate with other associations in the marine field to the end that their efforts for the advancement of the designing, building and operation of ships shall be most productive. K. L. Ames, Jr., American Steel Foundries, 332 South Michigan Avenue, Chicago, is acting secretary.

New Equipment Manufacturers' Agency in New England

Arthur H. Abbott, who was formerly connected with the Boston office of the General Electric Company as transformer specialist, has recently gone into business as a manufacturers' agent, with offices at 88 Broad Street, Boston. He is handling Schweitzer &

Conrad outdoor-substation equipment and liquid fuses, "Hi-Voltage" air-break switches, "Ohio" lifting magnets and fractional-horsepower motors, automatic electric control manufactured by the Sundh Electric Company, Karge-Baker flexible couplings, and stokers and steam-jet ash conveyors manufactured by the Frederick Engineering Company.

To Increase Heater Cord Output 50 per Cent

When the new equipment now on hand is installed, the Driver-Harris Company, Harrison, N. J., will be in a position to increase its output of heater cord 50 per cent. The present production is now around 4,000,000 ft. per month, and with this new equipment the capacity will be increased to 6,000,000 ft. The company disposes of its entire heater cord output to appliance manufacturers.

New York Edison's Vehicle Show Brings Results

From first observations, the results of the electric vehicle show staged by the New York Edison Company in its showrooms during the two weeks ended Feb. 12 will fully justify the effort. In speaking with Mr. Skinner, directly in charge of the show, and with various representatives of the companies exhibiting, a representative of the ELECTRICAL WORLD learned that there has been a great deal of serious thought given to the use of the electric vehicle and the industrial truck in solving the problem of transportation.

Representatives of virtually every steamship and railway line in New York City attended, and the volume of inquiries received was very satisfactory.

The important factor observed was the interest in electric vehicles as a whole in working out industrial and transportation problems, rather than interest in the product of any one manufacturer. Of course, there were some orders placed for both kinds of trucks.

Visitors from central stations as far west as Chicago were present and it is highly probable that in the near future similar shows will be instituted in several sections of the country.

Purchasing Agents Discuss Coal Contracts

W. L. Chandler of the Dodge Sales & Engineering Company, Mishawaka, Ind., president of the National Association of Purchasing Agents, has called a meeting of the fuel committee of this organization to be held at the William Penn Hotel at Pittsburgh on Feb. 18 and 19.

The purpose of this meeting is for the fuel committee to meet and discuss a fair, equitable and inviolate form of contract governing the purchase and delivery of coal.

There will be about thirty-seven members of the fuel committee present, each representing a local association, with Ernest H. Hawkins, E. I. du Pont de Nemours Company, Wilmington, Del., as chairman of the committee and of an advisory council of five members of the fuel committee.

It is the purpose of the fuel committee to reach some form of contract which may be standardized, and at a later meeting the advisory council will meet with representative coal operators, distributers and purchasers to secure their advice and co-operation relative to the provisions of the contract as worked out at this meeting.

Long-Bell Lumber Company to Build Mill and Lumber Plant

The Long-Bell Lumber Company, Kansas City, Mo., is planning to erect a large mill and lumber plant on the Cowlitz River at Kelso, Wash. The proposed plant will have a daily capacity of 1,000,000 ft. and will be equipped with electrically driven machinery throughout. The company turns out wood poles of all kinds and other lumber products used in the electrical industry.

Sanborn Electric Enters Appliance Jobbing Field

The Sanborn Electric Company, Indianapolis, contractor, has taken up the jobbing of electrical appliances and will act as distributer for the Bluebird washing machine, Utenco ironer, Blakeslee dishwashing machine, Capitol ironing machine, Rutenber and Simplex heating appliances, etc. A. I. Clifford, who was formerly associated with the Luxam Electrical Supply Company, Fort Wayne, Ind., is in charge of the sales division of the Sanborn company.

Employees' Representatives Co-operate in Wage Reduction

A wage reduction of 13 per cent to piece workers and 8 per cent reduction to hourly and day workers was announced last week by Richard H. Rice, manager Lynn (Mass.) Works, General Electric Company, effective Feb. 14. Salaried employees, whose increases had not been as high as other classes, are not to be reduced at this time. About 11,000 employees will be affected. The reduction was made on the recommendation of the employees themselves through the joint adjustment committee. This committee consists of four members from the employees, chosen through the shop representative system, and four representatives of the company. The recommendation was made unanimously after a series of meetings in which the business situation was thoroughly discussed, and the amount of the reduction was left to Mr. Rice to determine.

No cut will be made at present in the pay of foremen, assistant foremen, leading hands, draftsmen, engineering and co-operative students, apprentices and instructors, because the wages of these groups have increased by a considerably smaller percentage than the wages of others. In announcing the reductions Mr. Rice pointed out that the present business situation demands the most careful handling in order that its effects may be minimized. In addition to lower costs for the future, intense activity along productive lines is essential to preserve the business in hand, he said.

Fort Wayne Works of General Electric to Be Increased

Sixty acres of ground have just been purchased by the General Electric Company in Fort Wayne, Ind., for the expansion of its Fort Wayne works. This property is adjacent to the present property of the company, and it is planned very shortly to begin the erection on this land of buildings which will add about one-tenth to the size of the plant. According to the company officials, the new property is big enough to provide space for the eventual doubling of the size of the Fort Wayne works.

It is the intention of the company to put up two large one-story buildings on a part of this new property, each affording at least 65,000 sq.ft. of floor space. The transformer shop of the Fort Wayne plant, which has been experiencing a splendid boom in business in recent months, will be housed in these buildings.

At the present time the Fort Wayne plant of the General Electric Company occupies a total of 1,300,000 sq.ft. of floor space and under normal conditions employs about 6,000 workers. The erection of the additional buildings will mean that the company will have to employ at least 500 additional workers.

Combustion Official Abroad for Consultation

George E. Learnard, president of the International Combustion Engineering Corporation, 11 Broadway, New York, has just gone abroad to confer with certain officials of the Underfeed Stoker Company, Ltd., of London, England, as well as with some well-known men of France. Through the International company there is close affiliation between the Underfeed Stoker Company, Ltd., London, and the Combustion Engineering Corporation, New York. The Underfeed Stoker Company, Ltd., is planning to build a large new factory near London, and Mr. Learnard is to be present when this work starts. It is also expected that he will be on hand when work is started on a French factory.

Mr. Learnard's belief is that the whole subject of proper combustion engineering is more or less a keystone in any reconstruction and rehabilitation program and that the general moral effect of considering the enormous economies that can be brought about by proper combustion engineering is perhaps more helpful to the general situation than the mere saving of dollars that it represents.

The Thordarson Electric Manufacturing Company, 501 South Jefferson Street, Chicago, announces the appointment of J. L. Finnicum as sales manager. Mr. Finnicum was formerly connected with the Doubleday-Hill Electric Company, Pittsburgh, for more than eight years in the capacity of salesman and in charge of the apparatus department. For the last two years he has been acting as district manager at Chicago for the Electric Products Company, Cleveland.

The Pelton & Crane Company, Detroit, announces the return of the "Pelton" electric furnaces. The company discontinued the manufacture of these furnaces in 1916 when the supply of certain necessary materials was cut off.

The Yale & Towne Manufacturing Company, Stamford, Conn., has filed notice of increase in capital stock from $5,000,000 to $25,000,000.

The Harrisburg Machine & Electric Welding Company, Harrisburg, Pa., recently organized, is planning to establish a machine shop in a building now being erected in the vicinity of Eighteenth and Chestnut Streets, which it is expected will be ready for occupancy about the middle of March. Later the company proposes to erect a new plant at the corner of Eighteenth and Chestnut Streets to provide for increased operations.

The Gwilliam Supply Company, Philadelphia, manufacturer of conduit fittings, has removed its plant from 528 North Hancock Street to 830 North Hancock Street.

The Appleton Electric Company, Chicago, is now established in its new plant at Paulina and Wellington Streets, where it has much larger quarters.

The Crown Chandelier Manufacturing Company, New York City, manufacturer of lighting fixtures, etc., has removed from 103 Mott Street to 610-12 Broadway, where it has considerably more floor space and increased facilities to take care of its rapidly increasing business.

The Mutual Metal Manufacturing Company, 1948 North Kedvale Avenue, Chicago, has been organized to take over the plant of William Christensen, manufacturer of lighting-fixture parts.

The Utility Fittings Company, Philadelphia, manufacturer of electrical conduit fittings, has removed from 812 Walnut Street to 1932 East Westmoreland Street, where its new factory is located. The company, it is said, contemplates taking on several new lines in conjunction with its regular line of products.

The Acme Electric & Manufacturing Company, Cleveland, manufacturer of battery-charging apparatus, dies, tools and gages, has enlarged its factory space and has purchased a new building at 1444 Hamilton Avenue. It has recently developed a motor-generator for motion-picture purposes. The company has established sales agencies as follows: Otto Sarvas, 1966 Broadway, New York City; Elliott Reynolds, Sixty-third and Oxford Streets, Philadelphia; R. H. Barber, 4111 Ravenswood Avenue, Chicago; R. L. Lunt, 716 McKnight Building, Minneapolis; Detach & Company, 555 Turk Street, San Francisco; A. C. Gilchrist, 1444 Hamilton Avenue, Cleveland; L. J. Kaiser, 2476 Park Boulevard, Detroit.

The Crocker-Wheeler Company, Ampere, N. J., announces that it will remove its Philadelphia office from the North American Building to 1209 Arch Street on or about Feb. 15. Samuel Russell, Jr., has been in charge of the Philadelphia office since 1897.

Thebo & Starr, Sharon Building, San Francisco, engineers and constructors, have issued a four-page leaflet showing photographic reproductions of work completed west of the Rocky Mountains since 1905 which was supervised by the members of their firm.

The Delta Electric Company, Marion, Ind., has filed notice of increase in capital stock from $115,000 to $165,000.

J. Livingston & Company, Inc., Grand Central Terminal, New York City, constructing, electrical and mechanical engineers, announces the opening of a branch office at 123 West Madison Street, Chicago, under the supervision of L. F. Brooker, vice-president.

Foreign Trade Notes

GERMANY HAS ELECTRICAL ARTICLES TO EXPORT.—According to a report from the United States Consul at Gothenburg, Sweden, Germany, in its advertising spreads in newspapers of western Sweden, shows that it is now in a position to export many articles of trade, among which are general electrical fixtures, generators, etc.

THE HOOVER SUCTION SWEEPER COMPANY OF CANADA, LTD., will hold its second annual dealer conference at the Royal Connaught Hotel, Hamilton, Ontario, Feb. 9 and 10. Talks on merchandising and selling, business conditions in Canada, etc., are among the subjects to be discussed.

NEW ELECTRIC PLANT IN BLACKBURN, ENGLAND.—The Electricity Committee, according to the London *Times*, has approved revised estimates amounting to £850,000 for the completion of a new electric generating plant. Application will be made to the Electricity Commissioners for permission to borrow £600,000, the difference between the amount already approved and the amount of the revised estimate.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LTD., London, England, manufacturer of cable, is, according to the London *Electrician*, inviting applications for an issue of 250,000 ordinary shares of £1 at the price of £1 4s. per share, the proceeds to be used to finance expansion in business and to provide for additions to its works to meet future demands.

MARKET FOR ELECTRIC LAMPS IN NETHERLANDS EAST INDIES. — The trade in electric bulbs for the various municipalities in the Netherlands East Indies, according to John A. Fowler, trade commissioner, is controlled by the companies supplying the energy. On the directorate of most of these companies is a firm which before the war was the representative in the Netherlands East Indies for the German General Electric Company. Since the war this firm has been incorporated and has formed a subsidiary company that specializes in electrical supplies. It may be inferred that all supplies for the large municipal plants are routed through this subsidiary company. There are a large number of private installations for estates and some municipal lighting systems outside of the above-mentioned combination.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A commercial agent in Spain (No. 34,392) desires to secure the representation of firms for the sale of electric machines for planing and polishing waxed floors, electric stoves, etc.

A commercial agency firm in Ceylon (No. 34,409) desires to secure the representation of manufacturers for the sale of wire, electric lamps and general wiring accessories.

A machinery importing firm in Spain (No. 34,411) desires to secure an agency from manufacturers and exporters for the sale of steam engines, turbines, electrical supplies, etc.

A firm in India (No. 34,412) desires to receive quotations from manufacturers of semi-indirect lighting fixtures, etc.

A commercial agency in Italy (No. 34,413) desires to secure an agency for the sale of electrical fixtures, electrical apparatus, etc.

A firm of engineers in England (No. 34,422) desires to purchase or to secure an agency for articles used in electrical and mechanical engineering, such as glass and metal reflectors or shades and electric motor accessories.

New Apparatus and Publications

MOTORS.—The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1113, describing its type "Sar" single-phase repulsion motor which it is just placing on the market.

MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, has issued bulletin 125, in which it gives instruction for ordering and adjusting repair parts for the Wagner single-phase motors.

LEATHER BELTING.—The Edward R. Ladew Company, Inc., Glen Cove, N. Y., has recently issued two publications, one entitled "The Proof Book" on leather belting, and the other a catalog describing the manufacture of Hoyt leather belting.

SEPARATORS. — The Griscom-Russell Company, 90 West Street, New York City, is distributing a form sheet describing the new Stratton separator for power plants.

ANGLE FITTINGS, WATER HEATERS AND ROTOMETERS.—The American District Steam Company, North Tonawanda, N. Y., has issued bulletins Nos. 151, 152 and 153, describing its "Adsco Rotometer," "Adsco" water heaters and "Adsco" angle fittings, respectively.

TRANSFORMER AND CHOKE COIL FOR RADIO WORK.—The Clapp-Eastham Company, 139 Main Street, Cambridge, Mass., has issued bulletin ZR3, describing the new Z. R. S. switch modulation transformer and choke coil for radio work which it is about to place on the market.

New Incorporations

THE SEWICKLEY ELECTRIC MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $500,000. The incorporators are Arthur J. Kingsbury, L. B. Phillips, A. E. Silver, Dover. The company proposes to manufacture meters.

THE WESTERN ELECTRICAL PORCELAIN COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $550,000. The incorporators are T. L. Croteau, M. A. Bruce, S. E. Dill, Wilmington.

THE PARAGON POWER SPECIALTIES COMPANY, Hartford, Conn., has been incorporated with a capital stock of $5,000 by H. C. Bailey, Louis Z. Richards, Frederick R. Gleason and J. D. Cherry.

THE WESTERN NEW YORK FARM LIGHT & POWER COMPANY, Almond, N. Y., has been incorporated with a capital stock of $6,000 by G. A. and H. A. Guenther and L. B. Stewart.

THE O. K. BATTERY SALES COMPANY, Schenectady, N. Y., has been incorporated with a capital stock of $5,000 by E. J. Sharpley, J. A. Bell and J. A. Franken, Jr.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 25, 1921)

1,366,533. BATTERY INDICATING DEVICE. Ralph H. Grant, Dayton, Ohio. App. filed March 31, 1916. For indicating condition.

1,366,534. ANODE; Joseph A. Hall, New Britain, Conn. App. filed June 4, 1919. For electroplating.

1,366,539. TELEPHONE TRUNKING AND SUPERVISORY SYSTEM. Edward A. Mellinger, Chicago, Ill. App. filed June 10, 1909. Automatically trunking.

1,366,544. STARTING AND GENERATING SYSTEM; William A. Turbayne, Niagara Falls, N. Y. App. filed May 20, 1916. Automobile.

1,366,545. DYNAMO-ELECTRIC MACHINE; William A. Turbayne, Niagara Falls, N. Y. App. filed July 20, 1915. Automobile.

1,366,546. DYNAMO-ELECTRIC MACHINE; William A. Turbayne, Niagara Falls, N. Y. App. filed March 27, 1916. For automobile.

1,366,559. PRODUCTION OF ELECTRODES FOR GALVANIC BATTERIES; Harold N. Cox, Glen Ridge, N. J. App. filed April 12, 1919. Caustic alkaline electrolyte.

1,366,562. POLE STRUCTURE; Frank Engel, Niagara Falls, N. Y. App. filed Dec. 13, 1915. For preventing edges of pole pieces from cutting through insulation.

1,366,567. EARPIECE FOR THERMIC TELEPHONES; Pieter de Lange and Robert Aernout, Utrecht, Netherlands. App. filed Nov. 4, 1915. Introduced into the ear.

1,366,580. INDUCTION MOTOR; John Martin, Rugby, England. App. filed Jan. 12, 1920. Large number of possible speeds with two induction motors.

1,366,595. MARINE-ENGINE GOVERNOR OR CONTROLLER; Sydney J. Sanford, Los Angeles, Cal. App. filed Jan. 19, 1918. For preventing the propeller from racing.

1,366,600. RESISTANCE UNIT; William Schwagermann, Yonkers, N. Y. App. filed June 30, 1919. Cylindrical, mounted endwise.

1,366,606. TELEPHONE RECEIVER; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 27, 1919. Better speech reproducing.

1,366,607. TELEPHONE RECEIVER; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 28, 1919. Better reproducing.

1,366,617. TELEGRAPHONE. Holly E. Weir, Plainfield, N. J. App. filed Oct. 28, 1916. Speech recording and reproducing.

1,366,627. HIGH-FREQUENCY ALTERNATOR; Ernst F. W. Alexanderson and Samuel P. Nixdorff, Schenectady, N. Y. App. filed Dec. 6, 1918. For radio.

1,366,629. LIGHTING VEHICLES; Morton Arendt, New York, N. Y. App. filed April 25, 1917. Battery-charging system.

1,366,648. LIGHTING FIXTURE; Joseph Goodman, Pittsburgh, Pa. App. filed April 22, 1919. Shade can be vertically adjusted.

1,366,650. SIGNALING SYSTEM; Baxter P. Hamilton, Brooklyn, N. Y. App. filed Feb. 27, 1919. Plurality of signals.

1,366,653. PROCESS OF MODIFYING STARCH; Ellery H. Harvey, Lansdale, Pa. App. filed May 13, 1920. Electrolytic.

1,366,661. INSULATED CLEAT; Bennett G. Jansson, Saugus, Mass. App. field Jan. 23, 1917. Nail for securing telephone wires.

1,366,699. INCANDESCENT ELECTRIC LAMP SOCKET; Norman W. Nutt, Trenton, N. J. App. filed May 3, 1919. Detachable shell.

1,366,700. ELECTRIC SWITCH; Norman W. Nutt, Trenton, N. J. App. filed June 14, 1919. Snap action.

1,366,701. ELECTRIC SWITCH; Norman W. Nutt, Trenton, N. J. App. filed June 14, 1919. Snap action.

1,366,702. INCANDESCENT ELECTRIC LAMP SOCKET; Norman W. Nutt, Trenton, N. J. App. filed Aug. 1, 1919. Keyless.

1,366,720. PROCESS AND PLANT FOR INDUSTRIALLLY CARRYING OUT CHEMICAL REACTIONS IN AN ARTIFICIAL ATMOSPHERE; Marie C. J. E. de Loisy, Paris, France. App. filed June 26, 1919. For chemical processes.

1,366,752. WATER HEATER; Richard M. Stephens, Glen Ellen, Cal. App. filed Dec. 27, 1919. To heat small amounts.

1,366,756. CAUTERY ELECTRODE; Reinhold H. Wappler, Yonkers, N. Y. App. filed Feb. 12, 1919. Surgical.

1,366,794. ELECTRIC WATER HEATER; Frederick Hachmann, St. Louis, Mo. App. filed June 12, 1920. No corrosion.

1,366,799. STORAGE-BATTERY CLIP; Charles F. Hartung, Alhambra, Cal. App. filed Feb. 4, 1919. For charging or testing.

1,366,812. SELECTIVE OR PRINTING TELEGRAPH; Charles L. Krum and Howard L. Krum, Chicago, Ill. App. filed May 17, 1915. Impulses controlled by tape.

1,366,830. FREQUENCY-SELECTING RECEIVING CIRCUIT; Frederick E. Pernot, Berkeley, Cal. App. filed Dec. 19, 1917. Receiving circuit turned.

1,366,838. TRANSMITTER FOR CABLES; Fred L. Rogers, Brooklyn, N. Y. App. filed May 5, 1919. Automatic telegraph.

1,366,840. HEATER; Harry A. Scisinger and Emmett W. Adams, Chicago, Ill. App. filed June 29, 1920. Heat-radiating drum.

1,366,844. VARIABLE-POWER REGULATION; John A. Snee, Jr., West Elizabeth, Pa. App. filed Feb. 16, 1915. To keep wheel under most efficient load.

1,366,851. ELBOW FITTING FOR ELECTRIC INSTALLATION; Wheeler H. Vibber, New London, Conn. App. filed Dec. 2, 1919. Conduit fitting.

(Issued Feb. 1, 1921)

1,366,911. LIGHTING FIXTURE; Harry A. Holloway and Louis E. Trachsel, St. Joseph, Mo. App. filed June 2, 1919. Conveniently attached and detached.

1,366,912. RELAY; William Kaisling, Chicago, Ill. App. filed Oct. 22, 1917. Telephone.

1,366,914. SAFETY CUT-OUT SWITCH; Oliver M. King, St. Joseph, Mo. App. filed July 9, 1919. For series lights.

1,366,916. GASOLINE HEATER; William A. La Belle, St. Louis, Mo. App. filed Sept. 25, 1919. For engines.

1,366,945. RHEOSTAT; Floricel A. Rojas, New York, N. Y. App. filed Feb. 20, 1919. Compression type.

1,366,953. RADIO RECEIVING APPARATUS; Henry K. Sandell, Chicago, Ill. App. filed Oct. 13, 1919. Thermionic or electrionic type.

1,366,960. METER; Rudolph F. Schuchardt, Chicago, Ill. App. filed Nov. 29, 1918. Power factor.

1,366,979. MAGNETIC SEPARATOR; Georg Ullrich, Magdeburg, Germany. App. filed Jan. 21, 1916. Magnetic field in several zones.

1,366,984. WINDING FOR MULTIPLE-SPEED MOTORS; Hans Weichsel, St. Louis, Mo. App. filed July 16, 1919. Single phase.

1,366,996. CONTROLLER-OPERATING MECHANISM; Hubert K. Wood, Bayside, N. Y. App. filed April 19, 1917. Time switch.

1,367,021. ELECTRODE-ADJUSTING MECHANISM; Edwin L. Crosby and Oliver J. Marshick, Detroit, Mich. App. filed Oct. 31, 1919. For rocking furnace.

1,367,089. CONTROL SYSTEM FOR ELECTRIC FURNACES; Raymond T. Pierce, Wilkinsburg, Pa. App. filed Dec. 14, 1918. Constant temperature after initial setting.

1,367,097. ELECTRODE FOR ELECTROLYTIC CELLS AND PROCESS OF MAKING THE SAME; Clarence J. Rottmann, Wilkinsburg, Pa. App. filed April 5, 1917. Condensers, lightning arresters, rectifiers and the like.

1,367,098. APPARATUS FOR PROTECTING METAL-VAPOR RECTIFIERS; Bela B. Schafer, Baden, Switzerland. App. filed Feb. 10, 1920. Aperture of arc-guilding sleeve shut off from cathode by a louver.

1,367,102. CONSTANT-TEMPERATURE DEVICE; Joseph Slepian, Wilkinsburg, Pa. App. filed July 10, 1918. To maintain thermocouple at constant temperature.

1,367,103. SYSTEM OF CONTROL; Gerald F. Smith, Wilkinsburg, Pa. App. filed March 11, 1919. During regenerative period.

1,367,106. CONTROL SYSTEM; Wilfred Sykes, Pittsburgh, Pa. App. filed July 11, 1914. To control voltage of generators.

1,367,118. SYSTEM OF CONTROL; Andrew H. Candee, Pittsburgh, Pa. App. filed June 15, 1917. Electric railway vehicles.

1,367,122. CONSTANT-TEMPERATURE DEVICE; Lewis W. Chubb, Edgewood Park, Pa. App. filed July 10, 1918. For maintaining temperature of a member constant.

1,367,124. ELECTRIC FURNACE; Ora A. Colby, Irwin, Pa. App. filed Jan. 8, 1919. For heaing metal bands.

1,367,125. INDUCTION LIQUID HEATER; Ora A. Colby, Irwin, Pa. App. filed April 7, 1920. Installed in household boiler.

1,367,137. MOTOR-CONTROL SYSTEM; Edward A. Hanff, Wilkinsburg, Pa. App. filed June 11, 1915. Dynamic braking.

1,367,138. MOTOR-CONTROL SYSTEM; Edward A. Hanff, Irwin, Pa. App. filed Nov. 22, 1916. For driving reciprocating mechanisms.

1,367,139. ELECTRICAL SYSTEM; Edward A. Hanff, Irwin, Pa. App. filed Dec. 9, 1916. Control by varying field excitation and polarity of generators.

1,367,140. MEANS FOR CONTROLLING FLASHING IN HIGH-VOLTAGE COMMUTATOR MACHINES; Rudolf E. Hellmund, Swissvale, Pa. Simple and effective.

1,367,155. ELECTRICAL SYSTEM; Walter O. Lum, Pittsburgh, Pa. App. filed May 16, 1916. Operation of reversing rolling mills.

1,367,165. RADIO-TELEGRAPHIC RECEIVING SYSTEM. Haraden Pratt, San Francisco, Cal.

1,367,169. TELEPHONE ATTACHMENT; Harrison D. Sterrick, Pittsburgh, Pa. App. filed July 10, 1919. For supporting receiver.

1,367,212. ROTARY WELDING MACHINE; William S. Southwick, Clinton, Mass. App. filed April 22, 1918. For making fencing.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

AMESBURY, MASS.—The Bryant Body Company is considering operating its plant by electricity and supplying energy to other industrial plants in that section of the city.

BROCKTON, MASS.—The Department of Public Utilities has granted permission to the Edison Electric Illuminating Company to issue $516,600 additional capital stock to pay floating indebtedness and for extensions, etc.

BRIDGEPORT, CONN.—The Tide Water Oil Company, Bostwick Avenue, plans to erect a power house and pumping plant at its local works.

Middle Atlantic States

BROOKLYN, N. Y.—The Brooklyn Edison Company, 13 Willoughby Street, will soon ask for bids for the construction of a power house, 37 ft. x 100 ft., at Livonia and Miller Avenues. G. L. McKnight, engineer, is in charge.

BUFFALO, N. Y.—The City Council is considering plans for the installation of a municipal electrically operated ice-manufacturing plant at the Massachusetts Avenue pumping station. The cost, including equipment, is estimated at about $270,000.

BUFFALO, N. Y.—The Wickwire-Spencer Steel Corporation, River Road, has preliminary plans under way for the installation of considerable electric equipment in the proposed addition to its plant to be constructed at a cost of more than $1,000,000.

DELANCEY, N. Y.—The Delancey Electric Light Company, Inc., has applied to the Public Service Commission for permission to construct and operate an electric power distribution plant.

NEW YORK, N. Y.—Plans have been filed by the New York Edison Company, Irving Place and Fifteenth Street, for the erection of a substation, about 39 x 56 ft., at 159-61 Greene Street, to cost about $160,000.

OLD FORGE, N. Y.—Plans are under way by the Village Council for the construction of a municipal electric power plant to be operated in connection with the water-works system. The cost is estimated at about $50,000. W. D. Morris is clerk.

ATLANTIC CITY, N. J.—The Atlantic City Tire & Rubber Company, 3304 Atlantic Avenue, contemplates the installation of considerable electrical equipment in its proposed automobile tire manufacturing plant, to be built on North Georgia Avenue, at an estimated cost of $70,000.

EDGEWATER, N. J.—Considerable electrical and mechanical equipment, including cranes, hoisting apparatus, conveying equipment, etc., will be installed by the Luckenback Steamship Company, 44 Whitehall Street, New York City, in its proposed new freight terminal in Edgewater.

ELIZABETH, N. J.—The Board of Public Works is considering improvements to the street-lighting system. It is proposed to replace gas lamps with arc lamps.

GLEN MOORE, N. J.—The Delaware River Quarry & Construction Company, 21 Bridge Street, Lambertville, plans to erect a power house in connection with its proposed quarrying and rock crushing plant near here, to cost about $100,000 including equipment. R. A. Montgomery is president.

WOODBRIDGE, N. J.—The lighting commissioners of the seventh district of Woodbridge Township, which comprises, Fords, Hopelawn and Keasbey, contemplates improvements to the lighting system. The cost is estimated at $7,000. W. Lybeck of Fords will be in charge.

ALLENTOWN, PA.—The Pennsylvania Power & Light Company has arranged for an issue of $8,000,000 in bonds, part of the proceeds to be used for extensions and improvements to its plants and system in this section.

CHESTER, PA.—The Delaware County Electric Company contemplates rebuilding its one-story works at Front and Market Streets, recently damaged by fire.

EAST BERLIN, PA.—The East Berlin & Abbottstown Electric Company, recently organized with a capital stock of $15,000, has applied to the borough councils of East Berlin and Abbottstown for franchises to erect poles for an electric distribution system. P. C. Smith is president.

LOCK HAVEN, PA.—The Lock Haven Electric Light & Power Company plans to erect a new electric generating station to cost about $300,000. Work will be started immediately.

PHILADELPHIA, PA.—Bids will be received at the office of the depot quartermaster of the United States Army, Philadelphia, until Feb. 25 for furnishing 14,200 ft. of copper cable.

PHILADELPHIA, PA.—The Federal Trust Company has had plans prepared for the erection of an addition to the power plant on Hicks Street.

BALTIMORE, MD.—Considerable electrical and mechanical equipment will be required in connection with the proposed new municipal hospital to cost about $750,000. Negotiations are under way for an appropriation for the construction of the building.

North Central States

ATWATER, OHIO.—A petition is being circulated for the installation of a lighting system on certain streets in Atwater.

CLEVELAND, OHIO.—The Cleveland Railway Company is considering an issue of $3,000,000 in stock for the construction of a proposed railway power plant. F. Sanders is traction commissioner.

LIMA, OHIO.—The City Council has authorized an expenditure of $180,000 for the installation of an ornamental lighting system on twenty-five blocks in the center of the city and on part of Market and Main Streets.

SOUTH ELGIN, ILL.—A committee, including F. Wills and others, has been appointed to investigate the proposal of erecting an electric transmission line from Elgin to this village. The cost has been estimated at $5,000.

RACINE, WIS.—The Milwaukee Electric Railway & Light Company is considering the extension of its electric distribution lines from Racine to Franksville and Thompsonville and supplying light and power along the proposed route.

RAMONA, WIS.—A transmission line will be erected from the light and power plant in Madison to supply electricity for the proposed lighting system in Ramona.

NASHWAUK, MINN.—A proposal to issue bonds to the amount of $50,000 for light and water improvements will be submitted to the voters.

SHERBURN, MINN.—The electric light commission of Sherburn is negotiating with the Commonwealth Power Company, Mankato, for the extension of a transmission line from either Truman or St. James to Sherburn.

GRISWOLD, IOWA.—The construction of an electric light and power plant to cost about $50,000 is under consideration by business men here. Tentative plans include the installation of oil engines and three generators, of 200 and 100 direct-connected units, respectively.

KANSAS CITY, MO.—A uniform system of street lighting by electricity to replace the present gas and electric lamps has been recommended by a "get it done" committee. The committee recommends that all multiple lamps be replaced with one-lamp standards. The cost is estimated at about $500,000. The present system consists of 5,621 gas lamps, 153 electric lamps of 600 cp. and 33,856 electric lamps of 250 cp.



A $2,000,000 STATION IS BEING RAPIDLY CONSTRUCTED AT MARION, OHIO, BY SANDERSON & PORTER OF NEW YORK FOR THE COLUMBUS, DELAWARE & MARION ELECTRIC COMPANY

HILLSBORO, KAN.—Bonds to the amount of $60,000 have been voted for improvements to the municipal light plant.

Southern States

JACKSONVILLE, FLA.—Bonds to the amount of $190,000 have been voted for extensions to the street-lighting system and other municipal improvements in South Jacksonville.

OCALA, FLA.—The Cove Company contemplates the development of power on the Wichlacooche River.

GADSDEN, ALA.—The Southern Manufacturing Company contemplates the installation of electric power at its door-manufacturing plant.

NEWTON, ALA.—The Houston Power Company plans to erect a dam and power house on the Choctawhatchee River to develop 2,000 hp.

HARDY, ARK.—The Mammoth Spring Light & Power Company, Mammoth Spring, plans to supply electric energy in Hardy.

PINE BLUFF, ARK.—The Arkansas Light & Power Company has applied to the Arkansas Corporation Commission for a certificate of convenience and necessity to erect 43 miles of high-tension transmission lines between the Picron power plant and Malvern. A similar petition was filed for a line from North Little Rock to Dardanelle for service to a number of adjoining towns. The company also contemplates extending its lines from El Dorado to the oil fields, 6 miles distance. H. C. Couch, Pine Bluff, is president.

OKLAHOMA CITY, OKLA.—Arrangements have been made by the Oklahoma Gas & Electric Company for an issue of $6,000,000 in bonds. Part of the proceeds will be used for proposed extensions to its plants and system. J. J. O'Brien is vice-president.

DALLAS, TEX.—C. A. Mangold, vice-president of the Jefferson Hotel Company, contemplates the organization of a company for the construction of an electric light and power plant.

MISSION, TEX.—Bonds to the amount of $100,000 have been voted for improvements and extensions to the street-lighting, water and sewer systems, etc.

PLAINVIEW, TEX.—The Texas Utilities Company contemplates extending its electric power transmission system to Tulia and Kress. J. B. Scott is manager.

SIPE SPRINGS, TEX.—The Winchester Texas Oil & Refining Company, Fort Worth, contemplates the installation of an electric generating plant for pumping and other purposes in connection with oil development in Sipe Springs field. E. Kimble will supervise the installation of the equipment.

SPUR, TEX.—Grogan & Stovall, Vernon, have purchased the property of the Spur Light & Power Company and contemplate the erection of a power house and other buildings.

Pacific and Mountain States

ELLENSBURG, WASH.—The Kittitas Light & Power Company, recently incorporated with a capital stock of $36,000, contemplates the construction of electric plants. E. E. Wager, J. O. Sorenson and others are incorporators.

SPOKANE, WASH.—The Spokane & Eastern Railway & Power Company contemplates an expenditure of $151,000 for improvements, etc., this year. F. E. Connors is general manager.

WALLA WALLA, WASH.—The City Commissioners contemplate improvements to the street-lighting system.

OAKLAND, CAL.—The Council is considering improvements to the street-lighting system in the downtown section of the city of Oakland.

RIVERSIDE, CAL.—The Southern Sierras Power Company has been authorized by the Railroad Commission to issue $444,260 in bonds for the construction of hydro-electric plants on property formerly owned by the Mono Power Company. A main plant and the Adams auxiliary plant are now under construction.

SAN FERNANDO, CAL.—An electric lighting system will be installed on Mission Boulevard and Kalisher Street.

SANTA PAULA, CAL.—The purchase of an electric fire-alarm system is under consideration by the board of trustees.

CASA GRANDE, ARIZ.—Plans have been prepared by Long & Wichell, Dallas, for the construction of a sanitarium near Casa Grande, including twenty-five main buildings, to cost about $2,000,000. Plans provide for the installation of a lighting system.

PUEBLO, COL.—The Arkansas Valley Railway, Light & Power Company will start work April 1 on the reconstruction of its electric power transmission lines to Rocky Ford. The company plans to change the voltage from 33,000 to 66,000, which will necessitate the replacement of about 5,500 pole insulators. Alterations will be made to the distribution system, including changes in wiring and transformers.

Canada

HAMILTON, ONT.—The Hydro-Electric Power Commisssion of Ontario proposes to erect an 110,000-volt station near here for supplying energy to the easterly limits of the city. Upon completion of this work a new distribution station will be constructed in place of the one now at Gage and Burlington Streets. W. Ellis is chairman of the commission.

LONDON, ONT.—According to a report prepared by Alderman F. E. Harley, which he will submit to the municipalities at a convention to be held in London on Feb. 23 the cost of the electrification of the London, Huron & Bruce Railway is estimated at $1,642,500.

HULL, QUE.—The Ottawa & Hull Power Company will soon ask for bids for an auxiliary steam plant to cost about $300,000. R. Blackburn, Wellington Street, Ottawa, Ont., is superintendent.

Miscellaneous

LEON, GUANAJUATO, MEXICO.—The construction of an electric street-railway system is under consideration by the City Council.

SAN ANDRES TUXTLA, VERA CRUZ, MEXICO.—The municipal authorities are endeavoring to secure American interest and capital toward the construction of a large hydro-electric plant near San Andres Tuxtla, capable of generating 40,000 hp. to be distributed for industrial and domestic purposes. The construction of an electric street railway would also be undertaken in connection with the hydro-electric project.

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A Point that Should Be Made Clear to the Unthinking

POLITICIANS who seek to win popular support by favoring the abolition of the public service commissions presumably aim at a direct exercise of the police power of the state through legislation or by authority vested in municipalities in place of its delegation to a regulatory body. Assuming—for argument's sake only—that the main interest of the consumers in public utilities is to get service at the lowest possible price, this is not the way in which it is most likely to be done. Legislators may enact, but in the background stand the courts and the Fourteenth Amendment, and it needs only a superficial acquaintance with the trend of legal decisions in protested-rate cases to make it clear that while state and federal courts almost always treat commission rulings with the respect due to the findings of competent and impartial bodies exercising judicial functions, they are not habitually tender to statutes attacked as confiscatory. We are here neither praising the commissions at the expense of the courts nor the courts at the expense of the commissions, but merely suggesting that along the line indicated a doubt might with entire propriety be instilled into the minds of unreasonable consumers as to whether, from their own perverted point of view, it would be wise to get rid of the ills they think they have only to run into others that they know not of.

National Survey of Waste in Industry

WASTE is an economic problem. It connotes idleness, duplication of effort, competition, unnecessary expenditure of resources or of human effort, lack of co-ordination and standardization, improper use of the mechanism of production and distribution and other such conditions. If, therefore, waste is to be discovered and its effects overcome, the job must be taken up by technicians and engineers, who alone of all men are trained to search out, collate and interpret facts dealing with production and utilization. This the American Engineering Council proposes to do, for it has set itself the task of making a national survey of waste in industry and suggesting some practical plan for amelioration. It goes without saying that if the problem is approached in the proper spirit and the economic process as a whole considered, the study will be exceedingly profitable, more especially if it shall also reveal the best way of doing things as contrasted with existing methods. With a man like Herbert Hoover at the head of such a survey, the problem is certain to be handled in a big and broad way, with full recognition of the cost of reconstruction. The average reformer, even though he be an engineer, is very apt to overlook realities in his enthusiasm for the ideal. Nevertheless, we are all of the earth earthy and are not inclined to dispense with present methods for others admittedly better but whose economies are offset by the large expenditure of money or labor necessary to their adoption. All waste is not uneconomic, and therefore many new and better methods are for the time being prohibited. Actual wastage in this country, however, is tremendous, and the American Engineering Council can, if it will, be the prophet of a new and infinitely better industrial era.

Another Notable Record for the West

UNDER the lash of an urgent demand for more power when almost the whole of the State of California was suffering from the lack of sufficient rainfall, with the consequent decreased outputs from hydro-electric plants and increased demands for electric power for pumping irrigating water, the San Joaquin Light & Power Corporation constructed in fifteen months a hydro-electric generating station rated at 50,000 hp. The design of the plant embodies features of the most successful developments of the past as well as innovations of its own. Much of the apparatus has been placed outdoors at a considerable saving in cost over indoor construction, as outdoor construction in that territory has been found to be particularly economical, the climatic conditions being mild. It was in the actual construction of the dam, tunnels and station that many innovations were brought into play. The work on the dam was started even before a road was built. The tunnels were mucked by a steam shovel and the muck carried out in electrically propelled cars. In one month 453 ft. of tunnel was driven. Other records in speedy construction were made in laying the penstock and building the station proper. The need of the additional power was so great that at the completion of the plant an unusual popular demonstration of the starting of a hydro-electric station was staged at the site.

"Value of Service" Proposed as Basis of Rates

NO COMMUNITY consumer is entitled to rates from a transmission system that are out of proportion to the value of the service. This thought was dwelt on in our issue of last week by N. A. Kemmish in an article outlining a unit system of wholesale and retail rates. A factor called "value of service" is established for each community or group based on the cost of furnishing its own service, and the total costs of service are apportioned between the various groups on the ratio of any one factor to the sum of all. Each group thus obtains the advantage due it as part of the combined system, but it is given no advantage that its natural

position does not warrant. A great deal of discussion is going on at the present time as to what proportion of system costs a community should bear when a power plant is established in or near that community. Some contend that the location of the plant makes no difference and that the community should bear its pro rata share of the system costs. Others contend that the community should be treated as a separate unit and that none of the system cost should be borne by it. Either position is extreme and ignores the benefits of interconnection. Mr. Kemmish's plan provides a method of apportioning the costs that is well worth careful study. Interconnection on a large scale is developing more rapidly than is generally realized, and the rate problem is becoming more acute as a consequence. Much of the complication is the result of looking at the problem in too much detail in place of first visualizing it as a whole and then working down to details. Mr. Kemmish's article is a praiseworthy attempt in the right direction.

Shall Iron Conductor Be Used?

WHEN to use iron wire and when not is a much debated question. The outstanding physical characteristic developed in all tests and discussions is that the economical current-carrying limit of such wire is low, many placing 5 amp. as a maximum. Whatever this limit may be, it is clear that the value is relatively small and provides a very definite load-carrying limit. The relative prices of copper and iron affect the choice somewhat, but by and large the physical characteristics are the controlling factor. The first consideration in any case is that of future growth. Even though original loads may be well within the capacity of an iron conductor, any probability of growth of load or appreciable extension of lines will cast a serious doubt on the advisability of using it, since the expense of changing together with the interruption of service will far outweigh any temporary saving that its use may make. This usually confines iron wire to the lightly loaded lines where there is no chance of load growth or extension or where the possibility is extremely remote. The question is being extensively debated in connection with the rural service situation of the Middle West, and the general sentiment seems to turn rather strongly against the use of iron wire, principally because virtually every extension is potentially a part of a long line or an extensive network that cannot give adequate service if iron conductors are used.

While there is little question that the use of iron wire will always be relatively small, it must not be forgotten that there is a very definite place for it in short stubs on higher voltage lines where no possibility of load growth or extensions exists and in the sections where physical conditions put a definite limit on line lengths or loads. If its use means the extension of a service, without future embarrassment, that otherwise could not be extended, it can then be seriously questioned whether insistence on copper is a wise policy unless there are climatic or other conditions that will make iron short-lived and a public hazard. The whole question is one on which no general rule can be laid down. It calls for careful consideration in each individual case, and the decision will usually turn on the question as to what the possibilities of future growth are and whether the service justifies the investment in copper.

Tangling Up the Water-Power Situation

THE list which was recently published of water-power applications aggregating thirteen and a half million horsepower seems at first sight to augur immense developments and a vast addition to the industrial resources of the country. It has taken a good many years to get through a reasonable water-power bill allowing the utilization of resources in the national domain, and it now looks as though it would take considerable additional time fully to clear up the conflicts of interest and point of view which have arisen.

Apparently, as a cheerful beginning of difficulties, there is to be a sharp conflict along the line of state rights. This was perhaps to be expected because of the large regulative powers which have already been intrusted to state commissions. It would seem that no particular difficulty ought to be found in reaching a reasonable basis of operations, but the courts are slow, and it is much to be feared that many a project valuable for the community will be buffeted about for no inconsiderable time before it is allowed to come to fruition.

There is very active propaganda at work to keep hydraulic operations out of the national parks, in the belief that nature should here and there be saved from industrial inroads. With this point of view we must confess to a good deal of sympathy, but hydro-electric propositions at least have shown very little disposition thus to intrude on the rights of the public. To our mind the danger to the public comes, not from a desire to grasp improper privileges in national parks on the part of hydro-electric companies, but from the temptation of not altogether disinterested persons to start violent crusades for the establishment of extensions of the national park system with the amiable purpose of working a hold-up game and incidentally obtaining for the benefit of hotel keepers and transportation companies property which might better be devoted to the general service of the power-needing public. The monopolies which have already been granted around national parks will bear very thorough investigation, and we would suggest that they should be subjected to at least as close scrutiny as falls to the lot of power projects.

One thing at least is plainly evident from an inspection of the applications now on file with the government, and that is that they afford no substantial basis whatever for charging the existence of a water-power trust. They are, in fact, of various character, backed by all sorts of interests and having in common only the purpose of stopping the long neglect of hydraulic power and putting the streams which have run to waste at last in a position to contribute something to the public weal. Nobody holds for a minute that investors in hydro-electric enterprises are in the business entirely for their health, but there is not the slightest reason for suspicion that they are banded together for any monopolistic purpose. For the benefit of all concerned the outstanding questions regarding the issuance of permits should be pushed through to settlement as fast as possible, and above all things the United States government, the ultimate potential owner of all these developments, ought to provide an adequate and properly paid force to look after its interests and those of the public whom it is—perhaps by a fine flight of the imagination only—supposed whole-heartedly to serve.

California's Growth a Lesson to Other States

IF THE star of empire is ever to speed its way to the regions of the setting sun, electricity must be its harbinger. Right now it stands glittering above the town of Spencer, Ind., having moved less than ten miles during the last decade. But for the growth of population in California (due in large measure to the application and utilization of electricity) the center of population in the United States would have begun retracing its steps. No longer do the tillers of the soil outnumber the mechanics and artisans of our towns and cities. It is not so evident now as in the days of Bishop Berkeley that "westward the course of empire takes its way." Yet there is no doubt that the nation would be far better off if the population were more evenly distributed. Herding of people in towns and cities, with the attendant congestion and waste, can never be conducive to the proper development of any race; and here is where the saving grace of electricity can be brought into play, for it matters not whether the country be agricultural or industrial, all industry is amenable to its cultural influence. Are the boys to remain on the farm? Then they must have some of the comforts and advantages of city life, and those electricity can give them. It has done it in California; it can also do it elsewhere. Power is available wherever an electric line exists, so that industry is no longer constrained in that regard, and labor is more contented in the houses and gardens of model communities than in the stifling and stunting atmosphere of crowded tenements. No other state has applied electricity to the satisfaction of its wants like California, and what vast improvements can be made by that means! Gold, oil and climate may have been the lure that drew men to California, but it was electricity that kept them there and gave them contentment. Industrial and agricultural reformations are surely needed in this country, and what but electricity can bring them about?

The Interpretation of Statistical Data

AN INSTRUCTIVE study of the conditions about the Worcester (Mass.) load center, with special reference to probable gain through interconnection, is published in our columns this week. We have long consistently preached this policy, and it is doubtless wise in the present instance. Yet we cannot refrain from calling attention to the need of more care in the co-ordination of the statistical data if the deductions are to be fully convincing. It is not always averages that are the important thing in such a case—sometimes the variations from the average are more significant from the economic standpoint. One of the striking facts here is that taking the plants as a whole there was in capacity only a scant 11 per cent above the sum of the peaks. This indicates serious deficit in capacity, but where was it—in numerous small plants or in one or two conspicuous big ones? The particular remedy to be advised depends not on the average but on the answer to this question. It appears, too, that the average coal consumption was 2.65 lb. per kilowatt-hour. Very good; but how did the plants of varying size go to make up this average? If the figure is due to general bad performance of the plants under 2,000 kva., interconnection will help matters greatly by wiping out the worst cases. If, however, the average is due to operation of one or two large plants at bad daily load factor, strictly local treatment may have to be applied. Broadly, the situation shows probably large opportunity for interconnection, but until the variations from the averages are discussed the nature of that opportunity and the real gains that may be made cannot be disclosed. Moreover, when the interrelation with hydro-electric power is considered averages must be scrutinized even more closely, since a plant of great value in conserving power supply may seem uniquely bad in a less important particular.

Cable Temperature Research Is Flourishing

THE elusive problem of the temperature of underground cables in its relation to their life and rating has recently been attacked with new vigor, as witnessed by the A. I. E. E. convention report in this issue and by articles in recent foreign periodicals. From the increasing number of reports of study and observation there is good promise of an ultimate orderly basis for design and selection of cables for specific duties. The problem in its ultimate elements is a simple one, a known amount of heat energy liberated in a linear conductor and to be dissipated at some neighboring base temperature. Moreover, within the cable at least there is symmetry of the heat paths and easy opportunity for studying the thermal properties of the insulation. But this is very nearly all that can be said.

Within the cable the insulation, on the other hand, shows wide variation in properties. Dielectric losses develop at relatively low temperatures, but in many cases cables operate continuously at temperatures far above conservative standards. The life of the cable as dependent on temperature alone cannot be said to be known. Nor is it particularly important, as the temperature, dielectric stress and mechanical handling in combination are the determining factors. Cables must operate at stresses far below the dielectric strength of the free insulation. Even the heat conductivity of the insulation shows wide variations.

Outside the cable the properties of the heat paths for the losses have proved very difficult to pin down. Even in the simplest case of a cable buried directly in the soil the heat conductivity varies widely both in location and season. Although the base temperature is taken as 40 deg. C., summer values as high as 55 deg. are reported, and obviously winter values of 0 deg. and lower are possible. In duct structures further irregularities are introduced by the air layer around the cable, the walls of the ducts and the number of ducts in the structure. Here, too, observations show the widest discrepancy.

Imperfect knowledge and control of the electrical and thermal constants of the materials both inside and outside of the cable therefore present a fruitful field for investigation, in which there is now unusual activity. Discussion of the matter at the A. I. E. E. convention indicated that the members do not feel there is yet sufficient information concerning hot-spot temperatures and methods of measuring and controlling them to justify higher temperature ratings.

If the information that is needed for reaching more definite conclusions is formulated by cable manufacturers and operators the National Research Council, which has this subject under consideration, should be able to furnish the desired data.



Louis Kossuth Comstock

Originator of the Conference Club idea and leader in the movement to make electrical contracting a bigger, better and more profitable profession

NO MATTER how big a job some men have they are always able to devote time to the upbuilding of the industry in which they are engaged. To these men the industry owes much of its progress and broad conception. Such a man is L. K. Comstock, president of L. K. Comstock & Company, New York, the well known firm of electrical engineering contractors. It is doubtful if there is any one who has done more to broaden the field of the electrical contractor, to bring him into closer touch with the other branches of the electrical industry and to establish electrical contracting as a profitable business. It was he who gave to the industry the Conference Club idea, first as a means for stabilizing the labor situation in the contracting field and later as a forum where common problems might be openly discussed by recognized leaders among electrical engineers, contractors, central-station men, manufacturers and jobbers. The Open Price Association of New York City for the comparison of bids was another broad co-operative movement established through Mr. Comstock's initiative.

Although an engineer by training and experience, Mr. Comstock is an idealist in business and a true philosopher in the affairs of men. With unaffected open-heartedness and sincerity, his ambition to better the conditions in the electrical contracting field is everywhere recognized as finding its fulfillment in self-sacrificing leadership. Furthermore, Mr. Comstock is an organizer. It is one of his cardinal principles of business to delegate details to others and devote his own time to constructive planning for the future, not only of his business but of those divisions of the electrical industry in which the electrical contracting engineer is destined to play so fundamental a part. His was the first electrical contracting engineering firm to establish a sales organization to go out and sell his company's engineering services. In this policy lies the key that explains the volume of his business, which now is approximately $10,000,000 a year.

Mr. Comstock was born in Kenosha, Wis., Jan. 8, 1865, and was graduated from the University of Michigan in 1888. Although the electrical industry was then in its infancy, it appealed to the young man. He joined the staff of the Marr Construction Company of Pittsburgh, afterward the North American Construction Company. After four years in this work he moved to Chicago, where he went into the construction business for himself. The business panic of that era, however, forced him to close, and he entered the employ of the Western Electric Company as superintendent of construction. In 1900 he became electrical and mechanical engineer for the George A. Fuller Company in New York, but the desire to enter the construction field on his own account would not down. Consequently, in 1904, he launched the firm of L. K. Comstock & Company, an organization which has offices in three large cities of this country and one in Canada and heads the list of firms specializing exclusively in electrical contracting work.

How Far to Carry Industrial Metering

Extent of Industrial Plant Metering Should Depend on the Cost-Accounting System in Use—Power Cost May Be Distributed as Overhead Expense or Direct Manufacturing Cost—Practical Methods

By W. B. TODD

Engineering Department, Du Pont Engineering Company, Wilmington, Del.

IN THE modern industrial plants of today the extent to which metering of the electrical load should be carried depends upon the cost-accounting system in effect. The latter, in so far as the electric power costs are concerned, will vary with the nature of the product manufactured and with the degree of accuracy to which detailed costs must be computed.

Electric power cost may be considered as a direct manufacturing cost or may be distributed as an overhead expense. In either case the total monthly consumption of power and its cost must be definitely known. Where the factory has its own power plant it should be run as an independent unit and sufficient metering done and records maintained to furnish accurate data on the power generated and the cost per kilowatt-hour, including overhead. Where power is purchased the power bills show this consumption and cost monthly.

Whether the power cost is distributed as an overhead expense or applied as a direct manufacturing cost, the result will be the same if either method is carried to the same detail. As a direct cost it may be applied on either a machine-hour or a unit-production basis. To obtain the cost on a machine-hour basis power tests must be made on each machine performing an operation on the articles manufactured, and if the average load varies for different articles, the tests should cover this information. The machine-hour power charge on each machine may then be computed for each article manufactured, and the monthly power cost chargeable to each article depends upon the time required on each machine to furnish the actual monthly production of that article. This system of charging costs is quite expensive, as it requires considerable testing and accounting and is justified only where keen competition demands that the manufacturing cost of each article be accurately determined.

Where different products are manufactured, each having its own individual machinery, the power cost per unit of product, such as 1,000 lb., may be determined from power tests showing the average consumption required to manufacture this amount.

In either of the above methods there will be a discrepancy between the total power costs assignable and the actual total power cost caused by change of machine loads due to stock or operating conditions. This discrepancy may be distributed in three ways, all of which will give the same result: (1) Distribute the discrepancy over all estimated power costs according to their percentages of the total estimated cost; (2) take the estimated individual percentages and apply them to the total actual power cost; (3) adjust the rate per kilowatt-hour and apply the adjusted rate to the estimated consumptions.

In modern cost accounting the aim is to use all costs estimated from detailed studies. If the total actual costs differ from those estimated, the discrepancy should be distributed pro rata. If the discrepancy passes the point considered allowable owing to ordinary fluctuating conditions, an investigation should be made to determine whether the estimates were wrong or whether costs are increasing because of increased labor or material expenses or poor efficiency in operation, planning or management.

Where the electric power cost is considered as an overhead expense, a question arises as to its distribution. In factories making only one product, fabricated in only one form or style, the power cost along with all other costs is chargeable to that one product and no cost-accounting system should be necessary. However, where products in different forms are manufactured, departmental—and in many cases more accurate—metering is required if exact overhead costs on each product

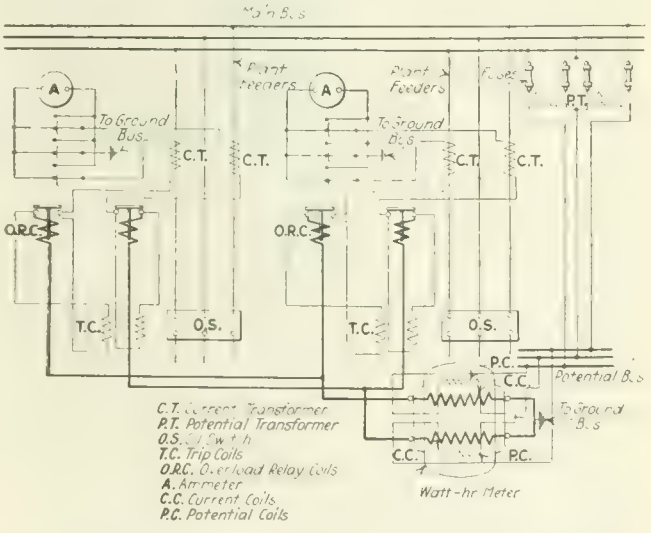


FIG. 1—IN THIS LAYOUT ONE METER IS USED ON TWO FEEDERS, BUT THE CONSUMPTION MAY BE APPORTIONED

The current coils of the meter are twice the capacity of the current transformer secondaries. The total load on both feeders registers on the watt-hour meter, but by throwing the ammeter switches the proportional consumption for each feeder may be determined.

are to be obtained. In many cases the application of the general overhead to all products manufactured results in a selling of certain of these products below cost, although the sale of the entire collective product may show a reasonable profit if the proportion of profitable products sold is great enough. A large number of industrial failures can be attributed to this cause alone.

Before it has been definitely decided to what extent power costs should be obtained the electrical engineer should submit an estimate of the cost of installing the necessary meters or conducting the required tests, and this cost, together with that incident to compiling the cost data, should determine whether the expense is justified for the results that will be obtained.

Departmental metering may be carried out in fact by

the use of watt-hour meters or by making occasional power tests with portable instruments to determine the proper ratio of average departmental load as compared with the average total plant load. Where a department may be shut down for a certain time, the watt-hour meters will take care of this condition; but with the tested ratio method the distribution should be made on the basis of department-days or department-hours. This will increase the percentages of the other departments, but owing to the decrease in the total electrical consumption, the actual monthly cost per department should remain the same unless the cost per kilowatt-hour varies owing to the change in monthly load factor.

General Metering Methods

If departmental metering can be done at the power house, the line losses are accounted for; but if the departmental circuits are not run separately and the metering is done at the department service entrance, the difference between the sum of the departmental consumptions and the total consumption at the switchboard in the power plant or at the electric service company's meter should be distributed according to the ratio of the departmental loads to the total load. Fig. 1 shows a scheme that has been used in an industrial substation whereby the load on two feeders furnishing power to one department was metered by one 10-amp. watt-hour meter, yet the ammeters gave directly the proper division of load and indicated the condition of each circuit as affecting current-carrying capacity. The current transformers have 5-amp. secondaries.

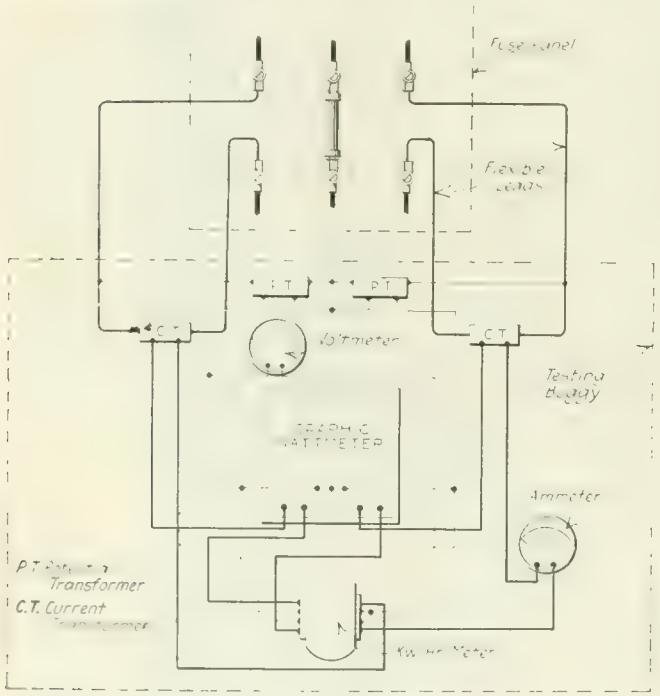


FIG. 2—MOTOR-LOAD CONDITIONS MAY BE CHECKED AT THE TIME POWER COSTS ARE CHECKED

The wiring layout is for a testing buggy now used in many up-to-date industrial plants for checking motor conditions and energy consumption. This particular arrangement of instruments has been used with good results in plants of E. I. du Pont de Nemours & Company and the General Motors Company.

The cost of lighting is often distributed either on the basis of the number of square feet of manufacturing space in each department or according to the departmental connected lighting load. These methods do not take into account the "load factor," which may differ considerably in the various departments because of operating conditions and the natural light available during the daylight hours. They afford no check on the amount of light wasted, and, particularly where the energy for lighting must be purchased at a higher cost per kilowatt-hour than for power, departmental metering with checking of comparative consumption will in many cases soon pay for the installation of the meters.

Testing by means of portable instruments has been mentioned above, and the arrangements for this work should depend upon the amount of testing necessary. For occasional testing separate instruments may be used as needed, but in large plants where considerable testing is done either for power costs or for miscellaneous metering to determine loads on circuits or individual motors, friction loads of drives, power-factor conditions, etc., it is most convenient to use a testing buggy with rubber-tired wheels. This buggy may be pushed around the floors and taken from floor to floor by means of the freight elevator. On this buggy can be mounted and wired up completely a graphic wattmeter, a watt-hour meter, an ammeter, a voltmeter, current transformers and, if necessary, potential transformers. With these instruments wired up as shown by Fig. 2, it is only necessary to handle for three-phase work the four current leads and the one potential lead. Where possible the "cut-in" on the circuit should be made at the fuse panel ahead of the motor or circuit to be tested, in which case the current leads can have terminal lugs taken from blown or renewable fuses, and in many cases the heavy capacity type of spring testing clips may be used. The potential lead need only be hooked on the end or the lighter-capacity type of spring clip can be employed. Rapid "cut-ins," without shutting down the motor or circuit, may be made by a helper holding the ends of a "jumper" at the terminal ends of a fuse block, while the tester pulls out the fuse and inserts or attaches the terminals of the current leads in or to the fuse block. This outfit enables the kilowatt-hour consumption, current, voltage, power factor and kilowatt load to be obtained, and where the load fluctuates considerably and frequently the maximum, minimum and average load can be accurately determined. The graphic wattmeter is particularly useful in studying cycles of operation. The current transformers should have enough ratio taps to take care of the range of motor horsepowers installed in the factory, or the ratios may be taken care of by two sets of transformers.

All Surveys and Tests Made at the Same Time

In many factories the testing of friction loads should be made to determine the correctness of motor locations, the alignment of shafting, the conditions of bearings and the tension of belts. These tests, in connection with those on individual motors to determine actual capacity needed to take care of the load pulled, will in most cases show that considerable power savings may be made by rearrangement of motors and drives and the use of ball or roller bearings. This information can be acquired while conducting the tests for power costs and will reduce considerably the test expense chargeable to the latter.

The electrical engineer of a plant should become familiar with the methods of handling electric power costs and should work in conjunction with the accounting division in order that metering may be arranged for but not carried beyond the point of necessity.

Hydro-Electric Plant Built in 15 Months

Methods that Were Employed to Hasten the 50,000-Hp. Kerckhoff Development Which Was Undertaken to Relieve Power Shortage Resulting from Postponement of Construction During War Period

By R. C. STARR
Construction Engineer San Joaquin Light & Power Corporation, Fresno, Cal.

DURING the war it was impossible for the San Joaquin Light & Power Corporation, as it was for other California companies, to increase its power-plant installations. As a result it found itself in the spring of 1919 with 4,100 unfilled applications on file for a total of approximately 40,000 hp. and with no power available to supply the demand, despite the fact that it had ample capacity for its load in 1914. Consequently it was necessary to install at the earliest possible date a plant of approximately 50,000 hp. rating. At that time the company had preliminary permits covering the total development of approximately 200,000 hp. on the north fork of the Kings River and on the San Joaquin River, but the Kerckhoff development on the latter was the only one which could possibly be constructed in a period of less than two years. Furthermore, the rapid increase in the price of oil made the company hesitate to take care of the entire increase in load by an increase in its steam-plant capacity, although a steam unit was installed in the Bakersfield plant in the summer of 1919 to take care of the spring load of 1920. The Kerckhoff plant also proved to be a relatively cheap development per kilowatt. These factors made its construction doubly valuable to the company at the time, and therefore construction was authorized late in the spring of 1919. By employing the latest ideas and methods in construction the work was so greatly expedited that the entire development was completed just fifteen months later, making it the first hydro-electric plant to be completed in America after the war.



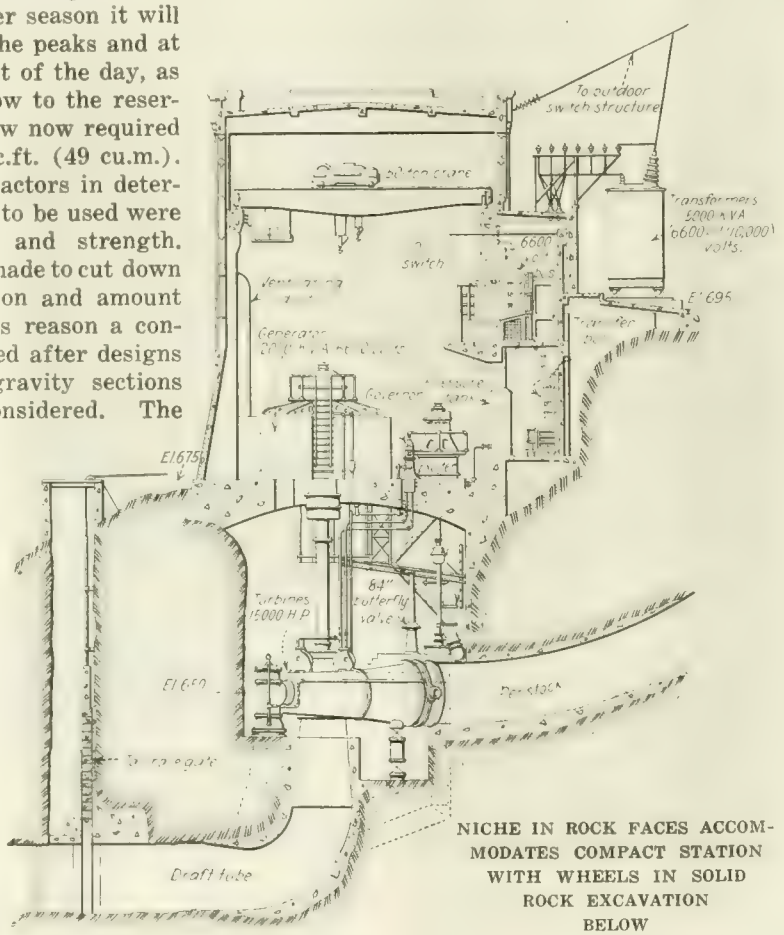
ALL CONSTRUCTION MATERIAL HAD TO BE CONVEYED DOWN A 2,700-FT. INCLINE WITH MAXIMUM GRADE OF 92.5 PER CENT

The Kerckhoff development, which is on the San Joaquin River 40 miles (64 km.) northeast of Fresno, consists of an arched dam 125 ft. (38 m.) high and 570 ft. (174 m.) long across a narrow gorge in the river; an 18-ft. x 18-ft. (5.4-m. x 5.4-m.) tunnel 17,000 ft. (5,180 m.) long through a granite mountain; three steel penstocks, each 950 ft. (289 m.) long feeding three water-wheels, each of 20,000 hp. rating; a reinforced-concrete power house with an outdoor high-tension bus and transformer station; a 110,000-volt transmission line, 110 miles (177 km.) long, and three reinforced-concrete substations in the San Joaquin Valley. The dam is a constant-angle arch dam, built in a narrow horseshoe bend in the river, about 2 miles (3.2 km.) below the company's power house No. 1. The storage thus formed impounds 4,000 acre-ft. (480 hectare-m.) of water, 3,000 acre-ft. (360 hectare-m.) being above the pressure tunnel. This will permit operation of the plant at full load for thirty-six hours during the dry season. More storage could not be provided at the Kerckhoff dam because station No. 1 limits the maximum elevation of the pond. However, the natural flow of the San Joaquin River, with a drainage area of 1,800 sq.miles (4,600 sq.km.) is augmented by water stored by other projects on the San Joaquin River and its tributaries, consisting of the Crane Valley reservoir, with 52,000 acre-ft. (6,300 hectare-m.) of the San Joaquin Light & Power Corporation, and the Huntington Lake reservoir, with 90,000 acre-ft. (10,800 hectare-m.) of the Southern California Edison Company. Future developments by the Southern California Edison Company at Shaver Lake, Florence Lake, Blaney Meadows, Vermillion Valley, Pitman Creek and other places on the middle fork of the San Joaquin River will increase the mountain storage of water by 300,000 acre-ft. (36,000 hectare-m.).

Like all California streams, the San Joaquin River is subject to floods during a period of approximately six months, during which time the flow of the river is

practically always in excess of 3,000 cu.ft. (84 cu.m.) per second with a maximum recorded flood in 1914 of 45,000 sec.ft. (1,260 cu.m.). The minimum flow of the stream at the present time, due to the Crane Valley and Huntington Lake storage, is approximately 500 sec.ft. (14 cu.m.). The future development of the Edison company will give a daily flow during the dry period of approximately 1,000 sec.ft. (28 cu.m.), which will mean that the plant can operate through the entire season with a 90 per cent daily load factor. Therefore the value of the Kerckhoff plant will increase with each additional development made on the San Joaquin River. During the high-water seasons the plant will be operated continuously at full load with 80 per cent daily load factor, and during the low-water season it will operate at full load on the peaks and at part load during the rest of the day, as necessitated by the inflow to the reservoir. The maximum flow now required by the plant is 1,750 sec.ft. (49 cu.m.).

The most important factors in determining the type of dam to be used were the elements of time and strength. Every effort had to be made to cut down the amount of excavation and amount of concrete, and for this reason a constant-angle dam was used after designs of multiple-arch and gravity sections had been carefully considered. The Kerckhoff constant-angle arch dam contains about one-half the yardage which would be required in a dam of gravity type using the same stresses, about 1,800 cu.yd. (1,375 cu.m.) less concrete and about 1,000 cu.yd. (764 cu.m.) less excavation than the best constant-radius arch dam which could be designed to fit the site. The arch dam also had the advantages over the gravity-section dam that there is never any danger of failure from sliding.



NICHE IN ROCK FACES ACCOMMODATES COMPACT STATION WITH WHEELS IN SOLID ROCK EXCAVATION BELOW

In order to handle floods without raising the maximum pond elevation (on account of power house No. 1 immediately upstream) and to gain the maximum head possible at all times of the year, fourteen 14-ft. x 20-ft. (4.2-m. x 6-m.) Tainter (radial) gates were installed on top of the dam. For operating these gates a specially designed motor-driven hoist is provided which runs on tracks along the top of the dam. One of the openings for Tainter gates has been equipped with a log chute extending out from the face of the dam, through which driftwood may pass without injury to the gates. The crest is constructed on a parabolic curve and a lip extends out over the downstream face to discharge the water free from the face and foot of the dam. The material from the excavation was cast downstream to retain a pool about 30 ft. (9 m.) deep between it and the dam into which the water from the crest falls, preventing erosion and vibration at the foot of the dam. The capacity of the Tainter gates permits the discharge of 100,000 cu.ft. (2,800 cu.m.) per second, this being sufficient to take care of any floods. When the gates are closed the water will back up the river 2 miles (3.2 km.) to the tailrace of power house No. 1. At the bottom of the dam are three 72-in. (1.8-m.) rising-stem sluicegates which are operated by means of a geared gate stand.

No fish ladder is used in connection with this dam, because at low-water stages—a period of six months each year—all the water will be required for the generation of power, thus leaving the river dry from the dam to the power house, a distance of about 11 miles (17.6 km.). Consequently it has been decided to build a fish hatchery near the Crane Valley reservoir and transport the eggs from the lower waters of the San Joaquin.

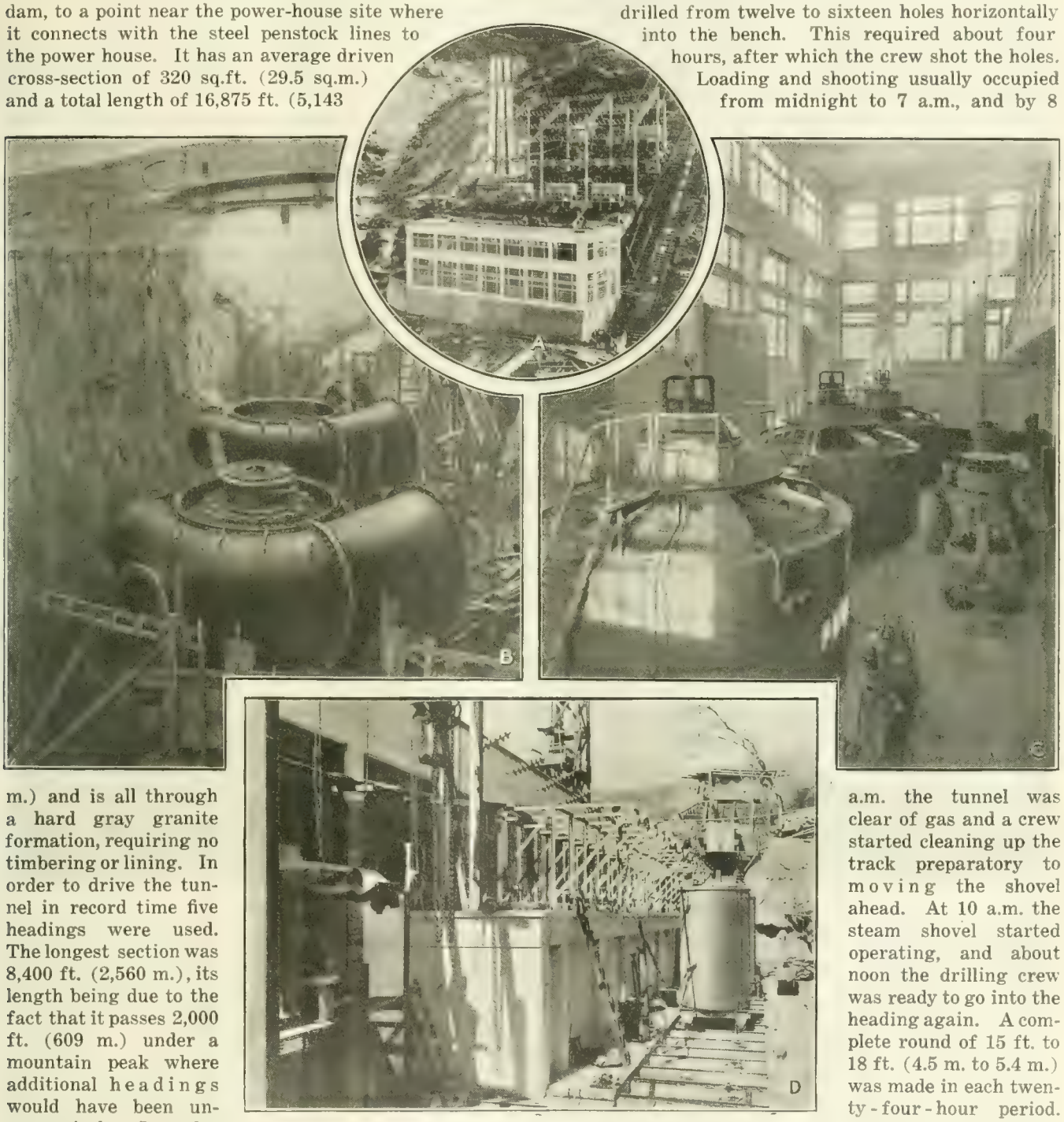
The first construction problem confronting the writer was the necessity for completing the dam before January, 1920, the beginning of the flood season. To reach the dam it was necessary to build 5 miles (8 km.) of road and an incline 2,700 ft. (900 m.) long, with a maximum grade of 92.5 per cent. If these had been completed first, sixty days would have elapsed before work on the dam could have begun. Therefore the diamond drill equipment, materials for camp supplies, etc., were packed on mules and hauled on sleds 7 miles (11.2 km.) over the hillside and down the steep mountain slope to the dam site, 1,100 ft. (330 m.) below. In this way the drill exploration for the foundations was completed, and a hundred men were put at work building a permanent camp and installing machinery at the dam site by June 1. The cofferdam diversion of the entire San Joaquin River through a flume was completed in less than sixty days. The excavation of 26,000 cu.yd. (23,700 cu.m.) of solid rock by steam shovel, and the entire construction of the dam, including 24,000 cu.yd. (21,900 cu.m.) of concrete, was completed Dec. 15, 1919, the first concrete being poured four months before. Meanwhile 17 (27 km.) miles of wagon road was built and steam shovels and other equipment were transported by trucks, so that with the completion of the dam before the winter flood the date of starting the Kerckhoff plant was fixed by the finishing of the tunnels.

Every effort was made to beat all existing records in tunnel progress. The correctness of the writer's belief in the superiority of the heading-and-bench method of tunneling with steam shovels mucking into electrically

hauled trains was fully demonstrated. The longest single tunnel to be completed was 8,400 ft. (2,560 m.) long, and this was driven from the two ends only in thirteen months' time.

The tunnel extends from Kerckhoff Lake, which is the storage reservoir formed by the construction of the dam, to a point near the power-house site where it connects with the steel penstock lines to the power house. It has an average driven cross-section of 320 sq.ft. (29.5 sq.m.) and a total length of 16,875 ft. (5,143 m.) and is all through a hard gray granite formation, requiring no timbering or lining. In order to drive the tunnel in record time five headings were used. The longest section was 8,400 ft. (2,560 m.), its length being due to the fact that it passes 2,000 ft. (609 m.) under a mountain peak where additional headings would have been uneconomical. In the "heading - and - bench method" used in driving the tunnel a bench about 14 ft. (4.2 m.) long and 7 ft. or 8 ft. (2.1 m. or 2.4 m.) from the roof was carried. A crew of four drillers and four chucktenders, operating four drills, drilled from thirty-five to forty holes from fifteen to twenty feet deep into the heading. The holes in the heading are drilled while the former shot is being mucked out. The mucking was done with "Marion 40" steam shovels operated with 100-lb. (7 kg.) air pressure furnished by a 4-in. (10-cm.) pipe line from the compressor house. The biggest factor in the progress made on these tunnels was the efficient operation of the steam shovels.

After the muck was cleaned up the bench crew drilled from twelve to sixteen holes horizontally into the bench. This required about four hours, after which the crew shot the holes. Loading and shooting usually occupied from midnight to 7 a.m., and by 8 a.m. the tunnel was clear of gas and a crew started cleaning up the track preparatory to moving the shovel ahead. At 10 a.m. the steam shovel started operating, and about noon the drilling crew was ready to go into the heading again. A complete round of 15 ft. to 18 ft. (4.5 m. to 5.4 m.) was made in each twenty-four-hour period. The highest rate of driving the tunnel was attained in May, when 453 ft. (138 m.) was excavated. The muck was hauled by 6-ton, 250-volt direct-current electric locomotives in trains of four cars each. In tunnel No. 2 "Exide Hy-Cap" storage batteries having 27.5 amp. rating on a five-hour basis were installed on General Electric locomotives. They were connected to float on the trolley, carrying approximately 265 volts.



FEATURES OF 50,000-HP. KERCKHOFF PLANT

A—At the top of the penstocks in background is a surge chamber excavated in solid rock. From the outdoor switching structure 110,000-volt lines run up mountain-side and then to Sanger, Corcoran and McKittrick. B—Waterwheels in pit below station. C—Three 14,200-kva. generators in area measuring 100 ft. x 36 ft. D—Transformers on concrete foundations back of station.

The batteries were always connected to the trolley except when handling cars within from 300 ft. to 600 ft. (90 m. to 180 m.) of the heading and on the dump, where no trolley was installed. This arrangement avoided the necessity of maintaining a trolley wire near the heading, where it would interfere with the mucking or shooting, or on the dump, where the track is not fixed. The method of floating the battery on a trolley permitted the use of a much smaller capacity in battery and did not require taking batteries out of service for charging. These batteries were operated five months continuously without discharging more than 50 per cent at any time and they were in first-class condition at the end of that time.

Locomotives thus equipped were able to haul four 6-yd. (5.4-cu.m.) cars loaded with muck on a level grade at 6 miles (9.6 km.) per hour.

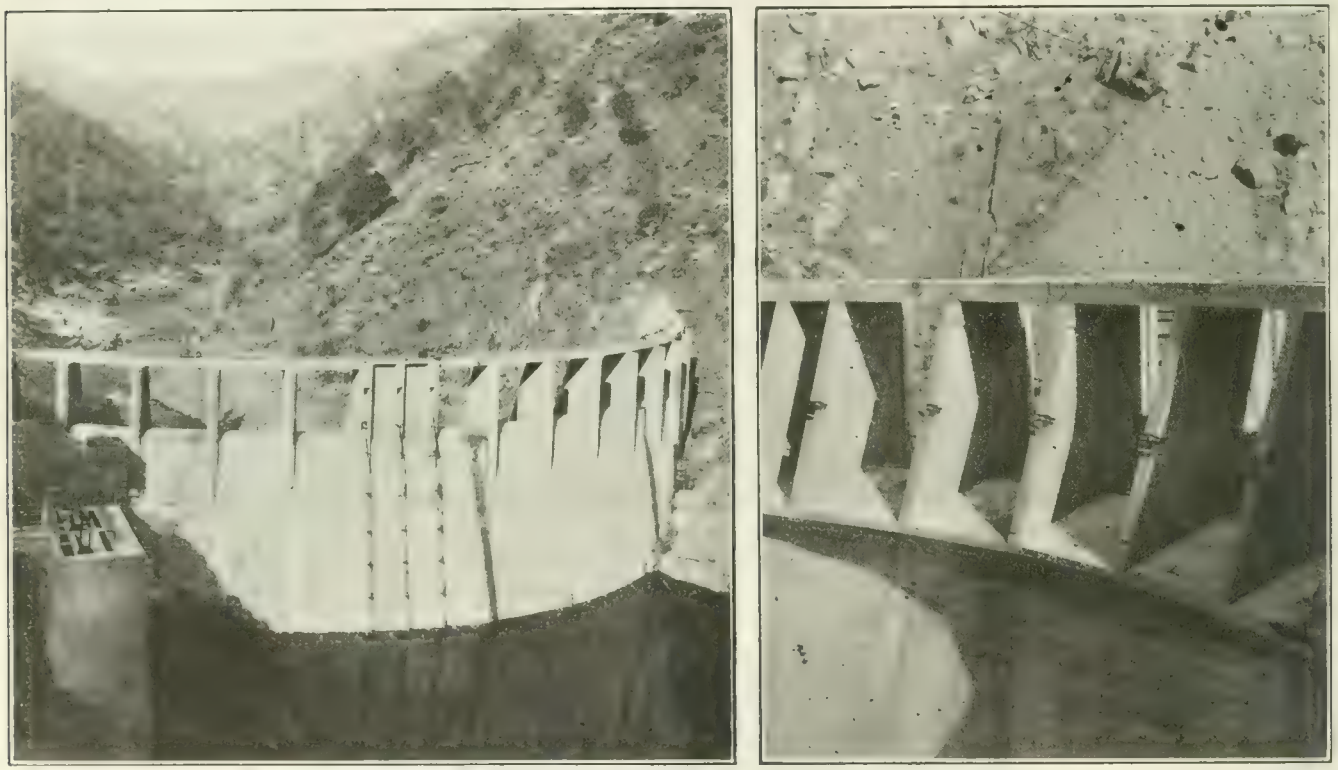
Records were also made in pipeline erection, three steel penstocks, 950 ft. (289.5 m.) long, 8 ft. (2.4 m.) in diameter at the portal and 7 ft. (2.1 m.) at the wheels, being installed in thirty-two days. Just outside the portal are three 8-ft. rising-stem gate valves, the valve and by-pass being operated electrically from the powerhouse switchboard and so interlocked electrically as to require operation in the proper sequence. Ahead of each waterwheel is an 84-in. (2.1-m.) butterfly valve, also electrically controlled from the switchboard and designed to close against the full penstock pressure in the event of failure of a waterwheel casing. Air-relief valves are provided on top of each pipe line to permit the entrance of air when the penstock lines are emptied, to prevent their collapsing. No standpipes are used, but a surge chamber has been cut out of the solid granite a short distance back from the tunnel portal. This chamber is 40 ft. (12 m.) in diameter at the roof of the tunnel and tapers to 17 ft. (5.1 m.) in diameter at the spillway elevation, which is approximately 20 ft. (6 m.) above the top of the Tainter gates at the Kerckhoff dam.

The factors determining the dimensions of the surge chamber were twofold:

(1) To discharge water flowing in the tunnel when load is rejected by the units in the plant, without seriously increasing the surge in the penstocks, the spillway being 5 ft. (1.5 m.) above the top of the Tainter gates in the dam.

(2) To provide water for the wheels when the plant load is suddenly increased while the water in the tunnel increases its velocity to take care of the increased load demand.

Completing a 50,000-hp. hydro-electric plant in fifteen months under the conditions prevailing at the time would not have been possible had it not been for the wonderful support given by the management of the company, which comprises W. G. Kerckhoff, president; A. C. Balch, vice-president; A. G. Wishon, general manager; A. Emory Wishon, assistant general manager; I. W. Alexander, stock sales manager, and D. P. Mason, purchasing agent.



UPSTREAM FACE OF KERCKHOFF DAM BEFORE WATER WAS IMPOUNDED AND LIP ON DOWNSTREAM SIDE OF SPILLWAY

It would naturally be thought that such records for speed could be made possible only by enormous additional expenditures, but actual records prove this construction the cheapest of its kind completed since 1913.

Of the organization the following men deserve special credit for the part they performed: Henry R. Stevens, superintendent of construction; L. L. Ellis, assistant superintendent; Dick Pease, master mechanic; J. D. McDougal, general foreman of construction; B. F. Jakobsen, designing engineer; H. K. Fox, resident engineer at the power house; L. T. Jackson, resident engineer at the Kerckhoff dam; R. C. Starrett, resident engineer of tunnels; H. P. Van den Bossche, mechanical engineer, and A. H. Coutch, office manager.

The successful tunnel contractors were D. D. DeLuca and W. A. Whitmire, both of whom deserve special credit.

Features of the station itself will be presented in a later issue.

Economy Through Plant Co-ordination

Superpower Load-Center Analysis Shows Existence of Opportunity in This Direction — Data of Local Survey on Worcester (Mass.) Load Center — Striking Range of Plant Sizes and Unit Ratings

DATA showing results of the local power survey for the so-called Worcester load center were presented recently in Worcester, Mass., by Henry Flood, Jr., engineer-secretary Superpower Survey, New York, speaking before the Worcester Section of the American Institute of Electrical Engineers. He pointed out that through the interconnection plan which the Survey is studying opportunities for the more efficient production and distribution of electrical energy may be realized. Mr. Flood brought out the striking range of plant sizes and unit ratings in the Worcester load center and showed that for the year 1919 there was an excess of effective steam-plant capacity in that district of only 10.8 per cent above the aggregate peaks of that year in the steam plants. The average coal consumption was 2.65 lb. per kilowatt-hour and 125,000,000 kw.-hr. was generated in the steam stations. The total generated output of the district during the year was 344,000,000 kw.-hr., of which the central stations produced 94 per cent. The estimated increase in output of the central stations of the district, including the New England Power Company, is more than 125 per cent comparing 1920 with 1919. Sixty-three generating units of under 2,000 kva. in rating and eighteen plants under 1,000 kva. were in service in the district in 1919. By the Superpower plan, Mr. Flood declared, many small and relatively inefficient units will be shut down to insure the greater efficiency of energy supply from large installations.

SPECIFIC DATA ON EXISTING CONDITIONS IN WORCESTER LOAD CENTER

Aggregate annual peak classified as to cycles:	Kw	Percentage of Total
60 cycles	86,810	88
25 cycles	11,000	11
Miscellaneous	920	1
Total	98,730	

1919 output:	Kw.-Hr.	Percentage of Total
60 cycles	286,370,000	83 5
25 cycles	55,670,000	16 0
Miscellaneous	2,090,000	0 5
Total	344,130,000	

Load factor, 39.7 per cent.

Generated output 1910-1919*:

Year	Kw.-Hr	Year	Kw.-Hr.
1910	88,310,000	1915	227,000,000
1911	105,070,000	1916	270,660,000
1912	124,640,000	1917	300,050,000
1913	155,610,000	1918	308,420,000
1914	175,660,000	1919	344,130,000

Aggregate kw. peak load 1910 to 1991:

Year	Kw	Year	Kw.
1910	28,800	1915	74,200
1911	30,700	1916	84,100
1912	38,400	1917	87,700
1913	50,000	1918	88,500
1914	53,500	1919	98,500

* Increased 290 per cent in nine years, or 16.5 per cent annually compounded.

Load factor, 35 per cent.

Estimated future growth of energy†:

Out of a total output of 344,000,000 kw.-hr. generated in 1919, central-station companies representing 323,000,000 kw.-hr., or 94 per cent of the total, have given estimates as to the future growth of load, as follows:

Year	Kw.-Hr.	Year	Kw.-Hr.
1919	323,000,000	1923	496,000,000
1920	346,000,000	1924	543,000,000
1921	402,000,000	1925	590,000,000
1922	449,000,000	1930	789,000,000

In addition to the above, street-car companies generated 18,500,000 kw.-hr. in 1919. It may be assumed, approximately, that these companies will have an increase of 9,000,000 kw.-hr. in the next ten years, or a total of approximately 28,000,000 kw.-hr., which added to the above would equal 817,000,000 kw.-hr.

Daily diversity (Nov. 25, 1919):	Kw.
Aggregate non-coincident peak	86,100
Maximum coincident peak	84,860
Diversity	1,240

Percentage of diversity, 1.5. Kilowatt-hours generated, 1,136,946. Daily load-factor, 56 per cent.

† An increase of 125 per cent in ten years, or 9 per cent annually, compounded, excluding street-railway companies, and 140 per cent in ten years, or 10 per cent annually, compounded, inclusive of these companies.

Plant capacity:

Hydro-electric (45 per cent of total):	Kw.
60 cycles	61,580
25 cycles	8,600
Miscellaneous	350
Total	70,530

Steam (55 per cent of total):	Kw.
60 cycles	76,825
25 cycles	10,000
Miscellaneous	575
Total	87,400
Grand total	157,930

Range of power-plant size:

	No. of Plants
Rated at 50,000 kw	1
Rated at 20,000 kw. or over	3
Rated at 10,000 kw. or over	5
Rated at 5,000 kw. or over	9
Rated at 1,000 kw. or over	13
Rated at 500 kw. or over	18
Total	49

Range of size of generating units:

	No. of Units
Rated at 20,000 kva	2
Rated at 10,000 kva. or over	3
Rated at 5,000 kva. or over	11
Rated at 2,000 kva. or over	34
Rated at 500 kva. or over	63

	Kw
Generating capacity of steam-electric plants	87,400
Aggregate of steam-station peak loads	56,580
Excess steam generating capacity (54.5 per cent of peak)	30,820
Effective steam generating capacity	62,700
Aggregate of 1919 steam-station peaks	56,580
Excess effective capacity (10.8 per cent of peak)	6,120

	Tons
Coal consumed in 1919 in steam plants	167,000
Corresponding kw.-hr. generated	125,000,000
Corresponding kw.-hr. capacity	87,400
Tons of coal per kw.-year, at 2.65 lb. per kw.-hr.	1 9
Average B.t.u. per kw.-hr.	36,000

Use of power:

Power generated or produced by the companies allocated to these load centers sold their energy for the following purposes:

	Kw.-Hr.	Percentage of Total
Light	25,100,000	9
Power	204,600,000	73
Railways	48,000,000	17
Total	277,700,000	

Power production cost:

Fuel	$1,150,000.00
Maintenance	102,000 00
Other operating costs	480,000.00
Total	$1,732,000.00

Included in the above is $197,300.00 that represents operating costs of hydro-electric plants. The total operating cost of steam plants is equal to $1,534,700.00, or 1.22 cents per kw.-hr., exclusive of overhead charges, administration, etc.

Small Portable Photometer Shows Accuracy

May Be Carried in a Brief Case, but Has Accuracy Substantially Equal to Larger Types—Suitable for Measurements of Candlepower and Foot-Candles

BY DAVIS TUCK
Electrical Engineer Holophane Company

A NEW form of light meter capable of making photometric measurements of the same order of accuracy as the larger portable illuminometers has recently been designed by the writer that will measure candlepower, millilamberts and foot-candles to a reasonable degree of accuracy and which is truly portable since it may be carried in a brief case or traveling bag.

The scientific principle involved is not new but is the same as that used in both the Sharp-Millar and the Macbeth instruments. The greatly reduced size has been made possible by careful design to this end. The principle involved is that of the inverse-square law. The standardized electric lamp is moved with respect to a ground-glass plate which is the variable-standard

ILLUMINATION (FOOT-CANDLES) MEASURED WITH THREE PHOTOMETERS

Station	Macbeth	Light Meter	Foot-Candle Meter
1	14 8	15 0	16
2	12 1	12 0	13
3	12 2	12 4	14
4	12 0	11.8	10
5	13.5	13 6	11
6	14 2	14 2	15 5
7	14 7	15 0	17
8	14.9	15.0	15
9	14 7	14 7	12
Average	13 7	13.7	13.7

brightness against which the unknown brightness is matched.

The over-all length is 12 in. (30 cm.), the maximum diameter is 2⅛ in. (5.4 cm.), and the weight complete with the battery is 1 lb. 9 oz. (0.7 kg.).

The battery consists of three dry cells each 2¼ in. (5.7 cm.) long and 1¼ in. (3.2 cm.) in diameter, being one of the standard flashlight batteries. One of the larger forms of flashlight batteries has been used so as to

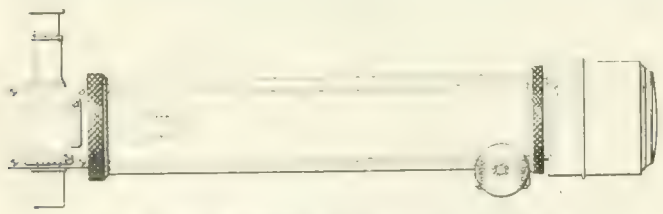


FIG. 1—CROSS-SECTION SHOWING ASSEMBLY OF THE LIGHT METER

obtain a comparatively long burning period of the lamp before the voltage drop is noticeable.

A lamp was selected which takes a small current from the battery (0.1 amp.), and it is burned at a low efficiency. This has the most desired effect of placing only a small drain on the battery and of maintaining the lamp at its standardized operating characteristics over a relatively long period.

The rheostat is circular in form and is arranged with a sliding contact so that resistance is cut in or out by turning the ammeter about its axis. When all of the resistance is cut in the sliding contact rides on an insulated plate that functions as a switch. In this way the lamp is at all times protected from having too high a voltage suddenly placed across it by an unskilled operator or because of absent-mindedness on the part of the skilled operator.

The ammeter is of the D'Arsonval type, and the shunt is made to give virtually full-scale reading when the lamp is operated at the standardized current. The glass over the face of the ammeter is fitted in the same way as a watch crystal, so that the scale on the ammeter can be easily accessible for marking the calibration point. The method of assembly of the rheostat switch and ammeter makes for compactness and lightness and

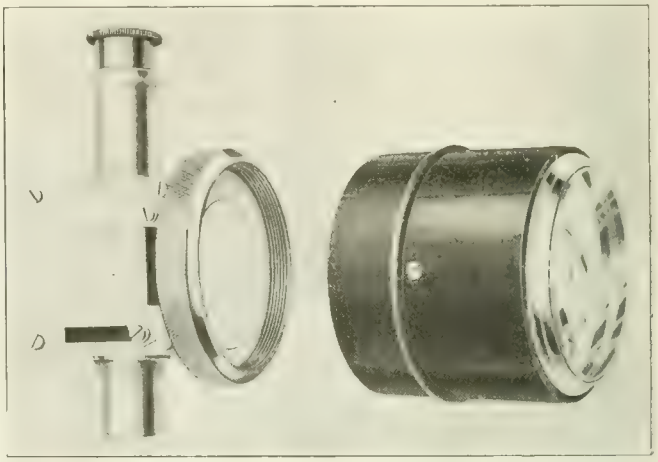


FIG. 2—PHOTOMETRIC ELEMENT AND AMMETER WHICH CONSTITUTE THE ENDS OF THE PHOTOMETER

makes wired or soldered connections unnecessary. Fig. 1 shows the assembly of these parts.

The tube which carries the battery and rheostat assembly also carries the lamp housing and is moved back and forth by means of a rack and pinion when measurements are being made. The lamp is placed in a half sphere with a piece of ground blue glass on one side over the opening. This construction has the advantage of avoiding the inequalities of illumination due to various lamp orientations and places the lamp in a dust-tight protected chamber. The ground blue-glass plate is a secondary light source, and its distance from the piece of milk glass in the light meter head determines the calibration constant of the instrument. Small variations in lamp dimensions therefore do not affect the scale calibration.

Three scales are provided, showing candlepower, millilamberts and foot-candles respectively. The scales are engraved on the sliding tube. The photometric device is a modified Lummer-Brodhun cube. The telescope has an adjustable focus.

The range of the foot-candle scale is from 0.5 foot-candle to 15 foot-candles. Provision is made for inserting neutral-tint screens either on the test or comparison side of the cube. The screens used have a transmission factor of 10 and 1 per cent respectively, so that the range is increased to 0.005-1,500 foot-candles.

A series of foot-candle measurements was recently made in a factory using a Macbeth illuminometer, the light meter and a foot-candle meter. The accompanying table shows how these readings compared.

It will be noted that the average foot-candle value measured by the three instruments were identical.

American Institute of Electrical Engineers

Midwinter Convention

Features of Papers Presented in New York, Feb. 16 to 18 Inclusive, on Limitations of Oil Switches, Permissible Cable Temperatures, Measurements and Miscellaneous Subjects—Need of Rating Circuit-Breakers on Basis of More Reclosures—Present Evidence Does Not Justify Raising Cable Temperatures

THE maximum temperature at which paper-insulated cable can be operated safely was the chief subject of discussion at the midwinter convention of the American Institute of Electrical Engineers, held in New York on Feb. 16 to 18 inclusive. Six papers were presented on this subject. Present-day limitations of oil circuit breakers ranked close to cable temperatures in importance, although only two papers on the topic were presented. Of the remaining subjects that came under consideration, regulation of frequency for metering purposes, short-circuit currents of induction machines, heat flow in armature coils and wave transmission were particularly interesting. With the exception of papers on flutter of composited telephone lines and telephone problems of railroads, and one on cable temperatures, presented quite fully on page 413 of the Feb. 19 issue, abstracts of all the papers follow. These abstracts are under the headings of "Oil-Switch Limitations," "Safe Cable Temperatures," "Meters and Measurements" and "Miscellaneous."

Recent experience of some of the large operating companies has indicated that the temperature limit of 85 deg. C. for paper insulation in low-tension (around 220-volt) cables may be too conservative. The present limits have been established in connection with investigations of insulation for high-tension cables and because of results showing that paper suffers mechanical deterioration when subjected to a temperature of about 90 deg. C. There is evidence that paper may suffer some deterioration and still be sufficiently good for low-tension service and will even stand withdrawal of the cable from ducts and reinstallation. The question is whether cables subjected to the usual load cycles may not operate at least a few hours a day above 85 deg. C. Data are furnished by cable manufacturers and users, and several suggestions are offered regarding possible temperature limits for short-time heavy loads.

The consensus of opinion, however, appeared to favor the present conservative temperature rating for paper-insulated cables. Even though higher temperatures may be safe, most of those who discussed the matter believed that the operating engineer should decide whether or not he was justified in operating at higher temperatures in his own particular system by sound engineering and economic considerations.

In one of the papers regarding oil switches some of the operating requirements and limitations were outlined, and recommendations were made by the subcommittee on this subject. These are particularly important because they represent the attitude of operating men as a result of actual experience with the apparatus. The comments refer chiefly to voltage-test requirements, ventilation of switch cells, short-circuit current-carrying capacity and method of rating oil circuit breakers.

Observations made in conducting high-current tests on high-tension circuit breakers were presented in another paper. This investigation showed the need of strengthening brush contacts and supports and of strong locks on disconnecting switches and brought out some requirements of instrument transformers. Aside from the information they gave, these tests were especially interesting because of the manner in which they were conducted.

The principal facts brought out in the discussion of the convention papers are included in this report.

Oil-Switch Limitations

Recommendations Based on Operating Viewpoint

Voltage Test Requirements Should Be More Severe—Ventilation—Short-Circuit Current-Carrying Capacity Advisable

IN ORDER to summarize the present-day indefinite operating requirements and limitations of oil circuit breakers, the A. I. E. E. (protective-devices committee), N. E. L. A. (apparatus committee) and Electric Power Club (power-switchboard and oil-circuit-breaker section) co-operated in sending out a joint questionnaire for oil-circuit-breaker data to the larger operating companies. Some of the observations and recommendations of the A. I. E. E. sub-committee on oil circuit breakers and switches were presented by its chairman, H. R. Woodrow of Stone & Webster, Inc.

There have been some failures due to the inability of the oil circuit breaker to withstand voltages encountered under operating conditions, therefore it would seem that the present test requirements, as specified by the A. I. E. E. standards, of two and one-quarter times operating voltage plus 2,000 volts may not be severe enough for the larger moderate-voltage system. Furthermore, these tests are usually made under clean, dry conditions, whereas the circuit breaker is subjected to abnormal conditions at the time of its operation. With this in view, the committee suggests that oil-circuit-breaker standard potential tests be investigated with an idea of increasing this test value. These tests should be made between all live parts to ground and between phases under minimum clearance conditions.

In order to reduce the maximum temperature and to

prevent accumulation of explosive mixtures in cell compartments, which has given some trouble, the recommendation is also made that careful consideration be given to ventilation of compartments, avoiding at the same time any method which would allow gas from one compartment to enter an adjacent cell. One company has found it desirable to carry the ventilation from each tank to the outside of the building. It would also be a great help if the contacts were made for greater ease and permanency of adjustment.

Since trouble has been experienced by some of the larger operating companies through the failure of oil circuit breakers to carry heavy short-circuit currents during the period required to open the circuit, it is recommended that all oil circuit breakers shall have a short-circuit current rating for periods of say both one and five seconds which should be at least equal to the interrupting capacity and in most cases two to three times this value. The manufacturers should test each line of their breakers or make periodic tests of breakers as they are brought through the factory.

The present-day practice of rating oil circuit breakers to interrupt a given root-mean-square current at normal voltage two times at a two-minute interval, the circuit breaker then to be in a condition to be closed and carry the rated current until it is practicable to inspect and make necessary adjustments, is not, according to Mr. Woodrow, in accord with operating requirements as reported in the replies to the questionnaire. For example, in some cases the operators find that after a breaker has opened automatically two, three, four and as high as five times, reclosing the breaker will restore service. Therefore the manufacturer should as soon as possible give a rating on oil circuit breakers on the single-shot basis and proportion these ratings on the reclosing basis. A breaker rated at a certain value on the single-shot basis would then be rated at a somewhat lower value on a two-shot basis and at other values below this on a basis of three shots, four shots, etc.

There is considerable difference of opinion as to what should be considered satisfactory operation of an oil circuit breaker, but it is suggested that it means the rupturing of current within a definite time limit after the energizing of the trip coil, which time allowance could be relied upon for selective operation of relays on the system, without throwing burning oil outside of the tank or causing permanent deformation of tanks or any of the current-carrying parts.

It is suggested that the rating be made with only the manufacturer's factor of safety to cover any inequalities of materials and manufacturing processes. The purchaser of an oil circuit breaker could then rely on a given rating at all times and should not count on more.

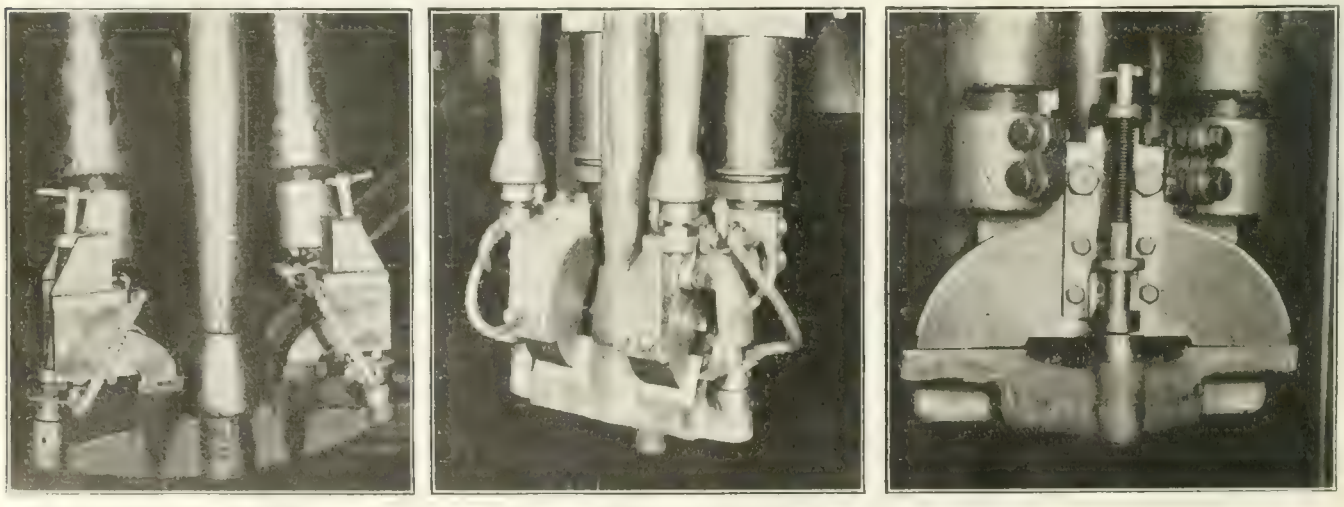
Tests made by one of the operating companies showed that reactance imposed a heavier duty on the oil circuit breaker than resistance for the same value of current. On the other hand, an increase in the speed of operation of some of the older type of breakers has made an improvement in the interrupting capacity. In 90 per cent of the cases reported venting the tanks has been found desirable.

It would be advantageous if some standards could be adopted by the oil-circuit-breaker manufacturers so as to reduce the number of types of oil required.

High Current Tests on Switchgear

Strength of Brush Contracts and Supports —Need of Strong Locks for "Disconnects" —Requirements of Instrument Transformers

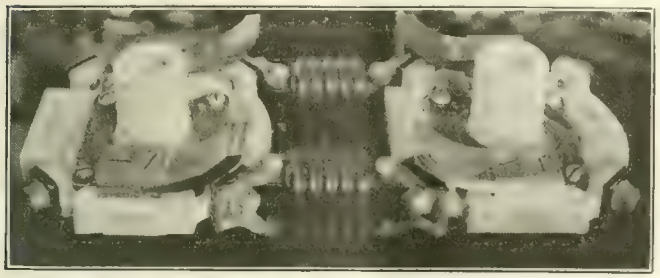
A SERIES of tests on oil circuit breakers and disconnecting switches to determine the ability of brush contacts and supports to withstand currents of the order of 100,000 amp. was described by Philip Torchio, chief electrical engineer New York Edsion Company. For the first time, he said, a synchronized motion-picture machine and an oscillograph were coupled to reproduce the coincident actions of the apparatus tested and the variations of voltage and current in the circuit. The tests proved that practically all the circuit breakers then on the market had the brush contact placed in the wrong position, so that when the current flowed the resultant mechanical force acted in a direction opposed to the brush pressure, thus tending to open the contact at this point, whereas if the position of the contact brushes had been reversed, the mechanical force due to this current would have been exerted in the same direction as the brush pressure, thereby tending to improve the contact. In addition to the force exerted at the contacts, it was found that the repelling force between contact supports was of such magnitude as to distort, and in some cases permanently displace, these parts.



IMPROVEMENTS IN TYPES CO-2, C-1 AND O-2 CIRCUIT BREAKERS

A—Quarter elliptic inverted brush contact for 1,200-amp. breaker. B—Circular inverted brush which increases contact pressure under load conditions. C—Half elliptic brush for 4,000-amp. brush.

In all these tests the circuit breakers were locked in the closed position. The arcing, therefore, was caused by the opening of the main and arcing contacts due to the mechanical force resulting from the high current. This phenomenon occurs in practice before the operating mechanism has had sufficient time to perform its function in opening under short circuit.



IMPROVED TYPE FH-3 OIL CIRCUIT BREAKER EMBODIES INVERTED CONTACT BRUSH AND TIE INSULATORS

On the basis of the results obtained, the manufacturers have revised the design of their circuit breakers so as to eliminate the trouble due to contact separation and displacements. The method of conducting the tests and reproductions of the oscillogram records are presented in the complete paper.

Switch Ratings Needed on One-Shot to Five-Shot Basis

THE severity of modern service conditions and cost of existing oil switches may necessitate radical changes in their design, according to the opinion expressed by Peter Junkersfeld. E. P. Peck and N. L. Pollard supported the subcommittee of the protective devices committee in its recommendation of rating oil switches on the one, two, three and even the five-shot basis, because it is usually necessary to reclose breakers several times after an interruption in order to restore service. Dr. E. E. F. Creighton agreed with Mr. Junkersfeld that oil switches may require radical change in design to meet present severe operating conditions, and went so far as to say that they might undoubtedly have to be designed to open short circuits as many as a dozen times in succession without being inspected.

A rather novel fuse construction was described by H. E. Trent in which the fuse wire is threaded through cement cylinders which are slightly separated so that the wire is exposed between segments. He referred to the advantages of this construction and to some tests conducted thereon. In a written discussion N. J. Conrad contended that Mr. Torchio's tests were not inclusive enough to prove that there are no potential fuses on the market which will successfully rupture a short circuit without resistance in series. He maintained that tests had been conducted on the Commonwealth Edison system which show the effectiveness of one style of carbon-tetrachloride fuse.

Replying to the foregoing observations Mr. Torchio said that his tests of potential fuses and remarks regarding them had not covered the carbon-tetrachloride fuse to which Mr. Conrad referred because he considered them more in the class of circuit breakers. However, he still maintains that potential fuses will operate better if used in series with a resister to limit the current. The tendency among users is to obtain the cheapest circuit breakers rather than to plan for future requirements and get switches that will meet them. The prevailing practice should be reversed, Mr. Torchio warned. Mr. Woodrow emphasized the need of opinions from operating men on circuit-breaker requirements if manufacturers are to be expected to furnish desirable equipment.

Safe Cable Temperatures

Conservatism Urged in Cable Rating

Freedom from Trouble Due to Overloading in Boston System Is Held to Justify Present Temperature Limits

ALTHOUGH a higher temperature is allowed in rotating equipment than in underground cables, the difference that exists is not so unjustified as may appear, L. L. Elden, electrical engineer Edison Electric Illuminating Company, held, because machinery is usually more readily observed and controlled. Besides, cable insulation suffers from aging. In fact, Mr. Elden's paper brought out that cables have been examined after being in stock for several years and it has been found that the insulation was too brittle to withstand the mechanical stresses of installation. Less rigid specifications for low-tension cables may be possible at the cost of more rapid depreciation, but the real question for cable users to decide is the rate of depreciation which they are willing to accept as the result of operating the cable at higher temperatures.

If, as seems quite likely, the existing temperature limit of 85 deg. C. may be safely exceeded for short periods without injury to paper insulation, it would seem preferable to apply an overload rating to low-tension cables which may be taken advantage of as occasion requires, rather than to operate such cables on a load-factor basis. The objection to the latter method lies in its impracticability of application to the operation of any system of distribution. In actual service each feeder operates on a load factor of its own which may or may not coincide with the system load factor. Further, load factor makes no distinction between seasonal loadings, a most important factor in the operation of a cable system.

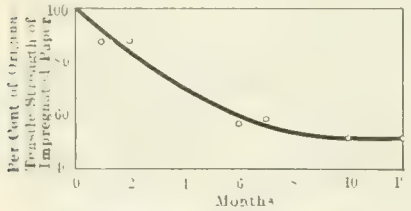
In the operation of the Boston company's 230-volt direct-current system during the past eleven years careful records of direct-current feeder loads have been maintained, which show that more than 800 amp. has been carried on 1,000,000-circ.mil concentric and single-conductor cables 75,800 hours. Of these instances 70 per cent have occurred in the winter months, clearly indicating the seasonal load characteristics of the system which afford such favorable conditions for operating cables at relatively high load values during the period of lowest temperature.

In eighteen years of use of single-conductor and concentric low-tension feeder cables there is no record of a failure of these cables due to loading conditions. While this may be considered evidence of too great conservatism in the use of the plant, it is the opinion of Mr. Elden that it is justified by freedom from interruptions of service. Therefore it is inadvisable to depart from the present practice to approve a higher degree of loading, which must invariably develop new troubles.

Risks in Raising Cable Temperatures

Mechanical Properties of Paper Insulation Are Destroyed Rapidly at 100 Deg. C. — Caution Advocated in Raising Temperature Limits

WHILE the experience of central-station men in carrying increased loads during the war indicates that low-voltage cables may be operated at higher temperatures than were considered safe in the past, W. A. Del Mar, chief engineer Habirshaw Electric Cable Company, did not consider that there is sufficient evidence to justify the manufacturers in agreeing to share the risks resulting from operation at or beyond the limit of temperature allowed heretofore. Five preliminary problems, he asserted in his paper, must be solved before the main one of determining the maximum safe operating temperature of insulating materials, such as impregnated paper. They are as follows:



WEAKENING OF IMPREGNATED PAPER AT 85-90 DEG. C.

1. What is the criterion of quality of paper insulation by which to determine whether it is satisfactory for service?

2. What is the effect of the continued application of various degrees of heat, expressed in terms of the criterion selected?

3. Will intermittent heat have the same effect as continuous heat, provided that the aggregate time of exposure and the temperature are the same in both cases?

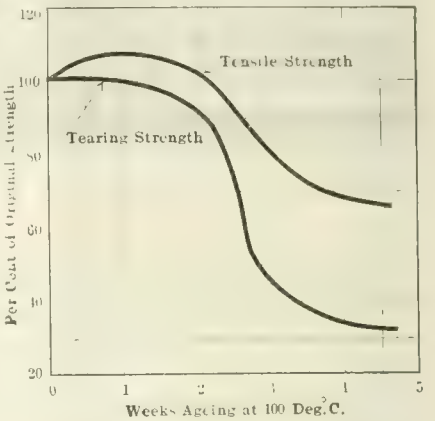
4. If the above questions should be satisfactorily answered, what form of rule should be adopted so as to make the best economic use of the information thus obtained?

5. If a rational rule for the maximum permissible temperature of paper insulation should be developed, how can the hottest-spot temperature of a cable in a duct be measured in order to insure that the cable is working within the rule?

In the opinion of Mr. Del Mar the tearing test is an excellent criterion for paper insulations. In this test the sample is subjected to increasing tearing stresses until the length of the tear has reached one centimeter. The reason for letting the paper tear a definite amount, rather than observing the force at which the paper begins to tear, is that paper varies in thickness and condition from place to place and the initial tear would only represent the strength at a spot and would not be a measure of the average quality.

When impregnated the tearing strength of manila rope paper is usually less than when unimpregnated, depending upon the nature of the impregnating compound, the temperature and duration of the process of impregnation and the amount of the compound retained upon cooling. Manila-rope paper usually contains from 5 to 10 per cent of moisture. Tests indicate that an increase of moisture increases the tearing strength up to about 10 per cent and decreases it above that point. Statements of tearing strength are therefore not complete unless the moisture content is specified. Tests made on rolls of paper immersed in petrolatum-resin compound maintained between 85 and 90 deg. C for a year indicate that at the end of the year paper loses about half the tensile strength it possesses just after impregnation, although it is in good enough condition even then for new low-voltage cables. It is probable that the tearing strength would have been even more reduced.

Among other tests which have been made some conducted with sealed lead-sheathed cables placed in an electric oven maintained carefully at a temperature of 100 deg. C. indicate that after the fourth week the paper becomes so brittle that it will crack when folded. The mechanical strength of paper-insulated cables is almost entirely destroyed by continuous exposure to a temperature of 100 deg. C. for three or four weeks. In Mr. Del Mar's opinion, cables in the same condition as these samples may operate satisfactorily, but the risk of continuing their service in this condition is obviously greater than with the insulation in good mechanical condition. About the same effect would be produced if cable were heated for three hours every day for eight months. Such a test is under way and when it is completed will show whether paper recovers any of its strength during the low-temperature intervals between intermittent heating.



PAPER LOSES STRENGTH RAPIDLY AT 100 DEG. C.

Cables Withstood Excessive Temperatures in Service

Temperature Surveys in Chicago Reveal Paper Cables Operating Intermittently [Near 180 Deg. C. in Crowded Duct Lines]

THE best that can be done at present to determine the maximum cable temperature that can be allowed, said D. W. Roper, superintendent of street department Commonwealth Edison Company, in his paper, is to obtain average curves showing the number of hours per year that temperatures near the maximum are maintained. From an examination of the insulation of cables corresponding to a number of such curves it should be possible to establish: (1) a lower limit at which the insulation will not be injured, even when the temperature is maintained for long periods of time, and (2) an upper limit above which insulation will be injured if such temperature is maintained for any considerable time. From the information so far obtained in Chicago, the best that can be done is to place the lower limit at about 110 deg. C. and the upper limit at about 180 deg. C.

With 1,000,000-circ.mil two-conductor concentric paper-insulated cables which were loaded more heavily than had been customary throughout the day and in which three pressure wires were laid with the outer conductors, careful measurements showed that the outer copper operated at slightly over 100 deg. C. in one case. The inner conductor was probably 8 deg. or 10 deg. hotter. In another case the load was about 10 per

cent heavier. While no measurements were taken in the latter case, the cable was removed after several years' service and reinstalled when examination showed the insulation to be in good condition.

The results obtained from temperature surveys indicate that the maximum copper temperature on the low-tension feeder cables in large and crowded conduits immediately adjacent to substations is generally higher than 105 deg. C. In a number of locations the temperatures considerably exceed this figure for several hours per day during five days of each week in winter months. In one or two cases where twenty-duct or twenty-four-duct conduits leave the substations with nearly all ducts occupied with loaded feeder cables, vacant-duct temperatures have attained approximately 100 deg. C. for short periods on Friday afternoons during two or three weeks in December. According to the Atkinson method, such idle duct temperatures indicate a maximum temperature approaching 200 deg. C. on the inner conductor of a concentric cable.

Upon removal of a section of one such cable a hole about 1 in. (2.5 cm.) in diameter was found in the lead sheath about 8 in. (20 cm.) from the mouth of the duct, apparently due to the catching on the edge of the duct when the cable was installed. In the immediate vicinity of the hole, the paper insulation was quite black and so brittle that it broke readily when handled. At another point 30 ft. (10 m.) away the paper insulation, while slightly darkened, was still well filled with compound and pliable, although it had lost some strength, indicating that the deterioration in insulation was not caused by heat alone but by its combination with the presence of air and possibly moisture.

Cable Samples Tested at 110 Deg. C.

Cable Considered Satisfactory for Low-Voltage Service Even After Continuous Heating for Ninety Days at 110 Deg. C.

RESULTS of a series of tests to determine the effect of various temperatures on the tearing strength of paper insulation were discussed in the paper of Wallace S. Clark, engineer of wires and cables General Electric Company. He gave data showing the usefulness of the tearing test and results of high temperature runs. It has been found that the ratio of tearing strength to the average tensile strength in sample A, cable not heated after manufacture, is 0.72; in sample D, heated ninety days at 100 deg., 0.57, and in sample G, heated ninety days at 110 deg., 0.64. The test showed that the tensile strength of the paper deteriorates less rapidly than its resistance of tearing. The higher rate of deterioration at 110 deg. C. is clear and is well marked by comparing the results from sample D, ninety-day bake at 100 deg., with sample E, thirty-day bake at 110 deg., the deterioration in thirty days at 110 deg. being virtually equal to deterioration in ninety days at 100 deg. From these results it was deduced that deterioration at 70 deg. C. is negligible; at 100 deg. it is marked in ninety days; at 110 deg. it is marked in thirty days, applying to the particular quality of paper and impregnating compound which were under test.

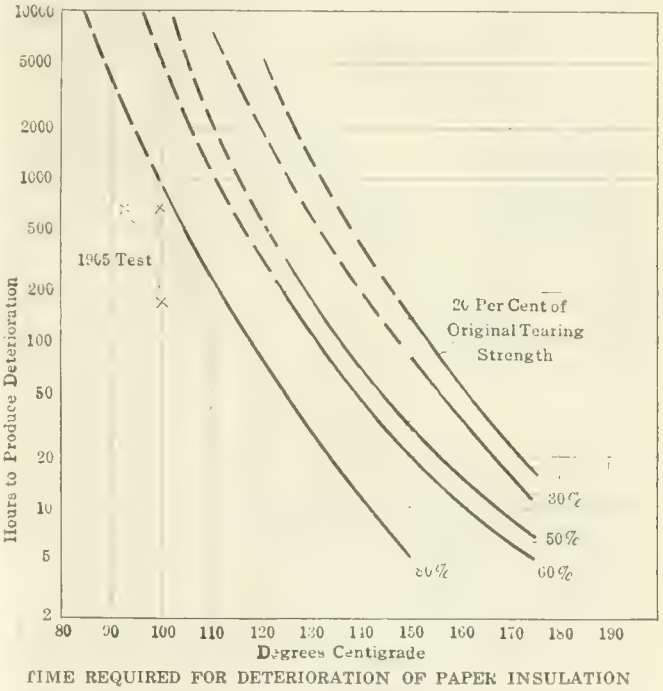
From an examination of the cable and paper taken from sample G, Mr. Clark believed that this cable would be perfectly safe for operation at low voltages. He also believed that cables so treated could have been withdrawn from conduit and reinstalled.

Paper Insulation Rapidly Deteriorates Above 85 Deg. C.

How Mechanical Properties of Cables Are Affected by High Temperatures—Recommendations Regarding Intermittent Overloads

THE principal effect of high temperatures on low-voltage cable insulations, according to the paper of H. W. Fisher and R. W. Atkinson, Standard Underground Cable Company, is the reduction of mechanical strength. Hence changes in the mechanical structure of insulations constitute a good basis for determining temperature limitations. The deterioration of paper is apparent chiefly in reduced ability to withstand tearing forces, bending or folding. Therefore apparatus for measuring one or more of these properties must be employed to make a satisfactory study of aging of paper. Descriptions of instruments for this purpose as well as data on a number of tests after various kinds of heat treatments were given in the author's complete paper.

If paper of uniform quality is subjected to a high temperature, the first effect noticeable is the greater



TIME REQUIRED FOR DETERIORATION OF PAPER INSULATION AT HIGH TEMPERATURES

ease with which the paper is torn. After longer heating it may be impossible to crease samples without cracking them. With a further degree of deterioration it is not possible to bend the paper an appreciable amount without breaking. A still further amount of aging produces a material which crumbles to a powder. The paper is not so sensitive to tensile tests as to tearing tests, since samples will show deterioration by tearing considerably before such effects appear in the tensile test. According to tests which have been reported to the standardization committee, the temperature of 85 deg. C. is justified as the maximum permissible temperature for underground cables because subjection of cable insulations to 93 deg. C. results in serious injury in about four weeks.

Impregnation affects the tearing resistance of the paper very slightly, according to tests. The great loss of tearing strength when the sample of paper is dried

and impregnated is said to be due to the change in moisture content and not to impregnation with compound. With the paper and oils used there appears to be very little difference between the aging effect at a given temperature of paper submerged in oil and paper exposed to air. This is contrary to the usual belief that the deterioration in air is much greater than under oil. This subject is said to require further study.

From the relation between temperature and number of hours required to produce certain definite amounts of deterioration it may be observed that the rate of deterioration doubles for a temperature increase of about 8 deg., at temperatures near 125 deg. C. Within the range of 100 deg. and lower, the increase of rate of deterioration with temperature is even greater, being roughly ten times as great at 100 deg. as at 85 deg. Thus it may be concluded that the annual rate of deterioration of a cable loaded so as to produce a temperature of 100 deg. C. for about two and one-half hours per day and a temperature much lower than 85 deg. for the rest of the day will be about the same as that of a cable loaded continuously so as to produce a temperature of 85 deg. Or, for a cable having a temperature of 100 deg. for two and one-half hours per day and of 85 deg. for the remaining time, the rate of deterioration would be nearly twice as great as for a continuous temperature of 85 deg.

Even after there are available sufficient experimental and laboratory data regarding the degree of deterioration occurring at different temperatures and under different conditions, the allowable amount of deterioration from the standpoint of operation of the cable still remains to be determined. As a definite limit the authors of the paper suggested a temperature which may be expected to produce a reduction of 20 per cent of the original tearing resistance of the paper after a period of, say, five years' time. This suggestion leads to the following temperature limit:

	Deg. C.
For continuously maintained temperature	78
For maximum temperature maintained five hours per day, temperature during remaining part of day low	85
For maximum temperature maintained two and one-half hours per day, temperature during remaining part of day low	90
For maximum temperature maintained one-half hour per day, temperature during remaining part of day low	100

Weight of Opinion Opposed to Higher Cable Temperature Rating

It Appears that Higher Temperatures Are Permissible, but Data Is Insufficient to Justify Changing the Temperature Rating

A BASIS for discussion of paper-insulated cable temperature ratings was laid down by Philip Torchio when he stated his conclusion that paper insulation under the lead sheath is in better condition to withstand 105 deg. C. than paper or varnished-cambric insulation on apparatus and machinery. He also expressed the belief that manufacturers are ready to guarantee cables at 100 deg. to 105 deg. C., provided the cables remain undisturbed in the ducts.

Most of those discussing this subject did not favor an increase in temperature rating, however, and urged that a better plan is to keep the present rating, which is considered safe, leaving the operating engineer to decide whether his conditions will justify operation at higher temperatures for short periods of time. It was the opinion of several of the speakers that there is not yet sufficient data at hand to determine what the hot-spot temperatures at inaccessible points in the ducts may be and that there are many variable conditions of undetermined importance involved in the problem.

After abstracting his paper Mr. Clark drew attention to two points of difference between cable and apparatus insulation—(1) that cables are guaranteed for five years and (2) that apparatus coils may be rewound readily. Mr. Fisher urged that A. I. E. E. rules be conservative since many companies do not have good facilities for controlling and observing cable temperatures, and in this recommendation G. B. Shanklin, W. I. Middleton, Prof. C. A. Adams and Dr. A. E. Kennelly concurred. Referring to the case of a torn cable sheath cited by Mr. Roper, Mr. Atkinson said the deterioration there might have been due to leakage currents instead of exposure to air since his tests did not indicate this harmful effect from such exposure alone. He also believed that standards not permitting reinstallation of cables were not justified, and C. N. Rakestraw amplified the point by saying that it was virtually impossible not to disturb cables when working on other cables in the same manhole.

Effects of Expansion of Cables Not Fully Known

In the matter of expansion and contraction of cables Mr. Shanklin did not believe enough importance had been attached to it. He also said that cables were expected to last twenty years. Prof. D. C. Jackson again called attention to the difference in expansion coefficients of the main elements of a concentric cable (two conductors, insulation and sheath). He said the different cementing materials used in class A insulation and cables might make a very appreciable difference in their resistance to high temperatures. E. B. Meyer and R. J. Wiseman agreed with Mr. Del Mar and Mr. Elden that cable temperature standards should not be raised. If they were raised, Mr. Meyer believed, actual temperature records would be required for financial adjustments.

Concerning the proposal to base temperature ratings upon load factor, P. H. Chase believed this would be a mistake, since the maximum load might last for a short time or a much longer time with the same load factor. Dr. Kennelly made a plea for actual measurements of cable temperatures by means of continuously recording temperature indicators installed at interior points in ducts. That the facts must be available and agreement reached before a change in standards is justified was Prof. C. A. Adams' belief and also that of F. D. Newbury.

H. R. Woodrow stated the economic problem involved in fixing temperatures at which cables should operate and H. C. Dean said experience on his system had indicated that high temperatures were not justified economically on account of the great I^2R losses. F. M. Farmer and W. I. Middleton commended the tearing resistance test of paper insulation.

D. W. Roper spoke of work being done by the British Electrical and Allied Manufacturers' Association and suggested that our National Research Council might take steps toward co-operation between the two countries.

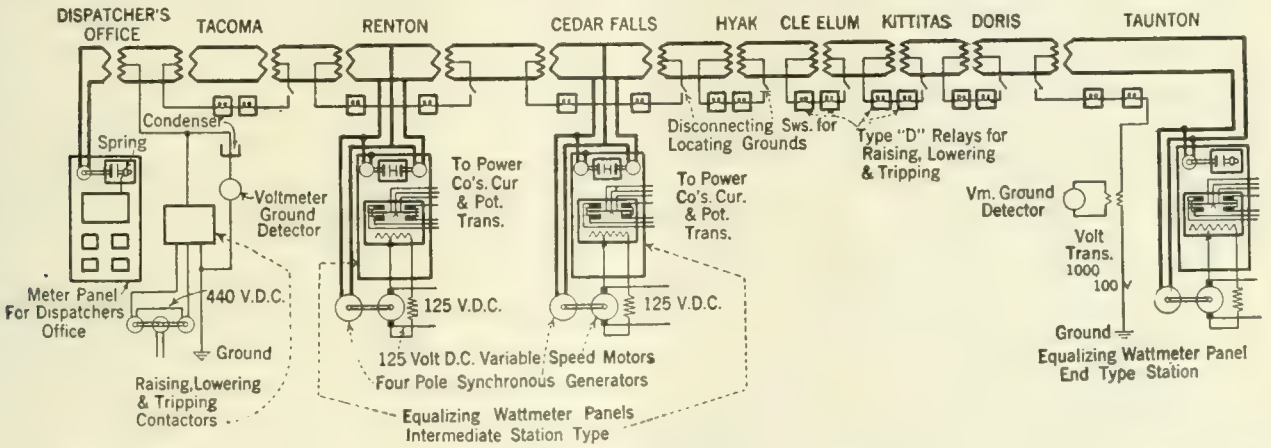
William Maver dealt with the early work on underground cables in 1889 and the years following when rubber-insulated and fiber-insulated cables were installed in New York electrical subways.

Meters and Measurements

Metering at Remote Points by Use of Frequency

Conditions Affecting the Transmission of Voltage or Current Are Eliminated by Meter, Depending on Adjustable Frequency

SINCE voltage drop is affected by resistance in the circuit and the current at any point is affected by leakage and induction, and since the transmission of energy is affected by both of these quantities, B. H. Smith of the Westinghouse Electric & Manufacturing Company pointed out in his paper, the problem of accurate metering at remote points has been a rather difficult one. Frequency, however, is not affected by any of these quantities, and this makes it possible to send out adjustable frequencies proportional to the energy consumption at any point and record the effect at a remote point either as indicating or integrated energy measurements. This is accomplished by connecting a wattmeter to a small alternating-current generator the speed of which, and hence the frequency, is proportional to the energy to be measured. Such a method is used on the electrified system of the Chicago, Milwaukee & St. Paul Railway for the purpose of supplying the load dispatcher with information. A base frequency of 25 cycles is maintained, so that if the load is zero 25 cycles is sent out. The frequency is increased up to 60 cycles for the maximum energy recorded. The control-circuit voltage is transformed from 100 volts to 2,000 volts for transmission to the recording station. For totalizing the energy being recorded the frequency at each station is increased by an amount proportionate to the power being received at that station. It is not done directly, however, but by another generator so controlled that its speed corresponds to the incoming frequency plus any power coming in on its own meter.



REMOTE METERING THROUGH THE USE OF VARIABLE FREQUENCY USED ON THE SYSTEM OF THE C., M. & ST. P.

Mr. Smith has shown that the line losses where the power control current was carried over both wires of the metering circuit and a ground return were so great that any attempt to meter by the direct transmission of either voltage or current would have been entirely inaccurate.

In discussing metering at remote points J. R. Craighead, General Electric Company, pointed out that the direct-current method had certain advantages, such as (1) that it is not affected by inductance or capacity, (2) there are fewer rotating elements to keep in order, (3) fewer wires are required, and (4) no phantom circuits are necessary. He also stated that leakage had not given trouble on the Montana Division of the Chicago, Milwaukee & St. Paul Railway. In reply, Mr. Smith said that on the Coast section of the line leakage had reached as high as 90 milliamperes on the power-control circuit, which uses direct current. For this reason the direct-current method was not practicable for metering purposes on this particular installation. C. F. Scott and W. H. Pratt also discussed the subject.

Limitation of the Stop Watch as Precision Instrument

Unreliability Great Defect in Modern Stop Watches—Inherent Errors Not Reduced by Adding More than Seven Jewels

BUILT for the non-technical public, the ordinary stop watch does not meet the requirements for engineering test purposes either as to accuracy or as to ruggedness, A. L. Ellis of the Thomson laboratory, General Electric Company, observed in the paper of which he was the author. Experience of more than twenty years in a manufacturing organization with more than 400 stop watches, including thirteen makes and nineteen models, indicates, Mr. Ellis said, that nearly all watches are in repair shops every two months, and in cases where their use is nearly continuous, as in meter testing, operation tests, etc., the intervals between repairs do not exceed two weeks.

A mechanically perfect stop watch will have an inherent error of as much as two-fifths of a second in a thirty-second reading, or at least one-half of this amount plus or minus the second limit. The addition of jewels to the number of seven in a stop watch is of some value, since the accuracy of the watch and its reliability of operation are increased for various positions. However, the further addition of jewels is not required, and the increased cost is out of proportion to any practical gain. It is to be hoped, Mr. Ellis said, that manufacturers will make a special effort to produce a stop watch suitable for all the classes of engineering work.

Mr. Ellis considered the errors which are found in the usual types of stop watches and discussed some of these errors from a technical viewpoint.

V. Karapetoff, H. M. Smith, W. J. Hammer, L. N. Potts and W. H. Pratt also discussed the subject.

Eddy-Current Measurement

AMONG the methods that have been investigated for reducing the eddy-current losses in cables, James A. Cooke, New York Edison Company, specified in his paper the impregnation of bare cables with varnishes and compounds to insulate the strands from each other and the insulation of layers of strands from each other by wrapping the layers with asbestos tape during manufacture of the cable. Measurements show, however, that the largest reduction is effected by impregnating the bare cable with sulphide solutions and then baking them. Mr. Cooke described a method of measuring eddy currents in cables and suggested methods of reducing the errors in making such determinations.

Wave Analysis Simplified

AN ELECTRIC network system for the analysis of alternating-current waves was described by F. S. Dellenbaugh, Jr., of the research division of the electrical engineering department, Massachusetts Institute of Technology. Long mathematical work is eliminated by this method, and the results are the same, he declared. Mr. Dellenbaugh also compared other methods of analysis with the electric analyzer, pointing out the advantages and disadvantages of each.

Miscellaneous

Short-Circuit Current of Induction Generator Is Serious

Conditions Identical with Those in Synchronous Machine Except that Transient Is Shorter and Current Dies to Zero Value

THE existence of a serious rush of current experienced in a short-circuited induction generator or motor was maintained in the paper of R. E. Doherty and E. T. Williamson, General Electric Company. This contention is in contradiction to a prevailing opinion that the current falls off immediately, which has led to the suggestion that induction generators be used to limit short-circuit currents on alternating-current systems. The authors declare that the conditions are identical with those in a synchronous machine, except that the transient is shorter and the current dies down to zero value.

To summarize the author's conclusions: (1) The sudden short-circuit current of a polyphase induction motor or generator, like that of a synchronous machine, is initially many times the normal rated current, and consists of an alternating-current and a direct-current component of approximately equal magnitudes in both primary and secondary. (2) The initial value of the root mean square of the alternating component is equal to the impressed voltage divided by the total leakage reactance. (3) Assuming the same leakage inductance, the initial current will be the same whether the machine is short-circuited as an induction machine or as a synchronous machine with the secondary excited with direct-current. (4) The leakage reactance under short-circuit conditions is lower than indicated by ordinary impedance tests. This is an important point to be considered in the design of large induction generators in which relatively low values of resistance may exist. (5) The actual duration of the transient is less than that indicated by the ohmic resistance and the reactance from impedance test, both because eddy currents increase the effective resistance and because saturation of leakage paths decreases. (6) Adding resistance to the primary winding will cause the direct-current component of that winding, and therefore the alternating component of the secondary, to die out rapidly, and it will prolong the transient of the primary alternating component and secondary direct-current. (7) The effect of load upon the value of the short-circuit current is virtually negligible.

Professor V. Karapetoff, Lawrence E. Widmark, Professor M. I. Pupin and Selby Haar discussed this paper.

Heat Flow in Slot-Wound Coils

FORMULAS for transverse and longitudinal heat flow in armature coils were worked out and checked by test results in the paper of Carl J. Fechheimer, Westinghouse Electric & Manufacturing Company. According to the tests there is very close agreement between the calculated values and test values for maximum temperature, minimum temperature and temperature at the end of the core, the exception being the maximum temperature at no load. There is slight difference between the calculated minimum temperature, considering transverse flow only, and the minimum temperature by test. On the other hand, there may be quite a large difference between the calculated maximum temperature, considering transverse flow only, and the maximum test temperature when the temperature is based on the maximum iron temperature instead of the rise. This applies even though the machine be of medium length, and the copper is worked at fairly high nominal current density with nearly negligible eddy-current loss. Thus it may be misleading, even in medium-length machines, to ignore the longitudinal flow.

R. B. Williamson, B. A. Behrend and Dr. Carl Hering commented upon this paper.

Great Future for Carrier-Current Communication

CARRIER multiplex telegraphy and telephony were discussed by E. H. Colpitts and O. B. Blackwell in an elaborate paper relating to the developments of the art. The propagation characteristics of open-wire lines were considered, including those lines containing intermediate lengths of cable. Commercial types of apparatus were described and actual installations were mentioned. It was pointed out that at present the apparatus is so expensive that the carrier-current system is economical only for relatively long-distance communication. Major-General G. O. Squier, in commenting on this paper, spoke of the wonderful development which is just opening in the radio field, especially in the range of higher frequencies. He mentioned that the navy had been experimenting with 200,000 cycles. Absolutely noiseless carrier currents, he prophesied, would be a development of the near future.

Dr. A. E. Kennelly claimed that such system as those mentioned in the paper would permit the present duplex systems to be set aside and the ground return to be discarded except in sparsely settled districts. He also foresaw that a higher type of man must be employed as a wire chief in the future.

Readers' Views and Comments

Water-Power Development in Public Parks

To the Editor of the ELECTRICAL WORLD:

SIR: The Pacific Coast States are, I believe, more directly interested in hydro-electric power enterprises which may to some extent involve land in national reservations and parks than all of the rest of the country. Therefore the observations of those closely in touch with the Pacific Coast section are the observations of those most vitally interested in the subject.

There are cases where a water-power development may be of questionable economy and at the same time would certainly destroy a scenic wonder or a beauty spot; but, on the other hand, there are certain projects of excellent economy which will create spots of beauty and charm where none exist at present. In still other cases the development will give a beautiful lake, for instance, in place of a certain waterfall. Take as a case in point, the Merced River above and behind the Yosemite Valley in California. The impoundage of the flood waters of this river would result in decreasing the flood flow, which occurs at a time when there are very few in the valley to see the falls, the valley being snowbound. This impoundage would prolong the season later in the year during which tourists flock to the valley to see the wonderful falls. At the present time the volume of water over these falls rapidly decreases in the early summer because of the quick run-off.

This is only one instance, but as in each instance there is so much to be said on both sides of the question, a definite law prohibiting development in national parks should not be enacted. It would be reasonable, however, that the decision in each instance should be placed in the hands of a federal department or commission for the exercise of careful judgment.

J. M. BUSWELL.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Engineering Education in Our Universities

To the Editor of the ELECTRICAL WORLD:

SIR: In regard to the article in the Jan. 15 issue of the ELECTRICAL WORLD entitled "Electrical Engineering Students Increase" it is my opinion that words and printer's ink have both been lavishly wasted in recent years in putting on record the thoughts of various individuals regarding the increase in the number of students attending our universities now as compared with five years ago. I am further of the opinion that it is rarely of value to attempt to explain such occurrences. There are, of course, many reasons which can be very briefly stated, such as increased prosperity during the last five years and the conviction of many that the requirements of the war period proved the necessity for young persons of both sexes, and especially the men, having their minds properly trained for some useful service. Whatever the reasons may be, they are of little consequence as compared with the facts, and I am more concerned with a straightforward consideration of the increased responsibility of engineering institutions than with all the reasons for the increase which might be expressed in a volume devoted exclusively to that purpose.

Undoubtedly many students have undertaken engineering work in our universities and technical schools who are virtually without the natural intellectual endowment necessary to success in such a course. These students should be got rid of as soon as possible in all of our institutions. Even if this were done, however, there is probably not one institution in this country that is properly equipped and manned with the adequate staff of instructors to meet the present demands.

If our engineering institutions will stick to fundamentals, eliminating all informational courses, and insist upon a high standard of achievement in their classes, and if at the same time the necessary financial support is at once given to these institutions, then, in my opinion, the very best possible service will be rendered by them to the people and to the great engineering organizations and enterprises of the nation.

C. L. CORY,
Dean College of Mechanics.

University of California,
Berkeley, Cal.

Electrical Service in Argentina

To the Editor of the ELECTRICAL WORLD:

SIR: The Columbus Company for Electrical Enterprise of Glarus-Zurich has just published its annual report for 1920. This holding company is largely interested in foreign enterprises, especially in South America. Thus the Columbus company exercises the controlling interest in the Argentine "Compañia Italo-Argentina de Electricidad" of Buenos Aires. In reference to this latter undertaking the report says that in 1919 the Argentine company's plant for the generation of electrical energy had already been enlarged by the installation of a fourth group of turbo-generators of a capacity of 10,000 kw.—built by the Swiss Brown-Boveri Company—and during the last year another order for a fifth group of turbo-generators of the same capacity has been placed with the same Swiss company. Great attention had to be paid to the supply of fuel. In order to provide this on an efficient basis, a special fuel supply company, styled the "Compañia General de Combustibles," was formed at Buenos Aires with a capital of 3,000,000 pesos. This company has started the erection of large oil reservoirs at the Argentine capital and has acquired a number of tank ships for the transportation of the oil.

At the end of June of last year the Compañia Italo-Argentina de Electricidad had installed 28,000 connections of 76,000 kw., as against 25,000 connections of 67,000 kw. during the same period of the previous year. These connections included not only private ones, but also those of the city of Buenos Aires for public light, the requirements of the state for harbor works and those for the Southern Electric Tramways Company. The production of energy rose from 58,000,000 kw.-hr. in 1919 to 75,000,000 kw.-hr. in 1920, and the earnings of the company allowed the distribution of a dividend of 7 per cent against 6 per cent in 1919. The capital has been raised from 5,000,000 pesos to 10,000,000 pesos. The largest part of this increase was subscribed by the Swiss holding company.

HENRY L. GEISSEL.

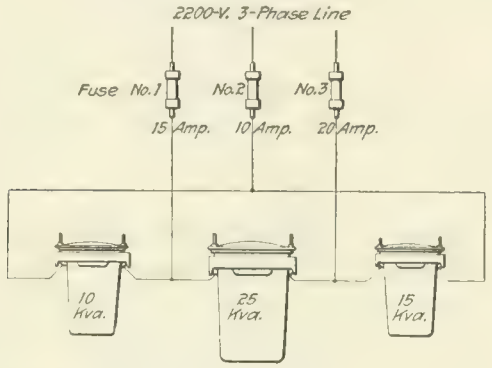
Münsinger-Berne, Switzerland.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Size of Fuses to Use for Distribution Transformers

THE correct size of a fuse to use with a 2,200-volt distribution transformer or any combination of transformers is quickly ascertained from the table shown here, which was prepared for the troublemen and line foremen of the Ohio Power Company, Canton division. To find the size of fuse for a single transformer



DELTA-CONNECTED TRANSFORMER BANK WITH SIZE OF FUSES SHOWN

the size of the transformer in kva. is first found on the top line of the table, and directly under it on the second line is found the size of the fuse. For transformers connected in delta or open delta it is necessary to use both the horizontal scale and the vertical scale of the table. For instance, with an open-delta bank the outside legs are fused the same as single-phase transformers of the same size. If the bank consists of a 10-kva. and a 20-kva. transformer, the outside legs have respectively 5-amp. and 10-amp. fuses. To find the size of

MAXIMUM FUSE SIZES FOR 2,200-VOLT TRANSFORMERS

Kva.	0 Single Phase	5	7½	10	15	20	25	30	37½	40	50	75	100	125	150	200
0	5	5	5	10	10	15	15	20	20	25	35	50	60	75	100	
5	5	5	5	10	10	15	15	20	20	25	35	50	60	75	100	
7½	5	5	10	10	10	15	15	15	20	20	25	40	50	60	75	100
10	5	10	10	10	10	15	15	20	20	25	30	40	50	60	75	100
15	10	10	10	10	15	15	20	20	25	25	30	40	50	65	75	100
20	10	10	15	15	15	15	20	20	25	25	30	40	60	65	75	100
25	15	15	15	15	20	20	20	25	25	30	30	50	60	65	75	100
30	15	15	15	20	20	20	25	25	30	30	35	50	60	65	80	100
37½	20	20	20	20	25	25	25	30	30	35	35	50	60	75	80	100
40	20	20	20	25	25	25	30	30	35	35	40	50	60	75	80	100
50	25	25	25	30	30	30	30	35	35	40	40	50	65	75	100	100
75	35	35	40	40	40	40	50	50	50	50	50	60	75	80	100	150
100	50	50	50	50	50	60	60	60	60	60	65	75	80	100	100	150
125	60	60	60	60	65	65	65	65	75	75	75	80	100	100	100	150
150	75	75	75	75	75	75	75	80	80	80	100	100	100	100	150	150
200	100	100	100	100	100	100	100	100	100	100	100	150	150	150	150	200

fuse for the middle leg, the kva. of one transformer (20 kva.) is found at the left-hand column and the line is followed to the right until directly under the kva. of the second transformer (10 kva.) in the top line. At the intersection of these two columns is shown the size of fuse to be used, which is 15 amp.

For closed-delta banks all fuses must be calculated by using both scales. For instance, suppose that there are three transformers of 10 kva., 25 kva. and 15 kva. respectively, connected as shown in the accompanying drawing. In this case by consulting the table it is seen that fuse No. 1 should be 15 amp., fuse No. 2 should be 10 amp. and fuse No. 3 should be 20 amp.

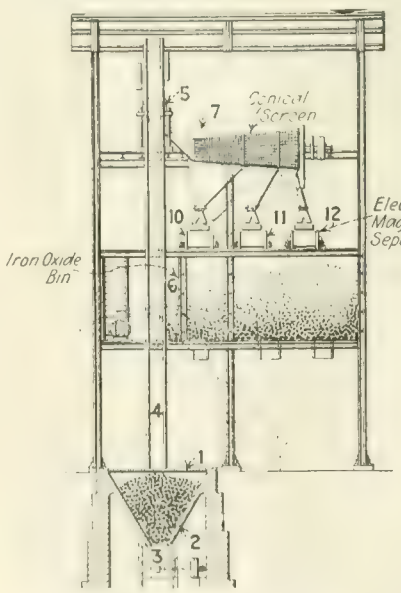
The fuse sizes given in this table do not correspond exactly with the ratings of the transformers, but they show the nearest size of fuse which is regularly carried in stock and which it is practicable to use with the transformer.

CARL A. WEGMAN.

Canton Division, Ohio Power Company.

New Process for Reclaiming Coal from Combustion Residue

A NEW process for saving unburned coal out of combustion residue has been developed by the Gruson Werke, a branch establishment of Krupp, in Germany, which, it is claimed, is simpler and quicker than the methods based on the different specific gravities of coal and clinker. The new process makes use of the magnetic qualities of the oxides of iron into which the sulphurous pyrites are transformed by burning and which are retained in the clinker. The basic principle of the process is the fact that the clinker, which contains ferro-oxides, responds to electro-magnetic attraction while the coal does not. The accompanying illustration shows a plant which has been designed for a combustion residue of 10 tons per hour. The ash is first put through the screen (1) with meshes 3½ in. (80 mm.) square. Pieces of unburned coal that do not pass through this screen are separated by hand from the clinker and carried off separately. All small pieces pass into the hopper (2) underneath and from there through the chute (3) into a bucket elevator which lifts them to the top of the square building containing the separating plant.



CLINKER SEPARATED FROM COAL BY MAGNETIC ACTION

Ash conveyed upward by bucket elevator (4) and after passing screen (7) five magnetic separators (as 10, 11 and 12) remove clinker.

The next step is the separation of iron from the ash, which is performed by the iron separator (5). The iron

sorted out falls into bunker (6), while the remaining material goes into a conical screen drum with different sizes of meshes. This screen separates the ash into four different sizes, 0-0.3 in., 0.3-0.8 in., 0.8-1.4 in. and over 1.4 in. (0-8, 8-20, 20-35, and over 35 mm.). The first three sizes are charged on to electromagnetic separators, (10), (11), (12) and two not shown, while the material over 1.4 in. (35 mm.) in size is taken to the crusher.

Separation of the clinker from the coal is performed by the electromagnetic attraction of the drums, on the surface of which the clinker is retained to a certain degree while the pure coal is thrown out by centrifugal force. The electromagnetic action counteracts to a certain degree the centrifugal force produced by the rotation of the drum and results in depositing the coal and the clinker respectively in different places, which can be kept apart by a wall. The pure coal is collected in compartments which have chutes at the bottom by means of which it can be loaded on trucks and carted away.

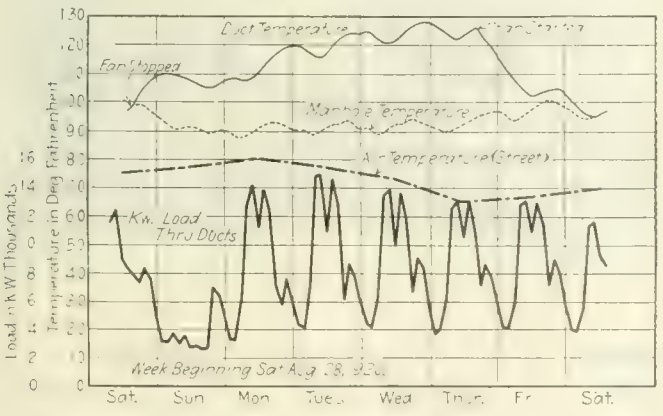
It has been found that a considerable amount of coal can in this way be recovered from the combustion residue, namely, 30 per cent from stationary plants and 40 to 45 per cent from locomotive ash. It is claimed that this new process besides other advantages has the merit that coal particles of every size can be recovered, while the small-sized particles are lost by the liquid treatment used up to now. Besides, the clinker obtained is absolutely free from coal and therefore better adapted for briqueting.

H. O. HERZOG.

Berlin, Germany.

Temperature of Cable Ducts Reduced by Blower in Manhole

UNDERGROUND conduit temperatures have been greatly reduced by the Toledo Railways & Light Company by means of a direct-driven blower installed in the manhole covers. As the blower and its supporting frame are portable they can be quickly taken to locations where abnormal temperatures exist, either temporary or of a permanent nature. The effect of the fan on the conduit temperature is shown on the curves

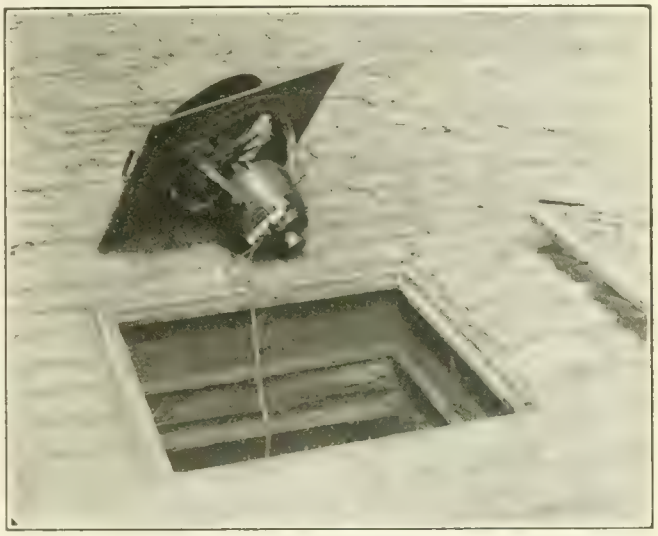


CURVES SHOWING REDUCED TEMPERATURE IN DUCT WITH MANHOLE BLOWER RUNNING

reproduced here. This shows the temperature with and without the fan.

The temperature record is secured by a recording thermometer with an 80-ft. capillary, which is inserted in the conduits midway between two holes. At this location there are approximately sixty conduits, 75 per cent occupied with cables carrying at the time of this chart peaks as high as 15,000 kw. in 220-volt direct current, 600-volt railway, 4,000-volt and 23,000-volt feeders. This chart does not represent the maximum temperatures experienced in this system, as at the time it was taken the atmospheric temperature was not above 80 deg. Fahr. During the very hot weather conduit temperatures have been experienced as high as 180 deg., and this great heat led to the development of this apparatus. Experience has shown that by the method described air can be circulated in the conduit system at sufficient velocity, even at high temperatures, to bring about safe operating conditions.

The outfit consists of a 15-in. Ventura wheel driven by a ¼-hp., 110-volt direct-current motor, delivering ap-



DUCT TEMPERATURE IS REDUCED BY MOUNTING THIS BLOWER IN MANHOLE OPENING

proximately 650 cu.ft. of air per minute, taking the air from the street and forcing it into the manholes. The direction of flow of the fresh air in a conduit system can be altered by plugging various ducts with waste. Reference to the photograph will show that the blower and motor are mounted on a steel plate which fits into the lower flange of the manhole cover. A conical hood is built over the fan to protect it from water, shedding the incoming water to a drainage ring outside the fan opening. The street cover plate is drilled to secure the same area for passage of air as the area of the fan opening. Energy is supplied through a two-conductor wire which is attached to the distribution box inside the manhole.

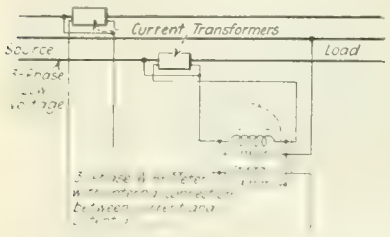
W. E. RICHARDS,
Superintendent Electrical Department.
Toledo (Ohio) Railways & Light Company.

Meter Installation Which Permits Easy Check on Connections

WHERE large amounts of three-phase energy are to be measured by a 5-amp., polyphase meter installed with current transformers on a low-voltage circuit the method of connection shown in the cut will minimize the likelihood of error and make possible a very simple and accurate check on the connections. In such installations it is extremely important to avoid the possibility of wrong connections, particularly those which will allow the meter to run forward on its normal load but with a large departure from accuracy. Such errors may easily be overlooked, with serious conse-

quences. With this method the ordinary house-service type of meter is used in which connections between potential and current coils are made inside the meter, the usual independent potential terminals being eliminated. The potential coils are energized by means of a tap connecting the primary and secondary of each current transformer. With these taps in place and the common potential wire connected to the third phase, the only possible error in connections is the reversal of one or both of the current-transformer secondaries. If the leads from the high-reading phase or both secondaries are reversed, the meter will run backward; if the leads from the low-reading phase are reversed, the meter will stop at unity power factor, run correctly at 50 per cent power factor and be increasingly fast as the power factor decreases.

The detection of such an error in current-transformer connections is a very simple matter. Assume that the meter is running ahead on its normal load and that it is desired to know whether the current connections on the low-reading phase have been reversed. Open the common potential connection by taking this wire out of the meter terminal block, leaving the two potential coils in series across the outside leads. If the meter has a separate potential tap for each element, these may be connected by a jumper. If the connections are correct, the meter will slow down to half speed in the forward direction; if the low-reading phase is reversed, it will run at half its previous speed but in the reverse direction. If the meter is so connected that it runs backward on its normal load, either the high-reading phase or both phases must be reversed. To determine which, open the common potential connection as above. If the high-reading phase only is reversed, the meter will run forward at half its previous speed, and if both phases are reversed it will run at half speed but backward. This is true for any power factor or any load, provided always that the load is approximately balanced.



INSTALLATION OF METERS IN THIS MANNER PRECLUDES POSSIBILITY OF ERRORS IN CONNECTIONS

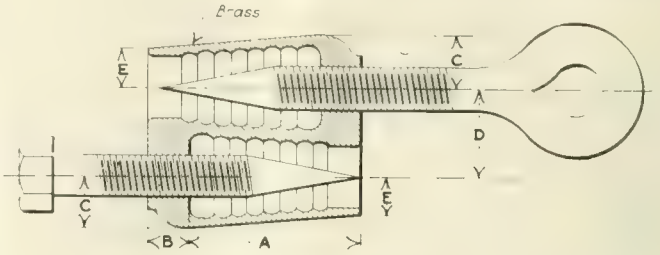
A study of the vector relations involved shows that when the potential connection to the middle phase is opened the phase relations are so changed that the former high-reading phase becomes the low-reading phase and vice versa. The phase angles between the potential pressures and currents remain the same, but the sum of the readings of the elements will be halved, as the potential coils are now in series across the line potential. If the low-reading phase current is reversed, it will assume preponderance and reverse the rotation of the disk.

This method is, of course, applicable in the case of a meter installed without transformers. However, in this instance the connections are usually more evident and an error is less likely. It will be found useful also for checking errors in internal connections of polyphase meters and reversal of the leads on polyphase standard meters.

ALBERT R. THOMAS,
Meter and Testing Department.
Southern California Edison Company,
Los Angeles, Cal.

Clamp Eliminates Soldering on Splices and Dead-Ends

A CLAMP for dead-ending and splicing cables which has proved useful in one of the electric railway substations of Chicago could also be used with advantage by many industrial plants. Instead of the old practice of skinning the cable installations back for about 20 in. or so from the end of the conductors for the purpose of making proper connection, only about 4 in. of bare cable is required for a strain connection or splice when this clamp is used. The bare end of the cable is slipped into a conical grooved hole in the clamp, and a pointed screw inserted at the closed end of the hole is screwed into the center of the cable. This forces out the cable against the grooved sides of the hole.

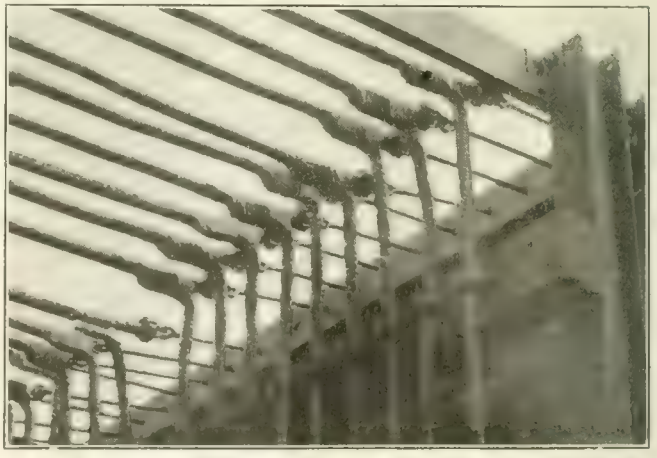


Dimensions for Dead-End Splice Clamp

Size of cable	A	B	C	D	E
4/0 to 350000 C.M.	2 5/8	1/2	11/16	1 1/4	9/16
500000 C.M.	3 1/2	3/4	1 1/16	1 3/4	11/16
1000000 C.M.	4 1/2	1	1 5/16	2 1/4	3/32
2000000 C.M.	2 5/8	5/8	13/16	3/8	9/32

DETAILS OF DEAD-END SPLICE CLAMP

The clamps are made of high-conductivity cast brass, and no solder is required to make the connection. The clamp has such a grip on the cable when the screw is in position that on a pull-out test a 1,000,000-circ.-mil cable broke under the strain but did not pull out.



DEAD-ENDS MADE WITH SPECIAL CLAMP WITHOUT SOLDERING. ONE CLAMP AT LEFT OF PICTURE HAS TAPE REMOVED

Chicago, Ill. W. H. WILLIAMS.

Avoiding Change of Phase Rotation

IN ORDER to prevent change in phase rotation of a line being worked on a New York State company makes it a practice to attach a rotation indicator to the circuit and leave it connected until the work is completed. On re-energizing the line a change of rotation is immediately noticed.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Keeping Shop Tractor in Shape

TO KEEP a tractor in running order it should be examined, oiled and greased every morning before its day's work begins. If any nuts are loose, they must be tightened up and perhaps held with lock washers or cotter pins. If there is too much loose play in the steering gear, have it taken up; also see that the machine steers easily and far enough toward both right and left. If the oil holes are filled with dirt, clean them out with a nail or wire so that the oil may reach the bearing it is intended for and not merely run over the outside. If the grease cups are screwed down tightly, remove them to see if they are not entirely empty or whether the grease is hard and thick. Remove the caps from the ball-bearing raceway of each wheel every few weeks and apply some soft grease like vaseline. One filling of soft grease on the driving gears will last about three months without attention, provided all the gaskets are tight. If the brake is loose, have it tightened properly as it is necessary to stop a small but heavy tractor very suddenly sometimes to avoid an accident. If the brake band is worn, have it relined, fastened with copper rivets and then adjusted to stop not too suddenly and so that it will not allow the tractor to proceed any great distance without coming to a positive stop. A tractor without a good brake is in danger of striking something or somebody, or it may roll down a grade and cause damage.

Solid rubber tires are ideal the entire year round on any kind of a road or floor, even on ice, snow or water. Their friction is more positive than that of either fiber or smooth iron tires, and they last several months even with almost constant use. These tires can be put on by almost any mechanic if a press of some sort is handy; the old tire can be pressed off while the new one is being pressed on if one is placed on top of the other. Every truck should carry a plainly stenciled shop number which will help in keeping a record of its repairs and charging.

Some tractors have the batteries removed for a new charge, while others can be charged as they stand by means of a suitable attachment plug. When a tractor is brought in for a charge its fuse, if it has any, should be removed. A fuse is a handy feature, as the driver can slip it into his pocket when the machine is to be left anywhere about the plant, thus preventing any one else from applying the current.

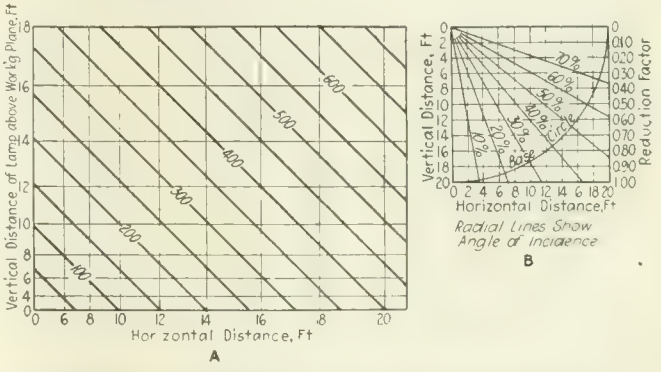
When the tractor gets very dirty from grease and dust a good washing with a hot-water hose will generally clean it, care being taken not to wet the brake band very much, which will cause it to slip considerably. If a compressed-air hose is handy, all the water can be blown off and no wiping will be required. A coat of paint once in a while on the body and wheels improves the tractor's appearance.

A good make of tractor can be abused to a costly extent by a careless operator, one who is given to speeding and then suddenly applying the brake, thus causing the machine to slide along a wet or oily floor. Starting from a dead standstill at full power may break the motor shaft and gears. Running slowly with the power on full and the brake only partly released will heat up the motor winding and the resistance coils.

East Berlin, Conn. H. S. RICH.

Diagrams to Assist in Illumination Calculations

IN THE solution of lighting problems by the point-to-point method the curve sheets reproduced herewith have proved very useful to the writer. The foot-candle illumination at any point is equal to the candlepower of the lighting unit toward that point divided by the



DIAGRAMS FOR CALCULATING FOOT-CANDLE ILLUMINATION FROM CANDLEPOWER CURVES

In diagram A the oblique lines show the value by which the candlepower of the unit must be divided in order to obtain the foot-candle illumination at a point situated away from the lighting unit at vertical and horizontal distances, as indicated by the corresponding scales of the diagram. The right-hand scale of diagram B shows the reduction factor by which the foot-candle intensity must be multiplied in order to obtain the illumination on a horizontal plane. The radial lines show the degree of incidence of the light coming from a source at a distance as shown by the vertical and the horizontal scales.

square of the distance from the lighting unit. Diagram A is useful for quickly ascertaining this value. The foot-candle illumination on a horizontal surface depends upon the angle at which the ray of light strikes the surface. Diagram B gives the multiplying factor which must be used for the different angles of incidence.

As an example of the application of the diagrams, let it be required to find the illumination in foot-candles upon a horizontal plane produced by a lighting unit 8 ft. above the plane and 6 ft. away measured in a horizontal direction. From Diagram A it is seen that the 8-ft. vertical line and the 6-ft. horizontal line intersect on the diagonal line marked 100. This means that the foot-candles at the point under consideration will be equal to the candlepower of the light in that direction divided by 100. However, as the illumination on the horizontal plane is desired, this result must again be reduced on account of the fact that the light is striking the plane at an angle. To find this reduction factor

diagram B is employed. On diagram B the 8-ft. vertical line and the 6-ft. horizontal line intersect at a point approximately midway between the diagonal lines marked respectively 30 deg. and 40 deg. Therefore the angle of incidence is about 35 deg. From this intersection point trace radially down to the intersection with the base circle. The radial line cuts this circle opposite the point 0.80 on the vertical scale at the right of the diagram. This means that the illumination of the horizontal plane is 0.80 times the illumination calculated in the foregoing (which is the illumination on a plane at right angles to the ray of light). Therefore the illumination in foot-candles on the horizontal plane is equal to the candlepower of the lighting unit at a 35-deg. angle divided by 100 and multiplied by 0.80. Foot-candle = (cp. × 0.80) ÷ 100.

As another example: Suppose it is desired to determine the size of lighting units required to obtain an intensity of 8 foot-candles upon the horizontal plane if the lighting units are to be 8 ft. above the working plane and spaced at the corners of squares 8½ ft. on each side. A point on the plane directly under the center of the square formed by the lights would be approximately 6 ft. from a point directly under one of the lights. Therefore the point will be the same distance from the lighting units as in the preceding example, 6 ft. horizontally and 8 ft. vertically. As the light from four units will be effective on the point, each unit must furnish 2 foot-candles. As the angles are the same as in the preceding examples, the reduction factor is 0.80. Consequently 2 foot-candles is the intensity required from each unit. This value divided by 0.80 and multiplied by 100 (2 ÷ 0.80 × 100 = 250) gives 250 as the necessary candlepower of the lighting units along the 35-deg. line.

These diagrams may also be used for calculating the foot-candle illumination on surfaces which are not in a horizontal plane, provided that the angle at which the light strikes the surface is known. The same procedure is used as in the former case, except that in diagram B the two scales representing vertical distance and horizontal distance may be disregarded and the value is calculated from the radial lines representing the angle of incidence and the reduction factor scale on the right-hand side of the diagram.

C. W. Kinney,
Worcester, Mass. Consulting Engineer.

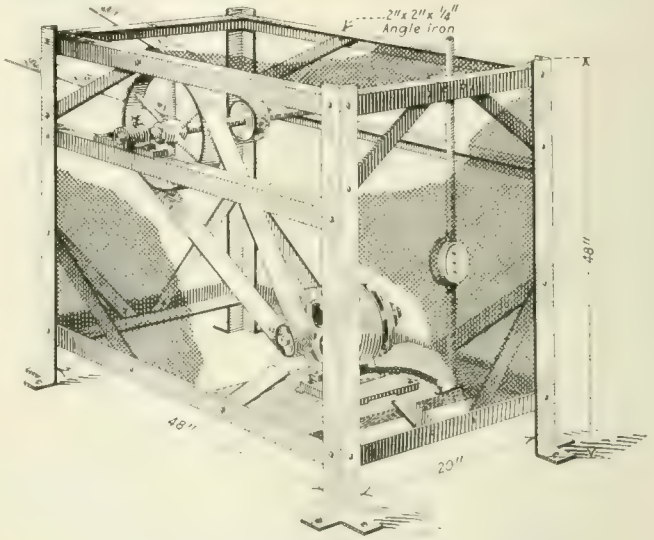
Maximum Temperature Allowable for Insulation—a Correction

In THE Jan. 15 issue of the Electrical World, page 154, an item appeared bearing the heading "Maximum Temperature Allowable for Insulation," which has created the erroneous impression that the figures as published apply to insulation used for any service. It should have been stated in the article that the data presented were abstracted from a report of the Industrial Control Section of the Electric Power Club (Bulletin 8,000, page 18, dated November, 1920), relating only to the temperature of coils for control apparatus. The information in the article, therefore, applied only to windings for coils to be used on control apparatus.

Attention is also called to the fact that the Electric Power Club did not recommend for adoption the figures referred to. The Industrial Control Section recommended certain specifications containing these figures to the Electric Power Club for use in the designing of coil windings for controllers. The report mentioned has not yet become part of the rules of the Electric Power Club and is simply in the form of a sectional committee report which will be subject to further consideration before becoming a part of the Electric Power Club standards. In its present form it was not intended for publication.

Individual Drive with Motor Mounted Separate from Machine

To APPLY individual drive to machines on which a motor cannot be mounted, the motors in the Hamilton-Brown Shoe Company, St. Louis, Mo., are set up in an inclosed angle-iron frame. These machines are leased under the condition that the user is not to drill holes in them or to file or cut away any parts in order to attach motors. When the speed of a machine is such that it can be belted directly from a motor fastened to an adjacent part of the building no special problems



MOTOR MOUNTED IN SCREENED FRAME INSTEAD OF ON DRIVEN MACHINE

The construction shown in the illustration was designed for a 3-hp., 1,800-r.p.m. motor, but it has been used for 5-hp. motors at 1,800 r.p.m. Motors up to 2-hp., 1,800 r.p.m., have been mounted in frames built of 1¼-in. x 1¼-in. x ⅛-in. angle iron.

are encountered, but very often a countershaft is necessary, and when this is the case much overhead belting and shafting has been eliminated by the development of the framework as shown in the accompanying illustration. The motor with the countershaft and framework is a unit which can be moved from one similar machine to another. Furthermore, the relative positions of motor and driven shaft can be changed around to meet different conditions.

In fitting the drive to a machine the angle-iron framework is lined up with the main-drive shaft on the machine to be driven, and the framework is bolted to the floor or to the ceiling as the exigencies of the case may demand. The framework affords a safe and suitable place for mounting motor, starting switches, fuse blocks, switch blocks, compensators, etc. The framework is inclosed with a wire screen to conform with liability insurance and safety rules. The framework can be made of either wood or steel and has been used for motors up to 5 hp. normal rating.

Hamilton-Brown Shoe Company, Albert Kochs,
St. Louis, Mo. Chief Engineer.

Armature Baking Reduces Number of Direct-Current Motor Repairs

ARMATURES are treated in the repair shops of the Brooklyn Rapid Transit Company by a baking, dipping and rebaking treatment. The method has reduced the number of armature repair jobs in the shop and improved service conditions.

When an armature is brought into the shop for overhauling it is stripped and the core is repaired, the commutator gone over and repaired and the armature rewound. The armature is then placed in the electric baking oven shown in the accompanying illustration and baked for ten hours at a temperature held between the limits of 240 deg. and 250 deg. Fahr. After this baking the armature is dipped in a black baking varnish. This dipping is done with the armature in a horizontal position, it being supported in the tank by the shaft and rotated in the varnish, which comes up only to the string band at the edge of the commutator mica "V" ring.

This method of dipping horizontally reduces the amount of varnish required, as the inside of the core is usually full of dirt and grease which cannot be removed and therefore does not take up varnish which would serve no useful purpose. The vertical method of dipping, especially when the armature is new, might be an advantage as all parts of the core would then receive a coat of the varnish and be protected from rust.

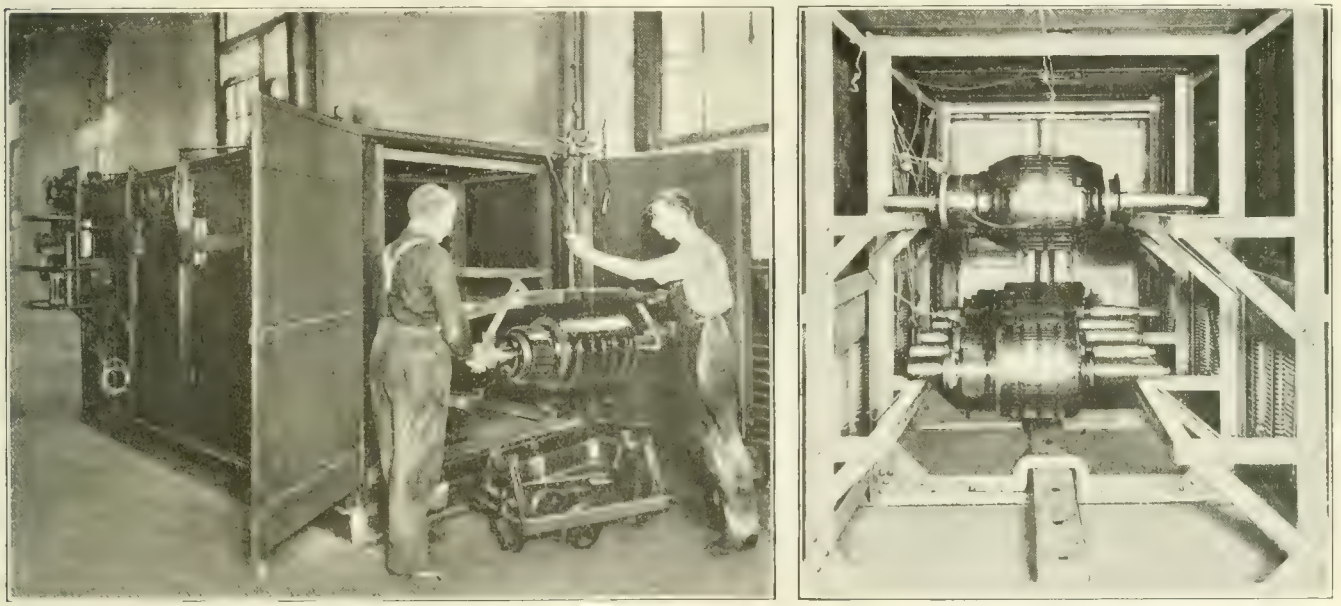
In the dipping process no particular attention is paid to the exact temperature of the armature when removed from the oven, although it is probable that as a rule each armature remains in the air some ten or fifteen minutes before being dipped. If dipped at too high a temperature the varnish tends to smoke, because of the volatile matter being driven off, although this seems to have no detrimental effect. After this dipping the armature is again baked for eight to ten hours at the same temperature limits of 240 deg. to 250 deg. Fahr. The range of armature ratings which are handled by this method is from 1½ to 150 hp. No distinction is made in the process between the various sizes, and as the length of baking time and temperatures are the same for the baking previous to dipping and the baking after dipping it is possible to have armatures going through both bakes on the same racks. The baking varnish which is used is one which will bake hard but will not become brittle. The advantages of treating armatures by this method might be enumerated as follows: (1) The coils are less subject to individual vibration; (2) all cracks are filled, which prevents the depositing of dirt or moisture; (3) loose laminations are sealed; (4) a coating is given to the core which protects the iron from rust; (5) bruised insulation is restored.

One disadvantage which might be called to the attention is the slightly increased difficulty of replacing a coil. However, in the experience of this repair shop it is hardly ever economical to replace the coil of an armature, but has been found a better operating practice to rewind the entire armature. The method of electric baking offers the advantages that a more even temperature can be maintained and that the process is automatic in its operation.

In the majority of cases electric energy is more easily obtained than the supply of live steam at a pressure of from 100 lb. to 200 lb., which is required for such work where steam is used for heating. The method, however, requires no elaborate equipment unless enough armatures are handled to place the work on a production basis. There is an opportunity for users of direct-current motors to treat the armatures by this baking method, even though the baking process be not carried out with the refinement allowed by the electric oven. It is possible to build the oven part of the equipment and possibly to install the heater equipment.

From experience the baking of armatures has been found to pay, and there is no reason to assume that the method would not produce excellent results for such types of equipment as electric mine locomotives.

As handled in the Brooklyn Rapid Transit repair shops the armatures are baked in the oven shown in the accompanying illustration. Two ovens of this type are in use, and the smaller sizes are placed in racks as shown in the right-hand illustration. The larger armatures, such as the 150-hp. size, are run directly into the oven on the type of truck shown in the foreground of the left-hand photograph. This truck is a standard



ELECTRIC OVENS USED FOR ARMATURE BAKING BY BROOKLYN (N. Y.) RAPID TRANSIT COMPANY

make and facilitates the handling of armatures in the shop. The armatures are lifted on to the rack with an air hoist. The oven shown in the illustration is 5 ft. 6 in. wide, 13 ft. long and 6 ft. high and has a capacity of eighteen armatures. The load of the oven when current is on is 50 kw. The current is probably on the oven about one-half of the number of baking hours, which would indicate a consumption of about 250 kw.-hr. for the baking of eighteen armatures. About 500 armatures are handled per month, requiring three barrels of the baking varnish and the services of three men.

Field Coils Are Impregnated

Of the 80,000 direct-current motor-field coils which are in use by the Brooklyn Transit Company about 50,000 have been impregnated in the repair shops. The additional 30,000 fields are wound with strap copper mica insulated and require no impregnating. When a field coil comes into the shop for repair the coil is rewound and taped with ordinary white cotton tape, after which it is impregnated with a compound that has an asphaltum base. The temperature of the compound tank is maintained at approximately 300 deg. Fahr., while the mixing tank is maintained at a temperature of 320 deg. to 325 deg. Fahr. The vacuum used for impregnating is about 27 in.

After the field coils have been impregnated they are a solid mass of the compound—so solid that a hard blow with a hammer will make no impression whatever. It has been found that no service trouble may be expected from field coils so treated, with the exception possibly of the terminal leads, which require renewing periodically. The compound seals all the cracks and makes the coil impervious to moisture and dirt. Each field coil is handled separately in this shop as no frames are sent in. The compound which gives best results is one which will not become brittle and will not chip on drying. The field coils should be placed on the poles as tightly as possible so that vibration will be reduced.

Most repair shops would probably not have the facilities for this impregnating work. After the field coil has been impregnated the outside insulation is placed and the completed coil is dipped in an air-drying insulating paint.

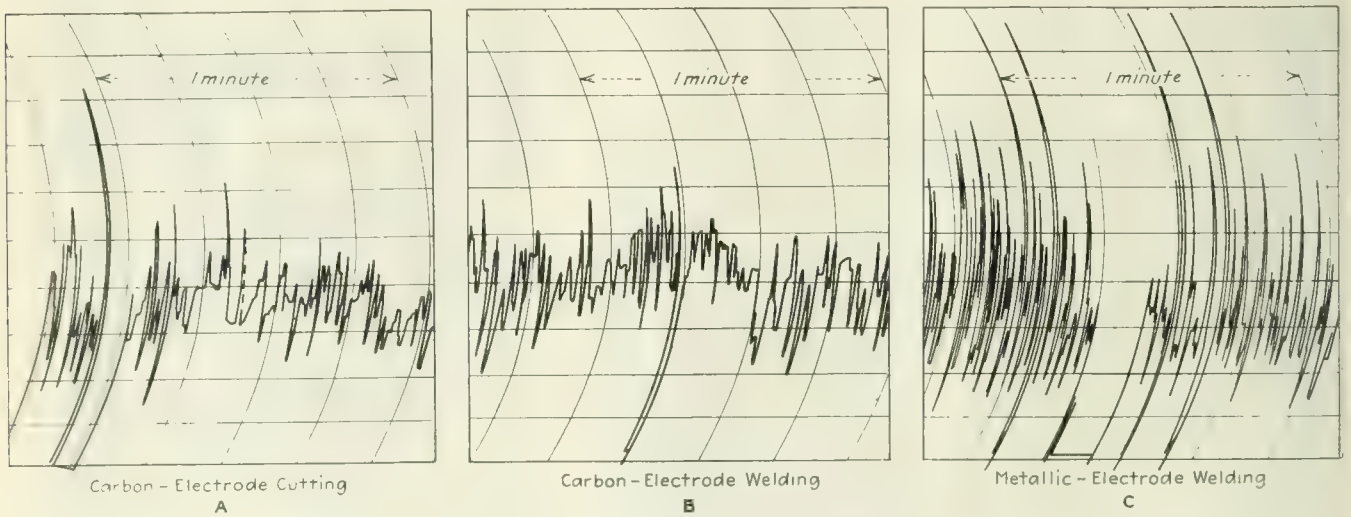
Field Editor Electrical World.

New York, N. Y.

Load Curves of Arc Cutting and Welding

Curves showing the current that flows through the arc on cutting metal by the electric arc, welding with carbon electrodes and welding with metal electrodes are reproduced in the accompanying illustration. These curves were made with the same meter connected to a 1,000-amp. shunt in the arc circuit. The energy was furnished by the same motor-generator set operating under identical conditions in the steel foundry of one of the large steel and iron manufactories in Pittsburgh. The motor is rated at 50 hp., 230 volts, 1,200 r.p.m., and the generator at 80 volts and 600 amp. With this set there is a reactance coil in series with the arc circuit, and also a switchboard with ammeter and voltmeter, rheostats, etc. The arc voltage in each case was from about 20 volts to 30 volts.

The outfit is used for cutting risers and fins from castings, cleaning out sand holes and preparing shrinkage cracks for welding by the use of the carbon-electrode arc. The carbon arc is also used for welding metal into large sand holes and welding the large breaks. The metallic electrode is used for smaller and more particular welding work where the carbon electrode would not be suitable.



CURRENT CURVES OF ARC CUTTING AND WELDING

A is cutting with carbon electrode, B is welding with carbon electrode and C is welding with metallic electrode

In curve *A* it may be noted that the carbon-cutting work is comparatively steady; that is, the time intervals between fluctuations are large and the fluctuations are small.

In curve *B* the carbon arc-welding produces more rapid fluctuations, their magnitude being about the same as those of the cutting curve. In curve *C* the metallic-electrode welding produces very rapid current fluctuations which are of considerably greater magnitude than those in A and B.

As the heating, and therefore the loading, of the motor-generator set depends upon the root mean square of the current drawn, it may be seen from the curves that from the standpoint of power consumption and equipment maintenance the carbon-arc welding is more desirable than the metallic-electrode welding. The former should, therefore, be used whenever the character of the work to be done and other conditions will permit.

D. W. Blakeslee,

Pittsburgh, Pa. Consulting Engineer.

Troubles Prevented in Electric Precipitation Plant

TROUBLE with a high-voltage direct-current precipitation plant due to static and high-voltage oscillations has been overcome by methods which may be applicable to similar plants. The electrical apparatus of this particular plant consists of motor-generator set and control, transformer, mechanical rectifier, line discharge and collecting electrodes. In order to obtain the desired unidirectional current at from 60 kv. to 100 kv. a rotary air-break switch is used to rectify the current from a high-potential transformer. Two arms carrying a segment of brass at each end are mounted on a shaft at 90 deg. to one another as shown in the drawing. The arms are insulated from the shaft and from each other and revolve between the adjustable brushes, which clear the plates by 0.25 in. Electrical synchronism is obtained by driving rectifier and generator on the same shaft. The generator furnishes the primary current of the transformer, and the voltage is controlled by variation of the field resistance.

With the motor-generator sets considerable trouble

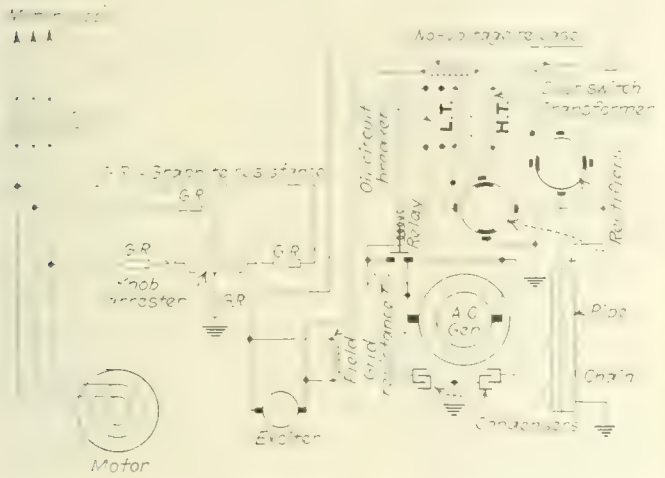


DIAGRAM SHOWING ARRANGEMENT FOR PREVENTING TROUBLES ON HIGH-VOLTAGE PRECIPITATION PLANT

Relay in generator circuit inserts resistance when oscillating currents become large. Condensers with grounded neutral point and connected across generator eliminate static. Choke coils and lightning arresters in motor leads prevent damage to motor.

has been experienced in the generators owing to a high potential puncturing the armature insulation and the power current following the high-potential arc burning the insulation and setting up a short circuit. This was due to one of two causes or a combination of both. Oscillations are set up in the high-potential line by the mechanical rectifier and also by the arcing between the discharge electrode or chain and the collecting electrode or pipe.

These oscillations are transmitted through the magnetic circuit of the transformer to the generator and set up a peak voltage much higher than the normal generated peak voltage and possibly high enough to break down the insulation in the weakest part of the circuit, this being the armature coils of the generator. The second cause of trouble is the static potential, which at times is very high, reaching 20 kv.

To prevent oscillations from becoming too great a relay is placed in the generator armature circuit. Normally this relay short-circuits a heavy grid resistance, but upon continuance of the surges the relay operates, removing the short circuit and inserting the resistance till conditions are again normal, when it resets itself. It has been proved beyond a doubt that a resistance in series with the low-tension side of the transformer greatly aids in obtaining smoother rectification and also increases the amount of the wave rectified. This object may likewise be accomplished by having this relay in the generator armature circuit to cut in and out resistance in the generator-field circuits. Normally this section of resistance is short-circuited, but upon a surge arising this short circuit is opened, thereby lowering the generator voltage until conditions have become normal again.

The static trouble was overcome by connecting across the generator armature leads two condensers in series with the middle point grounded as the drawing indicates. These condensers tend to absorb the static between line and ground and to absorb abnormal line oscillations.

Considerable trouble has been experienced with the motor winding going to ground caused by the insulation puncturing. This puncturing was due to static. To stop this trouble choke coils were inserted in the motor leads together with a three-phase knob lightning arrester with horn gaps and graphite resistances in series with each leg or phase. Since the installation of the choke coils no further motor trouble has been experienced.

As a general rule the operators found in these plants belong to the class with very limited electrical training, so that in order to safeguard the operator everything must be made as foolproof as possible. Accordingly the rectifiers are always inclosed in a cage with a door leading into them. By referring to the drawing a door switch connected to a no-voltage release coil on the oil switch connecting the generator to the transformer will be seen. Opening this switch opens the circuit through the no-voltage trip coil on the oil switch which connects the transformers.

If a man attempted to go into the cage before shutting down the machine, the door switch would immediately open the oil switch and cut energy off the rectifier.

R. H. N. LOCKYER.
Trail, British Columbia.

Repair Shop May Be Likened to a Hospital

IT IS common to think of the repair shop in industrial plants as the "hospital," but there the idea usually ends, although it can be carried further to advantage. A winding room ought to be "antiseptic" and therefore should be entirely removed from all machine-shop operations and shut off by a wall. A chip of metal in the insulation of a motor that is being repaired is like a germ in an open wound, sure to cause trouble later. This same idea applies with full force to commutator work.

To carry the thought a little further, it may be mentioned that in a hospital the patients who are cured are not left lying around in the operating room. So neither should repaired machines or parts be kept lying around the shop where other repair work is being done. A suitable storeroom, separate but accessible, with proper crane service, racks and protection from dirt, should always be provided for raw materials and finished work.

JAMES DIXON.
Reliance Electric & Engineering Company,
Cleveland, Ohio.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Bank Advertisements Commend Public Utilities

HOW the quality of service rendered by the public utilities has an important bearing on a city's growth and general welfare is evident from the advertising copy used recently by two of the largest national banks of Indiana. They are telling the public through advertising in home newspapers just what public utilities mean to their communities. The Fletcher American National Bank of Indianapolis is urging business to come to Indianapolis because of the electricity, gas and water, traction and telephone services afforded. The First and Hamilton National Bank of Fort Wayne is telling that city it should be proud of the utility services that are being rendered, one of the advertisements reading:

"Fort Wayne has reason to be proud of its public utilities. These concerns are carefully planning now that Fort Wayne's future growth may not be retarded. It is a matter of considerable importance for every Fort Wayne citizen to realize that our public utilities are looking carefully into the future that they may serve economically and well the growing city."

Characteristics and Costs of Domestic Water Pumping

WATER-PUMPING outfits in common use for house and farm water supply purposes range from the smallest size with a capacity of 100 gal. per hour, requiring a $\frac{1}{8}$-hp. motor, to those of 180, 250 and 300 gal. per hour, requiring motors of $\frac{1}{4}$ hp. to $\frac{1}{2}$ hp. Those for larger farms and estates have capacities of 1,000 gal. to 1,500 gal. per hour, requiring $1\frac{1}{2}$-hp. to 2-hp. motors. The needs of the average farm will probably be well provided for by outfits having capacities of 360 gal. to 720 gal. per hour, with motor capacities of $\frac{1}{2}$ hp. to 1 hp. Three hundred and sixty gallons per hour, or 6 gal. per minute, will supply a single $\frac{3}{4}$-in. garden hose. The storage tank provided will depend on the amount of water used, but practice in general leans toward the use of a tank only large enough to provide necessary elasticity and guard against unnecessary operation of the pump from reduction in pressure by leaky fixtures.

Tests made on several displacement-pump, compression-tank outfits of 100 gal. to 200 gal. per hour capacity showed over-all efficiencies of 15 to 25 per cent under normal operating conditions, with 17.5 per cent as a fair average. The efficiency increased with pressure, but the pump is likely to operate at a reduced pressure for a large percentage of its total operating time. Motor efficiencies varied from 40 to 60 per cent, with 50 per cent as a fair average. Thus the pump efficiency in this type and size of outfit may be expected to average about 35 per cent. These efficiencies result in a pumping duty of 2.1 kw.-hr. to 1.25 kw.-hr. per 1,000 gal. per 100-ft. head, with 1.8 kw.-hr. as a fair average.

Considering the capacities of these units, this figure compares very favorably with the average for the smaller city pumping units as shown by a series of tests throughout the state.

Watt-hour meters installed in several residences using compression-tank systems for soft-water supply to bathroom, kitchen and laundry revealed a maximum consumption of 0.75 kw.-hr. and an average of 0.45 kw.-hr. per person per month. So it is evident that at prevailing rates 1 cent per day for electrical energy is sufficient to provide an abundant supply of soft water for the average city family. For general water supply, however, where lawn sprinkling, stock watering, etc., are involved, the requirements are much greater and the cost is correspondingly higher.

Judging by the above figures on energy consumption, the soft-water requirements for a family of five people would be met by a pumpage of 1,250 gal. to 1,500 gal. per month, while for the general water supply on a farm equipped with modern plumbing and sewage disposal arrangements, involving the same number of people and fifteen to twenty-five head of stock, besides sprinkling and car-washing facilities, a pumpage of 750 gal. to 1,000 gal. per day would be required. But the rapidity with which farms are being equipped with these systems indicates that the up-to-date farmer considers that the advantages which are gained far outweigh the costs.

This information was presented by G. C. Blalock, assistant professor of electrical engineering at Purdue University, before the Indiana Engineering Society in January.

Commissioner Favors Public Utility Securities for Investment

WITH the view of obtaining from authoritative sources an unbiased survey of the investment status of public utility securities the New York *Globe* recently addressed the public utility commissions of different states with a request for an expression of their opinion. That such securities are considered inherently safe by the various commissions was indicated by the similarity of the replies in pointing out that the business is fundamentally sound and that under regulation the utilities are protected from loss due to operating costs beyond their control, while at the same time the public enjoys fair rates without discrimination.

Of particular interest is the opinion of Benjamin F. Cleaves, chairman of the Public Utilities Commission of Maine, in analyzing the public's attitude toward the utilities. He also points out that rates which have been increased to meet the higher cost of operating and financing cannot at once be lowered without re-

ducing the earnings of the company to a point below a fair return on the investment. In answering the request for his opinion Mr. Cleaves said:

I assume that it is not your purpose to ascertain whether the securities of a public service company which is improperly managed, unreasonably financed and in a situation which would render its securities of doubtful value are worth more or less on account of the mere fact that it is a public service corporation, but that you desire to know whether there is any inherent reason why the public may not safely invest in good public service securities to the same extent that the investor might place his money in the securities of a substantial and well-managed mercantile corporation.

Changed Public Attitude

I believe that the answer to the question is found in the changed attitude of the general public and the reflex change resulting from that public attitude of public service commissions, this change having taken place within the last three or four years and being due largely to conditions obtaining during the war period and resulting in a better and fuller understanding upon the part of the public of the necessities of public service companies and their customers and of what constitutes not only fairness but good business to both. A few years ago a great majority of those people whom we refer to as the public believed that practically all public service companies were either making excessive profits or charging discriminatory rates, or had too much water in their securities, or in some other way were directly antagonistic to the public, and hence the public must in a retaliatory spirit be opposed to these corporations. This belief was privately and publicly expressed by individuals and in too many instances was featured and fostered by some of the public press. Somewhat naturally public regulatory bodies yielded to the force of this public opinion, and failed to accord to public service companies anywhere near fair treatment. Public service companies were in the meantime not entirely blameless.

Within the last few years the whole situation has very materially changed. Public service companies have realized that there is necessarily a full partnership existing between each corporation and not only all of its customers but all of the public in the territory being served. Into that partnership more recently have come the public service commissions, with full understanding and realization that they must perform fully and fairly the work of an equal partner.

The public itself has also learned a good many things. It is now very generally understood and universally conceded that no public service corporation which is rendering fairly an adequate and dependable service and is endeavoring to do the right thing can continue properly to function unless it is adequately supported, and that support must consist of something more than mere financial support. There must exist upon the part of each customer a belief amounting almost to conviction that the particular public service agency is worthy of support and is in fact a necessary, useful and likable part of the daily life of the particular community.

To gain that public support the managers of public service companies realize that they must merit it. This has resulted in a genuine attempt upon the part of such managers to give the best service possible, give full publicity to all matters in which the public has the slightest interest, and to place themselves in active and close touch with their customers. It has also resulted in a much better feeling on the part of the great majority of those customers.

Service Is Paramount

Another thing which the customer has learned is that service is the principal thing desired, and that service of a dependable character is not obtainable unless the revenues are equal to the demands made upon the public service agency. Our particular commission has insisted to public service corporations that they were not authorized to have any secrets from the commission or the public, and that anything which the company did, or was authorized to do, was public property. We have also tried to educate the customers to a belief along the lines above indicated. In our own state I think I am justified in saying that the relations between the three groups—namely, the companies, their customers and the commission—are on a very much more workable basis today than they were even two years ago.

There is another situation which in the natural course of events will have its effect upon the value of the securities of a properly managed and financed public service company. During this period of increasing costs of operation very many of the public service companies have been obliged to increase their rates. Even under these increased rates the measure of return on the value of the property, figured upon a percentage basis, is today much less than that amount which would be regarded as a fair return. Otherwise stated, a company that three or four years ago was charging rates which yielded a return of 2 or 3 per cent above its interest charges is, even under the increased rates, receiving no greater percentage upon the value of its property.

Rate Increases Should Be Permitted to Remain in Effect

When the decrease in operating costs comes I believe the regulatory bodies will permit the increased rates to remain in whole or in part in effect in order that a worthy company may receive nearer a fair return upon the fair value of its property. This will necessarily place such companies in a much stronger financial position, will give them an opportunity to make a better balance-sheet showing, and will therefore inspire a greater confidence in the investing public with reference to the value of their securities.

In a matter of this sort attention can be called to only a very few of the high spots, and I have not attempted entirely to cover the matter. I have merely endeavored to lay down the premises upon which I could state to you the conclusion that I personally see no reason why the securities of the average public service company shall not in the future be a safer investment than in the past, and no reason why such securities should not take their place in popular favor with the securities of a non-public-utility character.

Merchandising and Sales Policies of Central Stations

WHILE there are many central stations which confine their merchandising operations to selling lamps and a few appliances, leaving most of the business to be handled by the contractor-dealers, a survey made by the merchandising committee of the Southeastern Geographical Section of the National Electric Light Association showed that the majority of companies favor an aggressive sales policy. Some members did not approve of the sale of other than energy-consuming devices.

It was the consensus of opinion, however, that, even though a company's merchandising department were conducted only for the promotion of load-building business, if it expects to build a really large sales department it will be necessary to handle non-energy-consuming equipment, because so much of this is closely allied with the better lines of energy-consuming devices. Companies which have been merchandising most profitably and for the longest time strongly recommend the sales of accessories.

Best results in placing electrical devices in the hands of the consumer have been obtained by the smaller properties through the medium of intensive campaign work, while large companies conduct perhaps only two or three campaigns during the year, in the belief that a substantial, continuous flow of business cannot be

built up by campaign work, which is used by them principally for educational purposes.

Although no fixed rules for merchandising in every locality can be laid down, the following general principles have been found essential:

1. It is necessary that proper sales records and "prospect" cards be kept, that these be followed up closely and that such systems be kept accurate and alive at all times.

2. Periodical canvass work is necessary for ascertaining the ever-changing situation.

3. Outside representatives must be retained on some basis of remuneration which is equally beneficial to themselves and the company.

4. Outside representatives must be supported by inside representatives in companies where this is justifiable.

5. In all companies outside representatives must be supported by neat and attractive sales and demonstration rooms and, most important of all, well-trimmed show windows.

Sales methods of different companies were found to vary as to detail, but were similar in many respects in that the most successful sales campaigns are those which have been carefully thought out in advance and where rigid follow-up rules are adhered to. Four fundamentals, each of equal importance to any sales campaign, are given as originality, canvassing, follow-up of "prospects," and salesmanship.

Some companies have used very successfully the manufacturers' representatives as experts in their particular lines to assist in sales programs. The services of these men can be had for the asking and afford two distinct advantages: They educate the community and produce sales at no expense, and they make experts of the local salesmen.

In the opinion of the committee, the practice of price cutting to obtain business is unnecessary and a mistaken policy. Those companies which maintain prices are doing the most profitable business and have built up an organization which will continue to grow.

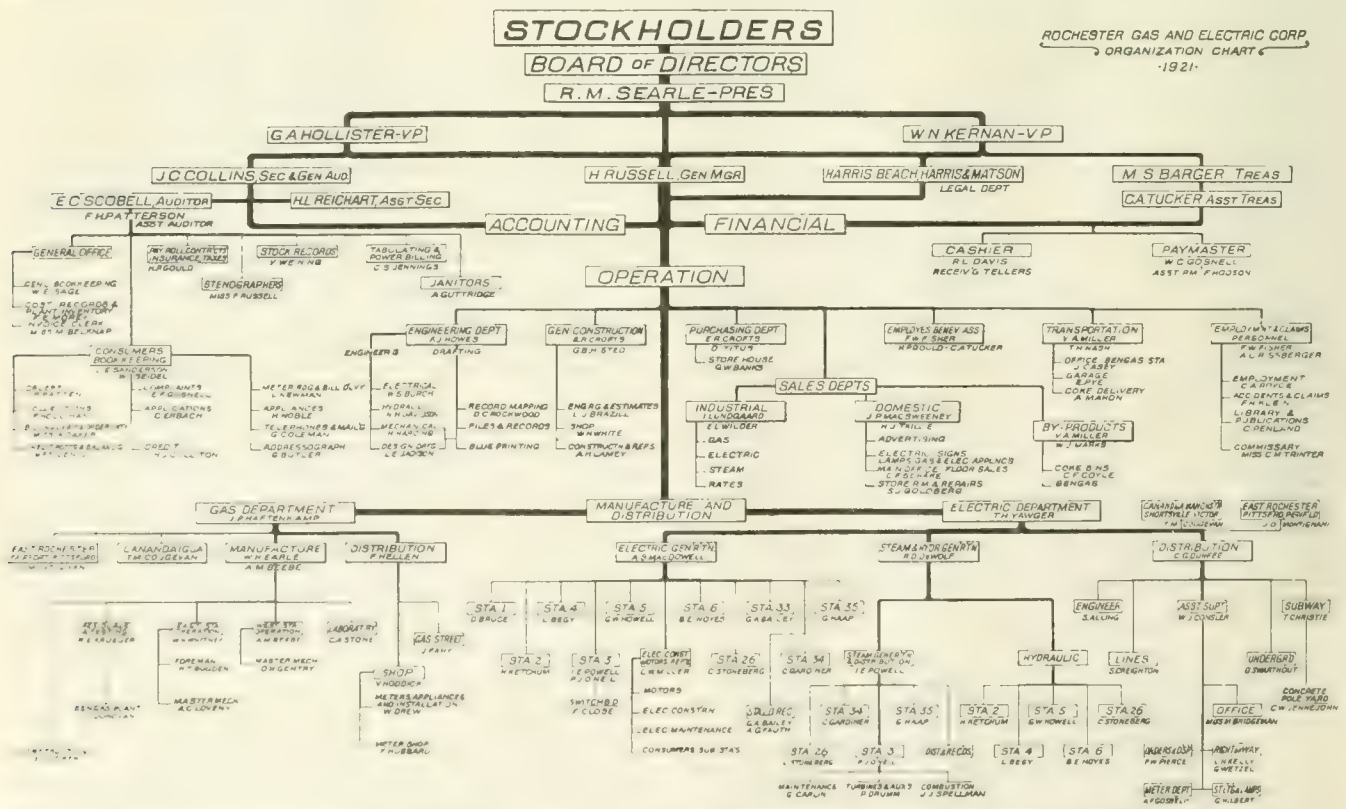
Consumers Pleased by Handling of Telephoned Complaints

THE day after a consumer of the Southern California Edison Company telephones in a complaint or a request for some minor service, such as replacement of blown fuses, a pleasant-voiced girl calls up the consumer and asks if the request has been properly taken care of or if there is anything further the company could do to be of service. It has been found that consumers are greatly pleased by this mark of courtesy.

In order to carry out the plan most effectively, when complaints are received the one receiving the complaint requests the name of the particular person who is telephoning in order that when the message is sent the next day it shall be possible to inquire by name for that person. This plan, which has just been put into effect, is to be used throughout the system of the Southern California Edison Company.

Organization Chart for Combination Electric and Gas Company

HERE is an organization chart prepared by the Rochester (N. Y.) Gas & Electric Corporation to show the relation of the company's personnel from stockholder to substation superintendent. In addition to showing the organization of the company the chart gives the names and indicates the responsibilities of the officers, engineers or superintendents in charge of departments, plants or divisions.



COMPREHENSIVE ORGANIZATION CHART OF THE ROCHESTER GAS & ELECTRIC CORPORATION

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Synchronous Motors for Ship Propulsion.—E. S. HENNINGSEN.—It is shown in this article that synchronous motors for ship propulsion must have the desirable induction-motor characteristics during starting and the synchronous-motor characteristics during running. How these characteristics, which may be conflicting, are harmonized in the design is explained. Motors and generators designed for ship propulsion differ from others because on shipboard both voltage and frequency are variable, and also because space, weight and accessibility for repair are of greater importance in marine work. Reliability, important in land service, is, it is contended, of even greater importance on shipboard.—*General Electric Review*, Feb., 1921.

Alexanderson High-Frequency Alternator.—E. BLAKE.—The principles upon which emfs. in the Alexanderson alternator are set up are described and constructional details of the alternator are considered.—*Wireless World*, Jan. 8, 1921.

Alternating-Current Motors and Control Equipment.—G. J. KIRKGASSER and E. W. SEEGER.—Common types of alternating-current motors are considered with special reference to speed control.—*Electrical Review*, Jan. 29, 1921.

Lamps and Lighting

Ship Lighting.—R. W. PEDEN.—The author dwells particularly on the importance of good lighting in case of accident when it is necessary for passengers to escape from the ship. The electrical fittings used on shipboard should be strong, substantial and rigid. There are three types found on modern vessels—(1) special ornamental or decorative fittings, (2) utility-type fixtures, such as are employed in staterooms, passageways, etc., and (3) watertight fittings for the engine room, the open deck, etc. A detailed discussion follows in which each division of the ship is taken up to show what the special requirements are.—*General Electric Review*, February, 1921.

Notes on Department-Store Illumination.—JULIUS DANIELS.—By means of a foot-candle meter a series of measurements were taken in department stores in New York, Boston, Philadelphia and Newark. It is shown how the data thus secured were used to increase the intensity of lighting of several of the stores which had been operating at low values.—*Transactions I. E. S.*, Dec. 30, 1920.

Generation, Transmission and Distribution

Design and Maintenance of Distribution Systems.—R. H. RICE.—Standards in the construction of distribution lines are discussed by the author, also the location of load centers, inspection schedule, line, transformer and service maintenance and records.—*Electrical Review*, Jan. 8, 1921.

Electrical Characteristics of Transmission Conductors with Steel Cores.—H. B. DWIGHT.—A method is presented by which the effect of the steel core of aluminum cables on the cable characteristics may be calculated.—*Electric Journal*, January, 1921.

German Insulator Standards.—Standardization of elements of construction is going on at top speed in the various commissions appointed by the Verein Deutscher Ingenieure. A second edition of the standardization rules for insulators has been published. Two sets of specifications are provided for subdivided insulators, one applying to cemented insulators, the other to such insulators where the different parts are fired together. There are also given detailed specifications for insulator testing. Electrical breakdown tests are made under oil. The voltage is to be raised from about seven-tenths dry flash-over value, in steps of 5,000 volts, one step every five seconds, till breakdown occurs. The breakdown voltage should be at least equal to one and three-tenths times dry flash-over voltage. Insulator porcelain is tested for porosity by soaking freshly broken pieces in a solution of 1 gramme (0.035 oz.) fuchsin in 100 gramme (3.53 oz.) ethyl alcohol and washing with pure methyl alcohol. No appreciable traces of color should remain on good porcelain after this test. In order to eliminate defective parts every porcelain element must have a factory test of fifteen minutes in air with alternating voltage of at least 95 per cent of the flash-over. The flash-over voltage is defined as the voltage which gives discharges at a rate of about three per second. Pin-type insulators are tested in water upside down and with the pinhole full of water. Ten per cent of each lot, or at least fifty insulators, must be thus tested, and if among these samples any breakdown occurs every insulator in the lot must be tested. Similar rules apply to high-voltage bushings and busbar supports.—*Elektrotechnische Zeitschrift*, Sept. 16, 1920.

Traction

Application of the Electric Locomotive to Main-Line Traction on Railways.—H. E. O'BRIEN.—In this discussion are given twenty-one advantages of electric locomotives over steam for main-line traffic and six disadvantages. Several tables are also presented giving a financial comparison, including both operating expense and investment.—*Journal Institution of Electrical Engineers* (London), September, 1920.

Italy's Great Railroad Project.—Nearly 4,000 miles of Italy's transportation system is to be electrified. All available water powers are to be developed and steam power is to be eliminated.—*Water Power* (official magazine Water Power League of America), Nov., 1920.

Maintenance on the B., A. & P.—F. W. BELLINGER.—Seven years of electrical operation on the Butte, Anaconda & Pacific Railroad under the severe conditions surrounding it have demonstrated the rugged qualities of the electric locomotive. To show that the maintenance costs with this type of motive power have been substantially less than with the steam engine a table of

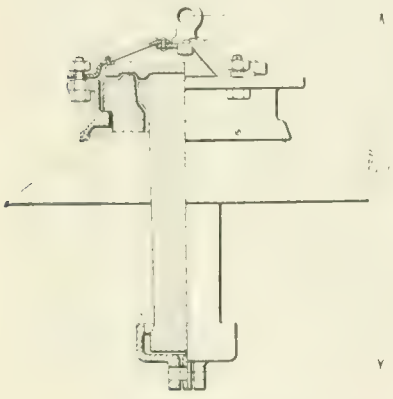
operating cost data for the electric locomotives is offered as follows:

	Cents per Mile
Maintenance of equipment expense, including repairs, supervision, shop machinery, tool	11.15
Locomotive engineers and firemen	11.55
Engine-house service	2.60
Cost of electrical energy	15.26
Lubrication	0.81
Other supplies	0.58
Total	14.95
Maintenance of equipment expenses (repairs) less supervision shop machinery tools	6.48

The author says that a force of thirty men in the shop suffices for inspection and repair work on this system.—*Electric Railway Journal*, Jan. 29, 1921.

Installations, Systems and Appliances

New Suspension Insulator. — G. Gastelnuovo Tedesco.—The insulator is shown in the drawing. The central rod, ring about its upper end and the cover are of porcelain. These are clamped together with a tripod attached to an eyebolt as shown. No cement is used in the assembly of the various parts. The metal cap at the bottom is screwed on two half rings. This insulator cannot be punctured by electric discharges and requires no electrical test before being used. If a discharge takes place it jumps from the petticoat to the metal cup, so that the porcelain cannot be damaged. The porcelain rod is subjected to tension, but as the pull required to break it is as high as 4,500 kg. nothing is to be feared. The insulator weighs 24 kg. Experiments made under rain showed that arcing took place at 95,000 volts; with two insulators in series it occurred at 170,000 volts, and with three insulators in series it occurred at 230,000 volts.—*Science Abstracts, Section B*, October, 1920 (Abstracted from *Elettrotecnica*, July 15, 1920.)



NO CEMENT USED IN ASSEMBLY OF PARTS

Electrophysics and Magnetism

Graphical Tables for Computing the Self-Inductance of Choking Coils.—J. Hak.—The Stephan and Spielrein formulas for computing the self-inductance of coils being rather cumbersome to use in practical work the author has developed a special kind of alignment charts permitting a rapid determination of the necessary coil dimensions when the desired inductance is given, together with the current strength. The chart may be modified in many ways to fit special probelms, as shown by numerous examples illustrating the application.—*Elektrotechnische Zeitschrift*, Dec. 2, 1920.

Brush and Glow Discharges of Electricity and the Formation of Spark.—Usaburo Yoshida and Hideki Hirata.—The natures of positive and negative brush discharge, and especially the parts played by them in the formation of a spark, were investigated. It was found that the stronger part and the weaker part of a positive brush were different in their natures. The latter was a pilot of the former, and the arrival of the end of the former at the cathode or at a negative brush caused a spark discharge between the electrodes. An explanation of the formation of the negative and the positive brush was undertaken by the consideration of the ionization by collisions of the electrons and of positive ions with the molecules of the arc.—*Memoirs of the College of Science, Kyoto Imperial University*, Vol. IV, No. 3, February, 1920 (Kyoto, Japan).

Electrochemistry and Batteries

Rise and Development of the Electrolytic Alkali and Chlorine Industry in Europe.—John B. C. Kershaw.—An outline of the electrolytic cells employed in the electrolytic alkali and chlorine industry of the United Kingdom, Germany, Austria, France, Italy, Switzerland, Russia and Belgium.—*Chemical and Metallurgical Engineering*, Jan. 26, 1921.

Notes on Nickel.—Paul D. Merica.—Brief notes on the metallurgy of nickel, giving information concerning limitations in rolling, annealing, welding and electrodeposition.—*Chemical and Metallurgical Engineering*, Jan. 5, 1921.

Units, Measurements and Instruments

Defects in Electricity Meters.—Walter Lawson.—A classification for repairs which have been found necessary in experience with a large number of meters over a long period of time affords an opportunity to investigate the chief defects of these meters with a view to correcting the design. Both house and power station meters are considered.—*Journal Institution of Electrical Engineers*, London, August, 1920.

How to Correct for Error in Instrument Voltage Transformers.—J. B. Gibbs.—The problem involved in phase angle and change in ratio of transformation is worked out by showing how wattmeter readings are affected by these transformer errors.—*Power*, Dec. 28, 1920.

Telegraphy, Telephony and Signals

Recent Attainments in Wired Radio.—R. D. Duncan, Jr.—The writer states that chief credit is due to Gen. George O. Squier for his early experiments with radio-frequency carrier currents combining the use of tuned circuits and a detector or rectifier at the receiving terminus. Thus the wire and radio transmission made use of the same conditions. Experiments are described using the telephone lines to study the possibilities of establishing communication over fairly long sections of line when employing extremely high carrier frequencies. It is said that no interference between the radio-frequency messages and ordinary telephonic and telegraphic signals being sent over the same line was produced. It is also said that, employing a system of high frequencies with power in the neighborhood of 2 watts, an excellent quality of telephonic and telegraphic signals was obtained between two railroad coaches, one of the coaches being stationary and the other coach in motion, over distances ranging up to 90 miles (145 km.).—*Journal Franklin Institute*, January, 1921.

Two New Vacuum Tubes.—Pierre H. Boucheron.—A description of two new tubes, one especially designed and adapted for amateur radio-telegraph signal detection and the other applicable to the equally important field of radio and tone frequency amplification. Tests of the new tubes are given in the paper.—*Wireless Age*, February, 1921.

Books of Technical and Industrial Interest

COMPLETE LETTERS AND DIARY OF VERNE LEROY HAVENS. New York: McGraw-Hill Book Company, Inc. 94 pages.

On Jan. 31, 1920, V. L. Havens, editor of *Ingenieria Internacional,* one of the eleven McGraw-Hill engineering publications, left New York City for an extended business trip through South America. Mr. Havens sailed south by way of the Panama Canal and visited important centers of Peru, Chile, Argentina, Uruguay and Brazil. On July 23 he sailed from Rio Janiero for New York. During this six-month period Mr. Havens conducted exhaustive studies of trade and market conditions. It is rarely that the personal notes of an intimate study carried on by a trained engineer and economist are made available through publication, but Mr. Havens has supplied very valuable details of this sort by the publication of his letters and diary in a ninety-four-page pamphlet. The publication will be found invaluable to any one interested in the business of South American countries, whether he be an engineer or an executive, for incorporated in the notes are the results of the thinking of an engineer of extensive experience with an executive's business interpretation of the things he saw and heard.

SPOT AND ARC WELDING. By H. A. Hornor. Philadelphia: J. B. Lippincott Company. 296 pages, 61 illustrations.

The author has presented the subject of spot and arc welding from the standpoint of practical application, making the point that in his belief there still exists a hesitancy in applying welding to new construction, especially to the joining of heavy steel parts. A considerable number of tests made in the spot-welding of heavy steel plates by the Emergency Fleet Corporation are recounted in full. A study is made of materials with regard to the problem of making a weld that will be equal to the strength of the particular material to be welded. General application of arc welding, theories of electric welding and demonstrations of heavy spot weldings are taken up. A series of lessons for operators of arc-welding equipment are also presented.

EXPERIMENTAL WIRELESS STATIONS. By Philip E. Edelman. New York: Norman W. Henley Publishing Company. 232 pages, 167 illustrations.

A very handy amateurs' textbook, containing a large amount of useful information concerning radio telegraphy from the experimenter's point of view. The treatment is simple and the illustrations are clear. There are twenty-seven chapters in the book, relating to the following topics: Nature of wireless transmission, aërials, coil and sub-surface systems, grounds and lightning protection, the transmitter and resonance, wave length, transformers, auxiliary apparatus, condensers, inductances, spark gaps, radiation indicators, advanced systems, vacuum valves, tube radio telephones, the receiving station, detectors, sensitive detectors, tuning, special receiving sets, receiving condensers, construction of receiving inductances, making the set work, miscellaneous applications, time and weather signals, radio-communication patents and rights of the experimenter. A good index closes the volume. The amateur will find the book very convenient for reference, and it contains much information that will be serviceable to the educated public.

MILWAUKEE ELECTROLYSIS SURVEY. Milwaukee: Compiled and printed by E. E. Brownell.

The author has taken the results of five different electrolytic surveys made for the city of Milwaukee and combined them to afford a general survey of this subject.

Books Received

THE NEW PHYSICS. By Albert C. Crehore. San Francisco, Cal.: *Journal of Electricity.* 111 pages.

GRUNDLAGEN DER ELEKTROTECHNIK. By A. Rotth. Leipzig and Berlin: B. G. Tuebner. 128 pages.

ENGINEERING ELECTRICITY. By Ralph G. Hudson. New York: John Wiley & Sons, Inc. 190 pages, illustrated.

SPACE AND TIME IN CONTEMPORARY PHYSICS. By Moritz Schlick. New York: Oxford University Press. 88 pages.

POWDERED COAL AS A FUEL. By C. F. Herington. New York: D. Van Nostrand Company. 338 pages, 124 illustrations.

WIRING FOR LIGHT AND POWER. By Terrell Croft. New York: McGraw-Hill Book Company. 448 pages, 426 illustrations.

LESSONS IN HEAT. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.; Franklin & Charles. 147 pages, illustrated.

THE THERMIONIC VACUUM TUBE. By H. J. Van der Bijl. New York: McGraw-Hill Book Company, Inc. 391 pages, 232 illustrations.

LESSONS IN MECHANICS. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.: Franklin & Charles. 221 pages, illustrated.

ELECTRICITY SIMPLIFIED. By T. O'Connor Sloane. New York: Norman W. Henley Publishing Company. 218 pages, 39 illustrations.

MODERN WELDING METHODS. By Victor W. Page. New York: Norman W. Henley Publishing Company. 292 pages, 113 illustrations.

A THOUSAND AND ONE FORMULAS. By Sidney Grensback. New York: Experimenter Publishing Company, Inc. 160 pages, illustrated.

HIGH-FREQUENCY APPARATUS. By Thomas Stanley Curtis. New York: Norman W. Henley Publishing Company. 270 pages, 150 illustrations.

DIE WISSENSCHAFTLICHEN GRUNDLAGEN DER ELEKTROTECHNIK. By Dr. Gustav Benischke. Berlin: Julius Springer. 640 pages, 602 illustrations.

ADVERTISING THE TECHNICAL PRODUCT. By C. A. Sloan and J. D. Mooney. New York: McGraw-Hill Book Company, Inc. 365 pages, illustrated.

THE STANDARD ELECTRICAL DICTIONARY. By T. O'Connor Sloane. New York: Norman W. Henley Publishing Company. 768 pages, 477 illustrations.

LESSONS IN ELECTRICITY AND MAGNETISM. By William S. Franklin and Barry MacNutt. Bethlehem, Pa.: Franklin & Charles. 254 pages, illustrated.

FUNDAMENTAL PRINCIPLES OF ELECTRIC AND MAGNETIC CIRCUITS. By Fred Alan Fish. New York: McGraw-Hill Book Company, Inc. 194 pages, 106 illustrations.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Boston City Council Opposes Edison Coal Clause

TWO orders attacking the inclusion of a coal clause in bills rendered the municipality by the Edison Electric Illuminating Company of Boston have been passed by the City Council. The first requests the Mayor to instruct the corporation counsel of the city to compel the company to refund to the city all moneys received from the municipality under coal-clause charges, dating from the time the company has been receiving coal under its contract with the mines, which was suspended by the federal authorities during the period of the war. The second order asks the Mayor to instruct the city auditor to withhold approval of all bills rendered by the company against the city for electricity that includes a charge under the coal clause.

No Indication that Power Commission Will Get More than $100,000

WITH only a few legislative days left, it is evident that the Federal Power Commission is going to be limited, at least until July 1, 1922, to appropriations at the rate of $100,000 per year. As this is written the sundry civil bill is in conference. It is believed that the Senate amendment which limits the salaries to be paid the chief accountant and to engineers to $3,000 and $2,400 respectively will be eliminated from the bill.

In view of a letter that was written to the chairman of the House committee on appropriations by the Secretary of War, any failure to eliminate the Senate amendment would be interpreted as indicative of a desire on the part of Congress that the Federal Power Commission should not function. In his letter Secretary Baker said in part:

> The commission has 175 applications, aggregating 13,000,000 hp., now awaiting action. It has a personnel of thirty-two individuals, loaned by the Departments of War, Interior and Agriculture. It will be able to perform only a small fraction of the work before it with such a force. Furthermore, this force is merely temporary. It cannot be assumed that the several departments will be able to continue such loans and at the same time perform their own departmental work which they are authorized and directed by Congress to do. The commission cannot and should not expect to secure a personnel for its work by any other means than direct appropriations therefor by Congress. If the work is not of sufficient importance to warrant such action, the federal water-power act should be repealed.
>
> It will be utterly impossible for the commission to perform its duties with a personnel limited in numbers and in salaries to that provided by the Senate amendment. The commission is required to prepare and to administer a system of accounting for licensing. The act requires that the system shall be similar to that prescribed for railroads and other carriers by the Interstate Commerce Commission. The work of both commissions in this respect is identical in character. The Interstate Commerce Commission is paying from $7,500 to $9,000 to the men in charge of this accounting division. The Federal Power Commission cannot secure a competent chief accountant or assistant accountant for the figures named in the Senate amendment. The effect of the amendment, therefore, would be to repeal by indirection all the provisions of the act which concern or are dependent upon the system of accounting.
>
> The commission is required to pass upon the plans and designs of projects of enormous magnitude. It will have to make valuations involving hundreds of millions of dollars. It is, of course, wholly impossible to do this with any engineering staff that could be secured for a maximum of $2,400 per annum.

Utility Commission Divorced from Industrial Court

THE amalgamation of the utilities commission of Kansas with Governor Allen's widely heralded industrial court has not proved to be so satisfactory an arrangement as was anticipated, judging by the action of the State Legislature in divorcing the two on Feb. 16.

By the terms of the bill, which is now ready for the Governor's signature, the Court of Industrial Relations ceases to have any jurisdiction over public utilities, and the Governor is to name a new utilities commission of three members which is to operate as originally intended before the industrial court was created.

Pupin, Inventor of Loading Coil, Receives Edison Medal

THE highest honor in recognition of electrical invention which the industry has to offer, the Edison medal, was bestowed on Dr. M. I. Pupin, professor of electromechanics at Columbia University, by the American Institute of Electrical Engineers on Feb. 18 for work in mathematical physics and its application to the electrical transmission of intelligence. It was Dr. Pupin's distinguished work in developing the "loading coil" which made possible long-distance telephone communication.

The important influence of Dr. Pupin's work upon wire and radio transmission was reviewed by J. J. Carty, vice-president of the American Telephone & Telegraph Company, and the medal was formally presented by A. W. Berresford, president of the Institute. In accepting the honor Dr. Pupin addressed the meeting on wave transmission.

Preliminary Superpower Survey Report Expected Soon

A PRELIMINARY report covering in a comprehensive manner the progress made thus far in the Superpower Survey is to be made public in the near future as a result of the meeting of the advisory board and engineering staff with the Secretary of the Interior

on Feb. 18. Secretary Payne expressed himself as being highly pleased with the progress of the investigation as disclosed at this meeting.

Those attending the meeting with the Secretary of the Interior were L. P. Breckenridge, M. W. Alexander, E. G. Buckland, Col. William Kelley, M. S. Sloan, Dr. George Otis Smith, G. N. Snider (representing A. T. Hardin), F. M. Feiker (representing James H. McGraw), W. S. Barstow (representing C. L. Edgar), W. S. Murray, N. C. Grover, O. P. Hood, Henry Flood, Jr., O. C. Merrill, H. Foster Bain, Alexander T. Vogelsang, P. S. Smith and J. C. Hoyt.

Massachusetts Companies Seek Right to Capitalize Premiums

THE right to capitalize premiums paid on stock is being sought by leading central-station companies of Massachusetts at the present legislative session in the interest of more convenient financing. E. W. Burdett, counsel for the Massachusetts Electric and Gas Association, addressed the committee on power and lighting recently upon a bill introduced by that organization which provides for the approval of the Department of Public Utilities before shares representing paid-in premiums can be issued. The new shares will be issued proportionately to stockholders of the date of the commission's certificate.

Mr. Burdett stated that the object of the bill is to remedy what is considered an error in requiring one stockholder or set of stockholders to pay more than others for the stock purchased by them from a company, instead of each receiving the full amount of stock for which he paid; to remove false values and the consequent misapprehensions and embarrassments thereby caused, and to create a wider and more favorable market for the stock of domestic gas and electric companies, first, by putting them within reach of a larger number of investors, especially those of small means, and second, by removing the handicap on their sale in competition with the securities of corporations organized outside of Massachusetts.

Under the present law increases of capital stock must be issued at such price (and at not less than the par value thereof) as determined by the directors and approved by the Department of Public Utilities. The result has been the issue of stock at an average premium of $39.17, and in the illustrative case of the Boston Edison company the average price received for its stock has been $179.54, resulting in a premium of nearly $18,000,000. In the case of the Lynn Gas & Electric Company the premium account is nearly as large as the par value of the entire capital, the exact proportion being 91.95 per cent. The diversity of dividend rates resulting from the varied premiums paid into different company treasuries causes misapprehension of the yield on the part of the public, creating an unfounded feeling of hostility, Mr. Burdett said. By bringing the nominal and real capital of the companies into harmony the percentage paid in dividends would be reduced substantially in harmony with the change in the value of the shares, the commission would be assisted in rate regulation and the market for securities broadened.

The bill was favorably reported by the committee and was in the Senate under discussion last week, a vote being expected this week.

Supply Manufacturers Complete Plans for Annual Meeting

PLANS are now virtually completed for the sixth annual meeting of the Associated Manufacturers of Electrical Supplies, to be held at the Hotel Biltmore, New York, on March 15. Because of cancellation of orders, deflation of inventories and adjustment of labor conditions, all of which contribute to a feeling of uncertainty and a spirit of economy and retrenchment, it has been decided to omit the banquet this year.

The following nominations for governors will be submitted to the meeting for election to take the place of those whose terms expire by limitation: S. H. Blake, General Electric Company, Schenectady; F. L. Bishop, Hartford (Conn.) Faience Company; A. H. England, Electric Service Supplies, Philadelphia; A. F. Mills, Crouse-Hinds Company, Syracuse, N. Y., and Robert Kuhn, American Electrical Heater Company, Detroit.

The following is a schedule of section meetings to be held at the offices of the association and at the Hotel Biltmore during the week of the annual meeting:

Tuesday, March 15.—Fuse Section, 9 a.m., association rooms; Electrical Porcelain Section, 10:30 a.m., association rooms.

Wednesday, March 16.—Fan Motor Section, 10 a.m., Hotel Biltmore; Outlet Box Section, 10 a.m., Hotel Biltmore; Industrial Lighting Fixture Section, 10 a.m., Hotel Biltmore; Snap Switch Section, 10 a.m., association rooms; Signaling Apparatus Section, 10 a.m., association rooms; Lamp Receptacle and Socket Section, 2 p.m., association rooms; Attachment Plug Section, 4 p.m., association rooms; Line Material Section, 2 p.m., association rooms.

Thursday, March 17.—Rigid Conduit Section, 10 a.m., Hotel Biltmore; Non-Metallic Conduit Section, 2 p.m., Hotel Biltmore; Armored Conductor Section, 4 p.m., Hotel Biltmore; Molded or Formed Insulation, 10 a.m., association rooms; Heating Appliance Section, 10 a.m., association rooms; Knife Switch Section, 2 p.m., association rooms.

Friday, March 18.—Panelboard and Switchboard Section, 10 a.m., association rooms; Air Circuit-Breaker Section, 2 p.m., association rooms.

South Dakota Hydro-Electric Plans Fail to Pass State Senate

ACTION by the State Senate last week will prevent any hydro-electric development by South Dakota for the present. Bills for development on the Missouri River at Mobridge and Mulehead were both overwhelmingly defeated. The Mobridge site was put forth by the State Hydro-Electric Commission, which has been looking for a suitable site for the past two years. Development of this site, it was estimated, would cost something over $16,000,000. Details were given in the ELECTRICAL WORLD for June 12, 1920, page 1390.

Utah Power & Light Offers Services in Municipal Plant Survey

A THOROUGH investigation of the proposal to erect a municipal electric lighting plant for the city of Ogden is requested by the Utah Power & Light Company, in a letter submitted to the city commission at its regular weekly meeting on Feb. 14. Recently the Mayor of Ogden announced that a bond election would be called to vote on the issuance of $500,000 bonds for the construction of a municipal lighting plant. The company offers its services in making a study of the problem.

New York Industrial Lighting Code to Be Revised

HEARINGS on revision of the industrial lighting code of New York will be held at different cities in the state within the next two months. Under the State Industrial Commission, the committee on artificial lighting, of which Thomas C. Eipper is chairman, has been working on changes in the present code adopted in 1918.

The proposed changes as approved by the committee embrace a more explicit wording of Rule 50, covering general requirements, methods of measurement, intensity, shading of lamps, distribution of light and emergency lighting. Illumination requirements now specify the minimum intensity for roadways, halls, stairways, storerooms, warehouses and manufacturing operations in general and were designed with the view to protecting the health of workmen, relieving eye strain and preventing accidents. At the same time these requirements were made as low as possible in order not to require the installation of expensive lighting equipment by factory owners.

Supplementing the code is a tentative table of minimum intensities for detailed industrial operation and processes submitted by the commission for the guidance of factory owners and operators. The data in the table are based upon actual tests, and it is the intention of the Industrial Commission to make these intensity requirements mandatory, together with the adoption of other revisions of the code.

The commission, in addition to making tests and gathering data for the revision of the lighting code, has done a great deal of work in correcting and improving illumination conditions in factories and industrial plants. That this work has been very effective and well received by factory owners is shown by the report for the fiscal year ended June 30, 1920. Of 12,293 orders issued for the correction of lighting conditions, there were 11,492 compliances. A number of the 801 orders remaining were canceled by the commission and a few are still pending.

Revisions of the code, Chairman Eipper said, are being made only after practical experience has demonstrated their advisability.

Midwinter Safety Meeting Next Week in Philadelphia

AS MUCH of the available data on the subjects of dust explosions, crane overhoist limit stops, signals and signaling in industry and the relation of boiler accessories to safety as can be gathered together will be discussed at the midwinter meeting of the Engineering Section of the National Safety Council, which is to be held in Philadelphia Feb. 28. The meeting is to be held jointly with the Philadelphia Section of the American Society of Mechanical Engineers and the Philadelphia Section of the Association of Iron and Steel Electrical Engineers.

The program is as follows: "The Engineering Aspects of Signaling," by A. H. Rudd, chief signal engineer Pennsylvania System, Philadelphia; "Crane Overhoist Limit Stops," by D. M. Petty, electrical engineer Bethlehem Steel Company, Bethlehem, Pa.; "The Relation of Boiler Accessories to Safety," by Warren Hilleary, superintendent of schedule rating Royal Indemnity Company, New York City; "The Lubrication of Air Compressors," by Dr. A. D. Risteen, director of technical research Travelers' Insurance Company, Hartford, Conn.; "Lessons from Electrical Fatalities," by S. E. Whiting, assistant chief engineer Liberty Mutual Insurance Company, Boston.

The program for the evening meeting includes two formal addresses to be followed by general discussion, as follows: "A Broader Field for the Engineer," by Prof. Dexter S. Kimball of Cornell University, and "Safety, the Fundamental of all Engineering," by L. A. DeBois, E. I. du Pont de Nemours & Company, Wilmington, Del.

Boston Edison Commercial and Operating Convention

THE first convention of the commercial departments and operating bureau of the Edison Electric Illuminating Company of Boston was held at the Edison Service Building in that city Feb. 16-17. About 130 employees attended, L. R. Wallis, superintendent of the sales department, presiding. Besides a free discussion of recent convention and other papers by other than company authors, the program included the following papers or addresses: "Sidelights of a District Salesman," by N. C. Fowler; "Illuminating Engineering," by Julius Daniels; "The Price of Electricity," by R. S. Hale; "Rates," by L. R. Wallis; "Information Department," by A. E. Josselyn; "The Application and Passing of an Order," by E. B. Locke; "Commercial Engineering and Power Sales," by J. W. Wattles; "Electric Cooking," by R. P. Loud; "Store Service," by E. M Guest; "Historical Sketch," by H. J. Law; "House Wiring," by E. W. Childs; "Service Warrants," by E. C. Kimball; "The Work of the District Salesman," by W. P. Fiske; "Duties of a District Manager," by A. J. Ash; "Customers' Adjustments," by E. H. Gray; "Electric Appliance Development," by J. M. Braff. L. L Edgar and L. D. Gibbs also spoke.

N. E. L. A. 1921 Convention Headquarters



The Drake Hotel, Chicago, is a new building located on the shore of Lake Michigan and said by some to be the most modern hotel in the United States in every particular. The N. E. L. A. convention, which is scheduled for May 31 to June 3, will be the first to be held in the hotel following its completion.

Nearly 8,000 Common-Stock Shares Sold to 938 Persons in Ten Days

DURING the first ten days of its local stock-selling campaign, which started Jan. 24, the Southern California Edison Company made sales to 938 persons, who purchased 7,880 shares of the company's common stock at the par value of $100 per share. The price to the public was $94 a share when cash was paid and $95 on the installment plan.

The company plans to sell $10,000,000 worth of this stock during the current year and feels confident that it will be successful in this undertaking. In talking of this plan to the ELECTRICAL WORLD R. H. Ballard, vice-president and general manager, said:

"We have heretofore sold nearly $9,000,000 of this stock directly to the public and feel quite confident that our 1921 sales, in view of the 8 per cent dividend rate, will amount to an additional $10,000,000. So far as our own bank interests are concerned there is no friction. A buying syndicate composed of Harris, Rollins and the National City Company buy our bonds at wholesale—they are just now buying another $5,000,000—and then distribute these bonds all over the country through their own efforts and by allowing virtually all established smaller bond firms to participate. For instance, there will be half a dozen or so of such firms in Los Angeles selling these bonds locally. Instead of looking on our direct sales of the junior securities or stock to consumers and the public as being in conflict with their own efforts, they, on the contrary, urge us to pursue this method as being of great benefit to bond sales in the stability it gives the company as a whole, both in meeting promptly all of its financial requirements and in the credit strength of widespread public support."

Narragansett Company Saves $362,000 by Use of Oil as Fuel

A MORE than ordinarily interesting statement is contained in the annual report for 1920 of the Narragansett Electric Lighting Company, Providence, R. I. This statement refers to the economy effected by the use of oil fuel instead of coal, an experiment which has now lasted more than a year and appears to have amply justified itself.

"On Dec. 24, 1919," President Edwin A. Barrows says, "oil was first used as fuel under our boilers, two boilers being equipped to burn oil. Considerable experimental work was done in the early part of 1920 toward securing the maximum efficiency and minimum maintenance cost. At the close of the year, as the result of these experiments, the company had in all fourteen of the twenty-four boilers then constituting our equipment using oil. These fourteen boilers are in addition equipped with stokers so that reversion to coal burning can be made if desired. In January, 1920, 90 per cent of our power was generated by coal and 10 per cent by oil. In December about 35 per cent was coal-generated and 65 per cent generated by oil. This use of oil for fuel has effected a very large economy during the year, especially in the face of the abnormally high coal prices, and in addition economies have been effected by the reduction of labor and coal handling in storage. The company's customers have benefited by this large saving of over $362,000. Otherwise a considerable increase in rates would have been necessary."

The operations of the company during the year, the report says, have been the largest in its history, and in spite of business uncertainty the outlook for 1921 appears good.

Higher Salaries and Larger Force for Patent Office Seem Assured

NOW that several efforts by Senator Norris of Nebraska to obtain approval of the conference report on the Patent Office bill have failed, it is believed at this writing that he will abandon that section of the bill authorizing the Federal Trade Commission to administer patents for government employees. The Senate is willing to approve the portion of the bill which increases the salaries of the technical men in the Patent Office and which allows expansion in the size of the present force. The House has already approved the conference report, including the federal employee patent plan.

Financial Problems, Publicity and Other Topics Discussed at Albuquerque

TRUTHFUL publicity as the best means of establishing harmonious relations between public utilities and the communities they serve was urged by J. F. Greenawalt, publicity manager of the Mountain States Telephone & Telegraph Company, before the annual convention of the New Mexico Electrical Association, held at Albuquerque on Monday and Tuesday, Feb. 14 and 15. Prof. R. W. Goddard of the State College made an address on "Electricity," tracing its historical development and dwelling on the practical importance of technical research. "Electricity for the Bakery, Hotel and Restaurant" was discussed by J. F. Senior, who pointed out the large field afforded central stations by the electric range, which serves a business almost unaffected by hard times. Prof. Charles E. Carey of the University of New Mexico presented a paper on "Lightning and Lightning Protection," enumerating eight features in the design of lightning arresters which should be included or avoided and eight other factors which have an important part in assuring protection. A paper on the relationship of the jobber to the central station, by Hollis R. Johnson of the Commercial Electrical Supply Company, St. Louis, presented the business-getting problem from the jobber's point of view.

A letter was read from William H. Onken, Jr., editor of the ELECTRICAL WORLD, dealing with the financial situation in which electric light and power companies find themselves because inadequate rates and the federal tax laws make it difficult for them to find new capital. Mr. Onken defended the state commissions against political attack and urged the New Mexico Electrical Association to help arouse public sentiment in their support. He referred to the country-wide advertising campaign of good will launched by the National Electric Light Association and pointed out how essential it is to cultivate the understanding and friendship of consumers and the whole community.

Officers elected for the coming year are: President, Arthur Prager, manager Albuquerque Gas & Electric Company; first vice-president, D. E. Bent, manager Tucumcari Light & Power Company; second vice-president, E. A. Bradner, manager Las Vegas Light & Power Company; secretary-treasurer (re-elected), Charles E Twogood.

Trial of Diesel-Electric Drive to Be Made on Oceangoing Freight Ship

DIESEL engines combined with the electric drive method of propulsion are to be installed in the American freight steamer *Fordonian*, owned by the American Mediterranean Steamship Company. It is estimated that two engines, each having 500 boiler-hp., will provide sufficient energy to drive the ship loaded at a speed of nine knots an hour.

The *Fordonian* was built in 1912 by the Clyde Shipbuilding & Engine Company at Port Glasgow, Scotland. She has a gross register of 2,366 tons and is 250 ft. in length. It is said that she will be the first deep-sea freighter to be equipped with internal-combustion engines supplying the power for the electric drive. This system was introduced on the Great Lakes several years ago, but did not work out satisfactorily. However, marine engineers said that it was not given a thorough trial.

To Move Town So as to Be Able to Build Dam

IT NOW seems practically certain that in connection with the construction of the American Falls reservoir on the Snake River in Idaho legislative authority will be given to purchase, condemn and improve land for a new town site to replace the portion of the town of American Falls which will be flooded by the new reservoir. The project calls for a 90-ft. dam, which would impound 3,000,000 acre-feet and make available for irrigation the entire water resources of the Snake River.

In addition to moving a large part of the town of American Falls it will be necessary to acquire the 6,000-hp. hydro-electric plant of the Idaho Power Company located just below the dam site. The proposed dam would make necessary the relocation of several miles of the Oregon Short Line Railroad. Indian lands as well as private lands would be flooded. This calls for time-consuming adjustments. All of these matters, however, are to be carried forward as rapidly as possible. Thus far arrangements have been concluded for the use of less than 1,000,000 acre-feet.

Brooklyn Edison Total Revenue Up $2,465,640 Over 1919

THE Brooklyn Edison Company's gross operating revenue for the year ended Dec. 31, 1920, as shown by its annual report, was $13,174,874, an increase of $2,465,640 over the previous year. Gross income, after deduction of operating expenses, taxes, reserve for renewals and replacements and inclusion of non-operating income, was $3,082,949, or $268,062 less than during 1919. The net income, after interest on funded and unfunded debt and bond discount, was $1,662,616, a decrease of $599,946 as compared with the year previous.

In the report attention is called to the high cost of material and supplies during the year and the consequent increased operating expenses. The report points out, however, that toward the end of 1920 the price of coal fell, and the company anticipates that it will obtain contract coal for its full requirements for 1921 at reasonable prices.

The new business obtained in 1920 exceeded that of any previous year. New power contracts were secured for an aggregate of 92,000 hp. The number of customers on Dec. 31, 1920, was 161,819, an increase of 36,295 for the year. Total kilowatt-hours sold during the year was 298,807,110, or 43,018,313 more than the year previous. The maximum load increased from 105,400 kw. to 116,500 kw.

During the year considerable new equipment was added. Two new substations were built and an existing substation was remodeled. Transmission and distribution systems were extended by the construction of 75 miles of 13,200-volt feeder cables for high-tension transmission and approximately 900 miles of feeders and mains, of which 385 miles are underground.

Consolidation of New England Hydro-Electric Companies Forecast

HENRY I. HARRIMAN, president New England Power Company, Boston, appeared before the committee on power and light of the Massachusetts Legislature Feb. 16 in support of a bill to facilitate the financing of hydro-electric companies, stating that the consolidation of the New England Power Company, the Connecticut River Power Company of New Hampshire (and Vermont) and the Rhode Island Power Transmission Company is sought by the controlling interest in these organizations. The proposed bill provides, first, that a Massachusetts electric utility owning a hydro-electric plant may issue bonds to an amount not exceeding twice the amount of the capital stock, instead of to an amount not exceeding the capital stock; second, if a refunding mortgage is issued and prior-lien bonds are placed back of it, the two bonds, one of which is collateral and the other original, shall not count as two; third, that such a utility may be permitted, when benefited by a reservoir in New Hampshire or Vermont, to own securities of such a reservoir company.

Mr. Harriman stated that the preliminary steps toward this consolidation have been taken, that an examination of the laws of about twenty leading states shows no such provision as the present Massachusetts requirement limiting bonds not to exceed the stock paid in, and that only the latitude already granted to street railways and railroads in the state is desired. Companies in Massachusetts, the speaker said, are handicapped in the marketing of their securities in competition with those of utilities incorporated in other states. The second provision is designed to offer more flexible financing, under commission supervision, through the omission of collateral bonds in counting the total allowed debt and through the adoption of interest rates responsive to prevailing market conditions. The New England Power Company system today represents an investment of about $30,000,000 compared with a mortgage of $2,000,000 ten or twelve years ago, and the rapid growth of these and other companies makes the use of serial bonds and other flexible financing necessary to further development.

The provision relative to storage-reservoir security ownership is designed to aid the financing and development of such facilities in cases where these are beneficial to companies outside the state within which the reservoir companies are chartered. Thus the Turners Falls (Mass.) Power & Electric Company and the New England Power Company interests have been respon-

sible for the construction of storage reservoirs in the upper Connecticut River which impound from six to seven billion cubic feet of water, and, subject to the approval of the Massachusetts Department of Public Utilities, it is desired that such corporations may participate in the ownership of the storage-reservoir companies, which are required by state law to be locally incorporated. Mr. Harriman said that in consolidating the three companies named by him it is desired to apply the rights already enjoyed in New Hampshire and Vermont to the combined company.

Connecticut May Extend Scope of Her Public Utilities Commission

A BILL has been introduced into the Connecticut State Senate by Senator Alexander L. DeLaney of Bridgeport to extend the scope of the Public Utilities Commission of the state to cover water, gas and electric companies in addition to the trolley companies, which now furnish the commission with its main field of activity. Hitherto the rates charged by the lighting, power and water companies have not been subject to commission control in Connecticut. The proposed act would bring the state in line with the majority of the states, in which the commissions exercise a wide jurisdiction.

Public Service Commissions Defended by Wisconsin Supreme Court

THE Supreme Court of Wisconsin, in a decision just rendered in the case of the Superior Water, Light & Power Company against the city of Superior, discusses at some length the reasons why regulation of public utilities through a state commission became a necessity. "The public utility law was enacted as a remedy for a well-recognized evil," the court declares. "The relations existing between the respective municipalities and their public utilities were most unsatisfactory. The impotency of the municipalities to deal with them so as to secure adequate and satisfactory service for reasonable charges was abundantly demonstrated. The officers of the municipality lacked the training in the technique of the public utility business which was essential either to protect the interests of the citizens or deal justly with the public utility company.

"Unreasonable demands made by the city as a result of a lack of information concerning the public utility business were as fruitless of just results as meek submission to the ultimatums of the utility. So it was determined to take from the municipalities the regulation and control of public utilities and vest that power with the Railroad Commission, which body, through its staff of experts, could acquire the information necessary to fix and enforce appropriate standards of service and just and reasonable rates which should adequately compensate the utility for the service rendered.

"It is believed that fourteen years of experience has vindicated the law as a measure of great public benefit, although recently, when abnormal industrial and commercial conditions have given rise to a general increase in rates of service, mutterings against the law or its administration may be heard. But it should not be forgotten that successful regulation must be fearless and fair, and accommodated to the exigencies of changing conditions. Critics should appreciate that private capital devoted to public service is entitled to a fair return, and that it requires more courage and character to render just than to render popular decisions."

Maine Governor Urges State Development of Storage and Water Powers

DEVELOPMENT of storage reservoirs and of undeveloped water powers incident thereto by the State was advocated by Governor Baxter of Maine in his recent inaugural address as successor to the late Governor Parkhurst, who died shortly after being inducted into office. Governor Baxter has long been greatly interested in water-power legislation, and as a legislator he advocated the retention of Maine's water powers for the benefit of Maine people, opposed federal interference with the control of these water powers, urged the appointment of a commission to obtain the facts about them for the benefit of the public, and was instrumental in attaching a restrictive amendment to such water-power charters as came before the last two legislatures. Speaking of the water-power legislative outlook in the state Governor Baxter said:

"The policy of non-transmission of hydro-electric energy beyond the state is supported by an overwhelming public sentiment, and in so far as the State of Maine is able to do so this policy has been safeguarded by law and by amendment. The Maine Water Power Commission, in my opinion, in its recent report has justified its creation and its continuance, as the only available channel through which the facts properly and impartially may be put before the people. Should the federal government attempt to assume control over Maine's water powers under the federal water-power act, or should any water-power corporation, in violation of the laws of this state and in disregard of the expressed will of the people, undertake to transmit the water powers of Maine beyond the confines of the state the Attorney-General will be directed to defend the rights and sovereignty of the state and to proceed against the offending corporation.

"Maine should not fall back into its former state of indifference to this vital question. Maine must advance. Private development should be encouraged and property rights must be respected. It need never be feared that the State of Maine will take property or rights from lawful owners without returning to them lawful compensation therefor. The construction of storage reservoirs and basins and the development of the undeveloped water powers incident thereto by the state should, in my opinion, be begun under proper safeguards after present restrictions are removed. Maine needs the benefit of its water powers, and the need becomes more pressing as years go by."

Business Men Want Stronger Illinois Commission

ON A REFERENDUM prepared by the directors of the Illinois Chamber of Commerce, 21,825 members out of 22,862 voted in favor of the state regulation of all public utilities, local or otherwise, by a state commission which should consist of men appointed because of their ability to give a non-political, unbiased and strictly businesslike administration of the commission's affairs.

Business Improvement Here and Will Grow Steadily, A. W. Douglas Says

REPORTS of traveling salesmen from every section of the country are to the effect that farmers are gradually marketing their crops, that bankers are beginning to make loans and extend credit and that a slow and natural working out of the processes of liquidation now in full operation will bring renewed prosperity in the near future. Lending full credence to these reports, Archer Wall Douglas, chairman of the committee of statistics and standards of the Chamber of Commerce of the United States, in his monthly review of business issued this week, asserts that the general thought inclines to early spring, March or April, as the date when distinctly definite improvement will set in, though in many parts of the cotton belt the belief is that June is early enough to expect a decided change. Scarcely any believe that present conditions will prevail throughout the year.

"All are agreed," Mr. Douglas adds, "that the only way to hasten matters is by the general exercise of the homely virtues of hard work and economy. A recent expression of opinion by a number of representative business men throughout the country brought out the significant fact that they were not so much concerned about the problems of labor, material, prices, transportation and collection, on the whole, as they were with the question of sales. In other words, when demand starts up, the whole tangled economic skein will begin to unwind. While non-employment is still large, there is more work and less idleness on the whole in industrial sections. The lessened production in manufacturing has naturally resulted in decreased output of coal. In the oil fields also there are falling prices accompanied by cutting down the output. Although building is practically at a standstill throughout the country, there exists the general expectation in nearly all sections of a revival in the early spring, provided lower costs, steady work and greater ease of money obtain."

Present-Reproduction-Cost Valuation Theory Criticised

IN GRANTING increased electric and heating rates to the Laporte Gas & Electric Company the Public Service Commission of Indiana recently dwelt upon what it holds to be economic unsoundess and legal anomalies in current theories of valuation, its viewpoint being somewhat at odds with the prevailing tendency of court decisions. It attacks the contention that present reproducion cost is the controlling factor, which, it says, tends to subject the utilities to "hazardous speculation, extreme financial uncertainty and obvious inequities." The contention, the commission holds, is in direct conflict with the contention supposed to support it, that utility property should be treated exactly like other private property, because the value of private property is its market value, and that is not at all determined by its cost of reproduction.

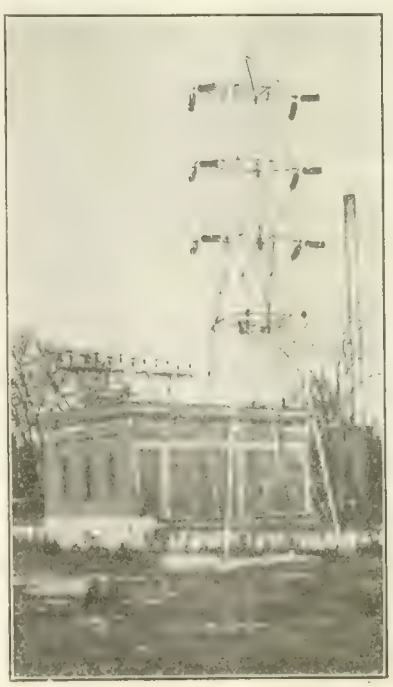
To apply the "market value" rule to public utility valuation would be a *reductio ad absurdum*, for market value depends chiefly on earnings, and earnings depend on rates, and rates depend on value. Nor does it logically follow that because the inventory used in valuation proceedings must be today's, therefore unit costs representing present costs of other units of property similar to the units in the plant valued must apply. The shrinkage in the purchasing power of money is a world-wide economic phenomenon due to fundamental social and economic factors, the commission insists, and all classes of society must be satisfied with decreased purchasing power until these factors are eliminated. To revise values in terms of the purchasing power of the dollar, whether such revision be up or down, is fundamentally unsound and might in the future involve utilities in bankruptcy. "The surest and most equitable method of insuring stability of values," in the commission's opinion, "is to consider prudent investment as the primary factor of value, thus insuring the utility against the evil effects of recurrent fits of economic fortune."

Well-Known Men to Address Oklahoma Utilities Association

THE third annual convention of the Oklahoma Utilities Association will be held at the Huckins Hotel, in Oklahoma City, on March 8, 9 and 10. The association is made up of electric light and railway, gas and telephone companies, manufacturers and suppliers. Among those who are announced to address the convention are H. J. Gordon, publisher of the *Public Service Magazine*, Chicago, Ill.; H. P. Wright, president H. P. Wright Investment Company, Kansas City, Mo.; Paul P. Haynes, member Indiana Public Service Commission, and C. C. Deering, secretary United States Independent Telephone Association, Des Moines, Iowa.

Georgia School of Technology Plans to Aid State's Industrial Development

AMONG other objects to be served by the fund of $5,000,000 which the Georgia School of Technology at Atlanta will launch a campaign to raise in April is the establishment of an industrial development department. This department, having in view the enormous natural resources of the state that still await use, plans to catalog and classify them, to bring them to the attention of capitalists and investors, to co-operate with civic bodies and public utilities, to conduct a general industrial service bureau, to compile for practical reference data pertaining to industry, to act as an industrial clearing house for the state.



Old Station Gives Way to Water Power

AS HYDRO-ELECTRIC energy enters by steel-tower lines this old central station at Torrington, Conn., goes into auxiliary service. A compact local substation now serves this normally busy manufacturing community.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Biggest Hydro-Electric Plant in Europe Projected.—The Diet of Moravia, a province of the former Austro-Hungarian Empire now constituting part of Czechoslovakia, has just approved a project for the construction of an immense hydro-electric power plant on the Thaya River. The works to be erected will, it is said, have a generating capacity of 80,000,000 kw.-hr. If carried out on this scale, the plant will be the largest of its kind on the European Continent. Leading Swiss banking institutions are reported to be interested in this project. The Swiss press, however, is strongly opposed to any such financial co-operation, basing its opposition on the fact that Swiss electrical enterprises have themselves to seek foreign money.

"Halting American Development."—Under this title Dr. William McClellan, former dean of the Wharton School of Finance and Commerce of the University of Pennsylvania and until recently vice-president of the Cleveland Electric Illuminating Company, has contributed an article to the February number of the *North American Review*. Dr. McClellan lays stress on the intimate connection that exists between the prosperity of public utilities and the general industrial progress of the country and points out that widespread development of the nation's resources is impossible when the agencies that furnish power and transportation are so restricted in their earnings that they cannot command the vast amounts of new capital necessary to their adequate expansion.

London's Supply of Electricity.—London continues to wrestle with the complex question of reorganizing its supply of electrical energy. The *Electrician* reports a partial solution, applying to the northeast district of the city, as worked out by E. M. Lacey and other electrical engineers. The district concerned has a population of nearly 2,000,000 and its present annual consumption of energy is 165,000,000 kw.-hr. In another year there will be an installed capacity of 92,000 kw. of efficient plant available, but, as this will soon be quite inadequate, the engineers recommend that a large station be erected with a capacity of at least 64,000 kw. at the outset. It is to contain five units of 20,000 kw. each and be designed for an ultimate capacity of 400,000 kw. The total cost of the station is put at £2,500,000. The cost of the transmission system for a maximum demand of 72,000 kw. would be £1,100,000.

Electrification of Melbourne Railways.—Nearly half of the suburban railway lines running out of the city of Melbourne, Australia, have been electrified, and it is expected that the rest of them will be so by the middle of 1923, the conversion, which was authorized in 1912, having been greatly retarded by the war. The London *Engineer* says that advantage is being taken wherever possible of the developments in electrical engineering since the war. For instance, the last two 14,500-kw. generators for one of the power houses will not differ outwardly from the generators already installed, but they will be capable of producing about 20 per cent more power with less fuel. Among other improvements will be automatically operated converting and switching plants at five substations and a new type of 20,000-volt switch gear occupying much less space than the old type.

Hartford's New Power Station.—The new station of the ever-enterprising Hartford Electric Light Company on the Connecticut River below the Dutch Point station is under way, and the engineers, Stone & Webster, expect that the first unit will be in operation in July next. This unit will be one of an eventual installation of five 20,000-kw. turbines, which can be doubled if the growth of business demands it. The building first constructed will afford room for three of these turbines with their auxiliary equipment. On account of the heavy floods to which the Connecticut River is subject, which cause a maximum difference in water level of 30 ft., it has been found necessary to place the condenser floor 20 ft. below high water and to make that portion of the turbine room below high water a watertight concrete box. The coal bunker extending across the boiler room will have a capacity of 2,000 tons.

The Demonstration Tidal-Power Plant at East Saugus, Mass.—The first plant of the Universal Tide Power Company is now under way at East Saugus, Mass., according to a report made by a committee of the Providence (R. I.) Engineering Society and based on the statements of the inventor of the machinery, J. A. Knowlton, and the engineer in charge of the earthworks and dam. This plant is for demonstration purposes only and is not intended to pay returns on the capital invested. The theory of its operation as explained by those behind the plan is, briefly, that the water which will be impounded in the river by the rising of the tide will on its recession run through a "hydraulic air motor," consisting of small reservoirs and floats, by means of which the water power will first be converted into air power. The energy in this compressed air is then to be converted into electrical power by means of an "air engine" and an electric generator. Mr. Knowlton estimates that 5.8 ft. of the entire tide range of 9.4 ft. will be used and that the plant will develop 37 hp. an hour continuously twenty-four hours a day. The cost of the plant is put at $200,000.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Joint Meeting of A. I. E. E. and A. S. M. E. in New York.—The fourth of the joint sessions of the New York Section, A. I. E. E., and the Metropolitan Section, A. S. M. E., is announced for March 25, when the topic will be industrial relations. Prof. Walter Rautenstrauch will be in charge.

Providence Engineering Society.—At last week's meeting John M. McMillin of Henry L. Doherty & Company gave an illustrated talk under the auspices of the Municipal Section of this society on "Relationship of Public Utilities to the Public." The Power Section is to meet on Tuesday, March 1, when Henry Kreisinger of the Combustion Engineering Corporation will speak on "Fuel and Its Combustion Under Power-Plant Boilers." On March 15 the society will hold a joint session with the A. I. E. E., and C. C. Whittaker of the Westinghouse company will discuss the electrification of steam railroads.

Empire State Gas and Electric Association.—The electric production and distribution sections of this association met at Rochester, N. Y., on Feb. 10 and Feb. 11 respectively. Before the first-named section F. A. Dresser of the Cortland County Traction Company read a paper on "The Problems of the Small Plants," and O. W. Bodler, electrical engineer with the Eastman Kodak Company, spoke on "The Importance of Close Voltage Regulation in Industrial Plants." Before the distribution men, John P. Hogan talked on the hydro-electric situation in New York State E. P. Peck of the Utica Gas & Electric Company read a paper on "Testing of High-Tension Insulators Before and After Installation," and Francis A. Westbrook of the Habirshaw Electric Cable Company discussed aërial power cables and grounding transformers.

Coming Meetings of Electrical and Other Technical Societies

Engineering Section, National Safety Council—Philadelphia, Feb. 28.

Providence Engineering Society—Providence, March 1.

Association of Iron and Steel Electrical Engineers—Philadelphia Section, March 5; Cleveland Section, March 14; Birmingham Section, March 19; Chicago Section, March 22.

Oklahoma Utilities Association—Oklahoma, March 8-10.

American Institute of Electrical Engineers—New York Section, March 11; Providence Section, March 15; Schenectady Section, March 18.

Associated Manufacturers of Electrical Supplies—New York, March 15.

Wisconsin Electrical Association—Milwaukee, March 23 and 24. (For program see issue of Feb. 19, page 448.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Powers of Oklahoma Commission Upheld.—That the Corporation Commission has a right to control and supervise rates and contracts entered into between two utilities or public service corporations where such rates are "unconscionable, oppressive and impair obligation of the public service corporations in their discharge of their duty to the public" was the holding of the Supreme Court of Oklahoma in denying the application of the Oklahoma Gas & Electric Company for a writ to prohibit the Oklahoma Natural Gas Company from establishing a city rate to replace the present contract with the Oklahoma Gas & Electric Company, which provides that the latter shall pay two-thirds of its gross receipts to the Oklahoma Natural Gas Company for the gas received from it.

Right of Condemnation Sustained.—An electric power company, according to the findings of the Supreme Court of Tennessee in Barger vs. Knox County Transmission Company, did not lose its right of condemning land for public use because it did not supply non-remunerative customers along a certain line, nor because of a contention that its right-of-way was improperly located, nor because it did not generate its own electricity but acquired it from another company, nor because it was affiliated with or promoted by other companies, nor because it was accused of violating the anti-trust laws; nor were the state laws under which it was sought to exercise the right of eminent domain in violation of the state constitution because they did not restrict to a public use alone the property authorized to be condemned. (225 S. W. 1046.)*

United States Court Sustains Power of Kansas Commission to Change Contract Rates.—An action of the Wichita Railroad & Light Company against the Public Utilities Commission of Kansas to restrain it from putting into effect an order granting increased rates to the Kansas Gas & Electric Company was decided in favor of the plaintiff by the United States District Court, and the commission carried the case to the federal Circuit Court of Appeals. That body reversed the decree of the District Court, holding that the commission had full power to issue the order, that the commission could permit a utility to charge rates in excess of those fixed by contract with consumers without impairing the obligations of such contracts, that the commission could authorize increases in the rate of utilities through specified surcharges, and that the order of the commission should be sustained. (268 Fed. 37.)

Powers of Courts and Commissions Over Rates.—An appeal was taken to the New York Supreme Court, Appellate Division, from the decision of the Special Term which granted an injunction to consumers of the Brooklyn Borough Gas Company in restraint of an increased rate permitted by the Public Service Commission, First District. (See ELECTRICAL WORLD, Jan. 22, page 228.) The Appellate Division has affirmed the order of injunction, which, the statutory rate having been declared unconstitutional, left no way for the company to arrive at an equitable rate save by judicial action. A dissenting opinion was filed in the Appellate Division by two judges, who upheld the commission's powers and asserted: "Prescribing a general rate for service is a legislative and not a judicial act. It may be exercised by the Legislature directly or by an administrative body to which the power is delegated. In the absence of such regulation the power to fix the charges is vested in the corporation itself, and, although a question may arise as to the reasonableness of the charge, depending upon the service rendered, as between an individual and the corporation, such question never concerns the power of the corporation to establish a system of rates. In the absence of such legislative regulation the courts have no power to determine the question."

Preferential Contracts Properly Annulled by Commission.—A suit brought in the California Supreme Court by Hartland Law against the Railroad Commission because he was forced by that body to pay to the Great Western Power Company rates fixed by the commission in spite of the fact that he had a twenty-year contract at lower rates has been decided in favor of the commission. The commission's view, to which is due a dispute of long standing, is that wherever there are favored consumers enjoying special rates under the terms of contracts like the one in question—where the utility company, in consideration of the use of certain machinery and appliances in the complainant's building, agreed to furnish steam heat for a period of twenty years at a low rate—there necessarily results an outright discrimination in favor of such consumers and an additional burden upon all others. The court declares that "It is not essential that a rate be greater or less in amount in order to be discriminatory; a difference in character of payment, such as the granting of privileges or concessions, may in itself give just such advantages as the act is designed to prevent." The holders of such special contracts may, the court indicates, seek restitution from the power company of any property rights given up in return.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Efficiency Insisted On.—The Indiana Public Service Commission has refused an application for increased rates made by the Rising Sun Water & Light Company because the utility failed to comply with orders of the commission with reference to improved service.

Small Plant Authorized to Discontinue Service.—The Illinois Public Utilities Commission has authorized discontinuance of service by the local utility in the village of Essex, where forty consumers and the municipality were formerly served, it being shown that the service, which had been furnished at pre-war rates, had already been discontinued on the expiration of a contract with the village, and no one making formal objection to the commission's approval of this discontinuance.

Jurisdiction of Arkansas Commission.—In granting an increase in electric rates to the Commonwealth Public Service Company of Fort Smith the Arkansas Corporation Commission announced its jurisdiction over the rates to be charged for electric service even where the property is in the hands of a receiver and pointed out that the regulation of rates by a commission, although these may be already fixed by a franchise with a municipality, does not cause an unconstitutional impairment of contract obligations.

Powers of Maine Commission.—The Maine Public Utilites Commission has, it asserts, no jurisdiction to refuse to approve a contract providing for the rendering of electric service to an applicant within certain territory where the contract is fair to both parties and no other company is authorized to do business in the territory in question, nor has it any authority to require or even advise one utility to purchase the property of another. The statutes of the state relating to monopoly are not enforceable through the commission, but only through the courts.

Good and Poor Territory.—The Public Service Commission of Washington holds that in fixing electric rates for a utility composed of an aggregate of widely separated power plants the economies of large production under common management and operation constitute a consideration of great weight. In determining the rate base for one community served by the Pacific Power & Light Company, which owns plants in both good and poor territory, the commission made an apportionment upon the basis of the demand in the different communities served.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Edward M. Graham, vice-president and general manager of the Bangor (Me.) Railway & Electric Company, was elected president on Feb. 9. When Mr. Graham in 1915 succeeded his



E. M. GRAHAM

father, the late John R. Graham, as the active operating head of the Bangor Railway & Electric Company, the Bangor Power Company, the Orono Water Company and the Bar Harbor & Union River Power Company, he was one of the youngest general managers to have charge of so extensive a property. The younger Mr. Graham gained his practical knowledge of railway and central-station management through an experience of several years under his father. He began his career with the Eastern Massachusetts Street Railway, at that time the Bay State Street Railway, which he served in various capacities. At the age of twenty-two years he was made superintendent of the Portland & Brunswick Street Railway and still later became assistant to the general manager of both the Lewiston, Augusta & Waterville Railway and the Cumberland County Power & Light Company, these being among the large public service corporations in Maine. Mr. Graham went to Bangor in 1913 as assistant to his father. He has been with the company there ever since. The companies of which he is now president and general manager operate electric railway lines in nine municipalities, in addition to providing sixteen cities and towns with light and power service.

John T. Kester has been appointed local superintendent of the Wabash Valley Electric Company, Sullivan, Ind., succeeding C. G. Hanna, who has accepted a position with the company at Clinton, Ind. Mr. Kester was formerly manager of the Noblesville (Ind.) Light, Heat & Power Company.

Dr. William McClellan, who was elected vice-president of the Cleveland Electric Illuminating Company nearly two years ago, has resigned that position to devote his time to his consulting practice. Dr. McClellan plans to take an extended vacation before entering upon active duties.

Jacob Hekma, secretary and treasurer of the Commonwealth Power, Railway & Light Company, Jackson, Mich., has been appointed vice-president of the company. G. H. Bourne, assistant secretary and assistant treasurer of the company, succeeds him as secretary, and George Sprague, Jr., has been appointed treasurer.

J. B. Crane, formerly with the Binghamton (N. Y.) Light, Heat & Power Company as construction superintendent, has become associated with the George T. Ladd Company at Pittsburgh. Mr. Crane in the past has been engaged in utility work with the Electric Bond & Share Company and the Great Northern Power Company of Duluth. He is widely known through the East and Middle West as a utility operator.

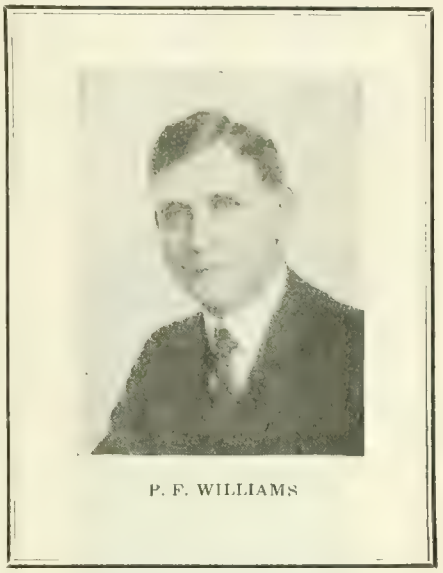
Major-General George O. Squier, Chief Signal Officer, U. S. A., has been



G. O. SQUIER

nominated by the President for reappointment. General Squier entered military service after his graduation from West Point in 1883 and has advanced by numerous promotions to his present post on account of his ability as an electrical engineer and officer.

Paul F. Williams, who has been selected to succeed H. B. Gear as engineer of distribution of the Commonwealth Edison Company, has been associated with its engineering work for twenty-three years. Mr. Williams was graduated from Purdue University in 1897 and upon leaving college received charge of the electrical construction work for a Wisconsin consulting engineer, part of this work being done in a branch office in Chicago. In 1898 he joined the staff of the Chicago Edison Company, the forerunner of the Commonwealth Edison Company, with which he has been connected ever since. His first position with the company



P. F. WILLIAMS

was in charge of interior-wiring inspection and distribution engineering in what is now the southern district of the Commonwealth Edison Company. He was brought into the general office of the company in 1900 as assistant to the general inspector. Upon reorganization and enlargement of the department in 1911 he was made assistant to engineer of distribution. Mr. Williams has taken out a number of patents on distribution apparatus. Based upon these patents, he created the G. & W. Electric Specialty Company, which he has successfully directed as president since its incorporation. Through this company's advertising and otherwise he was active last year in starting the "good-will" campaign as an aid to public utilities and electric manufacturers.

O. D. Mudgett, who for a number of years has been superintendent of the light and power division of the Androscoggin Electric Company, has received the same title and responsibilities under the new administration of the system at Lewiston, Me., from the Central Maine Power Company, George S. Williams of the latter company having succeeded F. D. Gordon as manager. Mr. Gordon is now general manager of the Cumberland County Power & Light Company, Portland, Me. Mr. Mudgett was assistant superintendent of the Lewiston & Auburn Electric Light Company from 1910 to 1914, when the Androscoggin company was formed, at which time Mr. Gordon became general

manager, Mr. Mudgett being appointed superintendent. Mr. Mudgett is a native of Gilmanton, N. H., and was graduated in electrical engineering from the New Hampshire State College. His early experience in electrical work was obtained at the Westinghouse factory in East Pittsburgh, Pa., and he was later attached to the Boston office of that company. He resigned to enter central-station work at Belfast, Me., in the organization of the Belfast Gas & Electric Company, now a part of the Central Maine Power Company's system.

G. E. Kimball, who has succeeded R. L. Eltringham as electrical engineer of the California Industrial Accident Commission, started his electrical experience in 1899 with the Queens Borough Electric Light & Power Company at Far Rockaway, Long Island, and in the shops of the Brooklyn Rapid Transit



G. E. KIMBALL

Company, Brooklyn, N. Y. In 1900 he was employed by the New Bedford and Fall River (Mass.) automatic telephone companies on line construction, telephone maintenance, telephone installation and as automatic exchange attendant. The exchanges in these two cities were the first automatic telephone exchanges of importance installed in this country. Entering the service of the Automatic Electric Company of Chicago in 1901, he was employed in the factory and the installation, engineering and experimental departments for a number of years. While in this service he was in charge of several large automatic telephone exchange installations. In 1910 he entered the service of the Bay Cities Home Telephone Company at San Francisco as superintendent of equipment and continued with that company until it was taken over and finally dismantled by the Pacific Telephone & Telegraph Company. Mr. Kimball remained in the plant department of the Pacific Telephone & Telegraph Company until 1917, when he became associated with the California State Industrial Accident Commission in the department of safety as state electrical inspector. He has been active in the administration of the general safety orders, electrical utilization safety orders and general lighting safety orders of this commission and in the formulation of the revised rules.

W. J. Hazel of the New York office of Robbins & Myers, Springfield, Ohio, has been transferred to the Canadian office of the company at Brantford, Ontario, where he will take up the duties of sales manager.

Charles Stirling, formerly assistant to W. J. Myers of the Robbins & Myers Company, Springfield, Ohio, has been appointed assistant manager of the Robbins & Myers Canadian factory at Brantford, Ontario.

W. W. Turner, who has been connected with the Chicago district office of the Elliott Company, Jeannette, Pa., has been appointed Chicago district manager to succeed C. L. Brown, who has been appointed sales manager of the company.

A. A. Hutchinson has been appointed manager of the Atlanta (Ga.) branch of the Combustion Engineering Corporation, 11 Broadway, New York City. Mr. Hutchinson was formerly with the Potomac Electric Power Company as construction engineer and superintendent underground testing department.

J. Allan Smith, president of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., manufacturer of storage batteries, car-lighting equipment and electric arc welders, has resigned to engage in business for himself. C. O. Miniger, vice-president of the Willys Corporation and general manager of the "Auto-Lite" division of that corporation at Toledo, Ohio, has been appointed to succeed Mr. Smith.

H. L. Ball, who has been appointed sales manager of the Requa Electrical Supply Company at Rochester, N. Y., is well known in the jobbing field. For the last three years Mr. Ball has been with the Rochester Electric Supply Company as sales manager, and previous to that he was with the Westinghouse Electric & Manufacturing Company in a sales and engineering capacity.

J. L. Finnicum, who has been made sales manager of the Thordarson Electric Manufacturing Company, Chicago, was formerly connected with the Doubleday-Hill Electric Company at Pittsburgh for more than eight years in the capacity of salesman and in charge of the apparatus department. For the last two years he has been acting as district manager at Chicago for the Electric Products Company, Cleveland.

Allen A. Ransom, who has held the position of export sales engineer of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., has resigned to become associated with the Olympia (Wash.) Light & Power Company as general superintendent. He will also reopen his office as consulting electrical engineer for the Northwest and Alaska, specializing on hydro-electric and transmission projects, mining, dredging and irrigation work.

Fred A. Scheffler, who was elected president of the Edison Pioneers at its annual meeting on Feb. 11 at the home of Thomas A. Edison, is a well-known pioneer of the electrical industry. He became associated with Edison in 1881 and as engineer designed for him the second electric locomotive built for experimental purposes at Menlo Park, N. J. Later Mr. Scheffler held such important positions as those of general superintendent of the Westinghouse Electric & Manufacturing Company's works at East Pittsburgh, general superintendent of the Brush Electric Company, Cleveland, and manager of the Sprague Electric Company's factory, Watsessing, N. J. Mr. Scheffler was also connected with the introduction of the Stirling type of boiler manu-



F. A. SCHEFFLER

factured by the Babcock & Wilcox Company. He is now general manager of the Fuller Engineering Company in New York City. He has the rank of fellow in the American Institute of Electrical Engineers and is a member of the American Society of Mechanical Engineers and the Engineers' Club, New York.

Obituary

Oliver Wolcott, for about ten years past superintendent of the Worcester Suburban Electric Company, with headquarters at Uxbridge, Mass., died suddenly on Feb. 7.

James C. Legg, a member of the Public Service Commission of Maryland and former president of the Baltimore Chamber of Commerce, died Feb. 1 in Baltimore from pneumonia.

Charles N. Wurth, an electrical associate of Thomas A. Edison for about forty years, died recently at his home in Orange, N. J. He was born in Switzerland in 1811.

Trade and Market Conditions

Business Reviews, Together with Market Letters
from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Competition, Not the Inauguration, Will Fetch the Business

BEFORE another week shall have gone by a new administration will have been installed at Washington. It is difficult to conceive, however, how this could greatly affect the present business situation as some have expected. Four months ago it was known that the nation would undergo a change in the politics of its administration, and there has been plenty of time for this certain event to be discounted.

As a matter of fact, it is clearly evident that the old law of supply and demand is still in control. The new administration will undoubtedly inspire in business a certain confidence that no detrimental legislation will be enacted, but more than that is needed to make business healthy again. Generally speaking, business has been better in February than it was in January, and March will probably show a similar improvement over February, and so on until business once more becomes satisfactory. In the meantime everything is being done, in some cases more or less hastily, to bring down costs. Wages are still coming down, and, as was to be expected, individual productivity is increasing.

Signs of competition are becoming more frequent. There has not been enough competition, however, to make it an asset to business. There is still too much sitting back waiting for the storm of depression to blow over. Good, strong, honest competition for orders would undoubtedly stir up a whole lot of trade.

Business is more or less like a boxer in its nature. For five years it has lived on the fat of the land and taken no exercise; it has grown fat and pudgy. Business must now go out and fight for a living once more. It therefore must train, and the exercise is called competition.

There is a lot of business to be done before many months are gone. This business will not come of itself to the manufacturer or jobber. He must go find it.

Outlook for Early Steel Revival Not Favorable

STEEL and iron, two of the fundamental factors in this nation's industry, were discussed before the Editorial Conference in New York on Feb. 18 by A. I. Findley, editor of *Iron Age*. In his address, Mr. Findley said in part:

"What is certain is that the steel trade is today in a depressed state and that those who in November looked for a moderate revival in the spring of 1921 are now setting the date for any marked improvement some months further on in the year. There is a growing belief that present conditions in the United States are due more than we were willing to believe last year to the financial and industrial straits of Europe. As never before, leaders in industry and finance in this country see that we are linked up with the rest of the world for better or worse.

"In view of its basic character, developments in the steel trade are important as an index to what is to be expected in 1921. Today there is about two-thirds operation of iron and steel works, with the possibility that with the coming of spring a temporary spurt in demand may bring the percentage up to 75. It has been found in other times of depression that wear and tear alone is good for about a 60 per cent operation in iron and steel.

"The outlook for an early and extensive revival of demand for iron and steel is not favorable. The fall in prices of agricultural products, which already represents a loss of $4,000,000,000 to the farming community, has reduced very much the demand for agricultural improvements. The railroads, which in average times take from 20 to 25 per cent of the steel output, are buying little. Rails and track accessories have been in best demand in the forms of steel which go to railroads. Until the railroads are freed from the stranglehold of the wasteful labor scheme imposed on them by the government they will not be free buyers of equipment. Today they have many idle cars with no early prospect of full use of their equipment.

"That the country is much underbuilt has been said over and over in the past two years. The automobile building program for 1921 can hardly be more than 40 per cent of that for 1920. The automobile industry has probably not taken more than 5 or 6 per cent of the country's steel output on the average, but its ramifications into various metal-working and machinery lines are such that it has been a very important sustaining factor. Shipbuilding demand for steel in 1921 is likely to be considerably less than in 1920. Mining, whether of coal, iron or non-ferrous minerals, will be restricted in 1921. So far as iron, copper and other metals are concerned, operations of the mines this year can hardly go beyond 60 or 70 per cent of last year.

"The most favorable indication industrially for the present year is the evidence of a return to economic production methods. It will be a good thing for producers to learn again how to sell their products."

Fixture Manufacturers Act to Stop Design Piracy

MUCH attention has been given in the past year or two by the fixture manufacturers to the question of design piracy in the lighting fixture field. The practice has become so objectionable that the National Council of Lighting Fixture Manufacturers, in convention at Buffalo last week, passed a resolution in an endeavor to curb it and finally eliminate it.

A committee of this council prepared a set of resolutions which, with three additions, was adopted by the council for incorporation in the bylaws of the council. Without reproducing the form of the resolution here, it provides for the appointment of a board of conciliation empowered by the council to review and pass upon all questions of piracy and to impose such penalties as it deems justified. Its action is considered final except that recourse may be had to the courts.

Where the controversy is purely local it may be handled by a local arbitration committee, from which appeal to the national council may be made. All opportunity is given to both parties to present witnesses and evidence, but failure to answer the complaint within a specified time brings the conclusion that the charges of the complaint are justified.

In all cases the cost of arbitration shall be borne by the party against whom the judges decide. The penalties to be imposed shall be (a) reprimand and demand for apology, (b) suspension from the association, (c) suspension of rights such as the right to exhibit at the annual fixture show, etc., (d) expulsion from the association, (e) publishing the decisions of the board in the *Lighting Rays*, etc., (f) cost fine, (g) disposition or destruction of infringing parts of fixtures, patterns, molds, etc., of the offending party.

Recommendation is made that there will be an attempt to settle personally any difference that may appear when a manufacturer believes he has a case of piracy against any other member of the association.

The council believes it should take an active part in any attempts to protect designs of its members and stop infringement. Of course, all patentable designs could be patented, but the cost would be enormous, and the cost necessary to protect them would also be enormous. At the same time, it is thought that questions of design patent can be discussed and judged more accurately by members of the council than by the legal courts.

Industrial Reflector Sales Expected to Increase

SALES of industrial reflectors show considerable falling off when compared with a few months ago, but at the same time a fairly good current volume of business is being done by many of the large manufacturers, according to reports received from them. This demand does not come from new buildings, for construction work is still at a low ebb over the country, but from existing plants that are revamping their old lighting equipment and installing up-to-date systems. One of the most recent developments in industrial lighting is a luminous-top reflector having a neck of opalescent glass, for use in locations which demand that a portion of the light be directed upward.

Excellent prospects for a good year's business are seen by nearly all manufacturers. Growing interest in better lighting, campaigns of education to teach the benefits of efficient illumination, and a resumption of building work along with general trade are all expected to contribute to this end. Just when a noticeable increase in sales may be looked for is uncertain, but producers for the most part anticipate an increasing demand some time between the first of March and the first of April.

Prices remain stationary, and there is virtually no possibility of any decrease being made, it is said, at least during the present lighting season. About the only item in the manufacture of reflectors which now costs less is that of steel, and this represents a very small proportion of the finished-product cost. Some manufacturers will even be working on high-priced stocks of steel until first-quarter shipments of this material are made about the middle of March.

Production is going right ahead in several instances in an endeavor to accumulate surplus stocks. The reserve supply now on hand at factories and distribution points is sufficient to insure prompt deliveries, shipments of most types being made either from stock or close to it. On the other hand, reserve stocks are not very large because raw material previously held back production to such an extent that orders fell far behind. These orders have only just recently been caught up with.

Bright Prospects for Farm-Lighting Plant Sales

MANUFACTURERS of farm-lighting plants see only good prospects for sales in the year to come. Optimism is widespread regarding future business, and the view is generally heard that 1921 will be a better year than 1920. The basis for this opinion is not the present market, however, as demand has been on the decline for some months, though there is still a fairly good current amount of new business.

Farmers in the West and the South have been especially hard hit in their buying power because of the price slump in cotton, tobacco and wheat and the necessity of carrying loans on their products. This condition should improve, it is said, but even at present, although it is harder, it is by no means impossible to make sales in those sections. Vigorous sales methods and campaigns of education are being planned by some producers to push their product in the spring.

In preparation for this producers are generally manufacturing plants for stock. As a consequence immediate delivery is quoted on present orders, though reserve stocks on hand are as yet only fair. Price reductions have been made by several manufacturers. The price sheet of one producer, dated Feb. 15, quotes reductions which range from 12 to 27 per cent, covering seven different plants. The new prices are guaranteed against a reduction until July 1. Another producer announces that a general price cut of 10 per cent will be made on March 1, while a third has only lowered quotations on two types, and that but a very small amount, such as $10 on a six-hundred-dollar power plant. Not all manufacturers have reduced prices, however. One of the largest makers of this product has not altered quotations and so far as can be learned has no intention of doing so, inasmuch as costs, including labor, are said to be no lower.

No Blanket Action Against Price Guaranteeing

THE Federal Trade Commission on Feb. 15 announced that it intends no blanket action against the practice of guaranteeing against price decline, but will consider each complaint upon the facts shown in the specific case. Any blanket order would have had considerable effect on many electrical manufacturers. The announcement says:

"The commission received so many complaints about the practice of manufacturers in guaranteeing commodities in the hands of wholesalers against decline in price that an extensive inquiry was made, resulting in expressions from more than 350 manufacturing and selling concerns, including trade associations whose represented membership must be more than double the number of individual statements. From the scope of the inquiry and the number and variety of replies, the result shown must be taken to be fairly representative of the difference in business opinion on this subject.

"The Federal Trade Commission, therefore, will consider each case of complaint of this character upon the facts shown in the specific case, applying the legal tests thereto. This action involves neither approval nor disapproval of the economic soundness of the arguments advanced before the commission for and against this practice."

The Metal Market Situation

LARGE copper producers claim to be holding to their price of 13 cents delivered, but this quotation is entirely nominal and probably adhered to for the moral effect which a substantial price drop would have upon the marketing of the $40,000,000 bond issue recently placed. Sales have been made under 13 cents, however, as low a price as 12.50 cents being taken this week. Consumers are showing little or no interest in buying. The outside market remains stagnant too, and foreign buying, which had taken a slight turn for the better recently, especially from Germany, has turned very weak. Premiums of about ⅛ cent per month are asked for forward delivery.

The price of lead has again been reduced by the leading interest, this time to 4.40 cents per pound. Demand continues light, though some sales have been made on the decline. Zinc presents a listless market, spot declining a fraction of a cent the past week.

NEW YORK METAL MARKET PRICES

	—Feb 14 1921—	—Feb 21 1921—
Copper	£ s d	£ s d
London, standard spot	71 0 0	72 5 0
	Cents per Pound	Cents per Pound
Prime Lake	13 50	13.25
Electrolytic	13 00 13 25	12 50 12 75
Casting	12 50	12 37½
Wire base	15 75	15 75
Lead, trust price	4 75	4 40
Antimony	5 25	5 20
Nickel, ingot	43 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 37½	5 30
Tin	33 50	32.50
Aluminum, 98 to 99 per cent	28 00	23 50-24.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	11 00-11 25	10 75-11.25
Brass, heavy	6 00 6 50	7 00- 7 50
Brass, light	4 00- 4 50	4 00- 4 50
Lead, heavy	4 00- 4.12½	3.75- 4.00
Zinc, old scrap	3 00- 3.25	3 00- 3 25

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE return to better conditions in the jobbing trade seems to be holding its own with no noticeable spurts noted. Buying is quiet from jobbers, while they on their part are only keeping up to the trade's demands in respect to their own buying.

More important price cuts have been announced this week, taking in fans, farm-lighting plants and further copper, motor and controller parts and armature and field coils. Shipments are likely to be delayed somewhat by the snowstorm of Feb. 20, which was quite general throughout the East.

Wage reductions are becoming more general and are causing little difficulty. Among the recent companies affected is the Westinghouse Electric & Manufacturing Company, in Pittsburgh, where a 15 per cent reduction will go into effect March 1.

NEW YORK

The optimistic tone to trade persists despite the fact that business comes only by fits and starts. Some jobbers, however, report slightly better sales all along the line. A few can detect no improvement, and still others state that the market is not consistent, but picks up one week only to decline the next. A general return of building construction work seems to be badly needed to provide a stimulus to wiring lines. This as yet remains lacking. Demand for heating appliances is poor and overstocks are frequent.

Jobbers are ordering goods only for replacement of current stock, and a thirty-day supply seems to be the most that is willingly carried on staple lines. Competition is very keen, and consumers who shop diligently are generally able to obtain shaded prices. Prices remained steady this week on most items so far as manufacturers are concerned. Collections still range about sixty days, but one or two jobbers report quite a decided improvement in the situation.

Flexible Armored Conductor.—Some improvement is noted in the slow market, though not a general one. Stocks are down to fairly low levels. From $60 to $66 per 1,000 ft. is asked for No. 14, two-wire, double-strip.

Metal Molding.—Demand seems to be very light, while the supply is plentiful. The three-wire and four-wire size brings from $67 to $70 per 1,000 ft.

Safety Switches.—Jobbers are carrying only a limited number in stock as the call is not large.

Conduit.—Stocks are more than ample for demand, which is light on the whole, though fairly good in a few instances. In 2,500-ft. quantities ½-in black is selling for from $70 to $76.50 this week and ¾-in. black from $92 to $101 per 1,000 ft.

Rubber-Covered Wire.—Some jobbers are making fairly good sales to industrials in small lots, but total demand is not great. Overstocks are still reported. No. 14 is sold as low as $7.50 and up to $9 per 1,000 ft. in 10,000-ft. lots.

Fuses.—The market for fuses is rather quiet now, and though normal stocks are on hand sales are slow. On the standard N. E. C. non-renewable type, 250 volt, 30 amp., jobbers are quoting from 10 to 11 cents each in standard-package quantities, though prices as high as 14 cents have been asked in one or two cases.

Porcelain.—There are plenty of knobs, tubes and cleats to be had, but sales are slow. In barrel lots "Nail-it" knobs are priced from $27 to $32 per 1,000, 3-in. x ⅝-in. tubes at $9.65 to $13.75, and two-wire unglazed cleats all the way from $21 to $34.

Schedule Material.—The market is quiet in this line, and jobbers are freely interchanging stocks to reduce surplus supplies which exist in many cases. These overstocks are growing less, but it will be some time before buying is other than hand-to-mouth.

Heaters.—The winter has been a poor one for sales, and jobbers with low stocks congratulate themselves. Overstocks are numerous, as many as 2,500 heaters being carried by one jobber. Price cuts have been made, especially in the retail trade, some dealers offering standard makes under $9.

Fans.—A reduction in price of 10 per cent has been applied on fans—portable, ceiling and exhaust—by several manufacturers effective early this week.

CHICAGO

Sluggishness throughout the entire industry continues to be the dominant feature. This is true of practically all lines in this region, although the industrial depression seems to be less marked here than in other sections. Electrical stocks are being permitted to run low, jobbers being content with a thirty-day supply of most items, while retailers and contractors are refusing to order until the bottom of the bin is in sight. Recent cuts in a broad range of electrical goods have actually worked to accentuate this disposition, as all hands seem determined to avoid any loss on stocks should further reduction occur.

The building situation shows promise of improvement. Last week a permit was taken out for the new seven-and-a-half-million-dollar Federal Reserve Bank, and in addition $1,000,000 worth of small jobs was initiated. Special loan offers are being made by banks, and various co-operative schemes are being planned. Non-employment remains a feature. Many men are out of work and wage scales are being reduced. Employment in the building trades is reported as aggregating less than 50 per cent of normal.

Bare Copper Wire.—Leading jobbers quote all sizes up to No. 8, in small quantities, at 18½ cents per pound. Carload lots are quoted over quite a range, $16.50 being a representative figure.

Insulated Wire.—Uncertainty prevails in prices on all items in which copper enters very largely. Weatherproof, triple-braid, No. 8, in lots of 500 lb., is quoted at $20.50 per 100 lb.; No. 6 at $20. No. 14 rubber-covered in 10,000-ft. lots is $7.85 per 1,000 ft. Flexible armored conductor, two-wire, No. 14, is priced at $62 per 1,000 ft., in 5,000-ft. lots or larger. Sales are quite lively, and some price cutting is indulged in.

Black Conduit.—The market is quiet, prospective buyers apparently being uncertain as to the future price trend.

Poles.—In spite of general reductions in the electrical field and in the wood-products field, prices are held firm. Opinions differ, producers saying that short season and long haul have completely offset the saving effected by lower-priced labor and slight weather interference.

Line Hardware.—A leading interest announces an additional 7½ per cent cut on all items on the list. No heavy buying is in evidence. It seems possible that prospective buyers are holding off to such an extent as to endanger their own welfare.

Insulators.—Prices on both glass and porcelain insulators are firm and unchanged. Stock conditions on small sizes are improving, but large sizes remain hard to get, four to five months still being the best delivery obtainable.

Power Apparatus.—Manufacturers and jobbers state that business has been so quiet for the past six weeks that it is hard to tell whether or not the recent 10 per cent price reduction has had any effect on the trade. Inquiries are scarce and orders more so. Small dealers continue to shade prices.

Control Apparatus.—Previously mentioned cuts in certain items have not become general. Those lines which have reduced prices report no change in the condition of business—inquiries fairly plentiful but orders scarce.

BOSTON

Little change appeared at the beginning of the week in trade conditions in New England. Inquiries are coming into jobbers' offices in somewhat greater volume, while actual sales are spotty and largely confined to orders for immediate necessities. Stocks are being liquidated to a point where real shortages are beginning to appear in some cases, one of the prominent Boston jobbers being cleaned out of certain wiring supplies at the end of the week. It is not difficult for buyers, however, to get material, with the exception of porcelain insulators and meters. Prices held pretty firmly throughout the week past between manufacturers and jobbers, but unstable conditions are evident in the retail trade, prices being based mainly on the size of local stocks. Collections are responding to vigorous follow-up efforts. Building and engineering contracts for the week ended Feb. 15 in New England totaled $1,387,300. The Boston building strike continues to impede progress in local wiring jobs and to reduce the sale of wiring supplies.

Rubber-Covered Wire.—Good stocks are in hand, and in order to move this material a reduction to $8 per 1,000 is being made on 5,000-ft. lots. This is increasing the size of orders, in view of the existing opinion that wire is unlikely to go much lower at present.

Insulators.—Inquiries are active and an early increase in buying is forecast. Deliveries are running long, a representative distributer quoting six to seven months on new orders. Foreign shipments are absorbing a considerable output of the later designs of high-tension material. Emergency requirements are being met on this side, but stocks are very low and prices are reported firm.

Flexible Armored Conductor.—Good-sized stocks are still on hand in many warehouses, although these are gradually being lowered. No. 14 double strip sold at $63 to $65 at the week end.

Lamps.—A healthy trade is being handled with excellent deliveries. Portable lamps are moving rather slowly, accompanied by price variations in retail quarters. Sign and window display lighting is active, and the development of new applications of low-powered illumination continues to expand the market for lamps of small size.

Washers.—Sales are continuing at a fair rate. Deliveries are prompt and jobbers are paying close attention to service.

Vacuum Cleaners.—Liberal stocks are in sight in both wholesale and retail establishments. Prices vary widely in the latter between different makes of cleaners, and conditions cannot truthfully be called stable as yet. The public is responding somewhat to vigorous personal sales efforts.

Irons.—Fair sales are being made, but buying is not up to normal.

Radiators.—Protracted mild weather for this season, a leading agent predicts, will result in large spring sales. Interest has been sustained in these devices throughout most of the winter. Prices held firm to the week end.

ATLANTA

The little spurt in jobbing activities reported last week seems to have spent itself, and firms report business for the past week rather slow, though there has been some activity in certain lines. Nevertheless, the underlying opinion is that the business outlook continues to improve. Official figures recently announced give the value of crops in the eight Southeastern states at approximately $2,000,000,000, serving to indicate that there is plenty of wealth in the section and that activities are only awaiting the willingness of the country to take some of the products on hand. The Federal International Banking Company went into operation the first of last week and announces that its total loan facilities of $17,500,000 have already be absorbed on goods destined for export.

Jobbers report the receipt of a fair number of inquiries for moderately heavy bills on goods, most of the inquiries coming, however, from industrial plants scattered throughout the section. Central stations and municipalities are also making inquiries for small lots, but contractors are buying on a hand-to-mouth basis. Collections continue rather unsatisfactory, especially from contractor and automobile classes.

Poles.—The movement of poles has materially slowed down in the past two weeks, and few orders are being received. Southern white cedar poles seem to be more in demand than heretofore owing to their low price. Stocks are heavy and no difficulty is being experienced in obtaining cars.

Conduit.—Conduit is moving rather slowly, though fair orders are reported from time to time. Stocks of galvanized show a shortage in 1-in. and 1¼-in. sizes. Stocks of black are somewhat spotty.

Industrial Lighting.—This line is fairly active, the more stable industrial plants having indicated their intention to improve their lighting facilities. An expectation of price reductions, however, is tending to hold up buying by consumers. Stocks are in splendid shape.

Flexible Armored Conductor.—The desire to cheapen construction as much as possible has created a demand for this material, and all jobbers report their sales as fairly good. Stocks are in good shape and shipments are good. Price, two-wire, No. 14, single-strip, $72 per 1,000 ft.

Heating Appliances.—There are very heavy supplies of heating appliances throughout the section, stocks of flat-irons being particularly large. Little or no movement is reported in this line, with the exception of irons, hollow ware being very slow indeed.

Lightning Arresters.—Manufacturers report a fairly active demand for high-tension arresters. Shipments are running from thirty to sixty days.

Meters.—For the first time in several months the jobbers and manufacturers' agents have been able to accumulate small stocks of watt-hour meters in the more popular sizes. While the largest jobbers report the volume of orders about 30 per cent below that of last year, they expect a revival in this line within the next sixty days. Shipments on two-wire and three-wire, 5 amp. and 10 amp., in the 110/220-volt type, are averaging about two weeks.

ST. LOUIS

Sales continue fairly strong and, judging by the average maintained during the past two weeks, February will run ahead of January in orders billed. Orders, it is true, are mostly small, but it is noticed that numbers of industrials which have been out of the market for some months are re-entering it again.

Non-employment is becoming less general. Several steel plants in the St. Louis industrial district have reopened within the last few days on a part-time basis. Automobile plants are augmenting production, encouraged by the success of the automobile show held in the first part of February. The peak of the non-employment situation is thought to be past and labor costs have dropped in most instances. Wages of the building trades are still high, though efforts are being made to lower the scales in force. It is agreed that this would give reality to a large number of building projects now only on paper.

Stocks of electrical supply houses are becoming less top-heavy and are down to normal on a number of items. Prices are holding well in most lines, but concessions on porcelain are very noticeable and are having a demoralizing effect. Collections are becoming better, one large jobber reporting an average of fifty days, while the general average is close to sixty days.

Non-Metallic Flexible Conduit.—Quotations vary, but the average would seem to be around $22 per 1,000 ft. of ¾-in. conduit and $25 per 1,000 ft. of the ½-in. size. Sales are light, but jobbers have not been ordering recently and the steady though slow demand has brought stocks close to normal.

Insulators.—Stocks are good on all but the largest sizes of porcelain insulators, and deliveries can be made out of stock except on the latter, delivery on which is being promised in five to six weeks. One large jobber has on hand a three to four months' stock of porcelain insulators under the 66,000-volt size. Supplies of glass insulators are ample to take care of demand, which is running along well.

Rigid Conduit.—The demand for the ½-in. and the ¾-in. black iron conduit has increased noticeably during the past

week, before which sales had been almost negligible. Stocks of all sizes are good, those of the larger sizes being heavy. Prices are firm. The ½-in. black is quoted at $77 per 1,000 ft., and ¾-in. at $102, and the 1-in. at $150, all in lots of 5,000 ft.

Rubber-Covered Wire.—A fair demand has continued during the past week, though orders are individually small. Stocks are getting down to normal in the popular sizes. Prices have not changed, No. 14 being quoted around $8 per 1,000 ft., in 5,000-ft. lots.

Lamps.—There has been no drop in sales, which have been good all through the winter. Stocks are complete and conditions in general, as far as the distributors are concerned, have been normal.

Motors.—Orders are slow. Manufacturers have about caught up on all back orders and can ship most sizes out of stock or make normal deliveries on special sizes and types. Supplies of fractional-horsepower motors are ample to take care of all demand. Prices are on a level about 10 per cent lower than they were in January.

Dry Cells.—Demand continues fair with stocks easily capable of taking care of it. Prices are firm, the No. 6 cell being quoted at $36 per 100 in barrel lots.

Hollow Ware.—Jobbers report steady sales after a slump which prevailed during the first half of January. The remainder of that month brought good sales, and February sales will show an increase. Stocks are generally good. Retailers are fairly well supplied but are ordering from jobbers in good quantities.

SAN FRANCISCO

The prevailing note is more optimistic. Building is a little better and the buying public is in a more reasonable state, there being less talk current about awaiting slashing reductions.

Motors.—Excellent deliveries are now being made on motors for the first time in several years. This has produced rather high jobbers' stocks, but the sales are good. Many farmers have postponed the purchase of pumping plants, and the heavy rainfall which will naturally cause a decrease in orders for motors is more than compensated for by power extension, especially in the San Joaquin Valley.

Vacuum Cleaners.—The prices on vacuum cleaners have remained steady. Canvassing is providing the bulk of the present sales, but local stocks are high and business is much quieter than at this time last year.

Schedule Material.—Local manufacturers' stocks are good but not excessive. Orders from jobbers and dealers alike are numerous but of minimum quantities. However, some manufacturers are even now placing big orders in expectation of a forthcoming break in the present small-order hand-to-mouth conditions. Heavy porcelain pieces, such as panel switches and cut-outs, are of slow factory delivery because the producing pottery factories are being reorganized and are apparently suffering from underproduction. Some manufacturers are also reporting a temporary shortage of porcelain key sockets.

Heating Material.—Strenuous selling efforts are producing a better demand for flatirons and small stoves, but jobbers' orders for other devices, especially hollow ware, are very low because of heavy stocks carried forward. Sales of radiators are tapering off rapidly toward the close of the cold season. Especially noticeable are the recent efforts of dealers to maintain well assorted and arranged stocks of heating-piece parts.

Weatherproof Wire.—Weatherproof base sizes in triple-braid are now being quoted at 22½ cents per pound.

Tape.—In looking over jobbers' tape stocks it is found that they are fairly heavy, although they would have been more so had not the size of the factory orders been reduced, because dealers are buying in smaller lots. Construction is decreasing, and for the next month or so at least it is felt that it would be unwise to purchase heavily. This drop in demand figures from 20 to 30 per cent in friction tape. Rubber-tape stocks, however, are rather low.

SEATTLE—PORTLAND

With the exception of a slight increase in sales of schedule material, tape, wiring devices and other material used in building construction, conditions in the Puget Sound district and in Portland show no particular change. Stock conditions are improving and prices, with the exception of wire, tape, etc., are holding. Logging camps and lumber mills are reopening slowly, but the major portion are operating on only a three-day week. It is believed this condition will obtain for at least thirty days. Surplus labor is being absorbed very slowly and the non-employment situation is still very acute.

Manufacturers and jobbers report that there is no improvement in business. There is a report that buying is very short and that customers who formerly bought in standard-package lots are now buying in unit-package quantities. Those who formerly bought unit packages are now buying broken-package assortments; showing a determination to buy only for actual present needs. Jobbers' stocks are naturally getting into excellent shape. About the only thing that is appreciably short, especially in the Portland district, is certain sizes of galvanized conduit.

Generally speaking, the credit situation in both Seattle and Portland is unchanged and money is not yet free. Warehouses are still full of last year's salmon pack because of lack of demand at what is considered desirable prices. For the same reason the fruit packers in eastern Washington and the Willamette Valley are still holding the 1920 crops. The farmers in these sections are also holding their wheat and other grains. Warehouses are full of wool with no market, and there is little demand for lumber. This naturally means an enormous amount of money tied up in commodities which are not moving and until some of these move appreciably much improvement cannot be expected in the way of obtaining ready money for financing new projects.

Tape.—Stocks are normal, and there is plenty on hand to meet current demand. No difficulty is being experienced in securing replenishments. During the past month demand has picked up appreciably, and from present indications, with increasing activity in new construction, it will continue on the increase. Friction tape, ¾-in., as well as certain special sizes, has dropped several times since the first of the year, and further reductions would not be unexpected.

Ranges.—Demand continues falling off, and from present indications this spring's demand will be far less than for several years past. Stocks are in good shape, but prices are considered too high, coupled with heavy installation charges.

SALT LAKE CITY—DENVER

One of the outstanding features of the business situation in the Intermountain region is the demand for loans in large and small amounts. It is taken as an indication that trade will hit a swinging stride as soon as the credit condition has sufficiently eased. Banks are still ultra-conservative in granting loans for any except the most promising projects. A mild open winter has decreased the demand for money on the part of sheep and stock men. Operating expense has been materially cut down and the request for credit reduced accordingly. The banks have thus been in a position to take better care of all who use credit. The investment market is showing a healthy increase in activity, with a steadily growing demand for high grade securities. The sugar situation, which has been passing through a critical period, shows marked improvement. The tendency of the federal government to favor protective tariffs has created a decidedly better morale among beet growers. Many sawmills that have been closed down for months are reported resuming operations, an indication that owners are confident that building and construction work will be revived in the near future. Building material prices continue on the downward trend.

Washers.—The demand is showing a steady improvement. Dealers are preparing for the annual spring drive and are stocking. Manufacturers are in a position to keep their jobbers amply supplied.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Westinghouse Takes Agency for Electric Furnaces

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces that it has been appointed exclusive sales agent in the United States, its possessions and Canada for the line of industrial type "Hevi-duty" electric furnaces manufactured by the Electric Heating Apparatus Company, 123 Sussex Avenue, Newark, N. J. The standard heavy-duty industrial furnaces include twelve different sizes from 18 in. wide, 24 in. long, 13½ in. high, inside dimensions, capacity 22 kw., up to 32 in. wide, 72 in. long, 16 in. high, capacity 80 kw. Either automatic or non-automatic temperature control is supplied.

Year's Fuse Tests Run Into Big Numbers

During the past year short-circuit tests on 6,795 cartridge-inclosed fuses were made by the Underwriters' Laboratories, Inc., at its New York City station, according to its January *Laboratories Data*. This number was evenly divided between 250-volt and 600-volt fuses, but approximately twice as many renewable as non-renewable fuses were tested. As high as 566 were tested in a single day. A large number were also tested at Chicago.

Follansbee Brothers Company Issues $4,000,000 Bonds

A new issue of $4,000,000 of first mortgage, twenty-year, 7 per cent sinking-fund gold bonds, dated March 1, 1921, is being offered by Follansbee Brothers Company, Pittsburgh, Pa. Electrical sheet steel is one of the company's products. The proceeds of this issue, together with an additional $1,000,000 realized from the proposed sale of $1,000,000 par value of common stock, will be used to retire an issue of $1,500,000 cumulative preferred stock, to complete the manufacturing plant at Toronto, Ohio, and to provide additional working capital. The issue is in denominations of $1,000.

Officials of the Arrow Electric Hold Banquet

The Arrow Club, composed of the officers and heads of the departments of the Arrow Electric Company, Hartford, Conn., held a banquet on Feb. 1, at the factory. The gathering was a success not only from the standpoint of entertainment but also because of the spirit of optimism which prevailed.



ARROW ELECTRIC DEPARTMENT HEADS AND OFFICERS MEET

Northern White Cedar Association Elects Officers

At the twenty-fifth annual meeting of the Northern White Cedar Association at Minneapolis on Feb. 8 and 9 Benjamin Finch of Duluth was elected president, W. B. Thomas of Manistique, Mich., vice-president, and H. F. Partridge of Minneapolis treasurer. M. H. Schussler and W. C. Meader of Minneapolis were appointed directors to serve two years.

Ryan Company to Specialize in Electrolytic Work

F. J. Ryan & Company, Franklin Trust Building, Philadelphia, specialist in electric heating problems in both the chemical and metallurgical industry, announces the appointment of departmental executives: S. H. Ourbacker, director of engineering; F. A. Hall, director of sales, and T. B. Bechtal, director of construction. From this time on the new organization will specialize exclusively in electrometallurgy and electrochemistry. Departments for the manufacture of its own low-temperature ovens have been added and structural and machine divisions created through associations with Philadelphia shops. The company has recently opened a New York office at 21 East Fortieth Street under the direction of E. C. Melby, who will have supervision over the New York district and export field.

Jefferson Glass Erects New Gas Producers

During the past twelve months the Jefferson Glass Company, Follansbee, W. Va., has greatly enlarged its factory space and has also improved factory conditions by the erection of new gas producers and muffled lehrs, which, according to C. H. Blumenauer, president, will not only improve the quality of the company's products but also effect a relief from the results of natural-gas shortage during the winter.

Note Issue to Finance Copper for Foreign Market

The Copper Export Association, Inc., has issued $40,000,000 in one, two, three and four-year 8 per cent secured gold notes in denomination of $1,000. These are secured by 400,000,000 lb. of refined copper, and the sums required for payment of principal and interest, it is reported, will be guaranteed by seventeen of the leading copper producers in this country. The Guaranty Trust Company of New York is trustee. All of this copper, it is announced, has been purchased by the Copper Export Association, Inc., for resale in foreign markets, from these seventeen companies: Anaconda Copper Mining, Calumet & Hecla Mining, United Verde Copper, Chile Exploration, American Smelting & Refining, Inspiration Consolidated Copper, Greene-Cananea Copper, Braden Copper Mines, Utah Copper, Ray Consolidated Copper, Chino Copper, Nevada Consolidated Copper, New Cornelia Copper, North Butte Mining, Utah Consolidated Mining Company and the Phelps Dodge and Kennecott Copper corporations.

Woodworking Machinery Maker Enters Motor Field

The S. A. Woods Machine Company, Boston, for years manufacturer of the "planers of woods," has added a motor department and developed a line of 5-hp. general-purpose induction motors —squirrel-cage, polyphase, double-rated, semi-inclosed, with 40-deg. ratings. This department is in operation now and will soon be in position to manufacture on a large-scale basis.

Toledo Crane Company Enlarging Plant

The Toledo Crane Company, Bucyrus, Ohio, successor to the Toledo Bridge & Crane Company, Toledo, manufacturer of "Toledo Cranes," has been chartered under the laws of Ohio. The company is now constructing and expects to have completed by March 15 a building, 120 ft. x 320 ft., to be used for erecting and assembly purposes; machine shop, 60 ft. x 300 ft.; structural shop, 90 ft. x 300 ft.; pattern shop, 60 ft. x 140 ft., all equipped with modern tools and arranged for continuous production, which

will enable it to maintain former standards of quality and service established for "Toledo" cranes. The main office of the company will be at Bucyrus, with sales offices in New York City, Boston, Philadelphia, Pittsburgh, Buffalo, Cleveland, Cincinnati, Chicago, St. Louis, Kansas City, Seattle, Salt Lake City, San Francisco, Birmingham and Minneapolis. C. F. Michael is president and W. F. Billingsley is vice-president and general manager.

Moorhead Laboratories Closes Contract for Vacuum Tubes

The Moorhead Laboratories Company, San Francisco, which operates one of the largest factories in the world devoted exclusively to the manufacture of vacuum tubes, recently closed a contract with the Radio Corporation of America, the General Electric Company and the American Telephone & Telegraph Company whereby it will continue to manufacture vacuum tubes under the Fleming valve and De Forest audion patents. These patents are controlled by the General Electric Company and the American Telephone & Telegraph Company.

Wilson Acquires Wescott Jobbing Business

The electrical jobbing business of George T. Wescott & Company, 645 Washington Boulevard, Chicago, has been taken over by Gordon D. Wilson, who will continue to represent the following companies under his own name: The Scranton Button Company, manufacturer of composition socket bushings, insulation material, etc.; Triangle Conduit Company, "Triduct" flexible non-metallic conduit, "Tricord" portable conductor for hard service, etc.; Dongon Electric Manufacturing Company, bell ringing transformers, ammeters; Fibro Products Company, electrical and mechanical tubes; Scranton Glass Instrument Company, battery thermometers, etc., and the D. M. Steward Manufacturing Company, "Lavite" insulators.

Contests Among Lamp Operatives Increase Production

"Ballot-box battles" have been waged among operatives of both the large lamp factories and miniature lamp factories of the National Lamp Works, Nela Park, Cleveland, in an endeavor to reduce shrinkage and increase production. The principal trophy was awarded to F. C. Kirchner, general manager of the Youngstown plant. Two cups also were awarded, for shrinkage and for production. In the miniature lamp contest the award went to the Cleveland Miniature Lamp Division, W. H. Stiles manager.

It has been the experience of the National Lamp Works that contests are a most effective means of getting quick and extraordinary results in either the selling or the manufacturing field. In the case of the "ballot-box battle" the increase in production attained was equivalent to normal output of several standard lamp factories, while the proportion of lamps spoiled in manufacture was reduced by a large percentage. A distinct improvement in morale throughout the organization is also noted during these contests.

Macbeth-Evans Cuts Line to Standardize

Sales instructions are just going out from the Macbeth-Evans Glass Company, Pittsburgh, Pa., that in order to provide unit production and to effect a standardization of the company's products the line of glassware has been reduced from 6,000 to 550 items. The company is aiming to concentrate its production on these items and produce for stock, expecting in the near future to have stocks sufficient to warrant shipments in seventy-two hours. To this end some other departments of the company are now assisting the electrical glassware department, which is running to capacity, to build these lines for stock.

Blaw-Knox Sends Engineer to Japan to Design Steel Towers

E. L. Gemmil, chief engineer of the structural department of the Blaw-Knox Company, Blawknox, Pa., has sailed for Japan, where he will design the transmission towers for the new high-tension line of the Tokyo Electric Power Company. The contract, which was closed a few weeks ago, calls for 5,000 towers.

Forty-Ton Electric Steel Furnace in Operation

About three weeks ago the United States Steel Corporation placed in operation a battery of two 40-ton hot-steel electric furnaces of the Heroult type for the United States naval ordnance plant at Charleston, W. Va. Although 30-ton furnaces have been built by this corporation and operated for nearly two years, this new furnace is said to be the largest hot-steel electric furnace ever built, and the limit, it is thought, has not yet been reached.

It was designed for operation at 3,000 kw., using 24-in. carbon electrodes, but it has functioned properly, according to tests, at 2,350 kw., at which figure the power factor noted was 91, and it is probable that the electrodes will be reduced to 20 in.

Western Electric Sees Biggest Year for Farm Lights Ahead

At a sales conference on farm power-lighting plants held in Chicago by the Western Electric Company, Feb. 1-5, the consensus of opinion was that the year 1921 will record the biggest sales of farm-lighting plants in the history of the company. The meeting was attended by the Western Electric district managers, the managers and sales managers of all branch houses and the company's power-light specialists.

The general purpose of the meeting was to discuss sales possibilities for the present year and to outline a plan of action. The latter will include a campaign of education on a scale never before attempted, intended to reach the farmer direct, through advertising in about forty sectional and state farm papers. Optimism over the outlook was freely expressed, and regarding present conditions the general opinion was that business is not bad, but just hard to get.

Universal Chain to Open New Mill

The Universal Chain Company, Stroudsburg, Pa., expects to open within about thirty days a new wire mill—that of the Pennsylvania Steel Wire Company. This mill will draw wire of any cross-section for the manufacture of lighting fixtures. A Chicago office will be opened at about the same time, with P. E. Pollano, general sales manager, in charge.

The Elliott Company, Jeannette, Pa., held a convention from Feb. 10 to 12 inclusive for its sales organization, which was attended by all the district managers, sales engineers and sales agents of the company. An exhaustive study was made of the Elliott products, and addresses were given by the engineers and experts of the company as well as those of the Lagonda Manufacturing Company and the Liberty Manufacturing Company.

The Acme Wire Company, New Haven, Conn., announces the opening of its Chicago office at Room 1105, Monadnock Block, 53 West Jackson Boulevard, in charge of H. B. Bassett. The company also maintains branch offices in the Guardian Building, Cleveland, in charge of J. T. Crippen, and in New York City at 52 Vanderbilt Avenue, in charge of H. S. Glasby.

The Lionel Corporation, Irvington, N. J., manufacturer of electrically operated toys, batteries, etc., is planning to erect a one-story addition to its plant, 30 ft. x 60 ft.

The Splitdorf Electrical Company, 2900 South Michigan Avenue, Chicago, is reported to be receiving bids for the construction of a six-story building, 120 ft. x 300 ft., at Twenty-second Street near Fifty-fourth Avenue, Cicero, Ill., to cost about $700,000.

The Harter Manufacturing Company, 522 South Clinton Street, Chicago, is having plans prepared for the construction of a one-story factory, 100 ft. x 125 ft., at Lincoln and Fullerton Streets, to cost about $50,000. The company manufactures electric light fixtures.

The Maring Wire Company, Muskegon, Mich., manufacturer of cotton-covered and enameled magnet wire, announces the appointment of the Beedle Equipment Company as its representative. The Cincinnati office, at 1309-10 Union Trust Building, is in charge of A. L. Beedle. The Indianapolis office, at 509-10 Lemcke Building, is in charge of F. T. Miles.

The National Lamp Works of the General Electric Company, Nela Park, Cleveland, has awarded contract for the construction of a factory, 80 ft. x 200 ft., two stories, at its new Indianapolis plant. The cost, including machinery, is estimated at about $200,000.

The Duplex Storage Battery Company, Beaver Dam, Wis., has recently been reorganized with the following officers: J. W. Deniger, Beaver Dam, president; Herman L. Schickel, Milwaukee, vice-president; M. A. Jacobs, Beaver Dam, secretary and treasurer, and Peter M. Kettenhofen, general manager. The company recently removed its plant from Milwaukee and now occupies the former works of the Beaver Dam Manufacturing Company.

The Combustion Engineering Corporation, 11 Broadway, New York City, has established a branch office at 521 Candler Building, Atlanta, Ga., in charge of A. A. Hutchinson.

The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, held a sales meeting at the Philadelphia plant the first week in February which was attended by the sales force covering the Eastern territory The daily discussions of the business conditions in the central station, railway, mining and industrial fields indicated recent increased activity and an optimistic outlook for the future.

The Motor Company, Winston-Salem, N. C., has opened a branch house at 633 South Elm Street, Greensboro, N. C. The company will handle the Lalley light and power plants, "Laundry Queen" electric washing machines, "Eureka" vacuum cleaners and other well known labor-saving devices and appliances for the farm and the home. O. C. Nance and Harry Sadler will be in charge of the Greenfield branch.

The Hart & Hegeman Manufacturing Company, Hartford, Conn., has filed notice of increase in capital stock of $84,000, making the total outstanding capitalization $105,000.

The Oriole Electric Manufacturing Company, Norwalk, Conn., has filed notice of change in name to the King-Craymer Electric Manufacturing Company.

Farley & MacNeill, 107 Federal Street, Boston, dealers in electric fixtures and supplies, it is reported, have leased the five-story building at 62-64 Stanhope Street, comprising about 16,000 sq.ft. of floor space, to be used as a storage-battery manufacturing plant.

The Cook Electric Company, Greenfield, Mass., manufacturer of electric products, is being reorganized. Charles I. Cook has disposed of his interest to C. E. Parson, who will head the company. Edgar M. Greves is also interested in the firm.

Foreign Trade Notes

FAIR TO BE HELD IN NETHERLANDS EAST INDIES. — Announcement has been made, according to the London *Electrician*, that the second Netherlands East Indies Fair will be held at Bandoeng, Java, from Sept. 19 to Oct. 9 this year. The fair will be international in character and will offer manufacturers an opportunity of exhibiting wares of all kinds. Everything pertaining to industry, commerce and agriculture will be presented.

HYDRO-ELECTRIC PROJECT IN LIRO VALLEY, ITALY.—The Società Idroelettrica Cisalpina, Milan, Italy, formed in March 1919, with a capital stock of 2,000,000 Lire, it is reported, has decided to increase its capital to 30,000,000 lire for the purpose of carrying out proposed hydro-electric project in the Liro Valley.

MANUFACTURE OF ELECTRIC COOKING RANGES IN ITALY.—With the object of manufacturing electric cooking ranges of the thermal storage type and all other thermo-electrical apparatus for household and industrial purposes, fourteen large Italian concerns have become partners in a company, known as the Società Italiana per l'Accumulazione Termoelettrica, Milan, recently organized with a capital stock of 5,000,000 lire.

DEMAND FOR ELECTRICAL SUPPLIES IN CHINA.—There is an increasing demand in Canton, China, for electrical supplies, the principal item being fans and accessories. There is also a demand for small electric generating units of about 2 kw. for use in government offices, homes of wealthy Chinese and a few factories. A growing market in this district for electric power plants and equipment also exists.

TELEPHONE INSTALLATIONS IN MANCHURIA.—Since the installation of American telephones in the city of Mukden the service has been so greatly improved, according to Consul-General Pontius, that it is now proposed to extend the service throughout the entire province of Fengtien. Of the fifty-six counties only twenty-six have telephone installations at present, the instruments for most part being of a very cheap grade imported from Japan. The provincial government is desirous of administering the telephone system of the [illegible] and is prepared to take over all the apparatus now in operation. The cost of providing the entire province with a [illegible] system is estimated at [illegible] Chinese.

NEW TARIFF ON ELECTRICAL GOODS IN SPAIN.—Official confirmation has been received at Washington that a new general tariff will be promulgated on March 20 to go into effect probably forty days after promulgation. Increased rates on electrical goods are expected, but the amount of increase has not been definitely decided.

New Apparatus and Publications

LINE EQUIPMENT. — The Electric Power Equipment Corporation, Thirteenth and Woods Stret, Phieladelphia, has issued bulletins Nos. 103, 104, 200, 202, and 600, covering its indoor choke coils, copper fittings, pole-top switches, outdoor bus supports and control switches respectively.

WATER HEATER.—The Electric Boiler Corporation, 475 Main Street, Cambridge, Mass., has issued a booklet entitled "Electric Boilette," describing an electrically heated and automatically controlled hot-water tank.

MOTOR DRIVE. — "Sectional Individual Motor Drive for Paper Machines" is the subject of leaflet 1933 of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

MOTORS.—Leaflet 1160-A of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., gives the features of the type CS squirrel-cage induction motors.

POWER STAND.— The 32-volt power stand manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is illustrated and described in folder No. 4448, entitled "Do Your Chores Electrically."

MOTORS. The General Electric Company, Schenectady, N. Y., has issued bulletin No. 48143.1, describing its alternating-current mill motors, type MI and MIS, for service in steel plants.

ELECTRIC TRUCKS.- The Commercial Truck Company, Philadelphia, is distributing a four-page leaflet describing its C-T electric trucks.

IRONERS.—The Western Appliance Manufacturing Company, 1407 L. C. Smith Building, Seattle, is distributing a folder describing its new "Mercer" electric ironer.

BRAKES.— The Cutler-Hammer Manufacturing Company, Milwaukee, has issued publication 850, describing and illustrating its electrically operated C-H brakes.

BATTERY TEST CHART.—The Allen-Bradley Company, Milwaukee, has published a new battery test chart, 14 in. x 31 in., to be used exclusively with the Allen-Bradley rate discharge test set.

ELECTRIC REFRIGERATORS. — "The Most Modern Household Utility" is the title of a small booklet published by the Colfax Company, Chicago, describing and illustrating its electric refrigerator.

BATTERY-CHARGING EQUIPMENT.— The Automatic Electrical Devices Company, 120 West Third Street, Cincinnati, has issued bulletin 620, illustrating its various types of fixed resistance charging panels for industrial trucks and locomotive service. Bulletin 621 covers its "Unipanels," sectional battery-charging equipment for charging industrial trucks, storage-battery locomotives, electric commercial vehicles and starting and ignition batteries.

SOLDERING IRONS.—The Baco Electric Company, Bode, Iowa, is distributing two leaflets, one describing the Baco electric soldering iron and the other the Baco electric "Soderwand."

PORTABLE ELECTRIC GRINDERS AND DRILLS.—The Cincinnati Electrical Tool Company, Cincinnati, has issued catalog No. 14, covering its complete line of portable electrical drills, grinders and buffers.

MOTORS.- The General Electric Company, Schnectady, N. Y., has issued bulletin No. 481.00A describing its commutating-pole direct-current crane and hoist motors, CO-1800 line.

COLOR FILTER.—The Holophane Company, New York City, has developed a color filter for use with its window-lighting reflector No. 922.

LIGHTING FIXTURES. — Circular 7A-C-2 issued by the Westinghouse Electric & Manufacturing Company, George Cutter Works, South Bend, Ind., describes the Westinghouse "Luxsolite" fixtures for street lighting.

RESISTOR FOR HEATING DEVICES. —The National Electrical Supply Company, 1328 New York Avenue, Washington, D. C., is manufacturing a new resistor for heating devices, rheostats, instruments, etc., designated as "calorel ribbon."

SWITCHES FOR BATTERY CHARGING. — The Automatic Electrical Devices Company, 122 West Third Street, Cincinnati, has placed on the market a heavy duty self-closing underload switch (type M), with ratings of 50 amp. to 200 amp., designed for charging large storage-battery mining locomotives.

INSULATING MATERIAL.—The Boonton Rubber Manufacturing Company, Boonton, N. J., has published a forty-eight-page booklet entitled "Boonton Bakelite," in which it describes and illustrates the method of manufacturing bakelite and its uses.

VALVES. The Yarnall-Waring Company, Chestnut Hill, Philadelphia, is distributing a leaflet describing its "Yarway" junior seatless valve.

HOIST.—The Revolvator Company, 327 Garfield Avenue, Jersey City, has issued bulletin No. 58, describing its electric motor-driven revolvator for stacking merchandise.

New Companies

THE OPALESCENT ART COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $73,000. The incorporators are M. L. Rogers, L. A. Irwin and W. G. Singer, Wilmington. The company proposes to manufacture lamp shades, electric signs, etc.

THE NATIONAL ELECTRIC MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $600,000. The incorporators are M. L. Rogers, L. A. Irwin and W. G. Singer, Wilmington.

THE WATTS COMPANY has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $225,000. The incorporators are F. R. Hansell, J. Vernon Pimm and E. M. MacFarland, Philadelphia. The company proposes to manufacture electrical and mechanical engines.

THE S. L. ANDERSON ELECTRIC SERVICE COMPANY, New York, N. Y., has been incorporated with a capital stock of $10,000 by H. G. Saulner, A. T. Rose and S. L. Anderson, Stony Point.

THE CRYSTAL ELECTRIC COMPANY, New York City, has been incorporated with a capital stock of $5,000 by F. H. Schwartz, I. G. Herman and E. Carter, 944 Aldus Street.

Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 25, 1921)

1,367,224. RADIO-RECEIVING SYSTEM; Harold De Forest Arnold, East Orange, N. J. App. filed Jan. 5, 1916. Telephony and telegraphy.

1,367,258. MARINE TELEGRAPH Charles J. Henschel, Brooklyn, N. Y. App. filed March 28, 1919. To transmit signals to different parts of vessel.

1,367,267. SANITARY ATTACHMENT FOR TELEPHONES; Henry C. Karlson, Borough of Hasbrouck Heights, N. J. App. filed Feb. 5, 1920. For attachment to mouthpieces of transmitters.

1,367,283. RATCHETING MECHANISM; Arthur Simon, Milwaukee, Wis. App. filed June 26, 1916. Solenoid ratcheting mechanism.

1,367,285. TESTING BLOCK; Martin M. Stimmel, San Francisco, Cal. App. filed March 3, 1920. For lamps, fuses, etc.

1,367,287. STORAGE BATTERY; Alfred J. Trigwell, San Jose, Cal. App. filed Dec. 29, 1919. Separators reinforce plates.

1,367,288. BATTERY PLATE; Alfred J. Trigwell, San Jose, Cal. App. filed April 16, 1920. Provides for expansion by heat.

1,367,298. ALTERNATING-CURRENT MOTOR AND GENERATOR; James Burke, Erie, Pa. App. filed Feb. 8, 1917. For regenerative operation.

1,367,305. TELEGRAPHY; George C. Cummings, East Orange, N. J. App. filed Aug. 7, 1918. Duplex.

1,367,319. MOTOR-GENERATOR SYSTEM; Carlton L. Kennedy, South Braintree, Mass. App. filed Oct. 23, 1916. To prevent excessive starting current.

1,367,338. SWITCHING MECHANISM; Harry G. Webster, Chicago, Ill. App. filed Dec. 26, 1916. Trunk telephone.

1,367,341. ELECTRIC HEATING UNIT; Charles C. Abbott, Pittsfield, Mass. App. filed Nov. 15, 1918. Resistance conductor inclosed in metallic sheath.

1,367,352. METHOD OF AND DEVICE FOR CONTROLLING ELECTRIC ARCS; Daniel F. Comstock, Brookline, Mass. App. filed Oct. 20, 1915. Projection apparatus.

1,367,364. ELECTRIC FURNACE; Abraham M. Erichsen, Porsgrund, Norway. App. filed Nov. 28, 1919. Smelting furnaces.

1,367,409. PROCESS OF PRODUCING FERROUS OXIDE; Archibald J. MacDougall, Toronto, Ontario, Canada. App. filed Aug. 21, 1920. Electrolytic.

1,367,442. ELECTRIC RESISTANCE HEATER FOR MELTING FURNACES; Alfred von Zeerleder, Geneva, Switzerland. App. filed Dec. 22, 1919. Three-phase resistance heater.

1,367,463. ELECTRIC WATER HEATER; Herbert W. Christian, Detroit, Mich. App. filed Dec. 19, 1919. For hospitals, residences, etc.

1,367,472. DEVICE FOR CONCENTRATION OF LIGHT RAYS; Walter J. Harvey, Toronto, Ontario, Canada. App. filed Nov. 26, 1917. Therapeutic and ophthalmic work.

1,367,486. MAGNETO-ELECTRIC MACHINE; Leonard Le Baron and Arthur C. Harrell, Pensacola, Fla. App. filed Feb. 24, 1920. Steady and uniform rotation.

1,367,489. TOILET ARTICLE; Patrick McGuire, Superior, Wis. App. filed May 8, 1920. Hair curler and dryer.

(Issued Feb. 8, 1921)

1,367,534. SELF-WINDING ATTACHMENT FOR SECONDARY CLOCKS; James W. Bryce, Binghamton, N. Y. App. filed Nov. 17, 1919. Master-control system.

1,367,535. WIRE HOLDER FOR TROLLEYS; John Bulthouse, Chicago, Ill. App. filed Sept. 8, 1919. For retaining wheel in proximity to wire.

1,367,552. METHOD OF ELECTRIC WELDING; Charles H. Kicklighter, Atlanta, Ga. App. filed July 28, 1919. Spot welding.

1,367,553. METHOD OF JOINING METAL BY ELECTRIC WELDING; Charles H. Kicklighter, Atlanta, Ga. App. filed July 28, 1919. Spot welding.

1,367,562. ELECTRICAL ATTACHMENT PLUG; Johann G. Peterson, Jersey City, N. J. App. filed Nov. 23, 1917. Leads connected simply.

1,367,567. ELECTROPLATING MACHINE; Harry A. Sedgwick and Patrick J. Sheehan, Milwaukee, Wis. App. filed March 3, 1917. Continuous action.

1,367,571. TRANSMISSION-EQUALIZATION ARRANGEMENT; George K. Thompson, Maplewood, N. J. App. filed Oct. 2, 1919. Telephone.

1,367,583. SYSTEM FOR SIGNALING; Bornett L. Bobroff, Milwaukee, Wis. App. filed April 2, 1918. Annunciator.

1,367,586. IGNITION GENERATOR; Paul H. Brandt, Cleveland, Ohio. App. filed Aug. 23, 1917. Inductor alternator.

1,367,590. TRANSMISSION CIRCUITS; Charles S. Demarest, Brooklyn, N. Y. App. filed May 17, 1919. Telephone signal.

1,367,592. STARTING AND SPEED-LIMITING DEVICE FOR ELECTRIC MOTORS; Joseph E. Feller, Brooklyn, N. Y. App. filed April 13, 1917. Automatic.

1,367,593. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed April 14, 1916. Rugged.

1,367,594. STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed Aug. 16, 1919. To avoid introduction of dust when filling.

1,367,595. STORAGE BATTERY; Fruce Ford, Philadelphia, Pa. App. filed Nov. 5, 1919. To keep cover from warping.

1,367,598. TROLLEY-WIRE CLAMP; Georges E. Henry, Mansfield, Ohio. App. filed May 13, 1920. Suspension.

1,367,599. CONDUCTOR SUPPORT; Georges E. Henry, Mansfield, Ohio. App. filed June 19, 1920. Trolley-wire clamp.

1,367,613. TRANSLATING DEVICE; William W. MacFarlane, Philadelphia, Pa. App. filed Nov. 22, 1917. Induction coils.

1,367,618. WIRE SUPPORT; Samuel S. Matthes, Mansfield, Ohio. App. filed June 11, 1920. Trolley-wire clamp.

1,367,619. WIRE CLAMP; Samuel S. Matthes, Mansfield, Ohio. App. filed Sept. 30, 1920. Trolley.

1,367,679. MOTOR-SPEED CONTROL; Frank W. Adsit and Benjamin E. Bienhoff, Minneapolis, Minn. App. filed March 1, 1919. Low rate of speed with maximum torque.

1,367,705. AUTOMATIC TELEPHONE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed March 21, 1917. Substation sending devices.

1,367,708. SUBMARINE PROPULSION SYSTEM; Robert V. Morse, Ithaca, N. Y. App. filed April 26, 1915. Greatly increased power for limited periods.

1,367,717. PRINTING-TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed Nov. 15, 1917. Multiplex systems of secret service.

1,367,727. ELECTROMAGNETIC DEVICE; James A Wotton, Montclair, N J App. filed Aug. 29, 1917. Relays having retractable armatures.

1,367,729. TELEGRAPH SYSTEM; George H. Bell, South Orange, N. J. App. filed April 17, 1918. Repeater system.

1,367,733. TELEGRAPH SYSTEM; George C. Cummings, East Orange, N. J. App. filed Dec. 27, 1918. Repeater system.

1,367,734. CONSTRUCTION OF REACTANCE COILS; Austen M. Curtis, Brooklyn, N. Y. App. filed Aug. 16, 1917. Radio.

1,367,735. PRINTING-TELEGRAPH SYSTEM; Amos F. Dixon, Newark, N. J. App. filed Aug. 1, 1917. Selecting switch mechanism.

1,367,746. EAR SHIELD; William J. Kent, Brooklyn, N. Y. App. filed July 16, 1918. For use by aviators.

1,367,774. SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed April 13, 1918. Selectively operated signal control.

1,367,781. ELECTRIC POCKET LAMP; J. Oskar Junghans, Schramberg, Germany. App. filed Oct. 10, 1916. Manually operated [illegible].

1,367,796. METAL WORKING BY ELECTRICITY; Charles A. Cadwell, Cleveland, Ohio. App. filed June 26, 1919. Copper welding.

1,367,804. STARTING AND LIGHTING SYSTEM; Thomas R. Du Bois, Niagara Falls, N. Y. App. filed Aug. 28, 1916. Automobile.

1,367,811. CABLE-WINDING DEVICE; Walter F. Grams, Venice, Cal. App. filed Sept. 25, 1919. For winding tape.

1,367,833. TERMINAL BANK FOR SELECTORS; John N. Reynolds, Greenwich, Conn. App. filed Feb. 5, 1917. Automatic telephone.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MANCHESTER, N. H. — The Mooer's Falls Company, recently organized by H. F. Straw, W. M. Parker of Manchester and others, contemplates the harnessing of the Merrimac River at Mooer's Falls, a few miles south of Manchester and near Goff Falls, for the development of water power. Report of the surveys of the project has been filed.

LOWELL, MASS. — At a recent town meeting it was voted to set aside the sum of $11,300 for the lighting of Main Street from the Lowell line to Foster's Corner.

HARTFORD, CONN. — The Connecticut Power Company, controlled by the Hartford Electric Light Company, will furnish electric energy for the operation of the Thames River Highway Bridge.

Middle Atlantic States

ALBANY, N. Y.—Bids will be asked in March by E. S. Elwood, secretary of the State Hospital Commission, for the construction of a new power house, and improvements to the present plant at one of the state institutions to cost about $125,000.

LONG ISLAND CITY, N. Y.—The Moto Meter Company, Wilbur Avenue, manufacturer of instruments for motor-car service, contemplates the erection of a power house, 16 ft. x 40 ft.

UTICA, N. Y.—The Utica Gas & Electric Company will start work immediately on the construction of a steam-turbine electric generating station at a point near the Mohawk River and the Barge Canal harbor channel. The plant, which is to be known as the Harbor Point Station, will be capable of developing an ultimate capacity of 50,000 hp. The cost is estimated at $1,750,000. W. J. Reagan is commercial manager of the company. T. E. Murray, Inc., New York City, is consulting engineer.

JERSEY CITY, N. J.—A bill has been introduced in the Legislature by Assemblyman H. Tuttle providing for a municipal lighting plant in all first-class counties. The bill will make it mandatory to issue bonds for the construction of an electric power plant for lighting county institutions, roads, and buildings which are owned or rented by the county.

NESHANIC STATION, N. J. — The Branchburg Township Committee will establish electric lighting in District No. 1 in Neshanic Station. An election will be held to arrange for the appropriation of a sum for lighting for the coming year.

WESTVILLE, N. J.—The West Jersey & Seashore Railroad Company contemplates improvements to its local power plant, including the installation of equipment for increased service.

ALTOONA, PA.—Changes to the street-lighting system in the outlying residential district are under consideration. It is proposed to replace the present arc lamps with 400-watt incandescent lamps. H. C. Hinkle is city manager.

HAGERSTOWN, MD.—The Hagerstown & Frederick Railway Company has completed the erection of a new 33,000-volt high-tension transmission line between Frederick and Mount Airy, a distance of 17 miles.

North Central States

CANTON, OHIO.—The American Forge & Machine Company has increased its capital stock to provide for the construction of a new power house and for other improvements.

DEFIANCE, OHIO. — Bids will be received at the office of the Director of Public Service of Defiance until Feb. 28 for furnishing one 24-kva. alternator, direct connected to a four-cycle gasoline engine; also transformers, switchboard, circuit breakers, voltmeter, ammeter, interior and exterior power and light wiring, lamps, conduits, pole line, etc., necessary to provide complete electric light and power circuits at the water-works plant. N. S. Hill and

S. F. Ferguson, 112 East Nineteenth Street, New York City, are consulting engineers.

KUTTAWA, KY.—The Public Service Company, recently incorporated with a capital stock of $15,000, contemplates the consolidation of the Kuttawa Water & Light Company and the Cumberland Electric Company. The erection and equipment of a power house is also planned. G. P. Ordway is president.

LACKEY, KY.—The Porter Mining Company, Second National Bank Building, Ashland, contemplates the construction of a power house in Lackey and the installation of two 750-kw generating units. Electrical apparatus and coal-mining equipment will also be required for the mines. F. Blackburn is manager.

INDIANAPOLIS, IND.—The Board of School Commissioners is considering improvements to the lighting system in the various schools. The cost has been estimated at about $100,000.

PRAIRIE DU CHIEN, WIS.—The Prairie City Electric Company has increased its capital stock from $30,000 to $75,000. The company contemplates enlarging its plant.

KANSAS CITY, MO.—A special election will be held on April 7 for the purpose of submitting to the voters a proposal to issue bonds to the amount of $1,050,000 for extensions to the light, power and water systems. L. H. Chapman is commissioner of the light and water department.

MAPLEWOOD, MO.—Bonds to the amount of $12,000 have been authorized for the installation of electric lamps on the main thoroughfare.

MOBERLY, MO.—Bids will be received by W. H. Wilson, city clerk, until March 10 for water-works improvements, including dam and power house, 5 miles of three-phase electric transmission lines, 5 miles of telephone circuit, filter plant, pumping station, two 200-hp. horizontal water-tube boilers, four centrifugal pumps, one of 400, two of 700 and one of 2,250 g.p.m. capacity; 700 g.p.m. compound duplex steam pump, alternate on steam-turbine-driven centrifugal pump of the same capacity; 400-hp. open-feed water heater, etc. Fuller & Beard, Chemical Building, St. Louis, are engineers.

Southern States

NORTH WILKESBORO, N. C.—The Superior Mill Company is negotiating with the city authorities for permission to utilize the surplus flow of water at the dam on the Reddies River for power purposes. E. V. Wellborn is general manager.

ANDERSON, S. C.—The Centerville Electric Company, recently incorporated with a capital of $7,000, contemplates the erection of a 6-mile transmission line. W. C. Gilmer is president.

LITTLE PIERCE FLA.—The proposal to issue $50,000 is voted for improving and enlarging the light and water systems will be submitted to the voters.

BIRMINGHAM, ALA.—The Mountain Grove Creamery, Ice & Electric Company, Mountain Grove, Mo., contemplates establishing a business and plant at Birmingham to cost about $150,000.

GULFPORT, MISS.—The Casino Hotel Company, 316 Hennen Building, New Orleans, La., will receive bids until March 10 for the installation of an electric plant for land development purposes, about 8 miles from Gulfport. I. N. Wise is secretary.

ROGERS, ARK.—The Rogers Power Company, recently incorporated with a capital stock of $50,000, contemplates the construction of power house and dams at the White River near Rogers. The company will supply electricity in Rogers and nearby towns. M. McMichael, E. G. Sharp and others are incorporators.

MONROE, LA.—The Union Power Company, recently organized with a capital stock of $3,000,000, is a combination of the interests of the Frost-Johnson Lumber Company and J. E. Cullinann of Houston, Tex. The new company contemplates building a series of electric generating plants in the Monroe gas field for furnishing electricity for lighting in northern Louisiana, southern Arkansas, Texas and Mississippi.



POWER PLANT NOW UNDER CONSTRUCTION AT SEWARD, PA., FOR THE PENN PUBLIC SERVICE COMPANY BY DWIGHT P. ROBINSON & COMPANY, INC.

MARIETTA, OKLA.—F. A. Price and J. Curtis, both of Gainesville, have purchased the local light and water plant for $75,000. The new owners plan to make improvements in the near future to cost about $20,000.

MOUNTAIN VIEW, OKLA.—Bids will be received by V. V. Long & Company, engineers, 1300 Colcord Building, Oklahoma City, about March 10 for the construction of a power plant to develop 175 hp. and the erection of a one-mile transmission line. The cost of the plant is estimated at about $30,000.

TAHLEQUAH, OKLA.—The construction of a municipal electric light plant in Tahlequah has recently been completed. Work on the installation of an ornamental street-lighting system in the business section is well under way.

Pacific and Mountain States

VANCOUVER, WASH.—At a recent meeting of the City Council a resolution was adopted in favor of improvements to the street-lighting system.

FREEWATER, ORE.—C. H. Downing has filed application with the state engineer for permission to appropriate water from the Little Walla Walla River for hydro-electric power development and irrigation purposes.

LOS ANGELES, CAL.—Plans are under way for the installation of an ornamental street-lighting system, maintained by underground wires, in Eagle Rock.

PIRU, CAL.—Plans are under way for the installation of a lighting system in Piru.

RIVERSIDE, CAL.—The Southern California Edison Company, which supplies a large amount of electric energy consumed in Riverside, recently opened for operation its power house, 75 miles northeast of Fresno, known as Big Creek No. 2. The Kern River Power House No. 3, capable of generating 40,000 hp., will be opened on March 1.

SACRAMENTO, CAL.—The Excelsior Water & Mining Company has applied to the state engineer for permission to divert 200 cu.ft. of water from Deer Creek by means of a concrete dam and a canal 9.88 miles long. The company also asks authority for the diversion of 200 cu.ft. from the same source by means of a dam 120 ft. long and a canal 5.2 miles long. The development of these power projects is estimated at about $1,880,000.

SAN FRANCISCO, CAL.—J. H. Hughes has made application for the diversion of 28 sec.-ft. of water from French Creek, tributary of North Fork Feather River, in Butte County, for power purposes. The cost is estimated at about $150,000.

SANTA MARIA, CAL.—The San Joaquin Light & Power Corporation has work under way on the reconstruction of its distribution lines in Santa Maria. Several extensions to the lighting system have also been made recently.

VENICE, CAL.—The City Council is considering the construction of an electric light plant. It is proposed to issue bonds to finance the work.

CORRINE, UTAH.—A new street-lighting system will be installed in the town of Corrine. Work will be started at an early date.

EPHRAIM, UTAH.—The Ephraim Commercial Club recently adopted a resolution favoring the installation of an ornamental street-lighting system.

PARK CITY, UTAH.—The Judge Mining & Smelting Company, Salt Lake City, has applied to the state engineer for permission to divert 30 sec.-ft. of water from Snake Creek tunnel, Wasatch County. The company plans to develop approximately 2,000 hp. for mining and other purposes in Park City and elsewhere in Utah.

RICHMOND, UTAH.—Extensions to the street-lighting system in the town of Richmond are under consideration. Electric service is supplied by the Utah Power & Light Company.

TRENTON, UTAH.—Extensions to the street-lighting system in Trenton are under consideration. Electric service is supplied by the Utah Power & Light Company.

MONTPELIER, IDAHO.—Extensions to the street-lighting system in this town are being considered. Electric service is supplied by the Utah Power & Light Company.

PRESTON, IDAHO.—Extensions to the street-lighting system in Preston are under consideration. Electric service is supplied by the Utah Power & Light Company.

CASA GRANDE, ARIZ.—A special election will be held on March 12 for the purpose of submitting to the voters a proposal to issue bonds to the amount of $30,000 for improvements to the municipal electric light and power plant.

MILLERS, NEV.—The Simon Silver-Lead Mines Company has surveys under way and contemplates early erection of a 38-mile electric transmission line from Millers to the Simon district. Energy will be supplied by the Nevada-California Power Company.

Canada

ALVINSTON, ONT.—Estimates of the cost of the installation of a hydro-electric system in Alvinston will be prepared by the Hydro-Electric Power Commission of Ontario. A by-law will be submitted to the ratepayers.

Miscellaneous

SANTA ROSALIA, MEXICO.—The water supply created by the great dam on the Conchos River at Boquillas, about 18 miles from here, it is stated, is to be used for irrigating more than 200,000 acres of land in the Conchos River Valley. This dam and the large hydro-electric plant are owned by the Northern Mexico Power Company of Santa Rosalia. The main canal will be about 130 miles long. The state government plans to build a dam across the San Pedro River to cost about $15,000,000, and the reservoir thus created will have a capacity of 1,000,000,000 cu.ft. of water. B. R. Enriquez is chief engineer of the irrigation department of the State of Chihuahua.

Electrical World

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Herbert Hoover's New Sphere of Service

NO CABINET appointment for very many years has been greeted with such an outburst of popular approval as met the announcement that Herbert Hoover would be numbered among President Harding's official advisers. This approval came from all political parties, all classes of citizens and all geographic sections of the nation. To engineers it is especially gratifying that one of their leaders should be so recognized; but, quite apart from this, engineers can join with other Americans in applauding the selection of a man with the great administrative ability, the boundless energy, the broad and fearless outlook and the practical humanity of him who fed Belgium during her invasion and has mitigated the horrors of after-war famine in half a score of European countries. Mr. Hoover, the President has announced, is to have a free hand in his department. Hitherto the Secretaryship of Commerce has ranked as one of the least of Cabinet portfolios. It is a safe prediction that when Mr. Hoover shall surrender it it will rank among the greatest.

Expansion of the Society for Electrical Development

GOOD news comes from the Society for Electrical Development. Announcement is made that William L. Goodwin has joined its staff. From now on the excellent work which the society has done will, by the injection of so picturesque and strong a personality as Mr. Goodwin's, be materially expanded and enhanced. Such a union of able and co-operative forces must logically lead to more extensive work, and this in turn will justify greater recognition and support from the industry. That support the Society for Electrical Development has always been entitled to and now must have in larger measure, if the electrical idea is to be pushed vigorously and if co-operation within the industry itself is to be more than empty adulation. Messrs. Wakeman and Goodwin, however admirably fitted for the task each may be, cannot of themselves and unsupported exert any lasting influence on the course of events in the industry. The mere consolidation of co-operative forces does not superinduce accomplishment or excuse the manufacturer, jobber, contractor and public utility operator from performing the duty which each owes to the others and to the public of rendering such service within their respective spheres and powers as may tend to make more happy and contented the lives and lot of their fellow men. But the leaven must work from below, not from above. Co-operation nationally is unthinkable without co-operation locally, and fruitful soil awaits tilling in many localities. By establishing electrical leagues in all of the large cities of the country the Society for Electrical Development can render meritorious service to the industry and add new luster to its laurels. For this task Mr. Goodwin's experience and aptitude are admirably suited. He has toured the country on exactly such work and now will have the services of an established organization to follow it up, an advantage heretofore lacking. The opportunities indeed are numerous, and with Mr. Goodwin's help the S. E. D. should have no difficulty in making the most of them. The union of co-operative forces is certainly a happy one, and the results accruing from it are sure to be telling. We shall watch with interest the developments which are bound to follow.

Light Up and Be Seen

ABRAHAM LINCOLN believed no duty was more constant than to keep accessible to the people. Accessibility is essential to any one engaged in public affairs, and no one is more closely connected with public affairs than a public utility operator. To be widely and favorably known is an asset. This is true not only of individuals but also of companies and industries. At this time, when the National Electric Light Association is engaged in a nation-wide campaign of good will, every effort should be put forth to make the campaign effective by focusing the attention of the public on the electric light and power business. This is a work worthy the zeal of every manager. Not only should the advertisements of the association and of the electrical manufacturers be printed locally, but the story should be told by word of mouth to every one in the community. It is futile, however, to talk about something that people know little about and to try to interest them in investments they have rarely seen. To accentuate the campaign the officers and power stations of electric light companies should be the brightest spots in the community. There is nothing more attractive than light. It causes surprising transformations. It begets good cheer and confidence. Therefore, as the apostle of light, every electric utility should use it freely. If we are to get some benefit out of the good-will campaign, let's all light up and be seen.

The Daylight-Saving Muddle

IT LOOKS very much as if in the coming season we were to have another sample of the confusion thrice confounded that afflicted the clocks of the Northeastern States last year. Massachusetts, New York and New Jersey are struggling with the situation, which is being severely let alone by most of the other states. Now, from a personal standpoint we like daylight saving well enough. We do not think that central station companies as a whole are particularly interested in the matter just now, and the whole problem seems to have resolved itself into a struggle between the dwellers in the large

cities and their immediate suburbs and the population of the United States at large. Such questions are bound to arise when, as here, an abnormally large portion of the population is urban; but why this particular matter should cause so much disturbance when the remedy is simple and easy it is a little hard to see. Granted that there is an irreconcilable difference of opinion between the country community and the city industrial community, why should not the former stick to standard time if it so prefer and the latter adjust its habits to the hours suitable for daylight saving without attempting to thrust its preference down the throat of any one else?

There would be one great practical advantage in this suggestion because those who deem it wise to keep early hours in the summer probably would not all keep the same hours, which would have a beneficial effect on the urban transportation situation. We should be entirely cheerful if daylight saving were accepted or rejected by the people at large, but the whole proposition reached a *reductio ad absurdum* last season when in certain summer colonies the conservative natives held to Eastern standard time and the seasonal visitors stuck to daylight saving. The "up-state" proposition of local option in New York would lead to a somewhat similar result.

Production Economies in Industrial Plants

SURPRISING results have been shown by those industrial electrical engineers who have given careful study to plant production. Through the use of graphic charts it has often been possible to visualize the entire range of production methods. Such checks are infallible evidence of what has actually been accomplished by a machine, department or industry. That is, in a plant using electric power to any extent whatever energy consumption bears a very definite relation to the output. In some cases this may not be entirely true as relates to the finished product, but it is true for the unit processes. The method makes it possible to study operations in various sections of the plant or unit machines and to proceed almost automatically and at very little expense. For instance, when one well-known mining company had difficulty in obtaining accurate records of production for electric shovels, a recording instrument placed on the supply lines of particular installations made it possible to check records at the substation several miles distant. The efficiency of the working units was improved quite remarkably.

In the interest of self-advancement, if for no other reason, the men in charge of the electrical department of an industrial plant should be wide awake to the possibilities of such studies. Where it is difficult to open the eyes of the management to the necessity for work of this kind or the benefit to be derived by the investigations, even a start may produce evidences which will be helpful in justifying more elaborate installations of recording apparatus and facilities for analyzing the records.

For this preliminary work an elaborate outlay of instruments is unnecessary, for it is possible to make interesting studies with such indicating instruments as usually are at hand. Instruments of this kind do not give so much detailed information as graphic meters, but they may be the means of obtaining a more complete outfit at a later date. Frequent readings of substation indicating instruments where no recording instruments have been installed will also offer interesting possibilities. This opens an interesting field for the industrial electrical engineer, a field full of possibilities for economies by which he can demonstrate in a practical way the growing need for an adequate electrical division in the organization of the industrial-plant production department.

The Dangers that Lurk in Complacency

COMPLACENCY might be defined as the state of mind induced when one is well pleased with himself. On another page S. M. Kennedy, vice-president of the Southern California Edison Company, dwells in his characteristic manner on the dangers of the complacent state of mind in officials and underlings of public utilities. War conditions tended to foster extreme independence and something approaching patronage on the part of all dealers in commodities for which the demand exceeded the supply, and this attitude in turn aroused resentment and hostility on the part of customers and would-be customers—both dealers and customers thus proving themselves entirely human. Always a mistake, under present conditions the complacent attitude should not be tolerated for a minute where public relations are concerned, and where it may still linger in the precincts of electric light and power companies a perusal of Mr. Kennedy's article should arouse executives to the task of rooting it out and keeping it out.

Power Development of the Future

A FEW years ago dependable data showed that many hydraulic plants could not successfully compete with first-class efficient steam plants in the production of power. To an extent even now the balance in cost is rather a nice one, but there are many hydraulic developments which will pay at present and probable future prices of fuel which would not have done so ten years ago. In general the outlook for hydro-electric development is rather better than worse. Aside from this, there is the imperative necessity of keeping the cost of fuel from mounting out of sight by such measures of conservation as can be taken, and this again calls for more water power. But water power alone cannot be utilized efficiently in most topographical situations. To make the most of the total run-off either enormous storage must be present or developed or auxiliary power must be provided so that something like full utilization of all the available water can be obtained, which is quite impossible at the present time with even a moderately steady demand. The situation therefore calls for the combination of steam and water generating plants, so that the cheaper power can be fully utilized without failing to meet the supply at times of maximum demand.

Superpower plants situated suitably with respect both to fuel and water supply are a logical necessity. However, the importance of water supply is not always fully recognized, because it is perfectly easy to conceive a condition where the whole volume of a considerable stream would have to be utilized for condensation. This necessity limits the available situations for the great plants of the future. Ofttimes the mouth of the mine is the spot preferred for such plants, but generally they

cannot be erected there for lack of water. The problem then to be faced is finding the situations that will give the best balance in both requirements.

It must not be forgotten that with proper transportation facilities energy as coal can be very cheaply transmitted. Roughly, one can say that a ton of coal represents 1,000 kw.-hr., and it is a perfectly easy matter to lose in electrical transmission enough energy more than to cover the cost of judicious and well-planned transportation. The real importance of the so-called mouth-of-the-mine plant lies in its ability to utilize fuels not suitable for transportation in any other way than over a wire. As a rule the steam-driven superpower plant involves both kinds of transportation, for it will be located with reference more to its general usefulness and its possibility of water supply than to absolute propinquity to the coal mines. It is not unreasonable, therefore, to expect the very great stations of the future to keep up the use of transported fuel in order that they may more efficiently generate and distribute electrical energy.

The financial strain imposed by an attempt at present to create great superpower distributing systems is so serious that we do not look forward to immediate action in the broader aspects of the situation. What is far more likely to occur is the growth of such systems by concerted action among great enterprises now active, exchange of power over long distances, strengthening the common supply by gathering energy from hydroelectric sources, completing and interlocking the distributing networks that are subsidiary to the transmissions proper. Splendid as the big projects which of late have been suggested are, they must face the financial conditions which inhere in the situation as it is, and we are half inclined to believe that the superpower system will come upon us sooner than we think, but in a form which we shall only gradually come to recognize as the accomplished fact.

Equations for Long Transmission Lines

IN THE extension of the field of any art the attack of new problems usually means the introduction of new factors hitherto absent or negligible in the application of underlying physical principles. A particularly striking instance in the electrical field is the extension of the distance of power transmission. In the early days of continuous currents Ohm's law sufficed. With the introduction of alternating currents line reactance appeared, and for many problems today it is the only important additional factor. With long high-voltage lines, however, line capacity appears, and we have in our calculations in addition to time the new variable of distance to reckon with.

The differential equations for a long line are very simple in form, but their solutions involve exponential or the equivalent hyperbolic functions of the line constants and of the distance. Unfortunately, relatively few engineers are expert in the handling of these functions. As a result we have had from time to time a number of proposed approximate methods which avoid the difficulty mentioned.

A noteworthy example of one method was presented in a paper by A. McKinstry before the British Institution of Electrical Engineers. The paper analyzes with thoroughness the equations for a 90-mile (145-km.) line and a 380-mile (610-km.) line, computing all of the important numerical values. Of particular interest is the deduction of the equation of the circle diagram of the power and reactive components of the load current, and from it the values of synchronous capacity necessary for controlling regulation and improving line efficiency.

It should be remembered, however, that much of the early objection to the use of the rigorous method of solution lay in the absence of complete tables of hyperbolic functions and the tedium of evaluating exponential forms. The former difficulty has been removed now by the excellent tables of Kennelly and others, and there is no longer any necessity for approximations of the type mentioned. There is no reason why an engineer should not use the hyperbolic and trigonometric functions with equal facility.

Epoch-Making Contribution on Multiple-Harmonic Communication

THE paper on "Carrier-Current Telephony and Telegraphy" read by Messrs. Colpitts and Blackwell at the midwinter convention of the American Institute of Electrical Engineers is an epoch-making contribution to the literature of multiple-harmonic telegraphy and telephony. It illustrates throughout the enormous practical importance of the principle of resonant selection in electric circuits. If a line circuit can be tuned sharply to a particular frequency, then, no matter how many frequencies are impressed simultaneously upon the line, the resonant circuit will respond promptly and selectively to signals of that one frequency. The paper might aptly be described as the application of vacuum tubes to multiple telephony and telegraphy.

A most important device described is the alternating-current filter. Three types are emphasized, namely, high-pass, low-pass and band-pass filters. The sharpness of cut-off in these filters is remarkable and indicates the result of much research work.

In addition to the remarkable achievements already attained by the American Telephone & Telegraph Company in multiple-communication circuits, as described in the paper, it is suggested that a very workable assignment of frequencies over a single two-wire line would be eight telephonic one-way bands, each 3,000 cycles per second wide, and sixteen one-way telegraphic bands, making a total of twenty-four channels without exceeding the frequency of 30,000 cycles per second. Thus one pair of wires may serve to carry on four telephone conversations and also the equivalent of eight duplex telegraph connections.

It is evident that in any such partition of frequencies the telephone is much more exacting than the telegraph. A telephone band occupies a range of 3,000 cycles per second. A telegraph band may occupy a range of only 200 cycles per second. Thus telephony comes wide, but we must have it. It is also evident that such a system of multiple communication finds its best field of usefulness in densely populated districts where wires are relatively scarce, special apparatus is available and trained inspection is forthcoming. Two wires as a metallic circuit can then be made to do the work of twenty, but the line construction must be of the first class, the wires must be balanced, and properly transposed, and intelligent care must be devoted to the entire system. In these directions we may look for the future development of multiple telephone and telegraph lines.



Lewis Buckley Stillwell

Whose recommendations led to the adoption of 60 cycles as the standard frequency in the United States, and to whom belongs much of the credit for making alternating current a commercial success in the early days

ALTHOUGH the genius makes the discovery of the fundamental principle, it frequently remains for the clear-headed, practical thinker to make the conception a commercial success. Because of his engineering vision in the early days of electric service, to L. B. Stillwell belongs the credit for removing many of the troubles that impeded the progress of the use of alternating current. Back in 1887 the Westinghouse company installed at New Orleans what was a record-size alternating-current lighting plant, but the feeders were carried on the same poles, and when the current was turned on it was found that the light intensity fluctuated so greatly that the service was useless. It looked as though alternating current was a failure until young Stillwell, but a year out of college, was sent to New Orleans. In less than two days he had by shifting the circuits eliminated the trouble. This was the first time that mutual inductance had been encountered commercially. It was not surprising then to find him working on this problem of induction, his labors resulting later in the issue of patents to him for a booster to regulate and control feeder circuit voltage, now commonly known as an induction regulator.

Upon his return from a visit to Europe in 1890 Mr. Stillwell was appointed chairman of the Westinghouse committee to select for that company a standard frequency. As a result 30 cycles and 60 cycles were chosen, and the latter has since become the standard for this country. Soon after this Mr. Stillwell was asked to direct the technical development of the plans for the first Niagara installation, which secured for Westinghouse the initial contract for three 5,000-hp. alternators. Subsequently, in 1897, he became electrical director of the Niagara Falls Power Company and the Cataract Construction Company, remaining until 1900, when the first 50,000-hp. plant at Niagara Falls had been completed. Other important contributions to the art by Mr. Stillwell are the time-limit circuit breaker and switchboard control for remote operation.

Born in Scranton in 1863, he was educated at Wesleyan and Lehigh, where he completed in 1885 a course in electrical engineering, taking mechanical engineering the following year. From 1886 until 1890 he was assistant electrician for the Westinghouse interests, and for the next seven years he was chief electrical engineer. In 1900 he went to New York to engage in consulting engineering, having been for the year previous retained in that capacity by the Manhattan Railway Company. That year he became electrical director for the New York City subway and elevated traction systems and later consulting engineer in charge of electrical equipment for the four Hudson River tunnels.

Mr. Stillwell's work has been of that high order which brings recognition from the engineering profession. He is a past-president of the American Institute of Electrical Engineers and of the American Institute of Consulting Engineers and was one of the two engineers elected to the board of the Chamber of Commerce of the United States when for the first time the engineering profession received such recognition from that body.

Feasibility of Hydro-Electric Power for New York Metropolitan District*

Resources at Niagara, in St. Lawrence and Delaware Rivers and in the Adirondacks Region Difference in Frequencies Present Obstacles — Interruptions to Service Cannot Be Tolerated — Disadvantages of Long-Distance Transmission Considered

By COL. WILLIAM BARCLAY PARSONS
Consulting Engineer, New York City

THE growth of electric central power stations of late is indicative of what is to be expected in the extension of the application of power. This development is reflected in the central-station power statistics of New York. In the state, exclusive of New York City, there was installed in central power stations and electric railway stations in 1910 approximately 550,000 hp., while in 1919 there was 1,150,000 hp. In the metropolitan district—that is, New York and the adjacent territory in New Jersey, which it is convenient to treat as a whole—the installation on the same dates amounted to 920,000 hp. and 2,100,000 hp. respectively, giving totals for the state, including the metropolitan district, of 1,070,000 hp. in 1910 and 3,250,000 hp. in 1919. From these figures it will be seen that the increase in installed capacity has been at the rate of more than 120 per cent in nine years for the metropolitan district and only slightly less for the remainder of the state. In order to be conservative, the probable installed capacity in 1930 has been placed at 6,700,000 hp., of which 4,500,000 hp. will be in the metropolitan district and 2,200,000 hp. "up state," an increase of about 100 per cent.

Translating these figures into dollars and estimating the cost of installing a steam-producing horsepower at $100 and a water-producing horsepower at $200 including transmission, there will be required during the next ten years in the state new capital for central station and transmission lines, exclusive of the cost of appliances for utilization, to the amount of $350,000,000 and $700,000,000 respectively. These estimates agree fairly well with those recently given in an electrical paper† to the effect that during the next four years there should be similarly expended in the United States a sum of money between $2,000,000,000 and $4,000,000,000. Such figures are appalling, but they must be faced and met or the electrical development of this country will suffer.

The same consideration—namely, the cost of production—that is driving individual producers of power to central stations is now forcing central stations to consider in what way their rising expenses can be kept within reasonable bounds. In this connection it is of the highest interest to note that one of the few items that have not been substantially raised in cost during the last few years is the selling charge for electrical energy. Although coal, which accounts for 75 per cent of the cost of producing energy, has more than doubled in cost and labor nearly doubled, so that the operation cost of generating electric energy in economically run central stations has risen from less than ½ cent per kilowatt-hour to nearly 1 cent per kilowatt-hour (exclusive of the cost of distribution and of interest, taxes and all overhead charges) the selling prices have risen but little. The proportion in rise in selling charges to the total rise in items of expense has been negligible, but it is manifest that such a condition cannot continue.

Unless some radical method can be devised to keep down the ascending rate of cost, higher charges must follow. It is no longer a question of furnishing power at a lower cost, but one of keeping the latter from becoming larger. Unless this question can be solved for the metropolitan district, industries will be driven away to cheaper sources of power.

To avoid the dilemma of higher prices or lack of fair returns on investments, recourse must obviously be made to some other method of producing central-station energy. One alternative is water power. Fortunately, New York State is particularly well favored in this regard, its potential resources exceeding all except three of the Pacific States. These resources lie:

1. In the difference in elevation of 327 ft. between Lake Erie and Lake Ontario, the greater portion of which difference is to be found within a short distance covering the Falls of Niagara with its upper and lower rapids. The Niagara River has a substantially constant flow which, fully utilized, would generate about 5,000,000 continuous horsepower.

2. In the St. Lawrence River, where it is estimated that between 500,000 and 600,000 continuous horsepower can be developed along the New York boundary; or, taking the whole river‡ between Lake Ontario and Montreal, perhaps 5,000,000 hp. can be obtained. Of the Niagara power half would belong to Canada, and of the St. Lawrence power such an amount as would be fixed by international negotiations, though, of course, the maximum that New York could receive would not exceed one-half.

3. In the Delaware River, which, fully developed with storage reservoirs and power plants utilizing the full head, could produce 350,000 hp. Here, however, the rights of three states are involved, although most of the storage reservoirs would be located in New York. Perhaps New York, including the metropolitan district, might secure for its own use 200,000 hp., although the reports of the State Conservation Commissioner claim only 40,000 hp. as being capable of development within the boundaries of the state.

4. In streams lying wholly within the state. By far the greatest portion of such power would come from the streams that rise in the Adirondack region, of which the largest are the Hudson, the Black and the Raquette.

*Discussed before American Society of Civil Engineers.
†See ELECTRICAL WORLD, Jan. 1, 1921.

‡See page 312, Feb. 5, 1921. ELECTRICAL WORLD.

The State Conservation Commissioner has estimated that the interstate streams have a potential undeveloped power amounting to more than 1,000,000 hp. The independent investigation that has been in progress for more than a year seems to confirm this estimate, provided the streams are developed as a whole. It is only by complete development that the expense incident to the making of large storage reservoirs capable of fully regulating the flow in all but very wet years can be economically justified. If development be left to unco-ordinated individual efforts, nothing like the above total amount of power can be had.

The total amount of hydro-electric power that can be obtained in New York, provided Niagara be fully utilized and that one-half the St. Lawrence power contiguous to New York State be considered, will not exceed 4,500,000 hp. But public opinion will not permit the full utilization of Niagara, at any rate not until the demand for new sources of power is more imperative than it is at present. Complete development of the St. Lawrence is also likely to be postponed for many years, so that New York's actual undeveloped sources in sight can be put as not exceeding 1,500,000 hp. It has been shown above, with a very conservative estimate for additional power installation, that before the end of the present decade there will be needed about 3,500,000 hp. It is, therefore, obvious that much of the power installation that can be expected in the near future will be of the steam-electric type, with the attendant high cost of operation.

Unless some radical changes are made, it will be impossible to serve all stations from the same transmission lines without wasteful frequency changes. Leaving out of consideration a few odd frequencies which are local in character and negligible in amount, it is found that the installations in New York State are divided as follows:

Frequency	Horsepower Installed
60-cycle	700,000
40-cycle	150,000
25-cycle	1,950,000

Unfortunately these variations in frequency are scattered throughout the state, although the frequency at which the Niagara current is generated (25 cycles) is the same frequency at which the greater part of the energy in New York City is generated, the figures in New York City being:

Frequency	Horsepower Installed
60-cycle	280,000
25-cycle	1,450,000

The 40-cycle frequency is found as a general thing in the territory adjacent to and extending from Albany westerly as far as Utica, but in this same territory there is to be found side by side with the 40-cycle a large amount of 60-cycle energy. A study of growth seems to show that 60-cycle power is increasing at a much higher ratio than either of the others and that there is a tendency on the part of 40 cycles to give way to 60. It is likely that within a comparatively short time 40 cycles will be eliminated and the state development will be confined to the two frequencies of 60 and 25. In New York City all the power generated at 25 cycles is converted to direct current for utilization. In the present state of the art there seems to be no reason why all this current could not be generated at 60 cycles as well as at 25, except for the fact that the present equipment is arranged for conversion from 25-cycle alternating current to direct current.

In that portion of New Jersey included within the metropolitan area the situation is different. Here the 60-cycle predominates, the installation being:

Frequency	Horsepower Installed
60-cycle	250,000
25-cycle	60,000

It is on the metropolitan district that the burden of furnishing new installation will fall. Of the estimated 6,700,000 hp. of installation that should be in existence in 1931 to meet the expected demand, 4,500,000 hp. will be found within a distance of 30 miles from New York.

The metropolitan district is not only the largest aggregation of population in the United States, but it is also the largest center of manufacturing. Here will be found one-twelfth in value of the total manufactured production of the country—an amount greater than that of the whole State of Pennsylvania. In this area demands for service are so much more exacting than in any other part of the state that any interruption of service cannot be tolerated. Service in New York City must be continuous. To this end the distributing companies have assumed the burden of great capital investment in placing all their transmission wires in underground conduits where they are as free from outside interruptions as it is possible for human ingenuity to devise. Duplicate lines, several generating stations and a great reserve of power guarantee continuity of service. Besides continuity, there must also be a readiness to meet sudden and unexpected demands.

In the metropolitan district, particularly the lower part of Manhattan Island, the normal times of peaks vary somewhat with the season; but, unlike conditions in other districts, an excessive peak may occur at any time and at any hour owing to sudden darkening of the skies. This requires the maintenance of stand-by plants that can be brought to full capacity on advance notice that may be limited in time by minutes only. These items so swell the expense of distribution that the cost of producing power represents a much smaller percentage of the whole than in plants located elsewhere. Hydro-electric power is less advantageous to the metropolitan district not only because in New York items other than production cost make such a great proportion of the total cost of delivering energy, but also because the source of hydro power is far removed. Being thus removed and not under direct control, it might not be available in time for an emergency peak.

Hydro-electric transmission lines to the metropolitan district, varying in length from 100 miles, as would be the case with energy from the Delaware River, to 250 miles from the Adirondacks and more than 350 miles from the St. Lawrence and Niagara, present to a manager in the metropolitan district worries as well as advantages. But duplicate lines, and especially lines coming from different directions, the most substantial type of aërial construction that the state of the art will provide, and main trunks with few if any branch connections between points of origin and delivery, will undoubtedly eliminate some of the fears and permit the bringing to New York of hydro-electric power to take a part of the 4,500,000 hp. that must be in operation in this district before 1930. Storage reservoirs, whence

can be drawn not only the regular supply but also a temporary excess, would furnish valuable insurance against a failure in coal delivery and present an additional and highly attractive feature. This insurance would offset many of the disadvantages inherent in long-distance transmission. Storage of fuel in New York, where the consumption is measured by thousands of tons a day, is possible for a few weeks only. On more than one occasion this city has been dangerously close to a point of actual shutdown due to this failure in delivery. Power thus drawn from storage reservoirs in times of such emergency could be restored by operating the steam plants over longer periods when fuel is available.

Great as are the potential resources of New York in water power, two things are obvious: (1) That in amount they are not in excess of actual requirements; (2) that the objections to long-distance transmission lines will prevent the bringing of the whole of the supply of the metropolitan district from northern points. The cost of fuel, which, although it may fluctuate up and down, nevertheless is bound over a course of years to keep on increasing, raises the question whether the time is not near when some other means of producing power should be resorted to than by bringing coal in bulk to New York and converting it here into energy. The average freight on coal to New York is now about $3.50 per ton. No matter what may happen to the price of coal at the mine, the cost of transporting coal is not likely to be reduced. If hydro-electric power cannot be obtained in sufficient quantities to carry the burden of the demand for additional power, it is only fair to ask whether the high cost of transportation cannot be reduced. It would seem worthy of serious study to compare the transmission of energy generated from coal at the pit mouth with generation of energy at the center of demand.

This is not intended as a suggestion for the burning of waste coal in existing refuse piles. There seems to be no evidence that such piles contain sufficient coal fit for burning to be a factor in supplying power for New York. If power is to be generated at the mines, recourse must be had to taking the whole of the output of certain mines, converting it into energy in large stations and then transmitting the energy thus produced.

A second solution is a more radical one, but it is one that is not impossible and is already engaging the attention of those who are competent to deal with it. This is the storing of energy in such shape as to be transportable in the way coal is transported. If this could be done, the excess and storm flow of streams could be utilized in manufacturing the chemical product, and the great sources of hydro-electric power in the tropics, which now have no market, and where it is hard to see how in the future there can be any market, would become available for producing power for the world at large.

In addition to the direct benefit in lower production cost resulting from hydro-electric development of 1,500,000 continuous horsepower, there is also the great indirect benefit due to the saving of coal. This amount of power, if generated in economical central stations, would require over 10,000,000 tons per annum, while if it should be generated in isolated plants and locomotives on railways, the coal required would be from 40,000,000 to 50,000,000 tons per annum. This saving would tend to preserve our rapidly diminishing coal supply.

Status of Foreign Railroad Electrification

Situation in Suspense Awaiting Decision as to Form of Current to Use—Conditions in Germany, Austria, Sweden, Norway, Holland, Switzerland and Italy

BY E. C. ZEHME
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THE electrification of railroads in Germany, Austria, Sweden, Norway, Holland, Switzerland and Italy is at present somewhat in suspense on account of the lack of a definite decision upon the form of current to be used. Only Switzerland and Austria are at present enlarging their existing single-phase lines. All the other countries, formerly inclined toward the single-phase system, are again in a state of doubt, especially since hearing about the successful operation of American direct-current roads.

PRESENT GERMAN ELECTRIFICATION CONFINED TO TWO LINES

For the time being the electrification of main roads in Germany has been confined to the two main lines, Magdeburg-Halle-Leipzig and Lauban-Königszelt. These two lines suffered badly during the war, being electrically operated only in part, as all the overhead copper wire had to be removed. The copper wire is being now replaced, and some steel wire is being experimentally installed. The installation of the roads in the Silesian mountains has been finished as far as Hirschberg. In the coming spring Lauban, it is expected, will be reached. The necessary funds have been granted for the electrification of the lines east to Breslau and west to Görlitz. The line from Magdeburg to Leipzig is expected to be operated electrically again in two or three months. The electrification of the Berlin rapid transit lines has just been begun, use being made of single-phase current.

No further electrifications are at present in progress. It is obvious that the war caused many of the delays. But the main reason was an unsuitable executive in the railroad ministry, who, with his peculiar ideas, caused a great deal of retardation. Since his resignation some new doubts as to the wisdom of selecting the single-phase system for all German lines are being heard. These doubts were caused by trouble experienced on the Silesian mountain road, which operates on the single-phase alternating-current system. An induced voltage of 4,000 was here discovered in the signal cables lying parallel to the road for 80 km., this induced voltage rapidly destroying the cables. The locomotives, which have an alternating-current commutator motor installed in the upper part of the engine, with rod drive, are at present in repair 85 per cent of the time. The authorities adhere, however, to the alternating-current system, and expect to invite an international congress to Germany in 1921 in the hope of justifying it. It is not expected that the delegates from Switzerland, Austria and Sweden will dare to say officially anything against the alternating-current system chosen by their own lands, and even in America might be found some advocate of that system who might be invited! Altogether, there are today operated electrically 1,514 km. of track in the German Republic, which was built by German concerns.

The Austrian Republic is pushing very energetically

the complete electrification of all of its main roads. A new law has been introduced and passed authorizing and directing the immediate start of the electrification of the following roads: (1) Arlbergbahn, Vorarlbergbahn and all branch lines; (2) Salzkammerguthbahn; (3) Westbahn; (4) Tauernbahn.

The total length of these lines together with the planned additions is 1,788 km., or 40 per cent of all the Austrian railways. These roads are to be operated, if possible, not later than the middle of 1925. The electrification is considered absolutely imperative due to the fact that the post-war Austria has only 16 per cent of the total coal requirements and that electrification will save about 50 per cent of the needed fuel.

Influenced by the German example, the Austrian railway ministry has adopted the single-phase system with 16⅔ cycles and 15,000-volt trolley tension. A number of new hydro-electric generating plants are being erected, and plants which are in existence are being much enlarged.

The electrification of the Arlbergbahn, with its 31.4 per cent grades, has already begun, and the locomotives nave been ordered from German-Austrian firms. They will have a shaft pressure not exceeding 14½ tons and a weight not exceeding 6.9 tons per meter length. Freight locomotives will have geared motors with rod-coupled wheels and express locomotives will have one motor driving by rods a blind shaft coupled to the driving wheels by rods.

Not including the newly planned lines, there are at present lines electrically operated over 575 km. of single track in Austria. Of these 66 per cent are alternating-current and 34 per cent direct-current roads.

Roads in Sweden Electrified More than in Norway

Sweden has at present 145 km. of electric railways (130 km. alternating-current and 15 km. high-tension direct-current), while Norway has 46 km. alternating-current and 27 km. direct-current roads. Ever since 1914 the Riksgränsenbahn has been hauling its heavy ore trains by single-phase, 15-cycle, 15,000-volt locomotives, which are fed from the Porjus hydro-electric plant. The southern extension of this line from Kiruna to Lulea is at present under construction. An extension to the north as far as to the seaport of Narvik is now under consideration.

The Swedish railway administration is now planning further electrification in the south, primarily for passenger traffic. A very exact study has been made as to the possible coal saving, the rentability of the lines and the best system to be chosen. The following data were derived:

	Total Efficiencies, per Cent	Relative Installation Costs	Relative Operating Costs
With three-phase, direct-current rotaries	54 0	100 0	13 2
With three-phase, single-phase motor-generators	55 0	94.5	13.0
With pure single-phase alternating current	64 7	97 2	12 6

Disturbances in telegraph and telephone lines caused by alternating-current railways have had special attention. A commission was appointed to study these causes and provide remedies. The result was a very elaborate report which was adverse to the adoption of the alternating-current system. The Swedish Reichstag approved recently the plans of a new electric alternating-current road from Stockholm to Gothenburg only under the condition that a satisfactory solution of all inductive disturbances shall be found.

Holland Plans Uniform Electrification

A uniform electrification of all the roads in Holland is planned, but the system has not as yet been decided upon. Today there are 33 km. of alternating-current 25-cycle, 10,000-volt lines and 19 km. of 1,200-volt direct-current lines in operation, but both roads, built by the Siemens-Schuckert company, are old (1908) and cannot be used as modern examples. The Dutch government, too, has authorized a committee to study electrification of railroads, including American direct-current systems and Swiss alternating-current systems. Owing to the lack of coal railway electrification will go hand in hand with a general electrification of all of Holland. Great emphasis is placed here, too, upon the perfect operation of all existing telegraph and telephone circuits.

Italy's Interest Centers Around Three-Phase

Italy has very little coal but a great amount of water power. For this reason the electrification of its railroads was considered at a very early stage. Today there are in operation 427 km. of direct-current roads, 317 km. of three-phase roads and 284 km. of single-phase roads.

The main interest is centered upon the three-phase roads, where Italy did pioneer work. The foundation for this system was laid by Ganz & Company of Budapest, Hungary, with the classic installation of the Valtellina road, built in 1900-1902 and operating very satisfactorily on 3,000 volts, three-phase, 15 cycles. Further contracts were later given by the state railways to the Westinghouse works at Vado (Ligure) under Mr. Kando's supervision for electrification of roads on the same system. The Swiss firm of Brown, Boveri & Company participated in this order by supplying locomotives for the Simplon tunnel in 1905. Direct-current roads are found west of Milan between that city and Varese. All the single-phase systems are around Rome and Naples.

Under pressure because of the present scarcity of coal, a special ministry for electrification of Italian railroads has been formed for the consideration of a plan of changing 1,870 km. of steam lines to electric lines. This undertaking, if carried out, will make about 3,000 km. of electric railways in Italy.

The largest number of electric locomotives for the Italian State Railways were furnished by the Westinghouse company in Vado (Ligure). There is at present a merger planned between the Brown-Boveri Company of Milan (branch of the Swiss house) and the Westinghouse company, in Vado, based upon an agreement between the Brown-Boveri Company, Westinghouse and Vickers, Limited, in England.

Italy has so far favored the three-phase system, which has no doubt given excellent results, with simple regeneration along the downward slopes of the Alps. It is therefore expected to adhere to this system for the future, with a possibility of change if some other method is found more advantageous. At the time when the Valtellina and Simplon roads were built a transmission of locomotive power by gears was not considered wise. Later experience, however, like that of the Lötschbergbahn and American roads, disproved this assumption and further Italian electrifications might take advan-

tage of the changed opinion. Using gears would not necessitate the choice of a very low frequency, and three-phase current could be taken from the many existing power plants of the country. It has therefore been decided to equip two roads near Rome with three-phase apparatus of a periodicity higher than 15 cycles.

SWITZERLAND'S ROADS CHIEFLY SINGLE PHASE

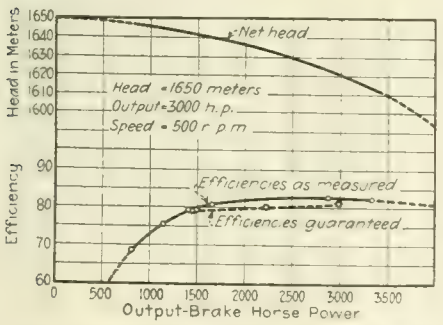
Switzerland, having no coal and an almost unlimited water-power supply depends chiefly upon electrification of its railways. There are now in operation 286 km. of high-tension direct-current roads, 115 km. of three-phase roads and 461 km. of single-phase roads. The "Swiss Study Commission of Electrification of Railways" decided in 1916 upon a uniform alternating-current, single-phase system, 15 cycles to 16⅔ cycles, employing a trolley voltage of 15,000. This system was first used by the Oerlikon company on its experimental road from Seebach to Wettingen in 1905-1907.

In 1913 the Swiss authorities decided to electrify the railway through the Gotthard tunnel, just after the Lötschbergbahn was opened for service. In 1918 the Bundesbahnen outlined and accepted a large electrification program, comprising 2,726 km., to be undertaken in three successive periods. On Sept. 15, 1920, the first electric passenger train passed through the Gotthard tunnel. The Swiss railways are 75 per cent state and 25 per cent private roads. Among the private roads the Rhätische Bahn, opened in 1920, and the Brenner Alpen Bahn are of importance. The Oerlikon works has devised a regenerative system for single-phase commutator motors. Its success cannot as yet compare with regenerative braking on direct-current locomotives.

Swiss Plant Under a Mile Head

WHAT is probably the highest-head hydro-electric plant in the world is installed at Fully, Switzerland, operating at a net head of 1,650 m. (5,412 ft.). The installation is near Martigny, in the Rhone Valley, and operates from an Alpine lake 2,150 m. (7,000 ft.) above sea level. The Pelton wheels are fed by a pipe line about 4.6 km. (2.85 miles) in length. This is connected to a tunnel 500 m. (550 yd.) long, which is partly under pressure. The generating station contains four wheels, each of 3,000 hp., which run at 500 r.p.m.

Each bucket is exposed more than eight times a second to the blow of the jet leaving the pipe at a velocity of about 180 m. (590 ft.) per second. The wheels therefore had to be designed with extreme care. These wheels have an over-all diameter of 3.715 m. (12 ft.) and are of forged steel. They carry fifty-four buckets each and are so designed that no part either of the disk or the buckets is subjected to a higher tension than 1,000 kg. per square centimeter (14,200 lb. per square inch). Even in case of runaway this takes care of a speed 50 per cent above normal. The buckets are carried in a mortised groove and are fixed tangentially by formed keys driven axially between them. The whole makes a very rigid assembly with the disk.



TEST EFFICIENCIES EXCEEDED GUARANTEES

Water from the feed pipe is conducted to each turbine by a cast-steel pipe 250 mm. (10 in.) in diameter, provided with a manually operated equilibrium valve. The jet pipe fixed to the bedplate under the turbine has a nozzle of tempered steel, the water discharge from which is regulated by a steel needle which moves in the axis of the jet pipe. The needle is always inclined to open when affected by the water pressure. It can be closed by a hand-operated screw, by oil-pressure mechanism or by the automatic governor. A cast-steel deflector placed between the nozzle and the bucket wheel is raised or lowered by the action of the governor, and when lowered causes a deviation of the jet away from the bucket wheel. The governing action is said to be particularly sensitive.



PIPE LINE FOR SWISS PLANT OPERATING AT A 5,400-FT. HEAD

The results obtained on speed regulation show that when a load of 2,300 hp. was suddenly thrown off the turbine the increase in speed was only 3½ per cent, as against 7 per cent guaranteed. These percentages are in relation to the speed before unloading. The permanent variation in speed between no load and full load was 3½ per cent, this being the variation for which the governor was set. The excess pressure generated in the feed pipe during unloading was 0.6 per cent as a maximum, corresponding to a generated head equivalent to 10 m. This result was considered particularly good because of the fact that overpressure of 10 per cent was specified. The efficiency curve shows a maximum value of 82.3 per cent, which is considered remarkably good in view of the nature of the plant and the fact that the wheel was originally made of abnormal dimensions in order that the runaway speed should not exceed 50 per cent above normal. Actual tests show that friction and windage losses amount to 5 per cent of the normal power.

Further details regarding this plant and the construction of the wheels may be obtained by reference to *Engineering* (London), Dec. 24, 1920.

Checking Efficiency of Generating Plants

Daily Records Which Amount to Twenty-four-Hour Efficiency Tests Are Kept for All Units in the Generating Station—Cost of Keeping Operating Records Is Well Repaid by Increased Operating Economy

By JOHN O. FUCHS
Production Engineer United Hudson Electric Corporation, Poughkeepsie, N. Y.

AS THE ELECTRIC production department of the United Hudson Electric Corporation is responsible for the entire production of all energy throughout the system it is in this way also directly responsible for the condition and maintenance of all equipment in the steam and hydro-electric generating stations. Experience has shown that the most essential factor in the efficient production of electrical energy and also in the continuity of service is the placing of all equipment in the best possible condition and maintaining this condition at all times.

With this object in view a system has been developed of keeping an accurate check on the performance of all generating equipment to ascertain if the equipment is operating at its best efficiency, in order that immediate steps may be taken to remove from service any defective units and place the same in good operating condition as soon as possible. It has been found that the expense of keeping these records is amply recompensed by the increased over-all efficiency obtained by strict adherence to the plan.

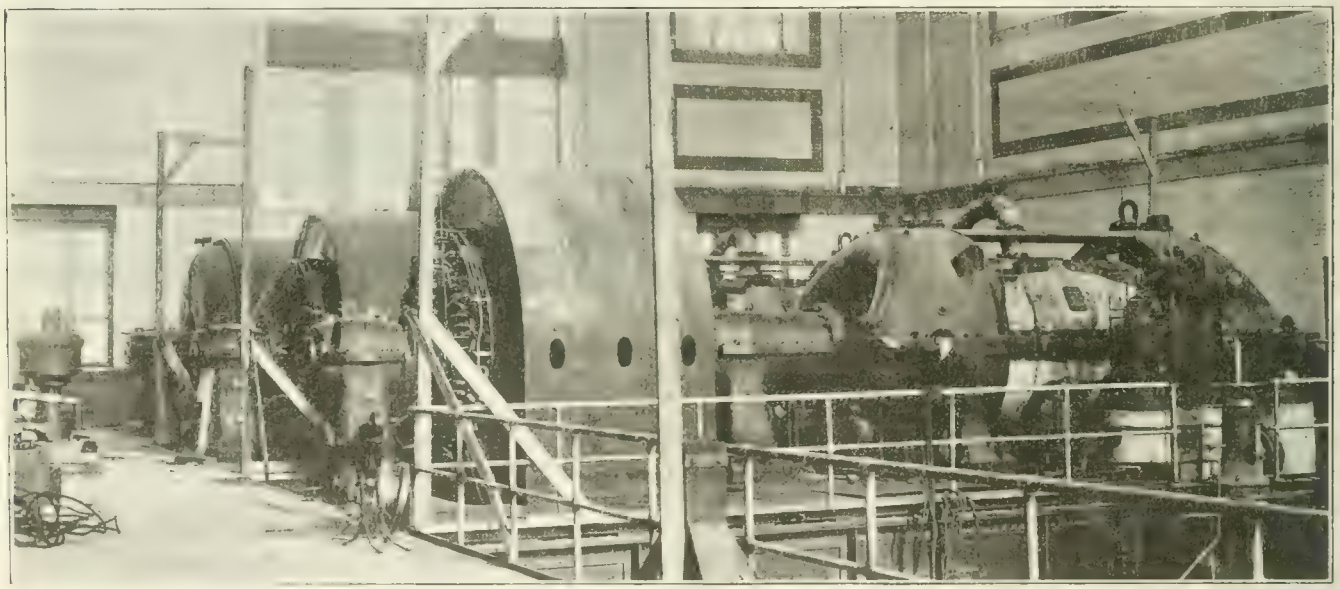


FIG. 1—CAREFUL INSPECTION OF TURBO-GENERATOR UNITS AT DEFINITE TIME INTERVALS IS ESSENTIAL

The methods of carrying out this system for the various types of equipment in the generating stations are covered in detail in this article in the hope that the data may be of benefit to other companies operating under similar conditions.

In Fig. 4 is shown the summary log sheet which is filled out each day at the Poughkeepsie Riverside station. This daily log sheet is typical of the steam generating stations of the system. The log sheet is made in three parts. Part I (not shown) gives a complete record of the number of hours each unit was in service during the twenty-four hours. The hours of service are shown by a line being drawn for any unit under the hours in which it was in service. In the case of the boilers a solid line indicates a steaming condition, a single dot indicates a single bank and a double dot a double-banked condition. The meter indexes of the various transmission and distribution circuits are also given on this sheet. The daily record of the street-lighting circuits for the city of Poughkeepsie and also the boiler cleaning and test record, together with the coal, oil and waste used, are also shown on the first sheet. On sheet No. 2 (not reproduced) are shown all the data regarding the operation of the plant for that day. This data is shown in three shifts and also for the twenty-four-hour period.

From the data given on log sheets Nos. 2 and 1 log sheet No. 3 (Fig. 4) is prepared. This sheet shows the final results from the boiler room and engine room separately and also from the plant as a whole—the final result obtained being the over-all plant efficiency.

The plant efficiency is total output ÷ total input.

The output is based on 1 kw.-hr. reduced to B.t.u. or 3415. The input is the total B.t.u. in the coal necessary to produce one kilowatt-hour. This is obtained by multiplying the load per kilowatt-hour efficiency by the B.t.u. per pound. We therefore obtain the formula:

$$\text{Plant Efficiency} = \frac{\text{output}}{\text{input}} = \frac{\text{B.t.u. per kw.-hr.}}{\text{Lb. of coal per kw.-hr.} \times \text{B.t.u. per lb.}} = \frac{3415}{\text{Item 112 (log sheet)} \times \text{B.t.u. per lb.}}$$

It can be readily understood that with the data available as shown on this log sheet a complete check is shown daily on the operation of the plant, since the log sheet is really nothing more than an actual twenty-four-hour efficiency test of the station. If any piece of equipment is not operating at its best efficiency this will imme-

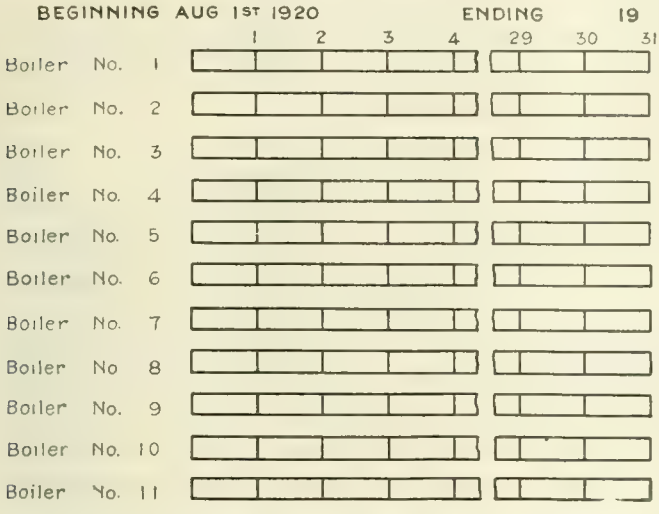


FIG. 2—MONTHLY REPORT SHOWS THE TIME EACH BOILER WAS BANKED, STEAMING OR OUT OF SERVICE FOR REPAIRS

diately be shown in the results of the plant operation, and as the boiler-room and engine-room results are shown separately the trouble can be quickly traced to its source.

How a Leak Costing $45 a Day Was Stopped

An examination of the log-sheet data will illustrate the value of keeping this information before the plant superintendent and the production engineer. During this period, with the grade of coal being used the average coal rate was 2.5 lb. per kilowatt-hour under normal conditions. The coal rate for this day is 2.64 lb., or an increase of 0.14 lb. per kilowatt-hour over normal conditions. When this result was obtained an investigation was immediately started to ascertain why this had occurred. The first place investigated was the boiler room, but the log sheet shows that this portion of the plant was operating satisfactorily. Referring to the engine room results, however, item No. 92, the water rate of unit No. 3, was running higher than unit No. 4. Under normal conditions the water rates of these two units are virtually the same. In investigating further item No. 98, the vacuum of unit No. 3, showed that the vacuum maintained on this unit was not so good as that maintained on unit No. 4, which immediately suggested the fact that something was wrong with the condensing equipment of this unit.

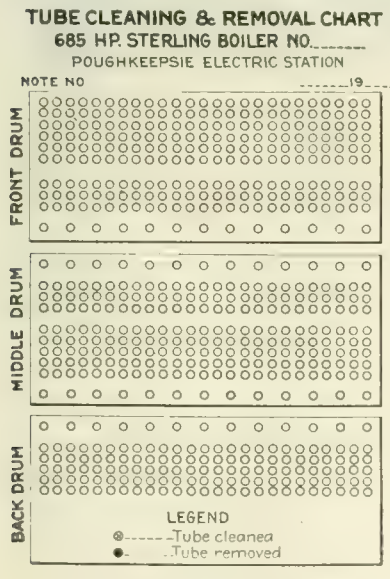


FIG. 3—CHART GIVES CHECK ON REMOVAL AND CLEARING OF BOILER TUBES

At the next favorable opportunity this unit was removed from service and the condenser inspected. It was found that a few small air leaks had developed and also that considerable dirt and scum had been deposited in the condenser by the circulating water. The condenser was thoroughly overhauled and put back in service, and satisfactory results were obtained thereafter. An increase in the coal rate of the station of 0.14 lb. per kilowatt-hour would mean a loss of approximately 6½ tons of coal per day, or a financial loss of approximately $45 per day.

Generating Units Overhauled at Least Yearly

As stated in the preceding paragraphs, a close daily check is kept of the operation of each generating unit, such as the vacuum maintained on the condensing equipment and the water rate of the turbine. Besides this

CENTRAL HUDSON GAS & ELEC. CO.
ELECTRIC PRODUCTION LOG SHEET NO 3 DAY Tues DATE Aug 1 4 1920

BOILER ROOM RESULTS

	ITEM	SHIFT NO 1	2	3	DAY	REMARKS
82	EVAP LBS WATER PER LB COAL AS FIRED	5.89	8.25	9.01	7.81	
83	FACTOR OF EVAPORATION	1.07	1.109	1.108	1.108	
84	EVAP FROM AND AT 212° PER LB OF COAL	6.50	9.14	9.99	8.65	
85	ACTUAL BOILER H R HOURS	13100	31400	19800	64300	
86	RATED	34744	34744	29264	98752	
87	PER CENT BUILDER'S RATING	37.7	90.5	67.6	65.1	
88	LBS COAL PER SQ FT GRATE SURFACE	12.0	20.5	11.6	14.8	
89	EFFICIENCY BOILER AND GRATE	49.0	69.5	76.0	69.8	

ENGINE ROOM RESULTS

90	WATER RATE – UNIT NO 1					
	GUARANTEE					
91	WATER RATE – UNIT NO 2					
	GUARANTEE					
92	WATER RATE – UNIT NO 3	15.8	15.2	15.5	15.1	
	GUARANTEE					
93	WATER RATE – UNIT NO 4	15.5	14.6	14.8		
	GUARANTEE					
94	WATER RATE – AUXILIARIES				5.44	
95	PER CENT AUXILIARIES OF TOTAL				26.4	
	VACUUM PRESSURE – INCHES ABSOLUTE					
96	VACUUM PRESSURE UNIT NO 1					
97	UNIT NO 2					
98	UNIT NO 3	1.48	2.08	1.94	1.87	
99	UNIT NO 4	1.55	1.86	1.91		
	DEG DIFF VAC TEMP AND CIR WATER DISCH					
100	UNIT NO 1					
101	UNIT NO 2					
102	UNIT NO 3					
103	UNIT NO 4					

PLANT AS A WHOLE

104	STATION SEND OUT K W HOURS	17320	4870	26630	92562	3860
105	GENERATED – NEWBURG				0	
106	– DASHVILLE	Cat O	Hunt 845	Nord 3200	14340	
107	PURCHASED WALKILL RIVER CO				1.300	44100
108	HONK FALLS POWER CO				2970	299
109	O&R ELECTRIC CO (MONROE)	100	Kings 5800		5900	
110	TOTAL SYSTEM OUTPUT				151800	
111	COST OF COAL PER K W H SENDOUT				2.0860	
112	COAL PER KWH ACCOUNTING				2.68	
113	EFFICIENCY	3.36	2.34	2.19	2.64	
114	WATER RATE OF STATION	22.5	19.4	21.9	20.6	
115	POWER FACTOR OF GENERATION				64.8	
116	PEAK LOAD	6000	7300	4800	7310	8600
117	SYSTEM PEAK LOAD				11245	5714
118	PLANT LOAD FACTOR	46.0	83.5	69.5	52.8	
119	PLANT EFFICIENCY	67	114	122	101	

FIG. 4—PERFORMANCE OF PLANT IS SUMMARIZED DAILY

daily check a complete periodic inspection is made of each unit at least once every year, or twice if deemed necessary. During this inspection the turbine casing is opened, the rotor is removed and all parts are thoroughly inspected.

Electrical Equipment.—A close check is kept on the condition of electrical equipment in the station, mostly by means of daily and weekly inspections by the chief electrician. The condition of the various high-tension transformers is watched by means of twenty-four-hour recording thermometers, the thermometers being regularly inspected and tested for accuracy. All oil switches, disconnecting switches, voltage regulators, etc., are periodically inspected and immediately removed from service if found defective, so that they can be placed in good operating condition.

Boilers.—A very close record is kept upon the operation of the various boilers by means of the monthly boiler report shown in Fig. 2. This report shows the time each boiler was in service, whether banked or steaming, and also when the boiler was out of service for repairs. The chart is filled in with various-colored pencils to show the above conditions, a red pencil being used, for instance, to indicate a steaming condition and a green pencil to indicate a banked condition. When the boiler is removed for repairs the chart is left blank during that time, and on the chart is placed a number which corresponds to the page in the boiler repair book on which the repairs made to the boiler at that time are listed. A chart covering tube cleaning and removal is also kept for each boiler, such as shown in Fig. 3. This chart shows all the tubes in the various boilers, and the tubes cleaned or removed are filled in with colored pencils. This chart enables the boiler-room superintendent to keep an accurate check on the tubes of each boiler cleaned or removed and also enables him, each time the boiler is taken out of service, to start cleaning the tubes where the tube cleaner left off the time before.

A complete record is also kept in the boiler repair book of any changes made to baffle openings in the boiler or any repairs made to the stoker equipment, so that there is always available a complete record of the condition of each boiler and stoker.

Coal-Handling Equipment.—For coal-handling equipment in this station a Brown locomotive crane and also a Jeffrey crushing and elevating system are utilized. The locomotive crane is driven by a separate steam boiler situated on the crane, and this boiler is designated as boiler No. 11 on the monthly boiler report, the same complete record being kept of repairs to this boiler as is kept in the case of the station boilers. The maintenance of the mechanical equipment of the crane and of the crushing and elevating equipment is left entirely to inspection, daily inspections being made of the crushing equipment and periodic inspections of the crane being made by the plant superintendent and hoist engineer.



FIG. 5—CLOGGED OR LEAKING CONDENSERS WILL CONSTANTLY DRAIN THE COAL PILE



FIG. 6—TURBINE RUNNER REMOVED FOR THOROUGH INSPECTION

Inspection Scheme in Hydro-Electric Generating Stations

Satisfactory maintenance of water-driven units can be obtained by close observation of their performance. The condition of any unit can be ascertained from observing its performance with various loads by means of the instruments installed for obtaining the temperature of the bearings, windings, etc. By this means a good indication of the condition of the generating end is afforded. The performance of the water turbine is checked by the load which can be carried by the unit at various heads, and if the unit does not come up to its usual performance the cause is immediately investigated. Of course, the length of time that the unit has been in service must also be considered, as when wear occurs in the various parts of the turbine a larger loss is experienced and more water is necessary to produce the same amount of energy.

Recently an additional check on the performance of hydro-electric units has been evolved. When a new hydro-electric unit is placed in service data are obtained from the manufacturers giving the flow of water necessary at various heads to produce various amounts of energy at the switchboard. These figures are assumed to be correct, and by a series of tests a water-level gage in the tailrace of the plant is calibrated from them. The calibration of this gage can only be made when no water is flowing over the spillway. After the gage has been calibrated it is a simple matter to check the operation of any machine at a future date by simply placing a given load on the machine and reading the tailrace gage. If the efficiency has in any way fallen off this gage will register a larger amount of water flowing than when originally installed.

An annual, or if necessary a semi-annual, inspection is made of the complete equipment, and any damaged parts are replaced; in short, the whole unit is placed in good operating condition. At each inspection a complete record is kept of all work done and changes made. This record is always available and helps the plant superintendent to guard against future damage.

The daily report and log sheet of each generating station is prepared at that station under the direction of the plant superintendent and placed on his desk before noon of each day, covering the previous twenty-four hours' operation of the plant to 12 o'clock midnight. In this way he has before him within twelve hours after its completion the complete record which will enable him immediately to remove from service any equipment the log sheet shows to have affected the over-all plant efficiency. The system operator is immediately notified, and arrangements are made with him for the removal of the equipment from service.

After the log sheet has been approved by the plant superintendent it is forwarded to the office of the pro-

duction engineer, where it is again inspected and checked over. In this way the two men responsible for the maintenance and operation of this equipment are kept in direct touch with all the details of the operation of each plant.

It should be understood that only the main points in the system have been touched upon in this article, as it was the writer's intention only to give a general idea of its working.

Oil Fields of Kansas Partly Electrified

Among 5,000 Wells 1,100 Are Motor-Driven—Use of Central-Station Energy Increases Pumpage and Is Most Economical Method Tried

OF THE 5,000 oil wells in the Kansas field, which lies near Wichita, 1,100 are supplied with electric power by the Kansas Gas & Electric Company. The development is only a small part of what may be expected, as only about 15 per cent of the proved territory has been drilled in.

The cost per kilowatt-hour for electrical energy and items of like character are scrutinized but casually by the oil men. Their chief aim, and in fact their only aim, is to get the oil out of the ground, and they have been won to electric drive largely because they have been afforded an opportunity to observe its relative dependability as compared with that of steam, oil engines or gas-engine drive. Electrically operated wells produce oil about 95 per cent of the time, while wells pumped with oil or gas engines will average a little better than 80 per cent. At the present time the Kansas Gas & Electric Company could secure business amounting ultimately to $3,000,000 in annual revenue, if it were possible to secure the large amount of capital and sufficient material and labor with which to increase the generating and transmission capacity to serve this field.

What Electrical Energy Is Used For

Excluding the ordinary domestic and commercial services to the various towns in and around the oil field, there are five applications of electric service which may be classed as oil applications. These are: (1) Oil-well pumping, (2) water pumping, (3) oil-pipe-line pumping, (4) oil-well drilling, and (5) electrical dehydrating operations. Of these five applications the first three are on a proved commercial basis, while the last two are more or less in an experimental state. Special interest, of course, attaches itself to deep-well oil pumping, for if this field were completely electrified, one-half of the power requirements would be found in motor installations engaged in pumping oil from the individual wells.

Water pumping is the next most important application, because in this particular field water is very scarce, and it must be pumped long distances from rivers, streams and springs for the use of the drilling rigs, as well as for domestic purposes of the oil-field inhabitants. The importance of water pumping can be appreciated from the fact that in drilling the cost of water is about one-half of the total expense. Pipe-line pumping is of course necessary if the oil is to be delivered to the various refineries situated both locally and at distances varying from 20 miles to 100 miles (32 km. to 1,600 km.).

The drilling of an oil well by motor has been lately receiving considerable attention. The electric dehydration of oil is no longer in the experimental stage in the California oil fields, but there are only two plants in the Butler County field and they are receiving considerable attention from the oil men. The consumption of electrical energy in these plants is very small, but a large number of them would represent a particularly desirable load, since it would be of a high power factor and would act as an offset to the low-power-factor pumping motors.

The transmission system of the Kansas Gas & Electric Company at the present time includes 110 miles (177 km.) of 60,000-volt lines and 45 miles (72 km.) of 11,000-volt distribution circuits. Two 60,000-volt lines connect Wichita and Eldorado by different routes and run through the heart of one of the oil pools. Four outdoor substations step the voltage down to 11,000 for distribution.

Facts About Individual Installations

One of the most interesting features of an oil-well pumping installation is the motor itself. The type of motor used was especially developed for oil-well pumping purposes and represents experiments of six years on the part of the manufacturer in developing this highly specialized apparatus. The motors are designed for two horsepowers and two speeds. For light wells the motor best adapted is rated at 10 hp. at 600 r.p.m. and 20 hp. at 1,200 r.p.m. For heavier wells the motor is rated at 15 hp. at 600 r.p.m. and 30 hp. at 1,200 r.p.m. The reason for this dual horsepower-speed rating is best understood from a knowledge of the operating requirements. The average oil well requires from 10 hp. to 15 hp. while pumping oil from the well, but when it becomes necessary to pull out the rods, tubing or the casting considerable more power is required.

The motors employed are so designed that on the high-horsepower rating they will develop four times their full-load torque. This is very important when it comes to pulling rods, tubing and casing. These motors have been known to develop 125 hp. for periods of one to two minutes when a particularly bad job of pulling was encountered. The motor has six slip rings, and arrangements are provided for changing the motor connections from one rating to the other by a four-pole switch mounted on a frame of the motor. The pumping operations are always conducted on the lower horsepower since only a small amount of power is necessary and since the motor does not attain its best efficiency on the high-horsepower side.

Water-pumping installations are very little different from those encountered in any other part of the country, except that the relative distances to which the water is pumped are somewhat greater than are usually attempted for commercial work. The application of motors to oil-pipe-line pumping has not as yet become very general for the large pumping stations owing to the fact that units are large and have become pretty well standardized to operate by means of steam engines. The pipe lines pump the oil from local storage tanks into large tanks on tank farms or into the main pipe lines, running in many cases considerable distances, even as far as Chicago or the Gulf of Mexico. The main-pipe-line stations require motors as large as 1,000 hp. The pressure on some of the pipe lines is as high as 800 lb. per square inch (56 kg. per sq.cm.).

Owing to the present financial conditions it has been necessary to finance main-line extensions by special

service contracts, and the oil companies have raised no question when it came to advancing money for financing such extensions. The distributing lines on the leases belong to the oil companies and are usually built on a time and material basis by the utility. In the case of the Empire Gas & Fuel Company, however, installations have been on such a large scale that all the distribution lines and electrification work were taken care of by the company itself. Where desired, the Kansas Gas & Electric Company maintains the lines and charges for such maintenance on a time and material basis. The motors are sold at predetermined contract prices, allowing the oil companies to make various deductions from the completed price in case it desires to do some of the installation work or if it desires to leave out such items as concrete floors, etc. The price of the 15/30-hp. motor, which is the one in general use, is $1,225, and the cost of the complete installation is $2,150. The difference between the two prices is caused by construction of motor house, foundation, material and labor, setting up the motor, etc.

Because these motors are operated in nine cases out of ten by oil-field labor that knows nothing whatever about the operation of electric apparatus, the company has organized a service department to look after the customers' motors when they so desire. An experienced motor man makes two inspections a week and where necessary makes various minor repairs and adjustments. For this service the company charges the customer $3 per motor per month.

The data in Table I have been worked to show the pumping costs both with motors and with gas engines, and they show that the savings for one month are considerable on a lease of sixteen wells.

The foregoing data represent a particular instance which, while not entirely typical, can be taken as a basis for commercial work. Experience shows that about 4,000 kw.-hr. is required per month to pump the average well, and that the cost of this service at the company's present rate amounts to about $80 per well per month, while where there are a number of wells on lease the average cost of pumping with oil or gas engines is about $6 per day.

TABLE I—PUMPING COSTS WITH MOTORS AND WITH GAS ENGINES COMPARED

	Motors	Engines
Total kilowatt-hours used on W— lease	27,485	
Total kilowatt-hours used by five pumping motors	21,910	
Average kilowatt-hours per motor	4,382	
Average cost per well at $0.15 per kilowatt-hour.	$65 73	
Cost per month per well if all sixteen wells were equipped with motors	43 82	
Add $3 for service charge	46 82	
Cost per month per well if all sixteen wells were equipped with gas engines		$25 00
Add $10 for repairs		35 00
	Six Men	Nine Men
Men to take care of equipment per month	$600 00	$900.00
Cost of equipment per month	$81 32	81.25
Men's time, gas and electricity added here	1 per cent	7 per cent
Loss at $2 per barrel per month	$559.13	$3,913.91
Saving of motor over gas engine per month	3,553.94	

All oil-field power is furnished on what is known as Schedule H, oil field power rate. This schedule is reproduced as Table II.

The Empire Gas & Fuel Company is said to be by far the largest individual user of electric power for oil-field work in the country. At the present time it has approximately 1,000 motors in operation, 750 of which are used for pumping wells. This company takes its power from the 60,000-volt transmission line and through its own substations transforms it to 11,000 volts for field distribution.

At the present time the company has fourteen electric drilling equipments with which it does all of its drilling in the Eldorado fields. So far the reports show that electric drilling equipment more than pays for itself on the first well in savings made over the use of steam power. Drillers as a rule do not take kindly to changes, but we have yet to find one who has operated electric drilling equipment and has not become a convert.

TABLE II—OIL FIELD POWER RATE

RATES: $2 net per month per contract hp., which entitles consumer to use during such month 30 kw.-hr.

	Net Rate per Kw.-Hr.
For the next 500 kw.-hr. used per month	$0.04
For the next 3,000 kw.-hr. used per month	.03
For the next 5,000 kw.-hr. used per month	.02
In excess of above-stated amounts	.01

PAYMENTS: The above-mentioned net rates apply only when bills are paid within fifteen days from the date thereof. When not so paid, the gross rates (being the above-mentioned net rates plus 5 per cent on the first $200 of bill and 2 per cent on the excess of bill) apply.

The Empire company does all of its water pumping for the Eldorado fields with motors. Approximately 20,000 bbl. per day is pumped from the Arkansas River, 30 miles (48 km.) distant, and is relayed from at least one station in the field. All of the company's shops are electrically equipped, and a large amount of electric lighting is used throughout the field.

It is impossible to determine accurately the economic benefits obtained from electric drive, but it is safe to say that electric motors more than pay for themselves in six months or a year, owing to fewer shutdowns, as compared with gas or oil engines. Operating costs are also reduced. Formerly where one pumper operated from four to six wells with a gas engine he can now operate fifteen to twenty with a motor. Rod trouble, as well as other troubles, is reduced. Cost of labor is minimized, as well as the number of stock repair parts required.

Operating experience shows many advantages of electric power in oil field operation. Of these the most important are economy in fuel, economy in labor costs, economy in time, possibility of accurate records, fewer accidents, less fire hazard, simplicity in operation, cleanness and quietness of operation, low depreciation and low repairs and maintenance cost.

It has always been assumed that oil-field operators were antagonistic to new methods, but it has been found that the pumpers and other field men have taken kindly to electrifying the fields.

HISTORY is to be studied and applied not for the purpose of advocating reaction. It is not the accurately informed who continually appeal to the good old times to the disparagement of the present. True history while ever a conservative force, yet holds the only warrant for real progress. It is ignorance of its teachings which leads men of good intentions to advocate either reaction or revolution, and a knowledge of its forces which aids men to promote the public welfare. That form of government which is based on the rule of the people through a republic in principle is the ultimate. There is great opportunity for improvement of administration. It is not enough that correct principles be declared in institutions, unless they result in corresponding action in practical life. Perfection requires not less effort, but more. Great privileges mean great responsibilities.—CALVIN COOLIDGE.

Dangers of Over-Complacency

This State of Mind One that Should Be Sedulously Shunned by Operators and Employees of Every Rank—Above All, the Complaint Department Is the Last Place for Such an Attitude to Be Assumed

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MORE than a century ago a noted Frenchman declared:

"Complacency is a coin by the aid of which all the world can, for want of essential means, pay its bill in society. It is necessary, finally, that it may lose nothing of its merits, to associate judgment and prudence with it."

One dictionary defines the word complacency as "tranquil satisfaction of mind and heart." . . . It will be observed therefore that complacency is not necessarily a reprehensible attribute, but it is over-complacency —the complacency without judgment and prudence— that requires attention and frequently correction.

In the public utility business in America, and especially on the Pacific Coast, during the past two or three years there has been a change of front in some particulars. In the earlier days of the development of the electrical industry and for a long period subsequently the central-station company was compelled to educate, illustrate, demonstrate, advertise and solicit in order to sell electric service. Today with many companies the conditions are entirely changed, and in some instances the motions have been completely reversed. Just at the time when the persistent labor of years was beginning to bear its best fruits, for justifiable reasons, the supply of surplus energy became diminished and in some instances gave out entirely. Applications for service poured in faster than ever before. "Prospects" that once were coy and had to be coaxed even to consider the proposals made seemed to change overnight and became friendly and familiar, and "prospects" that had been almost persuaded to change to electric drive quite suddenly became insistent in their demands and talked of their prior rights, because of offers previously made to them. The managers of power companies, on their part, who once were worried how they could get new business began to worry how they could keep new business from coming in so rapidly.

The Offensive Air of Superiority

Of course, this was considered a temporary condition —one that would last only until additional funds or more power might be available—but it lasted long enough to bring about an undesirable attitude in some directions. Big and little applicants, going into a power company's office in good faith to ask for electric service, were often received by employees and frequently by managers with an air of superiority as much as to say, "Our time has come and you may now await our pleasure." Then, with a "why should we worry?" tone and attitude, the anxious would-be customer was told that all the present supply of power had been sold, that there were three thousand seven hundred and sixty-five applications ahead of his, that he had better get busy and patch up his old plant and apply again for service at a later date, and if the Fates were kind maybe he would get it. Unfavorable comments on the power shortage situation in local papers were allowed to appear without any attention being given to them or the real causes of the embarrassing conditions being stated. No anxiety on the power company's part to explain, assist, modify or ameliorate the troubles—just an attitude of exaggerated complacency.

During this period there has accumulated a real danger to the utility company, and a reaction may be brewing that may strike at its very existence or at least impair its standing, usefulness and earning power. The public has a long memory—particularly for real or fancied wrongs—and when the right time arrives it will recall the over-complacent attitude of the company's representatives at a time when a little interest, anxiety, courtesy and consideration would have been more acceptable. If the rough edges of some of the spoken words had been trimmed off, it would have left a better feeling—and there would be fewer hurts and scars to be healed later. Too much complacency on the part of employees is irritating to a utility company's customers and also to the public. Persistence in this attitude should likewise be irritating to the responsible executives and managers of the utility company. Complacency is a twin sister of apathy and a near relative of contentment, and contentment often means stagnation. The managers of utility companies are trustees charged with heavy responsibilities—first to the public in connection with the needed service they supply, and second to the security holders, who by their confidence in the enterprise make the service possible. At no time can a utility company afford to be complacent and remain complacent, and least of all when things appear to be coming its way and it has the semblance of prosperity. Then is the time it needs most of all to ingratiate itself with its customers and intrench itself in public favor. The public may be kept quiescent and even pleased if it obtains what it wants—that is, good service under reasonable conditions—but no company ever accomplished this result through an attitude of complacency. On the contrary, over-complacency at critical times can easily undermine all the good work which may have been done previously and create a condition of antagonism and unrest which will surely hamper the business and ultimately decrease the revenues.

A Word to the District Manager

The "bug" called complacency has another direction of attack which is particularly dangerous to the company. This is through its district managers. The district manager is the head of the organization in his territory and the representative of the company as a whole and all for which it stands. It is his duty to be

a big man in the community, just as the company is a big and necessary factor in its business life. For this reason the district manager should be actively interested in all the business and community organizations—political organizations excepted. He should have a place in the chamber of commerce, board of trade, business men's clubs, improvement associations and similar associations, for they are useful and educational, and all of them more or less affect or are affected by the company's business and interests. Complacency in this direction is dangerous. The desire to let the other fellow do it should be throttled. For the district manager to say he is too busy and cannot keep up with these affairs is only an excuse. He may be busy doing less important work which might be done just as well by assistants. His duty is to know all that is taking place in his district. Perhaps he is sometimes weary and would like to stay home. It takes a mighty conscientious man to tell the difference between when he is tired and when he is just lazy. Over-complacency is liable to make a man think he's tired when he's only looking for an excuse to sit down and rest. Interest and anxiety to miss nothing are good antidotes for laziness, and these go with the brand of complacency that is associated with judgment and prudence. Most men want advancement and prosperity—that's the incentive that beckons through the daily grind of work. A man must go after what he wants, and what he doesn't want will come after him. Complacency is a finely disguised enemy of ambition—but an enemy just the same.

Complacency in Complaint Department

If there is one place more than another where a central-station company cannot afford to be complacent, it is in the complaint department. This observation applies not only to the manner in which complaints are received but also to the way in which care is taken of them. If there were less complacency in some directions, many complaints could be averted. Sometimes the operating department knows of conditions where lines or transformers are overloaded, where voltages may be low or interruptions may occur; but those in charge "take a chance" about the service, and it goes without saying that complaints usually follow. Sometimes fuses blow out, lamps burn out and appliances get out of order because of unnecessarily high voltage. Some one in authority has said, "Never mind; we'll take a chance." Again complaints pour in and consumers are inconvenienced, just because there has been too much complacency. Bills sent out for monthly consumption are not always clear and readily comprehended, and the consumer complains because he does not understand the calculation or thinks he is overcharged. This is indicative of too much complacency in the bookkeeping department. A collector is sometimes known to be a "grouch," or perhaps he is only temperamental, but at any rate customers complain about the treatment received. Some one is to blame, and probably it is that collector's chief who is too complacent about his work and takes a chance with the grouchy employee.

It is better to avert complaints if possible, but if they exist, the reporting of them should be welcomed. In the first place it gives the company a chance to remedy wrong conditions and to improve the service, and in the next place it creates an opportunity to make real friends. Nothing will please a patron more than to have his complaint received with polite consideration and to have the trouble remedied promptly. He is not only pleased but often he feels flattered that he, one of thousands of customers, by simply saying a word to a clerk in the company's office or over the telephone should start something which produces quick action and desired results. He talks it over with his wife and tells his neighbors about the splendid service furnished and how the big company had given his complaint special consideration. There is a fitting time for the company to play its trump card in connection with each complaint filed. After the complaint has been courteously recorded and passed on to the trouble department for prompt action—and after everything is supposed to have received attention—some one in the office, preferably a girl with a pleasing voice, should call the complaining customer on the telephone and inquire if everything is now satisfactory. If something yet remains to be done, it can be reported and cared for, and if everything is as it should be, the office knows it. But in either case the consumer is more than pleased, because his individuality is recognized and he feels that he counts for something.

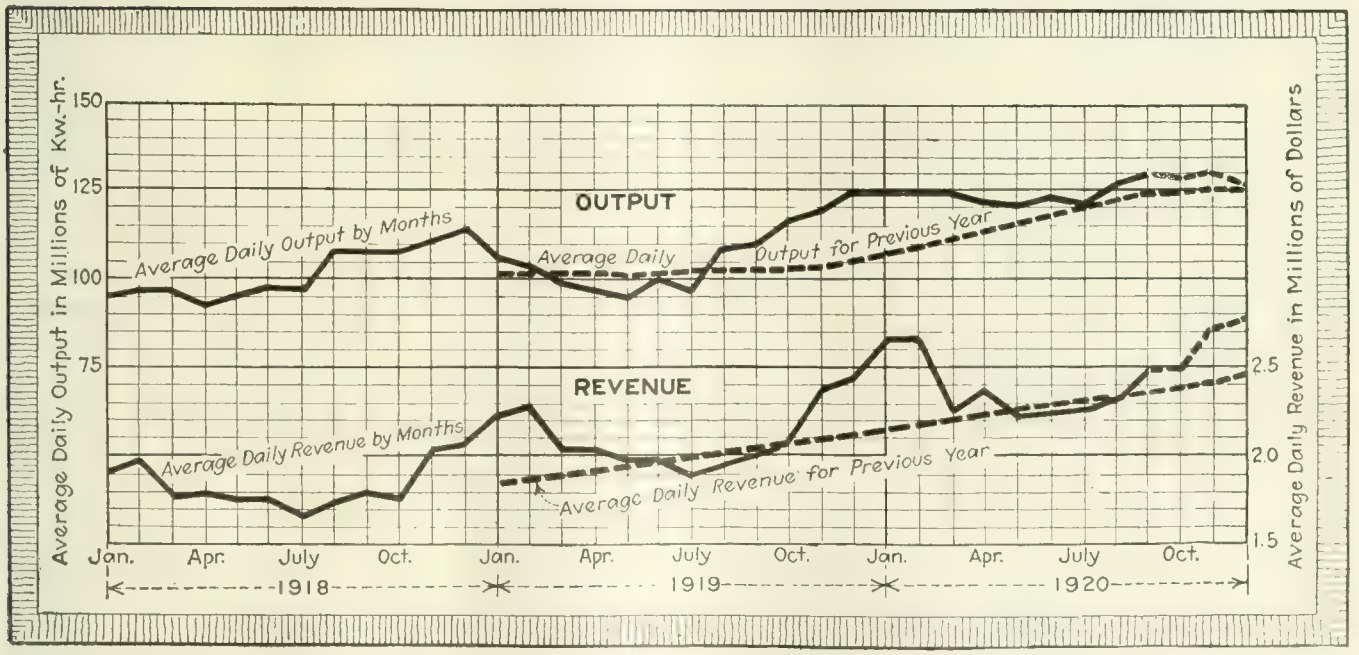
It is not altogether improbable that some day the public utility commissions will measure the standing of a central-station company by the character and quantity of complaints received and the manner in which such complaints are disposed of. When complaints are at a minimum the indications are that service is supplied at a high standard, and when complaints are many and poorly handled, then something must be wrong and some one is to blame. At any rate, in some way the commission will find out what is wrong, if the company managers don't, and the trouble will be found to be over-complacency on the part of some one who is likely a square peg in a round hole. If absence of complaints is to be one measure of good service and the proper reception and care of complaints is to be another, then some company organizations had better be reorganized. Complacency and good service have never yet traveled together and met with success. One of them must be sacrificed—and it is up to the district manager to indicate which.

Personal Appearance and Complacency

There is one other brand of complacency that is a menace to the district manager and all his assistants. It is an individual matter—sometimes even considered a delicate subject—and that is complacency regarding personal appearance. A sore cannot be cured by covering it up; it must be open to the sunlight and air. There is no use sidestepping this subject as it is important alike to the individual and the company. Some one once said that "a man may be known by the company that keeps him." As far as it goes the expression is all right, but it might well be paralleled by saying that "a company is known by the men it keeps—and that is the only way it is known." If such is the case, does each company employee, each man who is regularly seen and known as a company representative, do his part by watching his personal appearance and safeguarding the impression he creates? The answer is no. There are men in the district-manager class who set very poor examples to those under them. Then down the line there are men who ought to know better who are hurting themselves and hurting the company by their complacency as to their personal appearance. Unshaven faces are unpardonable on men whose work requires them to meet the company's customers in any capacity.

In some parts of the world where conventionalities are more closely observed a man who had to meet the public for a business organization would lose his position if he appeared for a day's work with an unshaven face. Clothes don't have to be new, but a little pride and effort will keep them clean. If a collar is supposed to be white, then it should be white as the snow on the mountain tops. If shoes are supposed to be black, then they should be as black and shiny as the face of a native in Central Africa. If a man is going to apply for a position, he usually endeavors to create a favorable impression by making a good appearance. He should be just as particular after he gets a position as he was when seeking it. Sometimes employees a little bit down the line think they are not observed and that their full value is not appreciated. If such employees only knew how much they are observed, their worries in that direction would soon cease. Some wonder why one man is sent up and another remains down. There is always a reason for promoting one man and passing by another. Sometimes the reason for staying down is too much complacency—too much self-satisfaction and not enough mental and physical activity. The well-managed utility company is jealous of its reputation and jealous of the reputation it makes through its representatives. Personal appearance is not everything, but it means a great deal, and each employee owes it to the company as well as to himself to give close attention to the impression he is making in this direction and see if he can improve it. If he is in doubt, let him ask some one who will tell him the truth. A writer has said: "Man was made for growth. It is the object, the explanation, of his being. To have an ambition, to grow larger and broader every day, to push the horizon of ignorance a little further away, to become a little richer in knowledge, a little wiser and more of a man—that is an ambition worth while." To reach out toward these ideals might well be the desire of every public utility employee. As he progresses he will be of greater value to himself and greater usefulness to the company he represents; but if his ambition becomes stimulated and he has his eyes glued to the upper rounds of the ladder of success, he will have said goodby to complacency until such time as he reaches his desired goal.

Output Decreases While Revenue Increases



CENTRAL STATION RETURNS FOR THE MONTH OF DECEMBER, 1920

RETURNS of central-station business for the month of December received by the ELECTRICAL WORLD indicated that the daily operations of the electric light and power industry during that month were only slightly below those of November, despite the industrial depression prevalent throughout the country. An increase of 6.1 per cent over December, 1919, is shown, which is far from discouraging. Moreover, another record of $2,780,000 average daily gross revenue was hung up during the month, so that while the output was practically at a standstill the revenue was materially increased.

Every section of the country except New England reported a decreased output as compared with November. Federal government reports on idle and active machinery in the woolen and worsted industries show that the highest point of curtailment for the year 1920 was reached during December and amounted to about 50 per cent, and that much of the active machinery was operated on short time. The shoe industry of New England was operating at about 40 per cent of normal, and other industries showed somewhat similar curtailments. In spite of these material decreases in power demand, however, the increased lighting load was sufficient to increase slightly the output of this section over

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Revenue from the Sale of Energy			Kw.-Hr. Output		
	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	1920 Thousands	1919 Thousands	Per Cent Increase
Jan.	57	$46,614	$39,002	19 8	2,581,096	2,186,732	18.0
Feb.	63	45,881	37,502	22 1	2,494,764	1,986,493	25.3
Mar.	65	46,155	36,840	25 0	2,698,890	2,103,587	28.0
April	65	45,547	36,541	24 5	2,603,692	2,098,559	24 1
May	65	43,888	35,512	23 4	2,631,560	2,179,916	21.2
June	66	44,434	35,528	24 5	2,630,831	2,175,645	20.2
July	66	46,608	36,265	28 5	2,677,131	2,234,215	20 0
Aug.	66	47,410	36,713	29 1	2,769,175	2,303,099	20.1
Sept.	66	49,224	38,209	28 5	2,734,179	2,327,460	17.4
Oct.*	66	51,370	41,055	25.1	2,797,625	2,499,488	11 9
Nov.†	66	54,440	44,673	21 8	2,757,447	2,493,601	10 4
Dec.‡	66	57,100	48,341	18 3	2,792,687	2,627,893	6 1

* Includes estimates for thirty-one companies, representing 5.5 per cent of the total installed rating of all central stations.

† Includes estimates for forty-four companies, representing 6.2 per cent of the total installed rating of all central stations.

‡ Includes estimates for eighty-seven companies, representing 17.9 per cent of the total installed rating of all central stations.

November, although the total output in the section was 7.2 per cent below that of December, 1919.

In the Pittsburgh and nearby districts independent iron and steel companies were running at only about 25 per cent capacity during December, but most of the Steel Corporation mills were operating at 90 per cent capacity. Operations in the textile industry of the Middle Atlantic States were from 60 to 70 per cent below those of 1919, and other industries in this district reported similar decreased operations, but to a less degree. In the South Atlantic States the output during December was about 13 per cent under that of November. The increased lighting load of the Atlantic States was sufficient, however, to bring the average daily output of the electric light and power stations to within 500,000 kw.-hr. of that reported in November.

The industrial centers of the North Central States were not so hard hit as were the industrial centers of the New England and Atlantic States. Some of the big steel mills in this section were working at 80 per cent capacity during December, but the independent iron and steel mills were operating at only about 35 per cent. The power demand of the automobile industry was about 30 per cent under that of December, 1919, and the leather, boot and shoe industries called for some 31 per cent less power. The increased lighting and heating load was sufficient to overcome a large portion of this decreased power demand, resulting in a net loss of about 4 per cent in daily output under that of November.

Curtailment in operations was general throughout the metal-mining and petroleum industries of the South Central States, but the textile industry of that section reported curtailment of less than 2 per cent. These decreased industrial activities were to a large extent offset by increased lighting requirements, but the output of the electric light and power plants of the section was about 5 per cent under that of November.

Mining operations in the Mountain States were slightly decreased during December, and non-employment was greater in this section than in any previous period during the last three years. The South Pacific section reported a decreased demand for power, while the North Pacific section reported increased output, although non-employment in the latter section was very large. The entire Mountain and Pacific Section reported a loss of about 2 per cent in daily output under that of November, which is approximately the same decrease that was reported for similar periods in 1919.

Every section of the country except the South Central States reported a record gross monthly income during December. The gross income of the South Central section, however, showed an increase of 25.5 per cent over that of December, 1919, which is the greatest yearly increase shown by any section of the country.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States		
		Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase
REVENUE	Jan.	78	$5,635	$4,718	19 8	59	$17,659	$14,625	20 9	51	$12,885	$10,799	19 6	53	$3,047	$2,538	19.9	75	$7,388	$6,322	16.1
	Feb.	82	5,354	4,368	22 1	61	17,245	14,343	20 4	55	13,191	10,403	26 0	53	2,949	2,360	24 7	79	7,142	6,028	18 3
	Mar.	82	5,136	4,044	27.0	63	17,696	14,299	23.7	57	13,270	10,469	26 5	54	2,910	2,287	27 8	79	7,148	5,741	24.2
	April.	82	5,087	3,943	29 0	64	17,700	14,383	23.5	57	12,690	10,042	26.9	54	2,952	2,181	35.2	79	7,118	5,992	19.2
	May.	82	4,897	3,741	30.1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32 0	79	7,067	6,147	15.1
	June.	82	4,948	3,778	30 5	65	16,525	13,449	22.1	57	12,412	9,776	26.9	54	2,849	2,127	33 9	79	7,700	6,398	20.5
	July.	82	5,009	3,802	28 5	65	16,899	13,438	25 5	57	12,822	9,793	30.9	54	2,747	2,194	35.0	79	9,131	6,948	31.5
	Aug.	82	5,075	4,093	24 0	65	17,210	13,731	25 9	57	13,497	10,151	32.9	54	3,168	2,281	38 1	79	8,460	6,457	31.1
	Sept.	82	5,409	4,296	25 9	65	18,081	14,456	24 5	57	13,834	10,522	31.5	54	3,262	2,386	36.5	79	8,638	6,549	32.0
	Oct.	82	5,675	4,623	22 7	65	19,201	15,722	22 0	57	14,458	11,667	23.9	54	3,504	2,551	37.3	79	8,532	6,492	31.5
	Nov.	82	5,817	5,014	17 5	65	20,924	17,112	22 1	57	14,993	12,537	19 5	54	3,851	2,906	32.5	79	8,775	7,104	23.5
	Dec.	82	6,574	5,703	15 1	65	22,357	19,090	17 1	57	15,377	13,109	17 0	54	3,779	3,008	25 5	79	9,013	7,431	21.2
KW.-HR. OUTPUT			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	207,158	159,773	29 8	60	853,057	717,303	19.2	69	841,841	731,758	15.2	56	140,736	117,677	19.9	75	538,304	460,221	16.2
	Feb.	82	187,264	148,103	26 2	62	809,865	672,836	20 1	73	858,939	663,523	29.4	56	130,473	98,098	33.0	79	508,223	403,933	26.1
	Mar.	82	198,603	148,512	33 7	64	897,327	711,828	26 0	74	913,659	711,761	28.1	56	137,306	102,545	33.6	79	551,995	428,941	28.6
	April.	82	187,174	144,922	29.1	65	883,264	701,778	25 9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May.	82	188,566	148,186	27.5	65	854,631	711,276	20 0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June.	82	189,934	149,607	26.5	66	865,714	721,688	19.9	74	855,013	681,780	25.5	56	132,733	99,660	33 2	79	587,437	522,901	12.2
	July.	82	190,668	159,000	20 0	66	881,241	714,485	23 5	74	841,351	702,302	19.7	56	138,937	106,460	30 1	79	614,934	551,959	13.4
	Aug.	82	194,028	171,002	13.5	66	905,170	728,097	24 2	74	891,712	750,787	18.6	56	147,082	111,573	32 0	79	631,183	541,640	16.5
	Sept.	82	194,730	170,593	14 1	66	905 872	758,737	19.5	74	878,237	758,017	15.9	56	147,524	113,649	30 0	79	607,816	526,464	15.5
	Oct.	82	196,310	191,132	2 7	66	964,739	841,694	14 5	74	896,241	817,757	9 5	56	157,267	126,769	24 1	79	583,068	522,136	11.7
	Nov.	82	193,262	183,580	5 2	66	952,933	825,132	15.5	74	911,573	851,577	7 0	56	144,759	125,335	15 0	79	554,920	507,977	9.2
	Dec.	82	210,993	226,947	7 1	66	971,541	908,173	7 0	74	907,693	839,933	8 1	56	142,077	134,250	5 8	79	560,383	517,580	8 8

Progress of the Superpower Survey

Annual Saving to Railroads of $90,000,000 Through Electrification and of 4,000,000 Tons of Coal by the Utilities, Together with Legislative and Financial Program, Told of by the Secretary of the Interior in the Report to the President

ALTHOUGH the complete report on the Superpower Survey of the Atlantic seaboard now being made by the Geological Survey will not be ready before the end of June, the work has progressed to the state where it has been found possible to make a brief statement showing the progress made so far and in a way indicating the scope of the investigation. Such a report was made last week by Secretary of the Interior John Barton Payne to President Wilson. It contains statements of probable economies in railroad, industrial and electric utility operations, recommendations for legislation and a summary of the suggested plan for financing a superpower system. The complete report follows:

The Congress, in appropriating for the Geological Survey, June 5, 1920, provided for the survey of power production and distribution in the United States, including the study of methods for the further utilization of water power and the special investigation of the possible economy of fuel, labor and materials resulting from the use in the Boston-Washington industrial region of a comprehensive system for the generation and distribution of electricity to transportation lines and industries.

While the final report cannot now be made, it seemed to me wise that a progress report should be submitted giving results thus far accomplished, and a brief statement of scope:

An organization was effected under the Geological Survey with offices for the engineering staff in New York City. The engineering staff includes William S. Murray as chairman, Nathan C. Grover, chief hydraulic engineer of the United States Geological Survey; Ozni P. Hood, chief mechanical engineer of the Bureau of Mines; Lorin E. Imlay, division engineer for the subjects of power and transmission; Henry W. Butler, division engineer for industries, and Cary T. Hutchinson, division engineer for railroads, with Henry Flood, Jr., as engineer-secretary. The engineering staff has been aided by the hearty co-operation of an advisory board of business and professional men, who accepted appointments for this special service. Of this board Prof. Lester P. Breckenridge of Yale is chairman, and the various interests connected with this investigation are represented as follows: Magnus W. Alexander of Boston, representing the National Industrial Conference Board; Edward G. Buckland, vice-president New York, New Haven & Hartford Railroad; Charles L. Edgar of the Boston Edison Company, representing the National Electric Light Association; Abraham T. Hardin, vice-president New York Central Railroad; Herbert Hoover, representing the mining industry; Lieut.-Col. William Kelley, U. S. A.; Elisha Lee, vice-president Pennsylvania Railroad; Dr. Arthur D. Little of Boston, representing the electrochemical and by-products industries; James H. McGraw, president McGraw-Hill Company, Inc., representing the technical press; John H. Pardee of New York, representing the American Electric Railway Association; Henry Cleveland Perkins of Washington, representing the mining industry, and Matthew S. Sloan of the Brooklyn Edison Company, representing the National Electric Light Association. The progress thus far made warrants the belief that the report will be completed by June 30, 1921.

Having in mind the objects of the Superpower Survey, namely, (1) allocation of the amount of waste in labor, coal and other materials due to the improper form of power generation and distribution within the Boston-Washington zone, and (2) recommendations regarding a regional power system by means of which these wastes may be eliminated, the Superpower report naturally divides into three divisions—(1) physical, (2) legal and (3) financial.

With regard to the physical aspect our investigation has been concerned with power necessary to (a) railroads, (b) industries, (c) utilities, and (d) a system of centralized electric generation and transmission to supply their power requirements through 1930.

Railroads

We find that there are twenty Class 1 railways included in the Superpower zone. These are divided as follows: First track, 14,500 miles; second track, 6,500 miles; total trackage (including yards and sidings), 36,000 miles. There are a total of 10,000 steam locomotives, of which 44 per cent are freight, 29 per cent passenger and 27 per cent switching. The total annual railroad coal consumption for 1919 was 19,000,000 tons.

Apparently one-third of this mileage can be economically electrified, including the greater part of the double-track mileage. Owing to lack of traffic density upon the branch lines these cannot be profitably electrified. The above 33 per cent of mileage will carry more than 50 per cent of the traffic, and by preferential arrangement of routes probably 60 per cent of the total traffic could be put over this mileage. Through the electrification of the above mileage a fuel saving of 6,000,000 tons, or $40,000,000 yearly, would be effected. Added to this saving will be $50,000,000 annually in favor of electric vs. steam engine repairs and maintenance.

The total unit cost of electrification will be approximately $40,000 per mile of main-line track, which with 12,600 miles to be electrified would cost $500,000,000. In addition, yard and siding trackage would call for $300,000,000, or a total of $800,000,000. This sum will cover the necessary construction and equipment for the railways.

The electrification above outlined will displace approximately 7,000 steam locomotives, which at a salvage value of $22,500 each will credit the electrification estimate with approximately $150,000,000, leaving a net investment of $650,000,000, which taken in connection with aforementioned savings of $90,000,000 per annum would return approximately 14 per cent on the investment.

Industries

There are approximately 50,000 industrial plants in the zone which either purchase or generate power. The Bureau of the Census is at present compiling the statistics of the 1919 Census of Manufactures. It is heartily co-operating with the Superpower Survey and will prepare on a form made up by this survey the power and fuel statistics for the Superpower Zone, which will show the power and fuel requirements in the thirty-six major industries in the following classification of plants: Plants which do not use any power, plants using only steam power, plants purchasing electric power and plants not in the above classes, classified as to size.

As soon as the tabulations are completed by the Bureau of the Census, we, in conjunction with experts in the various industries, will analyze and ascertain what possible fuel savings could have been made by the Superpower System in 1919. From the data at hand a saving of between 6,000,000 tons and 8,000,000 tons of coal is indicated. In the anthracite coal mines of Pennsylvania, by means of electrification and the supply of superpower, a conservative estimate based on actual tests shows a saving of 6,500,000 gross tons of anthracite. We are at present preparing cost estimates for completely electrifying the anthracite mines.

The data required of the industrial division will be ready by May 1 for assembly in final form.

Utilities

A large saving of coal can be effected through the more efficient generation of

power by the new superpower stations. We find that the average rate of coal consumption for present central-station output is 2¾ lb. per kilowatt-hour. Power can be produced in the Superpower System at an average rate of 1¾ lb. per kilowatt-hour. The present central-station output of coal-generated power within the zone is 8,000,000,000 kw.-hr. Therefore one pound saved per kilowatt-hour will conserve 4,000,000 tons of coal annually.

Electric Power Generation and Transmission

The location of the large superpower stations and their attendant transmission lines is related to the establishment of load centers throughout the Superpower Zone to which power will be transmitted from them at minimum distance. To date it is indicated that some twenty load centers will be established. By March 1 sufficient data will be at hand to establish these load centers, after which the location of new superpower stations and their interlinking transmission systems can be promptly determined in the zone.

The development of power outside of but for transmission to the zone is being most carefully considered, having relation to the St. Lawrence River, other hydro-electric powers and the bituminous coal mines. It has been agreed among the experts of the country that 250,000 volts will be an acceptable voltage for the transmission of power from distances greater than 200 miles and at about half that value for the zone itself

A conference with the coal authorities indicates that a fair figure to take for the average price of coal during the period of 1919 was $2.90 per ton at the mine, and during the period from that date to 1930, $3.50 per ton.

With regard to water power for the zone, a summation of the possible outputs from the Potomac, Susquehanna, Delaware, St. Lawrence (American rights), Raquette and the Adirondack powers indicates that for an average year there will be available 12,000,000,000 kw.-hr. and for a minimum year 8,360,000,000 kw.-hr., the plant capacity being 2,300,000 kw. to furnish this amount of energy. It is of interest at this point to state that in 1930 the total power requirement in the Superpower Zone indicated by projected growth curves will be 48,000,000,000 kw.-hr., of which amount the Superpower System could supply 36,000,000,000 kw.-hr. This, therefore, indicates that the water-power supply can be but from 20 to 25 per cent of the total. This fact forces the conclusion that most careful consideration must be given to the efficient development of power from coal.

The report will contain a chronology indicating time and location of superpower stations to be constructed in the order of their requirement, giving savings to be effected as their serial installation is made.

I am pleased to be able to say that through the unusual co-operation of the public utilities, the railways and the industries the completion of the work will be, after May 1, substantially a matter of computation and tabulation.

Concerning legislative and financial status the following paragraphs represent the general expression of opinion at the Washington meeting of the advisory board on Feb. 18.

Legislation

Legislation should take the form of an act permitting the formation of a corporation authorized to take by eminent domain lands or interests therein necessary or appropriate to the construction, maintenance and operation of lines for the transmission of electric energy. Such legislation may be by a separate act or by an amendment to the Federal Power Commission law.

As a condition precedent to the formation of such a corporation the proposed incorporators should be required to apply to the Federal Power Commission for a certificate that the project is desirable and is justified in the public interest. This application should be followed by a hearing after due notice to the governors of the states through which condemnation rights are asked. If the certificate is granted, the incorporators should be permitted to form a corporation with the usual powers and in addition thereto (subject to the approval of the utility commission of the state where the power is to be exercised) the right to construct, maintain and operate power plants and transmission lines and the right to purchase electrical energy from and sell it to electrical power producing and distributing companies. All of these rights should be subject to the exercise by each state of its full police and taxing power.

It will be observed that herein no new right is created as against any state, except that of taking by eminent domain the location of a transmission line for the transportation of electrical energy in interstate or foreign commerce. Each state retains unimpaired power to fix rates, to determine the character of structures and to lay and collect taxes to the same extent as such authority is exercised over power producing and distributing corporations of its own creation.

Financial

The plan of financing which has been suggested is based on the supposition that the Superpower System is in its very nature an extension of present power supply systems whereby, combining several large plants with present relatively small plants, economy in generation and conservation of natural resources can be secured over that at present attained. Therefore the vested rights of existing public utility power generating and distributing companies should be protected.

Dependence must be placed on the incentive of private initiative to lower costs and on some form of public regulation of prices to the consumer. The power generated and distributed by the Superpower System will finally be distributed to the public by means of existing companies, and the economies to the public utility companies which will result must ultimately be reflected in prices to the consumer through the action of the state regulating bodies.

The financial plan in bare outline provides for a superpower company with non-par stock as its only class of security. The public utilities within the Boston-Washington zone are to be entitled to subscribe for this stock pro rata, based upon capacity demand and load factor, stock not taken by these customers of the Superpower System to be offered to public subscription.

A contract between the superpower company and a local public service company would be a selling contract or a buying contract, while in many cases both buying and selling of electrical energy would be involved. These contracts, on which the state regulatory bodies would pass, would be adjusted from time to time to meet the progress of the art and changing conditions, whether favorable or unfavorable to costs of operation.

Returns upon the stock of the superpower company should be limited by specific provision to a fair division of the benefits derived from its operation between the investing public and the consumers that will make it possible for the superpower company to come into existence and at the same time be able to serve the public adequately. New capital is the keystone of the project, but the public demand is its foundation. This division of benefits would be attained by a rule under which the customer companies shall participate equally with the stockholders in any distribution, at stated intervals, of net earnings in excess of a specified rate of return, which itself should be more liberal than is commonly contained in the idea of public regulation. Thus efficiency in management would be rewarded and the public interest directly served. To secure the participation of the ultimate consumer in this division of benefits, provision should be made that the superpower stock held by any public service company be regarded as representing an extension to its existing station capacity rather than an outside investment security.

Absolute publicity of the superpower company's operations will be an essential condition. Freedom of action should, however, be also sought for this company in order to promote the free flow of capital to this enterprise, whose requirements will be large and continually increasing.

The prime object of the superpower plan is a larger supply of cheaper power. The Superpower Survey looks to the full utilization of all resources, and conservation of the country's fuel cannot be attained except with the aid of large capital investment. Neither the nation, by coal conservation, nor the individual consumer, by lower rates, can profit by the project, however sound in its engineering and economic phases, unless the conditions of financing are sufficiently attractive to warrant the use of the country's financial resources.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Business Situation of Electrical Industries of Germany and Austria

To the Editor of the ELECTRICAL WORLD:

SIR: Important developments are taking place in Germany's electrical industries which will not be without effect on similar affairs in Austria. Considerable increases in capitalization are being made in Austria. These follow one another rapidly, with a fusing of neighboring and related industries, such as that recently accomplished by the imposing Elektromontankunzern (Electro-mining Artificers). This more closely knit relation between the great electrotechnical firms and their important mining activities on the Rhine and the Elbe has two aims in view. First, it would strengthen the financial basis of the electrotechnical industries. Second, it hopes to provide the foreign complexion, due particularly to American participation, with a domestic counterweight that shall influence both the preferred shares with their multiple voting powers and also more extensive capitalistic interests. On the other hand, the sources of supply of raw materials have been expanded, thus enabling the electrotechnical fabricators to work with their own products all along the line from raw material to finished article.

Of course, the German electrical industries must not curtail their expansion if they are to maintain their world position, and it is a tremendous one to defend. Intimately allied and intertwined as these industries in Germany and Austria are, the latter is of much more modest dimensions; but it also shows no lack of endeavor.

Austria must see to it that her field of trade in the new national states—particularly in Bohemia and Hungary—is not undermined by the active local establishments and that the Near Eastern market is not alienated. So far Austrian firms have successfully maintained their positions. Their activity still continues at an unusually high pitch, maintained chiefly by the large government orders for materials destined for the electrification of the state railways of western Austria (in the Vorarlberg and elsewhere). But private deliveries are also satisfactory.

Electric power companies, however, are suffering some restriction in their financing efforts. Their activities have consisted heretofore in obtaining concessions and building power plants at their own expense, eventually maintaining them by selling power. The recession in the promoting of such installations is primarily due to the efforts of many communities to build their own electric power plants or, in cases where private plants are already in service, to exact penalties from them.

The future of the electrical industries seems to rest particularly in the execution of the water-power projects proposed and now holding first place in the plans for economic reconstruction of Austria is adopted by the Reparations Commission. S. SILBERSTEIN.

Vienna, Austria.

[This letter was dated Dec. 28, 1920. Before it was received the Austrian government had asked the Allied Powers to take over the administration of its affairs, and on Jan. 25 the United Press reported that the Inter-Allied Supreme Council had appointed a commission to determine what must be done toward the rehabilitation of Austria. No official statement, a Vienna dispatch under date of Feb. 5 asserts, has yet been received as to decisions taken. The policy adopted in the final program of reconstruction toward the movement reported by Mr. Silberstein will be of interest—EDITOR.]

Consumers' Power Company Does Not Think Straight Rates Better than Combination

To the Editor of the ELECTRICAL WORLD:

SIR: The writer's attention has been called to an article in the ELECTRICAL WORLD for Oct. 2, 1920, entitled "Straight Rate Better than Combination, in Opinion of Michigan Company." In this article it is stated that the Consumers' Power Company in its Grand Rapids district has contended that a straight rate is better than a rate based on connected load plus an energy charge, etc. I do not know the source of this information, but it certainly did not come from any officer of the company, for I am sure they all agree with rate-making authorities generally that a rate based on demand or connected load plus a running charge is much better for all concerned. As a matter of fact, that is the basis of virtually all of the rates charged by the Consumers' Power Company throughout the entire Michigan territory.

The rates of the Consumers' Power Company in Grand Rapids have been for some time for lighting purposes as follows: 8 cents per kilowatt-hour per month for the first 30 kw.-hr. used of connected load, 6 cents for the next 30 kw.-hr. and 4 cents for the excess. A few months ago the company asked the city authorities to agree with it on a slight increase and suggested: 9 cents per kilowatt-hour per month for the first 60 kw.-hr. used of connected load, 6 cents for the next 60 kw.-hr. and 5 cents for the excess.

The city authorities did not agree to make all of the changes the company suggested, and the residential rates remain as first stated. The city authorities, however, did give the company permission to charge an 8-cent flat rate per kilowatt-hour for commercial lighting, with an optional rate of $3 net per kilowatt per month plus a current charge as follows: 5 cents net per kilowatt-hour for the first thirty hours' use per month of the active load, 4½ cents net for the next thirty hours' use and 4 cents net for all energy used in excess of sixty hours' use per month of active load.

The city authorities have consented to the company's increasing its power schedules in various ways. I am writing you on this subject simply that you may have a correct understanding of the situation and that you may not by your reports indicate to readers that the Consumers' Power Company's officials are advocating straight rates per kilowatt-hour. Such is not the case, and we believe such rates, generally speaking, are unscientific and not productive of good results.

B. C. COBB,
President Consumers' Power Company.

New York City.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Cable Ducts Lowered 12 Ft. Without Service Interruption

TWO underground duct lines containing important feeders were recently lowered 12 ft. in Minneapolis without interrupting service over the cables. The city decided to depress a roadway 12 ft. in order to eliminate a grade crossing, and the central-station company was confronted with the problem of lowering its duct lines. It was at first thought that it would be necessary to take up the old ducts, discontinue the service and put in a new set of ducts after the street had been lowered. It was soon decided, however, that service must be maintained while the change was being made, and instead of tearing up the old ducts they were gradually lowered to the new level without disturbing the cables or the service, and at a cost between $10,000 and $12,000 less than the expense of removing and replacing would have been.



LOWERING DUCTS CARRYING 30,000-KW. LOAD

The street on each side of the ducts was first cut away to the desired level. Then the ground was further cut away under the ducts at points 10 ft. apart and a trestle erected of 6-in. x 6-in. uprights and cross-ties, as shown in the photograph. Two 2-in. x 10-in. planks were stood on edge on top of the trestle 1 in. apart, parallel to the road. The duct line was supported by long ⅝-in. bolts which passed between the two timbers, on top of which was placed a washer and nut for each bolt. Short cross-ties were slipped under the duct 2½ ft. apart, and a loop of ⅜-in. guy wire was passed around each end of a tie and through a pivoted eye on the lower end of the bolt. When all the bolts had been adjusted to take up the tension a scoop shovel was used to take out the remainder of the earth underneath the ducts, leaving them in suspension as shown.

In lowering, the nuts on every other pair of bolts were given three turns. Then the alternate supports were lowered by three turns of the nuts. When the ends of the bolts had been reached the nuts were taken off every other pair of bolts and the guy-wire loops were lengthened out by about the length of the thread on the bolts. The bolts were then put back in position, the nuts screwed down to take up the strain, and the entire process repeated until the ducts reached the new level.

Overhead-line material was used almost exclusively, and with the exception of the short lengths of guy wire and lumber, everything was credited back into stock when the job was completed. The ducts contained eight three-conductor No. 4/0 13,200-volt cables carrying a load of 30,000 kw. There was also one telephone cable. With the exception of the manholes, all of which had to be replaced, the line as now operating on the lower level is the same as the one originally installed on the higher roadway.

S. B. HOOD,
Superintendent of Distribution.
Minneapolis (Minn.) General Electric Company.

Scheme to Determine Whether Distribution Secondaries Are Overloaded

A SCHEME to calculate voltage drop on secondary distribution lines with loads distributed irregularly is embodied in the accompanying table and explanations. Overloaded secondaries may be spotted quickly by using this scheme in conjunction with a map showing secondaries, consumers, transformers and poles.

The table takes as standard a maximum voltage drop of 2 per cent for single-phase lighting circuits with a power factor of 0.95 and a maximum drop of 4 per cent on polyphase circuits with 0.80 power factor. The table is based on the fact that ten consumers or houses one span from a transformer will produce the same voltage drop as five houses two spans away or one house ten spans away. Each house is assumed to take 100 watts and each span is taken as 100 ft. (30 m.). An expression coined for this table is "house span." To get the "house spans" at one pole, multiply the number of houses connected to the pole by the number of spans between that pole and the transformer. The total house spans on a transformer is the sum of those at each pole. If the average span is more than 100 ft., the house spans must be correspondingly increased. Thus in the illustration the sum of the products is 0 + 1 + 0 + 9 + 8 + 10, etc. = 74, and since the average span is

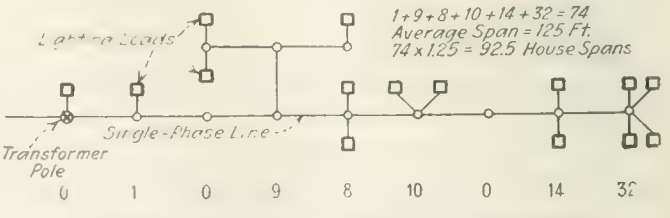


DIAGRAM EXPLAINING METHOD OF CALCULATING SECONDARY VOLTAGE DROP

125 ft., the value 74 must be multiplied by 125/100, giving 92.5 house spans. Turning to the table we find that a No. 5 three-wire or a No. 2/0 two-wire circuit is required. If the wire is actually smaller than this, the voltage drop is more than 2 per cent. If these

TABLES USED TO FIND OVERLOADED SECONDARY CIRCUITS—SINGLE-PHASE LINES

Maximum voltage drop, 2 per cent power factor, 0 95

Size Wire, No.	Two-Wire 110 Volts House Spans	Power Loss, Per Cent	Three-Wire, 110-220 Volts House Spans	Power Loss, Per Cent
6	28	2 1	84	2 1
5	34	2 0	102	2 0
4	41	1 9	123	1 9
3	50	1 8	150	1 8
2	61	1 7	183	1 7
1	73	1 7	219	1 7
0	87	1 6	261	1 6
2/0	103	1 5	309	1 5
3/0	118	1 4	354	1 4
4/0	139	1 3	417	1 3
Column	(1)	(2)	(3)	(4)

TWO-PHASE OR THREE-PHASE LINES

Maximum voltage drop, 4 per cent power factor 0 80

Size Wire, No.	220 Volts H.P. Spans	Power Loss, per Cent	440 Volts H P Spans	Power Loss, per Cent
6	39	5 0	156	5 0
5	47	4 7	188	4 7
4	56	4 4	224	4 4
3	66	4 1	264	4 1
2	77	3 8	308	3 8
1	89	3 5	356	3 5
0	102	3 2	408	3 2
2/0	115	2 8	460	2 9
3/0	130	2 6	520	2 6
4/0	144	2 3	576	2 3
Column	(5)	(6)	(7)	(8)

Frequency, 60 cycles. Spacing of conductors per N. E. L. A. standard cross arm.
"House spans" (columns 1 and 3) = 100 watts (assumed load for one house a distance of 100 ft. (assumed average length of span).
"H. P. span" (columns 5 and 7) = 1 hp. a distance of 100 ft., assuming 1 kw. load on secondary for 1 hp. output of motor.
Power loss (columns 2, 4, 6 and 8) = loss assuming load all taken at one point for voltage drop of 2 per cent in columns 2 and 4 and of 4 per cent in column 6 and 8.
Capacity of three-wire circuit taken as three times that of two-wire instead of the theoretical four times, to allow for unbalance.

particular houses take 200 watts each, the house spans should be further multiplied by 2.0, thus making 185, and a No. 2 three-wire circuit is required. The "H.P. spans" are used in the same way, substituting the number of horsepower actual load supplied from each pole for the number of houses. The corresponding power loss is given in each case, but the values given are strictly correct only when the load is all supplied from some one pole.

This information was presented by George S. Humphrey, electrical engineer West Penn Power Company, at a recent meeting of the Pennsylvania Electric Association. FIELD EDITOR ELECTRICAL WORLD.

New York, N. Y.

Maintenance of Feed-Water Pumps Prevents Breakdown

THE boiler-feed pump is one of the most vital pieces of equipment in a power plant, and the parts which usually need the most attention are the packing, plungers and valves. If the valves are allowed to become unduly worn and leaky, the pump will jerk and slam from one end of the stroke to the other. Furthermore, the pump will probably have to run about a third faster than normal in order to keep water in the boilers, and that means that one-third more steam is required to do the work. In trying to do its work with leaky valves the pump may also pull the piston rod out of the plunger, break a rocker arm or do damage to other parts of the equipment.

Leaky packing may be caused by uneven wear on the plungers. If the packing is tightened, the pump may force the plungers through it, but the packing will be loose near the middle of the stroke, while at both ends it may be tight enough to stop the pumps or it may break a gland or a stuffing box. These are a few of the troubles that are caused by the neglect of the simple maintenance work of truing up plungers and valves before they cause serious damage. JOHN M. MAY,

Traveling Engineer.

Iowa Railway & Light Company,
Marshalltown, Iowa.

Hauling Transformer Cases on Mountain Roads by Caterpillar Tractor

MUCH of the heavy equipment for the Kerckhoff power house of the San Joaquin Light & Power Corporation (see ELECTRICAL WORLD for Feb. 26, page 471) was hauled over the mountain roads from Auberry



HAULING 5,000-KVA. TRANSFORMERS FOR THE KERCKHOFF PLANT

by means of a 75-hp. Holt caterpillar track-laying tractor and trailers rated at 10 tons and 35 tons. This photograph shows six 10-ton trailers following the tractor around a curve, each trailer carrying a 5,000-kva. transformer. The trailers are of the cross-connected-reach type, so that both axles turn, causing the trailers to track. This train can carry more than 50 tons, and the speed and ease with which it negotiated the steep mountain grades and sharp turns facilitated construction work and reduced the cost of transportation. The maximum grade in this 5½-mile haul was 12 per cent approximately.

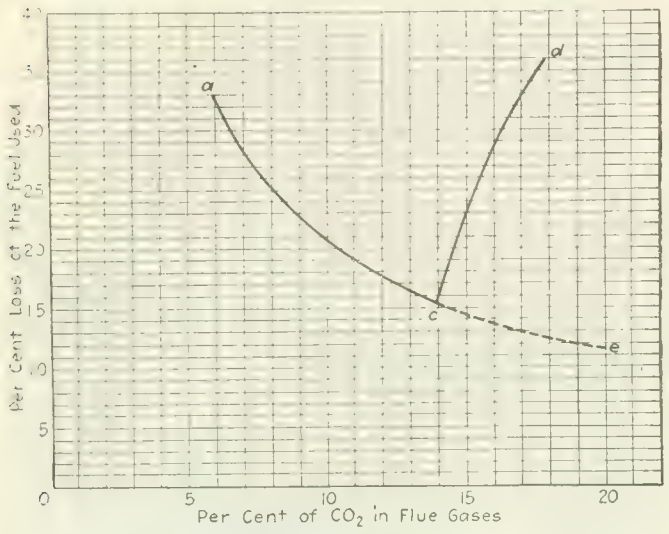
The heaviest piece of equipment hauled weighed 58,000 lb. This was hauled without difficulty on a 35-ton Holt trailer with steel wheels 60 in. in diameter and with 14-in. tread. The haul of 5½ miles was made in four hours, including time for loading and unloading. The total tonnage hauled by this method was 978 tons, of which thirty-nine pieces of machinery ranged in weight from 10 tons to 29 tons each. The average cost of hauling by this method was 13½ cents per mile.

R. C. STARR,
Construction Engineer.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Kinds of Chimney Losses and Their Relative Importance

HEAT is lost up the chimney in two distinct forms, namely, the sensible heat of the entire volume of flue gases and the heat represented by the chemical energy in unconsumed combustible gases. The amount of the sensible heat is a function of the temperature and the volume of the flue gases. The amount of heat lost in the form of chemical energy is a function of the heat of combustion of the unconsumed gases and their volume. The loss of heat represented by a certain per-



FLUE LOSSES WITH VARYING AMOUNT OF CO_2

a-c-e—Ideal conditions; no combustible gases present. *a-c-d*—Practical conditions; combustible gases appear after percentage of CO_2 passes point *c* per cent when air supply is excessive.

centage of unburned combustible gases in the chimney is much greater than the loss of heat due to excess air represented by an equivalent percentage of CO_2.

To burn fuel completely a surplus of air is necessary over what would be theoretically correct. The amount of this surplus varies constantly, depending upon the many different factors that influence combustion. However, maximum efficiency under practical conditions is attained when there is just enough surplus air to make complete combustion possible, that is, combustion without the escape of combustible gases up the stack. It is at that point that a reduction in the air supply results in an unnecessary waste of energy through the carrying away of sensible heat by excess volumes of flue gases.

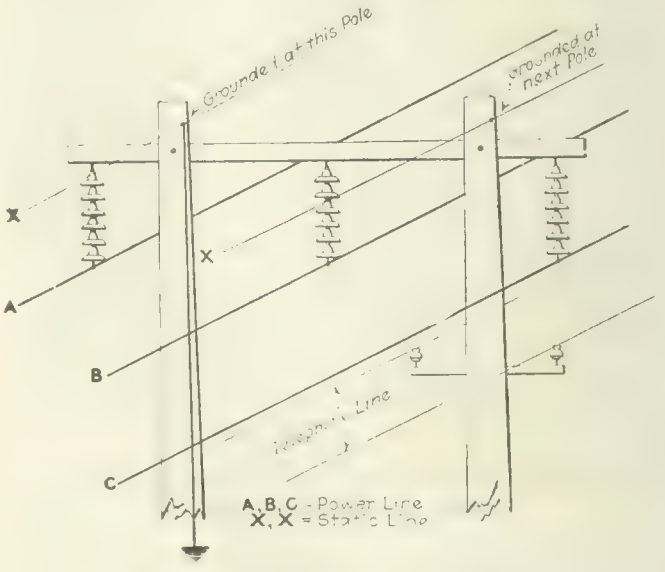
An idea of the magnitude of the fuel losses due to the escape up the stack of combustible gases when the air supply is insufficient, as compared with the losses due to the presence of excess air, may be gained by a comparison of the curves *a-c-e* and *a-c-d*. In *a-c-e* is a curve showing the fuel losses which take place with varying percentages of CO_2 (varying inversely with the excess air supply) in the flue gases, provided there are no combustible gases present. However, combustible gases (CO, CH_4 and H_2) are bound to begin to form at some point as the percentage of CO_2 is increased (air supply decreased), and, as mentioned before, losses due to the formation of these combustible gases are far greater in proportion to their volume than losses indicated by equivalent proportion of CO_2. This is graphically illustrated in *a-c-d*, where the portion *c-d* in the curve represents fuel-heat losses that develop beyond the point *c* where combustible gases begin to form, as the percentage of CO_2 is still further increased by reducing the air supply. The point *c* is the critical point. It is the point where combustion takes place with the greatest economy in fuel consumption. It varies not only in different furnaces, but varies constantly in the same furnace. The curves shown were plotted from generally accepted average values. They show that CO_2 readings alone cannot be depended on.

OLOF RODHE,
Chief Engineer.
Mono Corporation of America,
New York City.

Telephone Noises Reduced by Double Overhead Ground Wire

NOISE on a company telephone line using the same poles as a power line has been considerably reduced by running two grounded wires near the tops of the poles above the transmission line in the manner indicated in the accompanying sketch. The line is operated at 66,000 volts but insulated for 110,000 volts, the construction being of the A-frame type and the poles 400 ft. apart. The "static" wires were run above the cross-arm and were grounded at alternate poles.

A probable explanation of the reduction in noise on the telephone line is as follows: The transmission line consists of three conductors equally spaced in a horizontal plane, and the ground wires are installed symmetrically with respect to the transmission line and in a plane above it. The ground wires form a closed circuit every 400 ft., at the points where they are connected to ground. Under no-load conditions there is a voltage induced electrostatically in each ground wire. These voltages are of different phase and consequently cause a current to circulate in the loop formed by the ground wires. The current flowing in this loop is of sufficient duration to neutralize the electrostatic effects of the transmission wires. The effect on the adjacent telephone



GROUND WIRES WHICH REDUCE TELEPHONE NOISE

line is to reduce slightly the amount of voltage induced. Under loaded conditions the effect of the currents in the different wires is to induce electromagnetically a voltage in the ground-wire loop and cause current to flow which reduces the voltage induced by the transmission-line currents.

R. H. N. LOCKYER.
West Kootenay Power & Light Company,
Trail, B. C., Canada.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Call System Increases Work of Electric Tractors

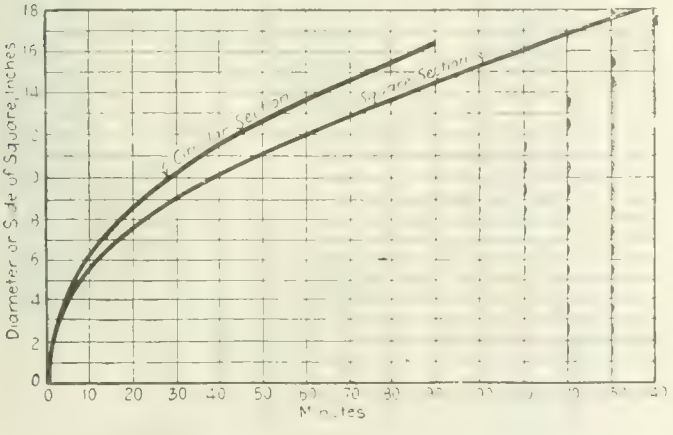
TO KEEP the industrial tractors busy in a plant in Connecticut a twenty-drop annunciator is installed at a central yardmaster's office. Each tractor when idle returns to the office and awaits a call. The numbers on the annunciator correspond to stations in various departments. Sometimes ten or more calls are shown on the annunciator at once. Then the most important departments are attended to first. When one tractor leaves, its call number is chalked on a slate so that the other machines may be sent elsewhere.

A record is kept of all calls. The result of this record soon convinced the firm that one particular department needed a tractor of its own, which was soon procured.

Boston, Mass. S. R. HOWARD.

Castings Cut Economically by Electric Arc Process

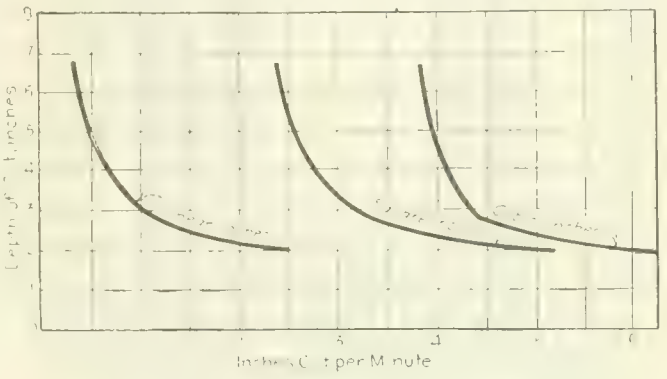
CUTTING steel and iron castings by the electric arc has proved both economical and speedy. In the field of steel castings the arc process is less expensive and as a rule sufficiently accurate and rapid to prove thoroughly satisfactory for cutting off risers and sink heads, and frequently to rectify errors in castings due to mistakes in design or building patterns, such as incorrectly located pads, omitted cores, cored holes that are too small, etc. In the field of gray-iron castings the arc process is much superior from an operating cost standpoint and possibly is faster than the relatively expensive high-pressure gas-cutting devices. The accompanying curves indicate the speed of cutting cast-iron sections using about 600 amp.



TIME REQUIRED TO CUT CAST IRON WITH ELECTRIC ARC

For cutting, the graphite electrode is generally used with current values of from 150 amp. to 800 amp., depending upon the class of work, the speed desired and the capacity of the electrical equipment. For example a ½-in. medium-steel plate can be cut at the rate of about 1 ft. (0.3 m.) in twelve minutes, using 150 amp., or about 1 ft. in about one and one-quarter minutes using 400 amp.

Cutting can be done with the metallic electrode process, employing bare wire or heavily wrapped wire. To use the bare wire it is necessary to operate the electrode



RATE OF CUTTING CAST IRON WITH ELECTRIC ARC

at a much higher current than for welding, which results in scattering the metal and making it difficult for the operator to maintain the arc. The wrapped electrode is undoubtedly better suited for this work, especially if it is dipped in water frequently during the operation. In fact, it is possible to cut with this combination in cases where it is out of the question to use the graphite process. For example, during the war the British navy used water-soaked, heavily wrapped electrodes for cutting holes 2 in. (5 cm.) in diameter and several inches deep in armorplate on battleships for attaching rigging to afford protection against submarine torpedoes.

These remarks were made by A. M. Candy, Westinghouse Electric & Manufacturing Company, at a meeting of the American Foundrymen's Association.

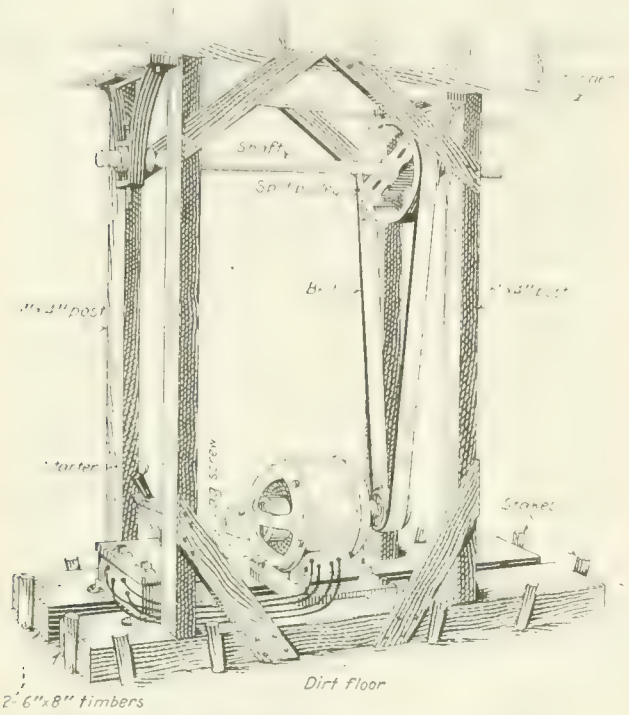
New York, N. Y. FIELD EDITOR ELECTRICAL WORLD.

Emergency Mounting for Motor

A QUICK job in setting up a 50-hp. motor to drive an overhead-line shaft was called for by the breakdown of a steam engine driving the tumbling barrels for cleaning castings in a New England manufacturing plant. This job was accomplished by setting the motor on two heavy timbers as shown in the sketch and bracing these timbers against the roof stringers by means of upright posts.

The tumbling barrels were driven by the engine in an adjoining room, the main shaft being overhead through both rooms. When the engine's piston rod broke, an old type 50-hp. induction motor was hurriedly transported from the stock room. The motor was placed on two 6-in. x 8-in. timbers laid on the dirt floor in a space directly under the shaft, and the timbers were braced under the overhead stringers by 3-in. x 4-in. posts. After leveling the timbers with shims the motor

was secured by four heavy lag screws, a split iron pulley was clamped to the shaft above and a 6-in. belt was hurriedly laced on. A four-wire line directly over the roof, driving the near-by blacksmith shop, was hastily spliced into, and the leads were carried in through an open window to the starting compensator on the floor



MOTOR WAS QUICKLY SET UP ON THESE TIMBERS FOR EMERGENCY USE

and thence to the motor. The bearings were oiled and the direction was tried, and in exactly two hours from the time of the breakdown the tumbling barrels were running again, this time by electric power. All the work was done by two millwrights, an electrician and a belt man.

H. S. RICH.

East Berlin, Conn.

Direct-Current Motors Kept in Synchronism in Paper Mill

DIRECT-CURRENT motors driving paper machines in the mill of the Crown-Willamette Paper Company, West Lynn, Ore., are made to operate at the same relative speeds under varying loads by coupling them with smaller synchronous motors connected in parallel. When the speed of a direct-current motor tends to drop the synchronous motor holds it up.

This drive consists of one unit for each section of the paper machine. Each unit consists of a direct-current motor and a synchronous motor of about 20 per cent of the rating of the direct-current motor, the synchronous motor being coupled with the direct-current motor through a reduction gear and a belt running on a pair of slightly tapered cones, which permit of a total range in speed of 12 per cent. The motors and cones are mounted on a common base and directly connected to one section of the paper machine. All of these synchronous motors are connected to a common bus not tied to any other line. They are excited from an exciter bus. The direct-current motors are all started from one central remote-control panel. The synchronous motors are started at the same time by the belts and gears. Since they are all connected to the same bus they will start and run in synchronism.

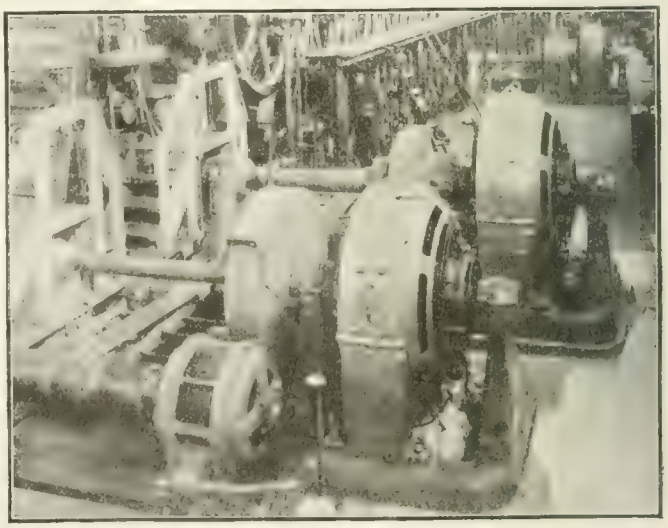
Under actual operation any change in the load on a particular section caused by changing the weights or otherwise altering conditions will be absorbed by the synchronous machine. If the load increases, it will act as a motor on that particular section and draw its power from the remaining synchronous machines, which will immediately act as generators and distribute the load over the entire drive. If the load decreases, the synchronous machine will act as a generator and supply power to the remaining synchronous machines, which then act as motors. Any change in load on any section is therefore distributed over the whole motor equipment and may change the speed of the paper machine as a whole but cannot cause any change in the relative speeds of the various sections.

So long as any synchronous machine operates within its rating either as a motor or as a generator it will not be necessary to make any adjustments, but if the indicating wattmeter in the synchronous machine circuit shows too much power it may be easily brought back to zero by turning the rheostat in the direct-current motor field.

The speeds of the different sections of the paper machine are not all the same. There is a slight increase from the wet end to the dry end, and this difference may vary slightly for different grades of paper and under different operating conditions. This variation is called "draw" and is taken care of by shifting the belts on the cones, which can change only the direct-current-motor speed since the synchronous-motor speed is fixed.

Each direct-current motor has a drum controller and rheostat in its circuit for individual starting, the last point of this controller being in the auxiliary circuit of the contactor which connects the synchronous motor to the dead bus. The actual closing of this contactor is by means of a push-button, but it can only be closed when the controller is on the last point.

The auxiliary-control panel controls the speed of the



SYNCHRONOUS MOTOR IS BELTED TO DIRECT-CURRENT MOTOR AND CONTROLS ITS SPEED

entire paper machine as a unit. When starting as a unit the drum controllers in the direct-current motor circuits should all be on the last point, with the synchronous motors connected to the dead bus. The starting button on the auxiliary panel will close the line

contactor on the motor-generator panel, applying a low voltage to all of the motors and turning them over at a low speed. To bring the machines up to speed the generator field is strengthened by turning the hand wheel on the auxiliary-control panels. This equipment, the first of its kind applied to paper mills, was developed by the General Electric Company.

New York, N. Y. FIELD EDITOR ELECTRICAL WORLD.

How to Clean a Dirty Motor Before Repairing

FOR cleaning a dirty motor before it is turned over to a repairman the writer uses a very effective method. After the end bells are moved and the rotor is taken out sawdust well soaked in gasoline is placed on the coils and laminations and rubbed into the cracks and along the wedges. Then the sawdust is blown out with compressed air, leaving the motor free from grease and dust. In order to protect the man who does this cleaning a helmet was made from a piece of canvas with a copper wire mesh inserted to look through. This keeps the sawdust from the head and neck of the cleaner.

This method of cleaning has been found much better and more economical than using gasoline and waste. In this plant there are more than 200 motors of different types, and these are used in some dirty places, such as blacksmith shops, grinding rooms and foundries. The method works satisfactorily on the dirtiest of the motors.

N. S. DAVIS.

Batavia, N. Y.

Energy and Plant Requirements for Artificial Ice Storage

THE accompanying tabulation gives the power consumption under the various conditions existing month by month for the storage of artificial ice near centers of high summer demand for the purpose of minimizing summer haulage and maintaining a high annual production factor in a few large ice-manufacturing plants. During the months of September, October and November, 1919, there was virtually an empty storage house, and it was possible to eliminate the refrigeration in those compartments of the house which had been emptied. From Sept. 25 to Oct. 13 no refrigeration at all was furnished, except to the lobby, and during that time ice was supplied direct from the main plant to consumers. The low energy consumption during the month of December, 1919, and January, 1920, was caused by low outside temperature, which averaged below the freezing point and necessitated almost no refrigeration.

The energy consumption is almost directly proportional to the total number of heat units admitted to the building and is independent of the amount of ice in storage as long as the temperature of the ice is kept below the melting point. The temperature of the storage space is maintained continuously at from 24 deg. to 27 deg. Fahr. (4.5 deg. to 3 deg. C.), with an estimated average of 26 deg. Fahr. (—3.3 deg. C.). The figures in the accompanying table give an average monthly energy consumption under normal operating and temperature conditions of about 155 kw.-hr. per degree difference between the average inside and average outside temperature. This figure can only be applied, however, to this storage house or to one of identical construction and exposure. It will be noted that more energy is required during both very cold and very hot months, and this is due to different causes.

During the coldest days of the low-temperature months no refrigeration was required, and all of the energy was used for refrigeration on the warm days. The amount of refrigeration was therefore entirely dependent on the difference between 26 deg. and the average temperature of the warm days, and not upon the average of all of the days of the month. An average for the entire month would be lower on account of the effect of the extremely cold days.

ENERGY REQUIRED TO STORE ARTIFICIAL ICE IN ST. LOUIS

Month 1919	Kw.-Hr	Tons in Storage, Average for Month	Average Daily Outside Temperature, Deg. Fahr.	Kw.-hr. ÷ Outside Temperature 26 Deg. Fahr.
January	2,290	3,659	37.8	197x
February	1,800	4,453	36.7	168
March	2,800	4,572	47.1	133
April	4,130	4,586	57.5	131
May	5,760	4,597	63.0	155
June	14,250	4,128	77.3	278x
July	14,480	3,137	81.6	260x
August	9,090	2,130	77.1	178
September	4,890	838	73.6	103x
October	5,070	47	60.8	146
November	3,160	730	44.8	168
December	870	1,648	29.6	242x
1920				
January	760	2,118	28.4	317x
February	1,900	2,822	34.8	216x
March	3,289	3,744	46.6	160
April	4,380	4,320	51.2	173
May	7,570	4,491	64.8	195x
June	13,820	4,386	75.2	280x
July	13,740	3,712	78.8	260
August	10,710	2,778	75.1	218x
September	10,050	2,175	72.5	218
October	5,450	1,528	64.0	143
November	2,980	1,192	43.7	168
December	1,580	1,162	37.5	137

The total of items in the last column not crossed is 1,860, or an average of 155 kw.-hr. per deg. Fahr. difference in temperature.

The high electrical consumption in the hottest month is ascribed almost entirely to the effect of the very frequent opening of the portholes and doors in the storage house. It is during these hot months that ice is unloaded from storage, and there is also a certain replenishing of the supply from the main plant.

The operation of the plant in summer requires a day and a night operator, each of whom, besides operating the mechanical equipment, can give a great part of his time to handling ice on the platform. However, one or more additional men are required within the storage in periods of storing and emptying. In the winter time one man operates the plant and fulfills all platform duties.

The average operation during the months of June and July requires between twenty-four and thirty-six hours of 11-ton compressor operation. This is usually accomplished by operating one compressor continuously and using the second machine during the daytime or the period of maximum outside temperature.

The ice-storage house, which is exposed on all sides, has outside dimensions of 68 ft. x 78 ft. and is 40 ft. high. It contains about 210,000 cu.ft. of space and has a capacity of 4,600 tons of ice. The building is constructed of buttressed brick walls, steel and frame partitions dividing the storage into three rooms. It has a frame and composition roof and is without any attic. The floor and all walls are insulated with 4 in. of impregnated cork board, and the ceiling is insulated with 5 in. of the same material. Adjoining the storage house on one side is a one-story brick engine room and lobby with a composition roof.

The necessary refrigerating plant consists of two

York vertical inclosed compressors of 11 tons refrigerating capacity, each driven through a leather belt by a 20-hp., 865-r.p.m., 220-volt, three-phase, 60-cycle, wound-rotor-type motor. A 7½-hp., 1,140-r.p.m., 220-volt, three-phase, 60-cycle squirrel-cage motor is belted to a 22-cu.ft. air compressor which operates three Curtis automatic elevating and lowering machines, each of which will handle 400 lb. of ice. The storage space is equipped with about 13,000 ft. of 2-in. direct-expansion piping so arranged that each of the three compartments can be operated separately.

All the expansion valves are in the lobby to facilitate temperature control by the attendant.

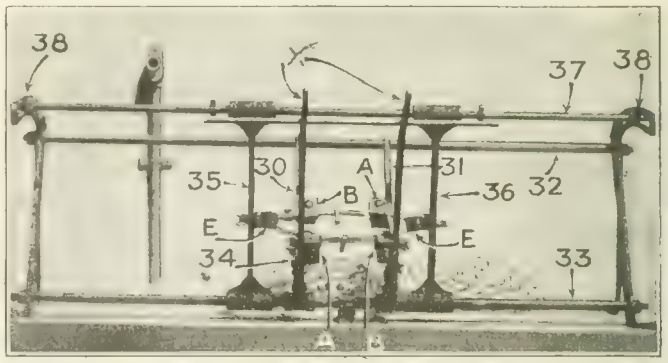
Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Adjustable Home-Made Coil Puller

A COIL puller designed to take all sizes of coils up to the maximum used for wire-wound coils, for open or semi-closed slots, was recently made in the repair shop of a large textile company. A coil shaped by this machine has the same form as one that was wound directly in the slots or on a former the exact shape of a coil. It has the further advantages of being adjustable to all sizes, being quick in operation and being usable by unskilled labor. It consists essentially of two clamps which hold one side of the coil and two other clamps on a pivoted arm which pull out the other side of the coil. The ends of the coil are formed at the same time by means of two clamps on another swinging arm.

As may be seen from the photograph and the front elevation of the drawings, the uprights 30 and 31 which hold the stationary clamps are adjustable along the upper rod 32 and the lower rod 33 to suit the length of the straight portion of the coil. This length is taken as the length of the core plus 1 in. or 1½ in. to allow for clearance on each side of the slot. After the length of the coil is set the approximate pole pitch is measured. If the distance between the slots in which the two sides of the coil must lie is 7 in., the uprights *XX* are opened up to a distance of 7 in. measured between the stationary clamps and the clamps on the uprights *XX*. This is best seen by examining drawing "section *CC*."

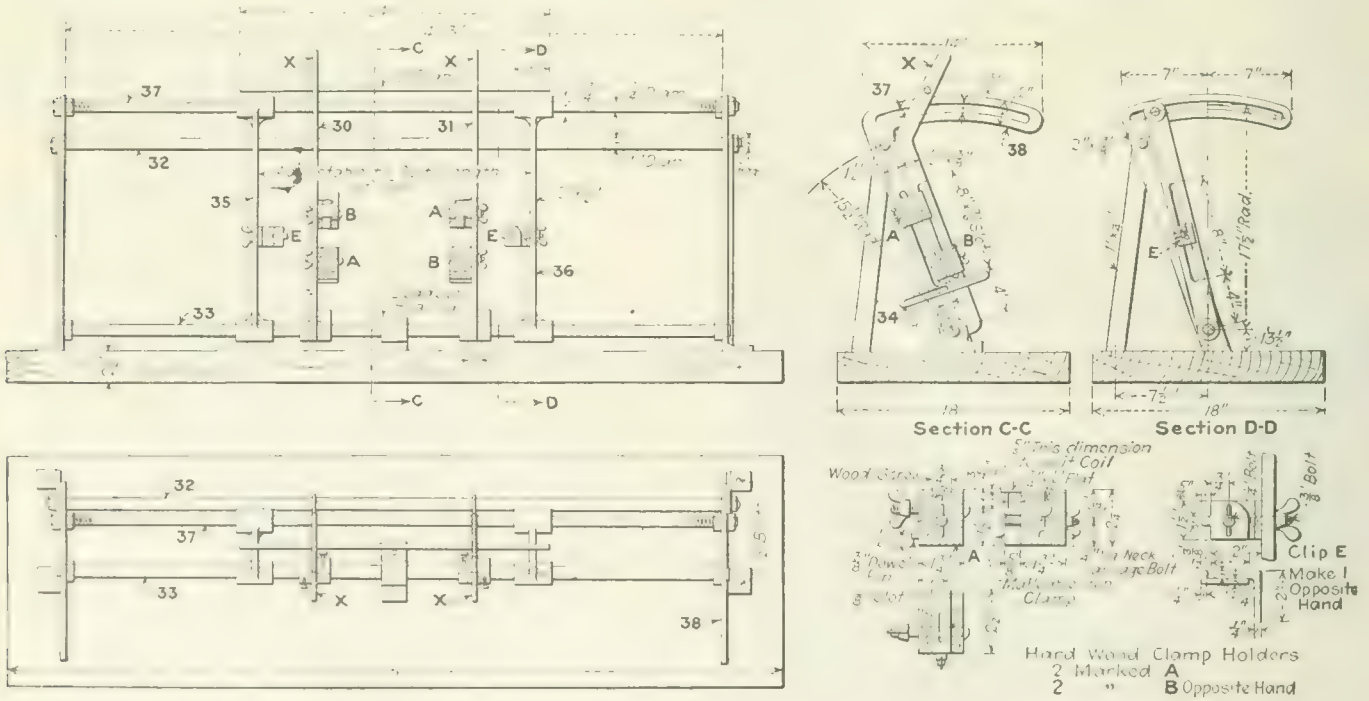
A trial coil is now placed in the clamps *AB*, so that the ends of the coil are on the right-hand side. Now the sliding members 35 and 36 are adjusted along the upper rod 37 and the lower rod 33, so that the clamps *EE* grip the coil at the ends as shown in the photograph. In this position it will be seen that the top half of the coil is held by clamps on the fixed uprights 30 and 31 and the bottom half is held by clamps on the movable uprights *XX*.



THIS SHOWS HOW THE COILS ARE CLAMPED ON TO THE STATIONARY AND THE MOVABLE UPRIGHT PIECES

In order that the coil may not be pulled open more than 7 in., there is a slotted bar, as shown in section *CC*, indicated by 34, and this bar is adjustable by means of a bolt to limit the distance that the arm *X* may be pulled out.

The coil is now pulled out to this limit by pulling on the crosspiece connecting the uprights *XX*. As these pieces are being pulled out the ends of the coil in the clamps *EE* have been drawn in toward each other as the pieces 35 and 36 slide on the rods 33 and 37. At the same time these ends of the coil have followed an arc as the pieces 35 and 36 pivot around the rod 33.



COIL PULLER USED FOR SHAPING COILS FOR PRACTICALLY ALL SIZES OF MOTORS

In order that the radius of the coil might be the same as that of the stator or rotor in which the coil is to be placed, the clamps *A* and *B* were positioned at a distance above the rod 33, so that the bottom of the coil held in the movable clamps on the arm *X* is the same distance from the center of the rod 33 as the distance from the center of the motor to the bottom of the slot if a rotor is being wound, or the distance from the center of the motor to the top of the slot if a stator is being wound.

After the coil is removed, if it does not fit the slot properly, either the angles are wrong or the pole pitch is of the wrong length. This is corrected by adjusting the clamps *A* and *B* up or down the uprights and changing the setting of the limiter 34. By adjusting the clamps *A* and *B* the angle of the coil is altered, and by changing the setting of the limiter 34, the throw is changed.

This outfit has proved to do very quick work, as a set of 108 coils for a 100-hp. motor was recently pulled in 2½ hours. The approximate cost of making the puller in January, 1921, was $45. L. E. WOOD.

Airedale Electrical & Manufacturing Company,
Bradford, Scotland.

Preventing Motor Burnouts Caused by Low-Voltage Trip Sticking

STICKING of the no-voltage trip coil of a compensator has often caused the motor connected to the compensator to be burned out. When the motor circuit goes dead on account of line trouble or is opened by a switch this relay should trip the compensator. If it does not, full voltage will be put on the motor when the line is made live again, which will damage the motor and may strip gears or shaft keys.

This tripping is dependent on the dropping of the solenoid core, which operates the latch and thus trips the compensator. The core is apt to stick and prevent the release of the compensator. This sticking of the core may be due to residual magnetism in the cast-iron case which incloses the solenoid and serves as a stop for the core on its up stroke, or it may be due to a mechanical cause such as corrosion of the various parts, projecting points on the laminations, etc.

A correction for the effect of residual magnetism can sometimes be found by changing the case which surrounds the solenoid or by changing the core and getting one which has a short-circuiting copper loop inserted in the top of the core. Some of the newer-type compensators do not have this copper loop in the solenoid core. The mechanical sources of trouble can often be corrected by removing the core and filing it carefully and thoroughly cleaning off the top of the case against which the core strikes. There is sometimes a slight stickiness at this point of contact, which also is a partial cause for the non-release of the core. The tripping latches should be cleaned thoroughly, removing all traces of rust, dirt, etc. The tripping mechanism should be very positive in action and should trip the compensator instantly on the release of the core.

A snap switch in the circuit which goes to the solenoid will allow the motor to be stopped by breaking the circuit and may be used to test the operating condition of the releasing mechanism. If the motor is stopped by tripping the latch with the finger, the test is not so accurate as when the solenoid core falls by the simple expedient of breaking the circuit. Operators should be instructed always to stop the motor by this method, and even if the motor is continuously operated twenty-four hours a day, the test should be made and the motor again started. This will assure that the tripping mechanism will work at a time of emergency.

It is well to test the overload relay coils occasionally to see what current will cause the compensator to open the motor circuit. This may be accomplished by sending current from a 110-volt line through the coils in series with a lamp bank. The current should be increased gradually until the plungers rise. An ammeter in the circuit will measure the current. If current transformers are used, the current must be sent through the relay coils and not through the line feeding the motor. In this case the ratio of motor current to relay current must be obtained from the nameplate of the current transformer. ROBERT HAMILTON.

Brooklyn, N. Y.

Support for Providing Adjustable Local Lighting

AN EASILY assembled lamp and reflector, which is useful for lighting some particular spot where work is being done, has been made out of a vertical telescoping pipe supporting a horizontal pipe which carries a lamp and reflector, as shown in the accompanying illustration. The lamp can be placed at any working height and at any horizontal location within the radius of the top arm. The fixture does not interfere with the operator in any way. An important feature is that the conduit is placed beneath the floor so that the working space overhead is clear of wiring.

The vertical member is made of a pipe firmly fastened in the floor. Into this a slightly smaller pipe is inserted. The second pipe is held in position by means of two nuts in the first pipe, the wing nuts being 90 deg. apart. At the top of the sliding pipe is a "T" holding a cross-pipe which slides in the "T" and which is also held in position by means of a wing nut. At the outer end of the horizontal piece is a condulet through which the lamp cord is run. At the lower end the lamp cord passes into a small conduit rising out of the floor. This arrangement gives two adjustments, vertical and lateral, in addition to a swing. Several modifications of the idea have been developed, some using a 4-ft. (1.2-m.) length of flexible-steel armored tube, instead of the horizontal pipe support. SAMUEL G. HIBBEN,



THE LAMP MAY BE MOVED CLOSE TO THE WORK

Consulting Illuminating Engineer.
Westinghouse Lamp Company,
Bloomfield, N. J.

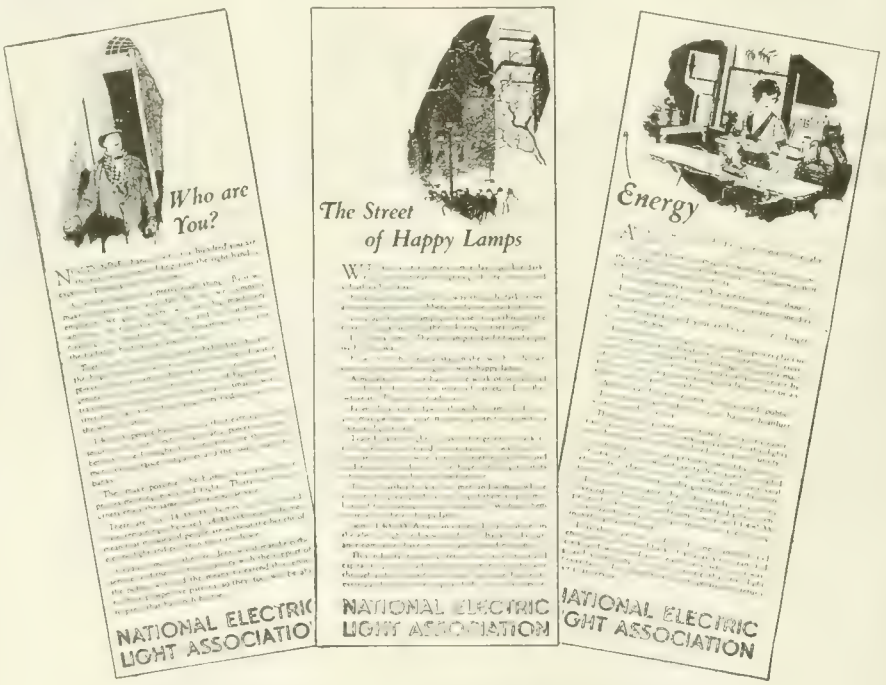
Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Manufacturers Co-operate to Build Good Will for Electric Utilities

A COMMON interest has brought the electrical industry together in the past few months as never before. Public confidence must reside in the electric light and power utilities if they are to go forward healthily. In other words, the utilities must have friends. It is not a new idea, but it is refreshing to find the rest of the electrical industry spending its money, and lots of it, to promote utility good will.

Although business is dull and manufacturers are finding it necessary to curtail almost everywhere, still they have sufficient breadth of vision to appropriate advertising space valued in excess of a quarter of a million dollars to make friends for the electric light and power companies. National magazines, the technical press, newspapers, folders—all are being used in some way to tell effectively the good-will story. This campaign is being directed by the National Electric Light Association as the major part of its national good-will program. A committee of manufacturers headed by P. L. Thomson of the Western Electric Company has undertaken to sell the co-operative advertising idea to the electrical manufacturers. So far this committee has met with a very gratifying response. It had an ambitious program to secure from the manufacturers pledges for one-twelfth of their 1921 contracted advertising space. The committee has been working only a short while, and already it has had promises of space from a very large number of companies.



THE FIRST THREE HALF-PAGE ADVERTISEMENTS OF THE N. E. L. A.

As a background for the advertising by the manufacturers the N. E. L. A. is running through the year in the *Saturday Evening Post* a series of thirteen half pages in which the public is taken into the confidence of the electric utility and made to understand sympathetically the unconscious reliance that the individual places on the utility. Three pieces of this copy are shown on this page, the first of which, that on the extreme left, appeared Feb. 19.

Large poster reproductions of the N. E. L. A. advertising are being made up on heavy paper, 15 x 22 in., for use by electric light and power companies in their windows. The association is also making up its advertisements in two-column newspaper matrices for local reproduction.

Co-operation, also, has been pledged and is being manifest from the publishers both of general magazines and of the technical press who appreciate the fundamental relation of the electric utilities to the every-day life of the public. In addition to publication advertising, some of the manufacturers are going one step further and are educating their employees through house organs so that they may be boosters for electric service. Still another form of co-operation in this movement is the insertion of good-will messages in the packages containing goods so put up. This plan is being worked out by the Edison Electric Appliance Company. Many of the utilities are using the national advertising locally, either as it is or by adapting it to their own uses, in newspapers and on posters. The cumulative effect of such advertising must naturally be extremely fruitful of results. George F. Oxley, under whose direction this campaign is being conducted from N. E. L. A. headquarters, says that the local co-operation with the national campaign is very gratifying. He has estimated that the total value of fall advertising space, both local and national, used in this effort will approximate a million dollars.

The following companies have agreed to tell the story of good-will in national magazines: General Electric Company, *Saturday Evening Post*; Westinghouse Electric & Manufacturing Company, *Saturday Evening Post* and *Literary Digest*; Western Electric Company, *Literary Digest* and *Collier's*; Wagner Electric Manufacturing Company, *Literary Digest*; Mazda Research Laboratories, *American Magazine*; McGraw-Hill Company, *Collier's*; the American Electrical Heater Company, Edison Electric Appliance Company, Habirshaw Electric Cable Company and Duplexalite Company have not yet designated the magazines which they will use.



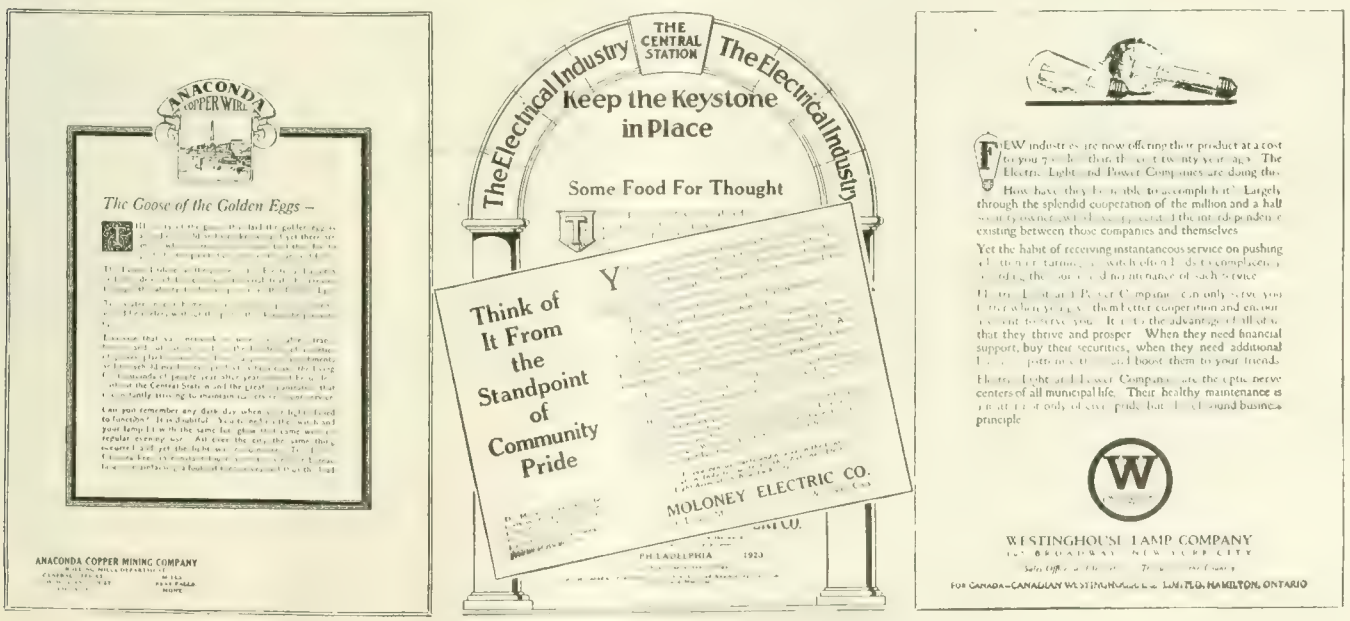
MANUFACTURERS' NATIONAL MAGAZINE ADVERTISING
A Westinghouse two-page spread and a General Electric page, both in the *Saturday Evening Post*, and one of the Western Electric good-will series

Two companies, Robbins & Myers and the McGraw-Hill Company, have decided to do newspaper advertising, the former in twenty-three and the latter in twenty principal cities.

The list of those who have pledged space in the technical journals is, of course, much larger and includes the following: Trumbull Electric Manufacturing Company, Plainville, Conn.; Hygrade Lamp Company, Salem, Mass.; Condit Electrical Manufacturing Company, South Boston, Mass.; Kuhlman Electric Company, Bay City, Mich.; ELECTRICAL WORLD; Burke Electric Company, Erie, Pa.; Electric Storage Battery Company, Philadelphia; Majestic Electric Development Company, Philadelphia; Locomotive Electric Washing Machine Company, Belleville, Ill.; *Electrical Review;* Federal Electric Company, Chicago; Sangamo Electric Company, Springfield, Ill.; Moloney Electric Company, St. Louis; Roller-Smith Company, New York City, *Electric Journal*; Power Specialty Company, New York City; Westinghouse Lamp Company, New York City; Packard Electric Company, Chicago; Sangamo Electric Company, house Company, Ltd., Hamilton, Ont., Canada; *Central Station*; Hamilton-Beach Manufacturing Company, Racine, Wis.; Syracuse Washing Machine Corporation, Syracuse, N. Y.; Britton & Doyle, Cleveland; Jeffery-Dewitt Insulator Company, Huntington, W. Va.; P. A. Geier Company, Cleveland; Anaconda Copper Mining Company, Chicago; Domestic Electric Company, Cleveland.

Reproductions of advertisements that have appeared in the national magazines, newspapers and technical press, as shown in these pages, are typical of the spirit of broad-minded enthusiasm with which the electrical manufacturers are helping the electric light and power companies to build good will.

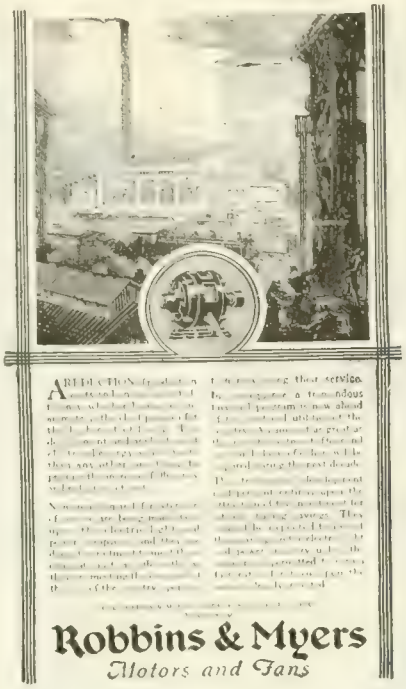
The co-operative campaign of the manufacturers ties in with the booklet good-will advertising prepared by the N. E. L. A. for distribution locally by the electric light



TYPICAL TECHNICAL PUBLICATION ADVERTISEMENTS
Anaconda Wire, Electric Storage Battery, Moloney Electric and Westinghouse Lamp early joined the movement.

and power companies. At the last count orders for around seven millions of booklets had been placed. It is planned that users of electric service will receive good-will literature at frequent intervals. These activities, together with the work of the state committee on public utility information, promise a better understanding on the part of the public of the electric light and power utility and its problems.

While it is true that the utilities, manufacturers, technical press and all in the industry will benefit proportionately to success of the campaign, still those who are conducting it are careful to impress on everybody that in the last analysis it is the public that will have the most lasting benefit through the greater and better service that will come by reason of the greater ease in financing made possible by a better understanding of the fundamental strength of electric light and power companies.



One of the newspaper advertisements Robbins & Myers will run in the papers of twenty-three cities

Public Sentiment Squelches Opposition to Rate Increase

FURTHER encouraging evidence of a better understanding by the public of the problems of the public utilitiy companies came to light recently in South Bend, Ind. . Application to the Public Utility Commission by the Indiana & Michigan Electric Company for an increase in rates brought forth a considerable show of indignation from certain of the company's customers. Those opposed to granting the increase composed a minority of the customers, and, not being very sure of their ground, they attempted to bolster up their case by adding to the number of protestants against the proposed rate. Personal solicitation was resorted to but gained practically no response. The following letter from F. H. Wellington, general manager of the South Bend Watch Company, is typical of the usual reception accorded to the opponents of the increase:

"After you left my office this morning it occurred to me that possibly I did not make myself entirely clear as to why I am not opposed to a just and reasonable increase in the rates of the local electric light and power company. We are big users of electricity for power as well as light in our factory, and naturally we are not anxious to increase the cost of anything which we buy or use unless we benefit from the increase. Now, here is just how I think we shall benefit:

"Public utilities are not essentially different from your plant or ours. Unless they can get a price for their product that will bring them a fair return on their investment they must naturally let their plant and their service deteriorate, and might eventually even be forced temporarily to suspend operation. Such a result would greatly inconvenience all users of their service.

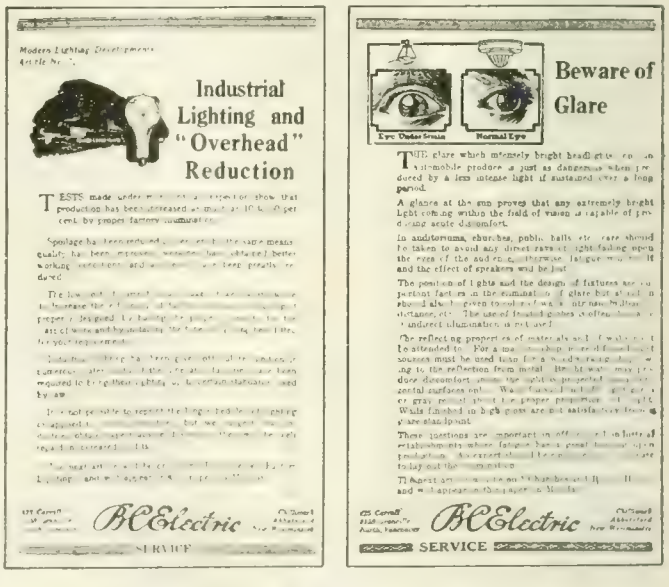
"You and I know how our costs have gone up during the past two or three years. We are not selling our goods for the same prices which prevailed before the war. We couldn't do it and continue to operate. Then why should we expect the light and power company to do the impossible?

"As manufacturers of high-grade watches distributed through more than 12,000 jewelers in the United States, we feel a responsibility to this big army of dealers in keeping our plant moving at a pace that will keep up with the demand for South Bend watches. From both their standpoint and ours, it seems to us that it would be a penny-wise and pound-foolish policy to try to save a few cents on our power cost and run the chance of ultimately getting poorer service or none at all. We are not in any way financially interested in the Indiana & Michigan Electric Company, but do believe in treating it, as well as all of our other business associates, fairly.

"Think it over and see if the same thing does not apply to your own business in much the same way."

Educational Campaign for Better Lighting

TO IMPROVE the general standard of lighting the British Columbia Electric Railway Company of Vancouver, B. C., recently conducted an educational advertising campaign. A series of eleven advertisements, beginning with the elementary ideas on lighting, has just been completed in the newspapers. Two of the advertisements, the third and seventh to appear, are shown here. The series was entitled "Modern Lighting Developments" and included the following subjects:



TWO ADVERTISEMENTS USED IN CAMPAIGN FOR BETTER LIGHTING

(1) "New Ideas on Lighting"; (2) "How Many Foot-candles?"; (3) "Beware of Glare"; (4) "Churches and Public Halls"; (5) "Store Lighting"; (6) "Show-Window Lighting"; (7) "Industrial Lighting"; (8) "Some Principles of Industrial Lighting"; (9) "Lighting the Home—the Living Room"; (10) "The Dining Room and Bedroom"; (11) "Street Lighting." Local electrical contractors were circularized and urged to clip out the advertisements and follow them up individually.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Dimensioning of Auto-Transformers and Booster Transformers.—F. HORSCHITZ.—Simple formulas are derived to give the best design of autotransformers, neglecting core loss and leakage flux. Electrically a booster transformer is identical with an auto-transformer, so that the same formulas may be used for both.—*Elektrotechnik und Maschinenbau,* Jan. 2, 1921.

Commutator Brushes for Synchronous Converters—R. H. NEWTON.—The electrical properties which must be taken into consideration in selecting brushes are that the brush must have sufficient resistance to limit short-circuit currents during commutation and must also have sufficient current-carrying capacity to prevent overheating. From the mechanical standpoint, the peripheral speed of the commutator angle of the brush-holder and whether commutator mica is undercut are the important factors. Generally speaking, the hard or carbon brushes have abrasive or scouring action on commutators, while the softer graphite grades lubricate and give the commutator a good polish. Proper methods of staggering brushes to prevent cutting of the commutator are illustrated.—*Electric Journal,* February, 1921.

Lamps and Lighting

Recent Applications of Color in Lighting.—AUGUSTUS D. CURTIS and J. L. STAIR.—The authors emphasize the importance of color from an artistic standpoint in home lighting, and some interesting applications are given to theater and stage lighting effects.—*Transactions I. E. S.,* Dec. 30, 1920.

Generation, Transmission and Distribution

Short-Circuit Currents in Large Installations.—A. DALLA VERDE.—The phenomena arising in single-phase and polyphase circuits when a short circuit takes place are analyzed and reviewed in this article, and simple formulas allowing the rapid determination of the intensities of the short-circuit currents are derived. Numerical examples are given.—*Science Abstracts, Section B,* Dec. 30, 1920. (Abstracted from *Elettrotecnica,* Aug. 15, 1920.)

Electrically Heated Boilers.—Electrically heated boilers for use on high-tension supply systems up to 8,000 volts, as built by a British manufacturer, are described in this article. Electrodes are immersed in the water and the currents pass directly through the water for heating purposes. It is said that experiments are under way for use of these boilers directly on voltages up to 15,000. Their use is especially advocated for making use of hydro-electric energy over Saturday and Sunday, when there is usually an excess of water power available.—London *Electrical Times,* Dec. 23, 1920.

Forward Steps in California Hydro-Electric Designs.—In California alone there are thirteen hydro-electric developments now under way, of which all but two are to be in service by January, 1922, developing a total of 522,600 hp. Several important installations are being or are soon to be made, including the 40,000-hp. single-runner units for the Fall River plant, the reaction turbines to operate under a head of 806 ft. (245 m.) at Kern River plant No. 3, and the 220,000-volt transmission system from the Pit River plant to San Francisco. A table gives the principal characteristics of these thirteen developments.—*Engineering News-Record,* Dec. 30, 1920.

Traction

Progress of the One-Man Safety Car.—HARRY L. BROWN.—A general treatise reviewing the advent of the light-weight one-man safety car, giving the economic aspects of design and utilization and the economies which have been obtained.—*Electric Railway Journal,* Jan. 22, 1921.

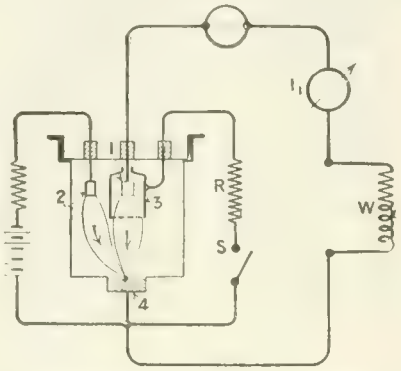
Electric Traction on the Berlin Railways.—WECHMANN.—After preliminary work extending over a period of several years the Berlin Railway Commission has now started actual work on the electrification of the suburban lines between Berlin and Bernau and Berlin and Hermsdorf. Single-phase alternating-current transmission at 15,000 volts and $16\frac{2}{3}$ cycles has been chosen. The power will be supplied for the present as three-phase current, converted into single-phase from one power station. The trolley wire will be catenary, suspended on towers 100 m. apart. The trains will consist of twelve passenger coaches and one power truck at each end. The motorman will be stationed at the front of the first coach, being able to look forward over the low power truck ahead of him. The advantages claimed for this system as compared with locomotives or motor cars are its lower weight, the high-placed and well-sprung motors, the higher efficiency of larger motors and cheapness. The disadvantages of slow acceleration (only 0.28 m. per second per second) with such power trucks is overlooked, as they are sufficiently fast for suburban traffic. Later, for the urban lines of Berlin, the two power trucks may be replaced by locomotives. Before the war the program (suburban lines only) could have been finished in one and one-half years, but it is uncertain how much longer it will take now.—*Elektrotechnische Zeitschrift.*

Installations, Systems and Appliances

Radiology Applied to the Testing of Materials.—A. P. M. FLEMING and J. R. CLARKE.—In the first part of this article a description of apparatus and a theory for the production of X-ray suitable for the examination of metals for ascertaining structural soundness are given. The second part contains general specifications for an X-ray installation, assuming that an induction coil is to be used. Future possibilities and usefulness in the examination of materials are said to be dependent on improvements of (a) the methods of production of X-ray, (b) the manner in which the effect of X-rays

can be appreciated by our senses, and (c) technique.—London *Engineering*, Dec. 24, 1920.

Relay for Strong Currents.—This relay utilizes mercury vapor and resembles a three-electrode valve. The figure shows the diagram of the apparatus and its connections: 1 is an iron anode, 4 a mercury cathode, 2 an auxiliary iron cathode and 3 the control electrode. These electrodes are contained in a metal case, which is then exhausted. The alternator is connected to the anode 1 and to the cathode 4 through the load W. During one half period the current passes through 1 and 4; during the successive half period the current is interrupted, but the current from the battery maintains the apparatus in activity. A single apparatus will therefore furnish a pulsating current, and two such devices, suitably connected, will furnish ordinary alternating current; but if the switch *S* is closed the current is immediately broken. This apparatus allows currents as large as several hundreds of amperes to be broken. The same apparatus suitably used can transform into oscillatory current the direct current furnished by the battery. Utilizing a battery giving 100 volts, this apparatus was capable of furnishing an oscillatory current of 40 amp.—*Science Abstracts*, July 31, 1920. (Abstracted from *Elettrotecnica*, May 15, 1920.)



DEPENDENCE OF SPARK VOLTAGE ON AIR PRESSURE

Electrophysics and Magnetism

Method for Determining the Fundamental and the Harmonics of an Alternating Current.—L. Lombardi.—This method, which is a development of the Joubert contact method, allows of the obtaining of either the resultant curve or, separately, the harmonics of an alternating-current curve. It is founded upon the fact that if the number of contacts is two or more per period the fundamental frequency gives zero deflection in the galvanometer. By employing an interrupter giving a number of contacts per turn equal to the number of periods of a given harmonic, only the current generated by this harmonic flows through the galvanometer. The apparatus utilizing this method consists, in the case of multipolar alternators, of a disk which can be put into motion by holding a point against the end of the shaft of the alternator, as an ordinary revolution counter, the disk being provided with 3, 5, 7, etc., contacts for alternators with 1, 2, 4, 8, etc., pairs of poles. Separate metallic stars with 3, 5, 7, etc., points allow of using 3, 5, 7, etc., contacts per turn. A metallic brush, which can be fixed in different angular positions, allows of different points of the resultant curve or of the different harmonics being obtained.—*Science Abstracts, Section B*, Nov. 30, 1920. (Abstracted from *Accad. Sci. Torino, Atti 55, No. 15*, 1920.)

Positive and Negative Photo-Electrical Properties of Molybdenite and Several Other Substances.—W. W. Coblentz.—The paper gives a description of new observations of positive and negative spectro-photo-electrical reactions in molybdenite, silver sulphide, etc., as dependent upon temperature as well as magnitude and direction of the current through the crystal. It is shown that for radiation of wave lengths less than 0.7μ the photo-electrical reaction in a certain sample of molybdenite is positive or negative depending upon the magnitude and direction of the current through the crystal. In three appendices data are given, (1) on a frequency relation in the sensitivity bands of molybdenite, (2) on a survey of the general spectro-photo-electrical properties of substances, and (3) on thermal radiophonic signaling apparatus.—*Scientific Paper No. 398, U. S. Bureau of Standards*, Oct. 11, 1920.

Electrochemistry and Batteries

The Chemical Industry of Switzerland. — Dr. A. Landoll.—Information concerning the manufacture of chemical-pharmaceutical industry products, tar dyes and synthetic perfumery in Switzerland. It is shown how the development of the electrochemical and electrometallurgical industries in Switzerland has been greatly extended during the last two decades by extensive developments of water power in that country.—*Chemical and Metallurgical Engineering*, Jan. 5, 1921.

Units, Measurements and Instruments

Measurement of Magnetic Blow-Out Forces in Circuit Breakers.—A. C. Bartlett.—It is shown that in the operation of ordinary circuit breakers the magnetic blow-out effect exists to a considerable degree. Comparative values of the magnetic blow-cut in certain variously shaped circuits were required, and a scheme was devised for making these measurements. The method, together with some data derived, is set forth by the author.—London *Electrician*, Jan. 7, 1921.

A Loop Test for High-Resistance Faults.—H. V. Higgitt.—This test is described as a modification of the loop test devised by Professor Jamieson, which gives an accuracy of the same order as a Varley loop, the accuracy for high-resistance faults being more or less proportional to the resistance of the fault. By the method described here the accuracy is independent of the fault's resistance, though the higher the latter the longer is the time required to take the test. The test is dependent upon the accumulation of charge in the capacity of the line.—London *Electrician*, Jan. 21, 1921.

Telegraphy, Telephony and Signals

Wireless Railroad Signals.—A new scheme of railroad signaling developed in Germany is described in which a sending apparatus has been placed on the locomotive with the loop antenna so suspended from the underside as to cause electric waves to be radiated toward the permanent way. At points of the road where signals are to be given to the train there are tuned circuits made up of loops, the characteristic waves of which are identical with the wave length of the transmitter. A visual signal within locomotive cabs gives well-defined indications when the track devices are passed.—*Wireless Age*, January, 1921.

The Capacitance of Flat-Top Antennas.—W. H. Eccles.—The author discusses the equation proposed by L. W. Austin for antenna capacitance, which, he says, is applicable with considerable accuracy to all flat-top antennas of any reasonable shape. He proposes a formula, however, which he holds to be simpler than the Austin formula and gives results accurate within 1 to 3 per cent.—London *Electrician*, Jan. 14, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Supreme Court Upholds Utah Commission in Special Contract Case

THE Utah Supreme Court on Feb. 25 rendered a unanimous decision sustaining the Utah Public Utilities Commission in the special contract case. This was the case decided by the Utah commission on Oct. 22 last whereby all existing special power contracts of Utah Power & Light Company customers in Utah were declared discriminatory and such business was ordered placed on standard schedules. See ELECTRICAL WORLD for Oct. 23 and Nov. 29. Thirteen customers appealed to the Supreme Court of the state on the ground that the commission had no authority to change any of the terms of contracts entered into prior to the creation of the commission. This is one of the most important cases ever handled by the Utah commission. It involves additional revenue to the power company of approximately $1,000,000 annually.

Reservations Already Coming in for N. E. L. A. Convention

RESERVATIONS for the forty-fourth annual convention of the National Electric Light Association, to be held in Chicago at the new Drake Hotel, May 31 to June 3, are already being received at the association's headquarters. At the next meeting of the executive committee, which will be held in Chicago on March 15, it is expected that many plans for the convention will take definite form and a preliminary list of speakers will be drawn up.

On Monday and Tuesday of next week the sub-committee of the Commercial Section will meet at the association rooms in New York for the presentation of their reports, and on Wednesday the executive committee of that section will meet for the purpose of mapping out its part of the program for the convention.

Engineering Council Urges Harding to Appoint Engineers

PRESIDENT HARDING has been requested by the American Engineering Council of the Federated American Engineering Societies to appoint an engineer as Assistant Secretary of War and to name an engineer for the vacancy on the Interstate Commerce Commission. Both communications were authorized by vote of the executive board of the council, of which Herbert Hoover is president.

The appeal to Mr. Harding to select an engineer as Assistant Secretary of War states that this position is one requiring "very special qualifications, a large part of which are concerned with engineering." The appointee, the appeal urges, must possess technical knowledge and executive ability and must be familiar with cost of construction and operation as well as having experience with various types of employees.

In requesting Mr. Harding "to give earnest thought to the selection for the Interstate Commerce Commission of a man who to his other qualifications adds the training and experience of an engineer familiar with transportation problems," the communication says:

"The engineer's training fits him for that mode of thinking which is indispensable to impartiality of judgment. One important function of the commission is the valuation of public utilities, and another is the determination of relationships and responsibilities of the management of such utilities to the public. No other body of men has given such extensive and scientific consideration to these matters as have members of the engineering profession."

House Votes Down Muscle Shoals Ten-Million-Dollar Appropriation

BY A VOTE of 193 to 182 the House of Representatives has refused to accept the Senate amendment to the sundry civil appropriation bill, granting $10,000,000 for completion of the Wilson Dam at Muscle Shoals. This is the second time that the House has refused to appropriate money for the completion of this project.

Fundamentals Laid Down in Detroit Electricians' Wage Controversy

SOME fundamentals were laid down in the decision just made public of the Council on Industrial Relations for the Electrical Construction Industry regarding the Detroit electricians' wage controversy. The employing electrical contractors had cut union wages in January from $1.25 to $1 per hour, on the ground that non-union shops were paying under $1 per hour and therefore were making competition too difficult and because the cost of living was much lower. The union men refused to accept the cut and denied the two statements above given.

The matter finally came before the council for settlement, and the council took the stand that the men were entitled to as high a standard of living as they enjoyed prior to war conditions, or in 1914. This standard was felt to be commensurate with the then current wage, or $4.56 per day. In addition, the council accepted the figures of the National Industrial Conference Board that 79.6 per cent of a workman's budget is for subsistence and 20.4 per cent for other purposes. The council then took the commodity index of the Bureau of Labor Statistics for the twelve months from Dec. 1, 1919, to Dec. 1, 1920, and applied the increase over the 1914 index to 79.6 per cent of $4.56, leaving the remainder the same. On this basis a daily wage of $10 was determined, and consequently it was held that the old wage should obtain until July 1, 1921.

The council was not inclined to give much weight to the matter of union and non-union labor competition. It did, however, state quite strongly that a union work-

man receiving the high wage owed it to himself as well as to his employer to work more efficiently and do more work than he has been accustomed to do in the same time. The council was also not in favor of having wage changes on the hour basis. It felt that a workman was interested more in the yearly income and that this was not considered in the hour scale. While the council was forced to exclude consideration of employment security, still it felt that a fair wage "is one which, upon an assumption based on statistics as to the duration of employment, will satisfy as nearly as possible all the workers' needs. The adequacy of the wage to satisfy all of the workers' needs is regulated by the cost of living."

Probability of a Three-Man Commission for New Jersey

SHOULD the lower house of the New Jersey Legislature pass the Walworth bill over the Governor's veto, the state will have a three-man commission, removal of which will no longer be a right of the Governor. The State Senate has already passed the bill over the Governor's veto, and the measure was under consideration by the House as this was written.

The Governor objected to having the power of removal taken from the hands of the chief executive of the state. He removed the old board, and it was this action which led to the present bill. The board in question was not the first public utility commission to be used as a political football by a New Jersey Governor.

Increasing Activity Seen in Street Lighting

PLANS for street-lighting systems are going ahead in a number of cities, and as soon as frost is out of the ground there should be considerable activity in this field of construction. Some of the systems are more comprehensive than others. For the Hollywood district of Los Angeles, Cal., for instance, the City Council is discussing the installation of a system estimated to cost between $1,250,000 and $1,500,000. Work has already started on the extension to the Fort Worth (Tex.) system.

When the 800 300-watt lamps are installed in the southern section of the city, Light Commissioner Selwyn Smith states, the street lighting of Fort Worth will have been increased 75 per cent.

The first lamps of the new type which is to be the standard for Rochester, N. Y., were received about two weeks ago after waiting, it is stated, eighteen months.

Bids for a boulevard lighting system for Lima, Ohio, have been authorized for advertisement. It has been decided to proceed with plans for construction as speedily as possible.

Kansas City (Mo.) officials are seriously considering replacing gas lighting for streets with electricity. The city now has 5,419 electric street lamps and 5,600 gas lamps. It is proposed to substitute for the latter 2,600 electric lamps, using 600-cp. lamps in the downtown district and 400-cp. lamps in the outlying districts.

Terre Haute, Ind., New Brunswick, N. J., and a number of other cities are already considering smaller additions to present systems.

Service at Cost Proposed for New Orleans

AS A REMEDY for the public utility situation in New Orleans a group of bankers has proposed that a service-at-cost plan be worked out for the New Orleans Railway & Light Company. It is admitted by both the city and the company that the present facilities are inadequate. J. D. O'Keefe, receiver for the company, has stated that to supply adequate service $5,000,000 should be expended at once on the company's electric light, railway and gas properties. To do this, he contends something must be done to restore the company's credit, and he proposes the establishment of a service-at-cost plan for each of the three classes of service.

National Parks Exempted from Water-Power Act Provisions

THE House of Representatives on Tuesday passed the Senate bill exempting national parks from the provisions of the federal water-power act. The measure, which then went to the President, would prevent construction of commercial dams and power houses in national parks.

Utility Financing at Longer Maturities and Lower Yields

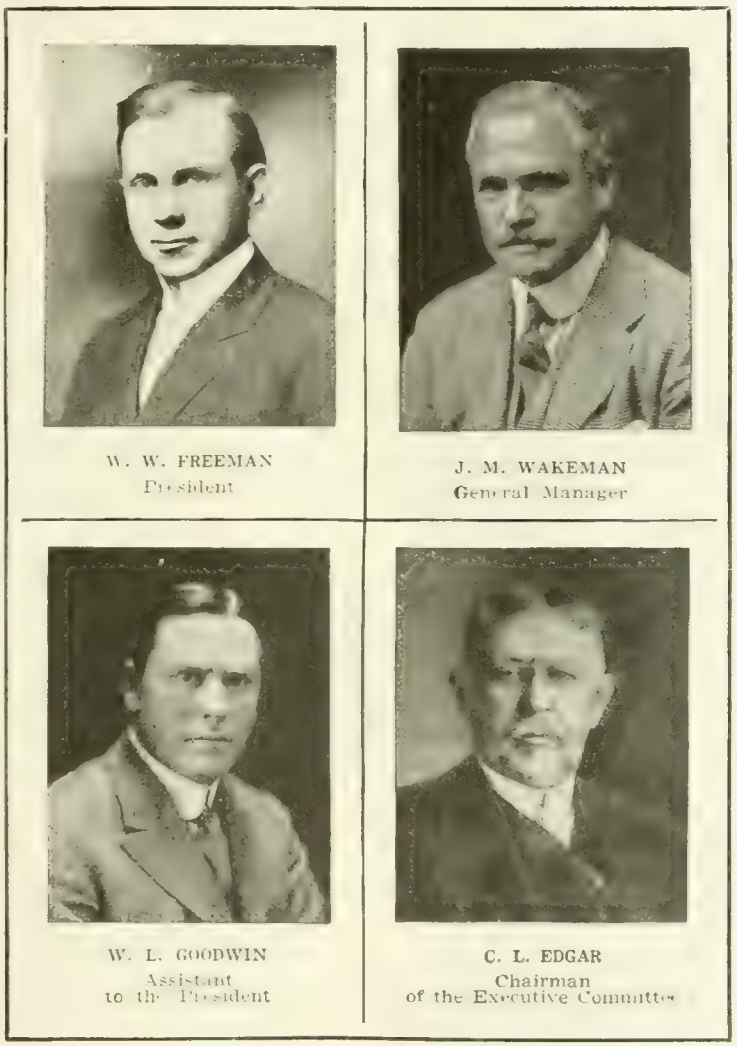
THE tendency that appeared in January in the financing of electric light and power public utilities toward longer term securities grew stronger in February, with a noticeable lowering of the yields. Eight per cent is the highest yield that appears, and but three of the ten issues carry that. The total for the month, $20,139,000, which is only about half that for January, is nearly twice as high as the corresponding total for February, 1920. The two most important issues are $8,000,000 in thirty-year bonds of the Pennsylvania Power & Light Company, sold at 92, to yield 7.68, and $6,000,000 in twenty-year bonds of the Oklahoma Gas & Electric Company, sold at 95, to yield 8 per cent.

Name of Company	Amount of Issue	Period	Class of Security	Purpose of Issue	Rate of Interest	Per Cent Yield	Offered at
Pennsylvania Power & Light Co	$8,000,000	30-year	First and refunding mortgage bonds Series A	Refunding and new construction	7	7.68	92
Manchester Traction, Light & Power Co	914,000	31½-year	First mortgage sinking fund bonds	Refunding	7	7.30	96.25
Idaho Power Co	1,000,000	26-year	First lien and general mortgage gold bonds		7	7.50	94.25
Colorado Power & Light Corp	725,000	11-year (due Jan. 1, 1929)	First mortgage gold bonds		8	7.50	91
Oklahoma Gas & Electric Co	6,000,000	20-year	First and refunding mortgage gold bonds	Refunding	7½	8	95
Newburyport Gas & Electric Co	650,000	15-year	Series A first mortgage gold bonds		7		Par
Northern Virginia Power Co	1,200,000	9-year	First general mortgage gold bonds	Refunding and new construction	7		
Iowa Railway & Light Co	400,000	20-year (due Sept. 1, 1932)	First and refunding mortgage gold bonds		7	7.80	94
Portland Railway, Light & Power Co	1,000,000	5-year	Gold notes	New construction	8		
Houston Electric Co	250,000		Notes	Repairs	8		
	$20,139,000						

Goodwin Joins the Society for Electrical Development

WILLIAM L. GOODWIN has joined the Society for Electrical Development, Inc. This news is contained in an official announcement issued from the society's headquarters by President W. W. Freeman. Thus the two most potent co-operative forces now at work in the industry have been consolidated. Mr. Goodwin has obtained a leave of absence from the General Electric Company and assumed his new duties as assistant to the president on March 1.

The notice sent out by the Society for Electrical Development is as follows: "President W. W. Freeman announces officially that William L. Goodwin will join the staff of the Society for Electrical Development on March 1 in the capacity of assistant to the president. By securing the services of Mr. Goodwin the society aims to consolidate the efforts which have been exerted so actively in recent years in the interests of genuine electrical co-operation throughout the country with the systematic work conducted by the Society for Electrical Development, and by such direct consolidation to promote co-operative development throughout the industry along lines of the broadest scope and most intense activity. Mr. Wakeman as general manager and Mr. Goodwin as assistant to the president will direct the activities of the society co-ordinately, under the authority of the president and with the active advice and support of the executive committee and directors.



W. W. FREEMAN
President

J. M. WAKEMAN
General Manager

W. L. GOODWIN
Assistant
to the President

C. L. EDGAR
Chairman
of the Executive Committee

"The directors' meeting held Feb. 19, at which broad plans of expansion were discussed and unanimously approved, was attended by fifteen directors, many of whom traveled long distances for the purposes.

"The program of work for the society during the coming year is being planned with enthusiasm, and the announcement of further important developments may be expected from time to time."

The news of Mr. Goodwin's appointment spread rapidly and gave rise to much interesting comment. In elaborating on the new line-up President Freeman said:

"Mr. Goodwin has done a fine work, and he is generally recognized as a prominent exponent of co-operation in the industry. Our aim in getting him to join with us was to consolidate all of the various agencies which have been active in the work of co-operation under the direction of the Society for Electrical Development and to expand that work to the utmost. Mr. Goodwin's connection with the society will give him a fine opportunity for employing his talents. He comes with a full recognition of the work which the Society for Electrical Development has done and will enter enthusiastically and energetically on a campaign along wider and more active lines. As a result of his coming we expect the interest in the society's work will be greatly increased and that this interest will be reflected in an enlarged membership and greater financial support. I rejoice that our conferences have culminated in such a happy union of forces, and I look to a program of larger effort with confidence and enthusiasm."

J. M. Wakeman, who has been the general manager of the society since its formation, had this to say when questioned by a representative of the ELECTRICAL WORLD this week: "It is unnecessary for me to comment on Mr. Goodwin's affiliation with the Society for Electrical Development or to introduce him to the membership. His great work in the interest of co-operation in the electrical industry is known to all, and it is gratifying to our membership as it is to me and the officers of the staff of the society that Mr. Goodwin's work is to be co-ordinated with the society's activities."

Very flattering indeed were the remarks of Charles L. Edgar of the Boston Edison company and chairman of the executive committee of the society which negotiated for Mr. Goodwin's services. "I am very much delighted at Mr. Goodwin's acceptance of the post of assistant to the president of the Society for Electrical Development," said Mr. Edgar. "Mr. Goodwin brings to the society experience gained in widespread travels through the country which have brought him in contact with the industry and given him the opportunity to stir up local enthusiasm which will henceforth be maintained through the co-operative efforts of the society itself. He will now represent all the leading branches of the industry through their active connection with the work of the society. Enthusiasm will no longer be permitted to slacken when he leaves town, because the society will follow up his pioneer work and insure its continuous development along co-operative lines. In other words, Mr. Goodwin

can now play the co-operative game better than ever, and the opportunities for future service by the society and Mr. Goodwin are simply wonderful. The field of service which he is entering will be greatly broadened by the hearty interest which manufacturers, jobbers, contractor-dealers and central stations are showing in the work of the society, to which is being accorded their able and enthusiastic support."

Interest naturally centers in Mr. Goodwin's impressions of his new job. While some time will elapse before his plans are finally matured and acted on, Mr. Goodwin is well pleased with the arrangement and intends to pitch into the work with his usual enthusiasm and vigor. He said:

"I have tied up with the Society for Electrical Development because I see a great opportunity for co-operative effort and because I appreciate that more can be accomplished jointly than singly. For four years I have been hammering away on co-operation. Now comes the chance to affiliate with an organization that has been engaged in co-operative work along somewhat parallel lines. Naturally I welcome the opportunity because it puts behind my work an organization representing no special interest. The society has done a fine job in educating the public to 'do it electrically,' and its efforts have borne fruit. A lot of insiders in the industry must still be educated, however, and that, I take it, is my job. The task which I shall cut out for myself will be to expand the society from within, to help the contractor-dealer, jobber, manufacturer and central station to see where they fit in and to teach the different interests the power and value of co-operative effort through the Society for Electrical Development."

Heavy Traffic Electrification an Economic Necessity

ECONOMIC aspects of heavy electric traction were outlined in a paper by A. H. Armstrong, chairman electrification committee, General Electric Company, at a well-attended meeting of the electrical section of the Franklin Institute, held in Philadelphia on Feb. 24. During the delivery of the address an interesting series of appropriate lantern slides was shown. These depicted recent snow scenes on the Milwaukee electrification, as well as typical heavy electric traction scenes in this country and abroad.

Coming to the place of the electric motor in the solution of the transportation problem, Mr. Armstrong said that electricity has amply proved its effectiveness in the operation of light high-speed trains in congested zones. It gives opportunity to relocate and redesign the whole terminal railway property along lines impossible with the steam engine. In addition to the passenger terminal development, the way has been shown to the solution of the equally vital problem of handling freight and express matters in city terminals. The steam terminal is not immediately adjacent to the shipper or center of distribution in a large city, nor is it well adapted to the expeditious or economic handling of freight. The electric terminal, on the contrary, may be located with proper regard to the needs of the shipper in the very center of the city if necessary.

Taking up the electric locomotive, Mr. Armstrong rated it as the most efficient and flexible known means of transforming potential into mechanical power. The electric locomotive also offers great advantages for relieving the congestion on mountain-grade divisions, which has reached such a point that additional rails must be laid to obtain the needed relief with continued steam operation. The development of the more powerful electric locomotive is the determining factor in the matter of grade revision, double tracking and mountain division operation.

Another marked advantage of the electric locomotive which was pointed out is its great reliability and consequent low cost of maintenance. The possibility of regenerating power also should not be forgotten.

Illinois Utilities to Hold Convention

THE electric power and railway and gas utilities of Illinois will hold their annual convention at the Hotel Sherman in Chicago on March 15 and 16 next. The morning session will be joint, while the afternoon sessions provide for parallel meetings for each of the three divisions. The program, so far as it relates to the electric light and power division, is as follows:

TUESDAY, MARCH 15

Morning Session.—President's address, W. M. Willett, president Illinois Gas Association; auditing committee's report, E. E. Corken, Central Illinois Light Company; secretary-treasurer's report, R. V. Prather; "Financing Through Your Customers," John F. Gilchrist, Commonwealth Edison Company.

Afternoon Session.—"Coal and the Electric Industry," W. L. Abbott; "Modern Accounting Methods," J. H. Thomas; "Testing of Instrument Transformers," F. A. Kartak.

WEDNESDAY, MARCH 16

Morning Session.—"What the National Association Is Doing"; American Gas Association, Charles A. Munroe, president; American Electric Railway Association, Philip H. Gadsden, president; National Electric Light Association, Martin J. Insull, president.

Afternoon Session.—"Methods of Measuring Reactive Factor and Apparent Power for Basis of Rate Making," Ray H. Wolford; "Comparative Cost of Producing Power by Isolated Plants Versus Central Station Under Present Conditions," John H. Mitchell; "Hazards of Faulty Switchboard Construction," Roscoe M. Pert.

The annual banquet will be held on Wednesday evening.

Remaining Federal Power Commission Regulations Ordered Promulgated

THE remaining regulations of the Federal Power Commission—those numbered from 11 to 20 inclusive—were ordered promulgated at the meeting on Feb. 28. It was pointed out that there was great difference of opinion as to the provisions of the regulations. This, in addition to their highly technical character, had made it necessary for the commission, with its limited personnel, to take some time in their preparation. In answer to the charges which have been made that the commission is holding up a large number of applications pending investigation, it was asserted that there are only two cases in which the charge is true. One case is on the Deschutes River, where there is a conflict between irrigation and power developments, and the State of Oregon has requested a federal investigation prior to action. The other case is on the Colorado River, where there is a similar conflict and where an investigation has been requested by Wyoming, Colorado, Utah, Nevada and Arizona.

First Licenses Under Water-Power Act Granted This Week

WITH the completion of its regulations, the Federal Power Commission was able at its session on Feb. 28 to authorize the issuance of its first licenses and permits. Incidentally the meeting was the final one during the term of office of the present commission. As a result every effort was made to take definite action on all pending matters so that the incoming commission would have to deal with a minimum number of pending questions.

Licenses were issued as follows: The Niagara Falls Power Company, Niagara River; Henry Ford & Son, Inc., Hudson River at Troy, N. Y.; Southern California Edison Company, authorizing an extension of its Big Creek system; Luther Hill, authorizing a project of less than 100 hp. in California.

Preliminary permits were issued as follows: Niagara River Power & Water Supply Company, Niagara River; Hydraulic Race Company, Lockport, N. Y.; Dixie Power Company, White River, Ark.; Washington Irrigation & Development Company, Columbia River, Wash.; Pitt River Power Company, Pitt River, Cal.; United Mills Company, Harpers Creek, N. C.

Licenses also were issued for transmission lines as minor parts of complete projects as follows: Southern California Edison Company, California; Coast Valleys Gas & Electric Company, California; Amazon Dixie Mining Company, Idaho; Butte-Jardine Metal Mining Company, Montana; Spanish Belt Silver Mining Company, Nevada; Paving Granite Quarries Company, South Dakota.

The license authorized for the Niagara Falls Power Company covers 19,500 cu.ft. of water per second to be developed under the Hydraulic Power Company plan. The license is to cover a period of fifty years. The company agrees, as a part of the consideration, to amortize completely its investment in Niagara plants Nos. 1 and 2 and Hydraulic plant No. 2. The investment in these plants is to be written off completely during the period of the license. Valuation is to be undertaken later.

The commission voted unanimously that in case of a modification of the existing treaty so as to permit of additional diversion it is the commission's judgment that it should be handled by the "over-the-top" developments, whereby the full head can be obtained by carrying the water down to the vicinity of Lewiston.

A preliminary permit was authorized for the Niagara River Power & Water Supply Company, covering 30,000 sec.-ft. in the gorge. The permit is for two years, with the understanding that before the license is issued the permittee will submit plans for the development

The commission voted to issue a preliminary permit to the Hydraulic Race Company covering a diversion of 500 cu.ft. per second through the barge canal, upon condition that before the issue of the license the applicant would submit complete plans for the utilization o that amount of water under a head approximatin that which could be obtained at Niagara Falls under conditions which would allow the efficient use of the water. This is the amount of the diversion which is now allowed under a permit granted by the Water Depart ment prior to the enactment of the water-power act.

The other seven Niagara River applications were rejected. The application of the Niagara Power & Development Company and of the Niagara, Lockport & Ontario Power Company were rejected on the ground that the commission is without authority to issue preliminary permits for the diversion of water from the Niagara River above the falls in excess of the amount authorized by the treaty. No action was taken by the commission which would indicate approval or disapproval if the additional diversion should be arranged.

The application of the city of Buffalo was dismissed because no specific plan of development was submitted. The commission also is of the opinion that the city has no legal authority to carry out any development.

The application of J. Kenard Thomson and Peter A. Porter was rejected because the application comes within the jurisdiction of the International Joint Commission and because of a doubt entertained by the commission as to the feasibility of harnessing the Niagara River below the falls.

The application of the Western New York Utility Company for the diversion of an additional 500 sec.-ft. through the Erie Canal was rejected, as was the application of the Niagara Gorge Power Company. The application of Millard F. Bowen for a canal, reservoirs, power houses, conduits and locks between Lake Erie and Lake Ontario also was denied.

Moves for Commission Regulation in Minnesota

THE Minnesota Legislature is considering a bill which if passed will permit the council of any city or village, except cities of the first class, to place before the Railroad and Warehouse Commission for adjustment questions of rates which the council feels should be changed. There is also a bill placing authority in the hands of cities of the first class the right to regulate line construction practices and also to regulate rates and other practices. This latter bill has appeared in every session of the Legislature during the past eight years but has always failed of passage. At present there is no state regulation of utilities in Minnesota.

Supply Manufacturers to Consider Uniform Standards at Annual Meeting

A MEETING of a joint committee of the Associated Manufacturers of Electrical Supplies representing factory mutual and straight line insurance companies will be held at the association's headquarters in New York on March 14 to discuss the possible adoption of a uniform standard of electrical requirements. At present there are some differences in the rules and regulations of the National Board of Fire Underwriters, the insurance companies and municipalities which the joint committee plans to reconcile. The general standards committee of the association will meet on the same day, when it is expected to adopt some standards which have been worked out. This committee will also elect new officers at this meeting.

The date of the meeting of the Heating Appliance Section, which was scheduled for March 17, has been changed to March 10 and will be held in the association rooms.

The board of governors will hold a meeting on Monday evening, March 14, in the association headquarters for the consideration of officers' reports, financial budgets and other matters to be acted upon at the regular meeting on the following day. The newly elected governors will be announced on March 15.

Insull Properties Make Good Showing

IN SPITE of the adverse conditions surrounding last year's operations, the Commonwealth Edison Company's financial statement for 1920, issued last week, showed only a slight decrease in net earnings over 1919. With gross earnings nearly $5,000,000 ahead of 1919, the increase in coal costs was such as to prove the determining factor in wiping out the increase, and net earnings show 9.2 per cent on the common stock as against 9.61 per cent for 1919. The net for 1920 was $4,708,401, as against $4,847,128 in 1919. The Public Service Company of Northern Illinois showed an increase on the common stock from 7.38 per cent in 1919 to 7.47 per cent in 1920.

In fifteen months the Commonwealth Edison Company stockholders of record have increased from 6,838 to 17,396, and when the installment purchasers gained in the recent campaign have paid for their shares the number will be upward of 26,000. The Public Service Company of Northern Illinois will show an increase in stockholders from 2,445 to 13,000 when installment purchasers have fully paid up.

Water-Power Trespass Procedure Formulated

A FORM of procedure to cover trespass was adopted by the Federal Power Commission at its meeting on Feb. 28. It is made the duty of the department having jurisdiction to report to the Federal Power Commission that a power project is going forward without permit or license. The commission then will call upon the trespasser to apply for a permit or license, furnishing at the same time copies of its regulations. The department concerned is to furnish a statement of any damages that may have been occasioned by the trespasser, and the commission will impose, as a condition precedent to the issuance of a license, an obligation to make payment for such damages as may have been caused prior to the issuance of the license.

Prospecting for oil and gas on lands reserved or classified as power sites is to be permitted on the understanding that the prospecting activities are in no way to interfere with the use of the lands for the purpose of power development. Prospecting permits will contain a clause in which the permittee agrees to vacate promptly and remove any property he may have on the lands in question.

Announcing End of War Troubles Proves Profitable, Says Sunny

WITH the beginning of the present year the Illinois Bell Telephone Company, through B. E. Sunny, its president, announced that so far as service and operating conditions were concerned the war emergency was at an end and operating troubles could not in the future be charged to war conditions. Commenting on that announcement recently, Mr. Sunny said to an ELECTRICAL WORLD representative:

"Many of our people were apprehensive as to the effect of such an announcement. As a matter of fact, we have had surprisingly little comment from our subscribers or the public. There is a great deal in the psychological effect of such things. Ninety-five per cent of the people are reasonable, ready to accept statements as to conditions, and will help to make relations as pleasant as possible if they are convinced that an honest effort is being made to carry out pledges. The small percentage that are overwilling to complain have had surprisingly little to say. Of course, when the announcement was made we had reached a position where service was normal and as free from operating errors as the human factor will permit.

"The most important result has been on our own forces. It is easy to excuse difficulties when a reason as strong as that due to war conditions is available. The announcement removed any possibility of falling back on that excuse and put us on the service basis existing previous to the war, when service given depended on the ability of the organization unhampered by abnormal conditions. As a result we have experienced a marked improvement in the morale of our operating forces.

"While in many respects we must, in common with all other business, feel the effect of the war for years to come, the time has arrived when the public is no longer willing to listen to the war excuse as a reason for failure to give service for which it is paying. With material and labor once more available, service with existing facilities can be given. The extension of service to cover hitherto undeveloped fields is another matter."

Boston Chamber of Commerce Opposes St. Lawrence-Great Lakes Project

IN A REPORT made a few days ago to the New England Traffic League a special committee of the Boston Chamber of Commerce urges strong opposition to the St. Lawrence-Great Lakes navigation and water-power project on the ground of too great cost and because Canada would benefit the most from the power produced. The committee averred that even if 3,500,000 hp. could be developed, as is estimated by those backing the project, Canada now controls at least two-thirds of this, while transmission of the remainder to the United States would be costly and chimerical.

Applications of Hot Cathode Tubes Are Increasing

BEFORE an audience that packed the auditorium of the Engineering Societies Building, the development and ever-increasing usefulness of electron tubes were outlined by Dr. Saul Dushman of the research laboratory of the General Electric Company on Feb. 25, when he spoke on this subject to the New York Section, A. I. E. E.

One of the very important applications to which hot-cathode or electron tubes have been put, according to Dr. Dushman, is the rectification of small amounts of energy, and this is made use of in the precipitation of smoke and gases. He said that electron tubes offer a much better means of rectifying high-voltage alternating current than the mechanical rectifiers now used in the Cottrell precipitation process.

Dr. Dushman presented in simple language the development of the various tubes known as kenetron, pliatron and dynatron by Dr. Irving Langmuir and others and showed how these can be applied to transmission and reception of signals, rectification of alternating currents and the production of alternating currents from direct currents by reversing the normal tube operation. An interesting phenomenon was pointed out

in the discussion of the dynatron attributed to Dr. Hull, which exhibits the characteristics of a stable negative resistance. The Coolidge X-ray tube was said to be a long step in advance of older tubes in its permanence and dependability.

A. A. E. Holds Conference on Public Information

THE importance of the engineer's telling the story of his work as it progresses was emphasized by F. H. Newell of Washington, D. C., at the national engineering conference on public information held in the Congress Hotel, Chicago, on Feb. 25. Mr. Newell pointed out that an employer is entitled to know what he is receiving from an employee, but cannot know unless he receives from time to time evidence of work done.

The engineer engaged in work in which the public is interested can gain recognition only through publicity that tells truthfully and forcefully the work that he is doing.

John G. D. Mack, state chief engineer of Wisconsin, in discussion, brought out the importance of avoiding the use of technical language in giving publicity to engineering matters. Such information can be presented to the public in a non-technical language and if this information is to be effective it must be done in this way.

That an independent technical press is recognized by the public as an interpreter of constructive thinking in industry was the assertion of F. M. Feiker, New York, vice-president of the McGraw-Hill Company, who discussed the engineer as a force in the solution of social as well as economic problems. He expressed the hope that a thorough understanding of the opportunities for the engineer and the independent technical and engineering press would grow out of the conference on public information.

The conference was organized and held by the American Association of Engineers.

Ontario Municipal Electricians Condemn Two-Dollar-per-Horsepower Rental

THE Ontario Municipal Electrical Association at its annual meeting, held at Toronto on Feb. 25, vigorously opposed the annual tax or rental of $2 per horsepower proposed by a committee of the Ontario Legislature to be levied on the undertakings of the Ontario Hydro-Electric Power Commission. The following resolution was passed:

"Resolved, That the Ontario Municipal Electrical Association places itself on record as being entirely opposed to the recommendations made by the committee of the Ontario Legislature and recommends that the Legislative Assembly do not take any action along the lines suggested until after a thorough investigation by competent authorities and without giving all interested parties a full opportunity to be heard."

Other resolutions adopted included one asking that the province transfer to the commission in trust for the municipalities the plants composing the Central Ontario system and one asking for a fixed tenure of office of the members of the Hydro-Electric Power Commission, and that the municipalities be allowed to elect representatives to the commission, the members of which have been heretofore appointed by the Ontario government.

The following officers were elected: President, Willoughby Ellis of Hamilton; vice-presidents, J. Ernest Banwell of Windsor, C. Alfred Maguire of Toronto, R. F. Elliott of Kingston, W. K. Sanderson of St. Thomas; secretary-treasurer, T. J. Hannigan of Guelph.

Home-Rule Control of Utilities Revived in Arkansas

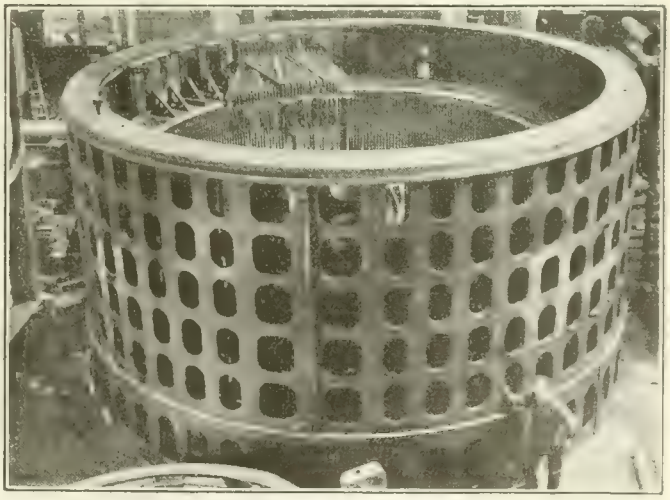
PUBLIC utilities in Arkansas are returned to home-rule control by the Emory-Walls bill, which has been passed by both houses of the Arkansas Legislature now in session and has been signed by Governor McRae. This bill repeals the act of 1919 which abolished the Arkansas Railroad Commission and substituted the Arkansas Corporation Commission. In repealing this act provision is made for a new Railroad Commission, to which certain powers formerly exercised by the Corporation Commission are transferred.

The new commission will have general jurisdiction over all common carriers, railroads, express companies, car companies, freight lines, toll bridges, street railways, electric and other interurban lines, telegraph and telephone companies, etc. No jurisdiction is vested in the commission, however, over any matter of rates or regulations of public utilities operating within a municipality, such jurisdiction being expressly conferred upon the municipality.

Procedure is prescribed whereby municipalities may assume ownership and direct operation of utilities after an election by the people. Provision is made for appeals from the rulings of any municipality in regard to rates or other questions to the Circuit Court.

With the enactment of this bill some question has arisen as to the status of companies which are operating under indeterminate permits issued by the Corporation Commission.

World's Highest-Rated Waterwheel Generator



FOR the Queenston-Chippawa development of the Hydro-Electric Power Commission of Ontario, now in the process of construction, there are on order five 45,000-kva. waterwheel generators, a new world-record rating. One of these machines, now ready for shipment, is here shown being set up in the manufacturer's shop. The generators are of Canadian manufacture.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Manufacturing Nitrogen by New Process.—The manufacture of nitrogenous compounds by a new electrochemical process has been begun in Sweden. The method has many points of resemblance with the Haber process, but is said to be more economical and reliable. Heating is effected by electricity, and, according to the statements made before an engineering body at Gothenburg, 1 kg. of combined nitrogen can be made with the consumption of 12 kw.

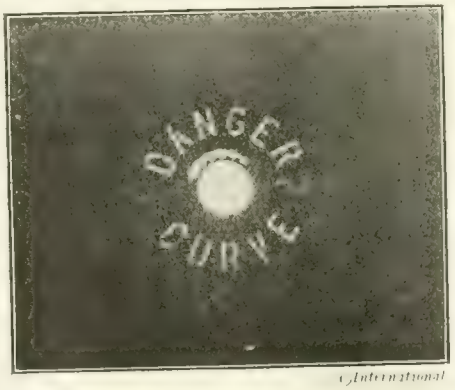
Cost of Caribou Plant.—Authority has been sought by the Great Western Power Company of California to issue general-mortgage 8 per cent bonds in the amount of $5,000,000, to mature in 1936, in order to complete its Caribou plant on the north fork of the Feather River, Plumas County, as well as to construct a transmission line carrying 165,000 volts from the plant to a substation at Valona, Contra Costa County. The company shows that the estimated total cost of the Caribou plant and transmission line will be $15,475,300, of which nearly $11,000,000 has already been provided

Bureau of Mines Electrical Specifications Before A. E. S. C.—The United States Bureau of Mines has brought three of its publications to the attention of the American Engineering Standards Committee for consideration as "tentative American standards." These publications concern specifications for portable electric mine lamps and storage-battery locomotives and safety rules for installing and using electric equipment in bituminous coal mines. By a special provision in the procedure of the committee important specifications in existence prior to 1920 may be approved without going through the regular process followed in new work.

An Italian Hydro-Electric Development.—One of the noteworthy hydro-electric installations of recent construction in Italy is on the Scoltenna, a torrential stream in an unusually rainy district in the province of Modena. *Le Génie Civil* gives a description of the dam and power house based on a communication from one of the engineers to the Italian Electrotechnical Association. The total head utilized is 367 ft. The dam is of the multiple-arch type with a maximum height of 78 ft. and a length of 250 ft. The reservoir capacity is 21,000,000 cu.ft., and a canal 16,600 ft. in length permits 280 cu.ft. a second to flow through the power house. The latter contains two 4,000-hp., 504-r.p.m. reaction turbines coupled to alternators. An annual production of 30,000,000 kw.-hr. is reached.

An Electrometallurgical Installation Planned for North Carolina.—A plan is on foot, according to the director of the North Carolina Geological and Economic Survey, to develop hydro-electric power in Cherokee County, N. C., where there are iron ores in commercial quantities, so as to make possible the establishment in that county of an electric furnace for the reduction of these ores and of other metallic deposits found in nearby territory, such as chromite, rutile and corundum. The town of Andrews is said to be specially interested in the project.

Flashing Beacons to Warn Motorists on National Highways.—The adoption of miniature land beacons which wink eighty warnings a minute has been recommended by traffic engineers as a means of helping to control automobile traffic on the national highways. More than a hundred cities and towns throughout the United States, it is said, have already erected these signals as an aid to motorists. The standardized colors, which, as in the case of railroad signals, are red, yellow and green, are flashed by "land lighthouses." The accompanying illustration shows these signals in use.



(International

Westinghouse Lamp Company's New Buildings.—The completion or early completion of three new factory buildings is announced by the Westinghouse Lamp Company. One of these buildings is at Bloomfield, N. J., one at Milwaukee and one at Indianapolis. The Bloomfield expansion, on which work began in the spring of 1920, has an area of 230,000 sq.ft., part of the new erection being an extension and the remainder an entirely new building of four stories. On the roof there is a long-range wireless telephone outfit for direct communication with the research laboratory in East Pittsburgh, Pa. The Milwaukee development is a three-story concrete structure with a floor space of 82,000 sq.ft. It is connected to the old building and will afford storage space and recreation facilities. The Indianapolis building was not begun until September, 1920, but it is expected to be complete by May 1 next. It will have four stories and basement, with 160,000 sq.ft. of floor space and facilities for manufacturing 35,000 lamps a day.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Institute of Radio Engineers.—Meeting at New York on Wednesday of this week, the Institute of Radio Engineers listened to a paper on "Piloting Vessels by Electrically Energized Cables," by A. Crossley.

March Meetings of A. I. and S. E. E.—Two papers have been added to those named in this column last week as scheduled for presentation before the Birmingham Section of this association on March 19—"Lubrication of Mill Motors," by J. E. Harrell, and "Value of Research in Steel Mills," by C. H. Watson. In addition to the March meetings of the Philadelphia, Cleveland, Birmingham and Chicago Sections, already announced, the Pittsburgh Section will meet on March 19, when W. A. Meddick, transportation engineer with the Lakewood Engineering Company of Cleveland, will discuss "Mechanical Transportation in Steel Plants."

American Physical Society.—Among the papers presented at the New York meeting of the American Physical Society in Columbia College on Saturday, Feb. 26, were "The Piezo-Electric Resonator," by W. G. Cady of Wesleyan University; "A High-Speed Oscillograph Camera," by E. A. Eckhardt, Bureau of Standards; "Photo-Electric Phenomena in Coated-Filament Audion Bulbs" and "Polarization Capacity and Polarization Resistance as Dependent Upon Frequency," by Ernest Merritt, Cornell University; "The Motion of Electrons Between Coaxial Cylinders in a Uniform Magnetic Field," by Albert W. Hull, General Electric Company; "An Electrical Doublet Theory of the Nature of the Molecular Forces of Chemical and Physical Interaction," by R. D. Kleenman, Union College, and "The Measurement of Paramagnetic and Diamagnetic Susceptibilities in Very Weak Fields," by S. J. Barnett.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Philadelphia Section, March 5; Cleveland Section, March 14; Birmingham Section, March 19; Pittsburgh Section, March 19; Chicago Section, March 22.

Oklahoma Utilities Association—Oklahoma City, March 8-10.

American Institute of Electrical Engineers—New York Section, March 11. Providence Section, March 16; Schenectady Section, March 18.

Associated Manufacturers of Electrical Supplies—New York, March 15. (For program see issue of Feb. 26, page 501.)

Illinois State Electric Association—Chicago, March 15-17.

Wisconsin Electrical Association—Milwaukee, March 23 and 24. (For program see issue of Feb. 19, page 448.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

No Writ of Review Granted Where Commission's Finding Is Justified by Evidence.—The Supreme Court of Colorado refused to grant a writ of review in a suit brought by the Burlington Gas & Electric Company against the Colorado Public Utilities Commission complaining that the town of Burlington had not complied with the law in establishing a municipal electric light plant. The court declared the commission's finding fully justified by the evidence. (194 Pac. 367.)*

Plaintiff in Discrimination Case Has Burden of Proof.—In Cock vs. Marshall Gas Company, in which discrimination was charged, the Court of Civil Appeals of Texas held that in such actions it devolves on the plaintiffs to produce affirmative proof to support their averments and they must show not only a difference in rate but also that the conditions of supply were substantially the same or such as to present no good reason for the rate difference. (226 S. W. 464.)

United States Supreme Court Has No Concern with Delegated Powers of a State.—The United States Supreme Court declared, in affirming judgment against the Erie Railroad Company and other corporations that brought suit to upset orders of the Board of Public Utility Commissioners of New Jersey, that the federal court of last resort has no concern with the question how far legislative or quasi-legislative powers may be delegated by a state to a commission or board. (41 S. C. R. 169.)

Permitting Recovery of Exemplary Damages Without Evidence of Wantonness Held to Be Prejudicial Error.—Reversing the verdict in Poor vs. Western Light & Power Company and remanding the case for retrial, the Supreme Court of Colorado found that, although the inferior court did not err in charging that the jury might find the company guilty of negligence resulting in the injury of a boy from a fallen wire, irrespective of the cause of the break, if the company knew or by the exercise of the utmost care should have known that the wire was down, the court did err in charging the jury that it might return a verdict for exemplary damages if it found that the injury complained of was "attended by circumstances of wanton and reckless disregard of plaintiff's rights and feelings on the part of defendant company," there being no evidence to support such an accusation and it being impossible to determine what portion of the damages awarded was allowed as exemplary or punitive. (194 Pac. 613.)

Proper Instructions on Duty of Electric Company in Maintaining Safe Conditions.—In an action for death resulting from electric shock, it was held by the California Supreme Court, in Robinson vs. Western States Gas & Electric Company, that an instruction in the trial court to the effect that an electric company should not only construct its line in a safe and substantial manner but keep it in such condition was not erroneous as implying that defendant was liable unless the line was absolutely safe, when the instruction was considered in connection with other instructions as to what constituted due care.

Death Due to Mental Strain Not "Accidental."—In O'Connell vs. Adirondack Electric Power Corporation the defendant appealed to the New York Supreme Court, Appellate Division, against a decision of the State Industrial Commission that the chief operator of the company's electric system, who died in his office while directing the restoration of service interrupted by a storm, lost his life from "accidental injuries" within the meaning of the workmen's compensation law. Ruling against the Industrial Commission, the court said, after quoting the medical testimony, which was that the fatality was due to dilatation of the heart or some similar ailment: "It would be a strange perversion to term the mental apprehension of news communicated an accident or an occurrence to the mind or body of the person receiving such news. It would be particularly strange in such a case as this, where the news conveyed was of a kind neither infrequent nor unexpected nor alarming." (185 N. Y. S. 455.)

Circumstances Under Which Diverted Water May Not Be Returned to Old Channel.—May one who has acquired the right to divert water from a watercourse on his land return it to its original channel when by so doing he damages the land of a lower riparian owner owing to the fact of a freshet having seventeen years before changed the course of the channel? This question, at issue in Stough vs. Steelville Electric Light & Power Company, the Missouri Court of Appeals decided against the defendant. The company had dammed a spring to make a reservoir, the water being brought through a race to furnish power to the company's plant and thence discharged so that it found its way back to the natural bed of the stream. A landowner is entitled to change the course of a natural stream within the limits of his own land, the court held, where he does not by so doing cast on the land of an adjoining proprietor water which would not naturally flow there, but restores the water to its natural channel before it reaches the land of the adjoining proprietor. (226 S.W. 295.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Stock Dividends Declared Illegal.—The Noblesville Heat, Light & Power Company having sought to transfer $100,000 from its surplus account to its capital account and to issue a corresponding amount of capital stock to its shareholders, the Indiana Public Service Commission declared such a transaction forbidden by the Indiana statutes.

Approval of Competition in Certain Circumstances.—The New York Public Service Commission, Second District, has held that an application for a certificate of convenience to construct and operate an electric transmission line to serve a manufacturing company in occupied territory will be granted where the existing utility's surplus energy is limited and it is owned and controlled by competing industrial companies.

Conflicting Interests of Transmission and Telephone Companies.—In granting to the Homer Electric Light & Power Company the right to construct a 13,000-volt transmission line along a highway in parallel with telephone circuits (see ELECTRICAL WORLD, Feb. 5, page 336), notwithstanding the prior occupancy of the route by the telephone company, the Public Utilities Commission of Illinois said: "In considering possible interference between supply and signal lines and the routing of new lines the commission must take into consideration every condition which, broadly speaking, may ultimately cause a burden to be placed on the citizens served with electric and telephone service, and the problem, therefore, becomes one of selection of the construction which will best serve the largest number of citizens. It is true that inductive interference in this case might be largely avoided by construction of a low-voltage line along the hard road to serve the applicants with electric service. Such a line, however, would practically parallel the existing 13,000-volt transmission line now constructed along the Wabash right-of-way which constitutes part of the transmission line between Lyons and Homer. The construction of this line, which would be in a large measure a duplication of an existing line, would mean a much larger investment, increased maintenance and probably impaired service. The construction of a 13,000-volt transmission line along the hard road, making possible the abandonment of the present line along the Wabash Railroad, would serve the purpose of transmitting energy to Fairmount, Homer, Sidney and adjacent communities, and would also serve the rural consumers."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Arthur S. Knight, who has recently established offices at Boston as public utility consultant, is well known in central-station and public utility commission circles through his long connection with the Boston Edison company in the field of rates, economics of operation, finance and accounting. Mr.



A. S. KNIGHT

Knight is a native of Boston and entered the employ of the New England department of the Edison company for isolated lighting in 1882 as office assistant. He continued with the Boston agency through subsequent changes until 1892, when he was appointed auditor of the Boston Edison company, later becoming controller. His pioneer work in central-station accounting has influenced the Boston company's practice for more than twenty years. Mr. Knight introduced principles and methods which have since been adopted by other companies, such as what is known as the "replacement theory of handling depreciation," used at Boston for a quarter of a century. Since 1902 he has been retained by the Boston company as a consultant on practically all matters except construction. He was among the earliest to realize the effect of load factor upon rates and to call attention to the defect in the original demand system caused by the failure to give any consideration to the element of size. At the last Edison Association convention he presented a written comment upon power-factor problems in relation to rates. Mr. Knight has specialized in the economic aspects of rate regulation and company administration, investigations for clients involving intricate technical relations, theories and methods, and has played an important part in many commission and court proceedings of public utility interest. He is a life member of the Engineers' Club of Boston and has been on the board of governors since the club began. Mr. Knight is also a member of the Edison Pioneers.

R. T. Long, who for the last thirty years has been a member of the engineering department of the Anderson (S. C.) branch of the Southern Public Utilities Company, has resigned as superintendent of plants and lines to accept a similar position with W. C. Whitner & Company, Richmond, Va. When the first plant of the old Anderson Electric Light Company, containing one 750-light generator driven by steam power, was started in 1890, Mr. Long was its dynamo attendant. Four years later, when the company decided to build its 120-kw. hydraulic plant at High Shoals, Mr. Long was appointed superintendent in charge of its construction. This plant led to the building of the Portman plant, which was started in 1896 under the direction of W. S. Lee, resident engineer. When this plant was placed in operation in 1897, with a total generating capacity of 1,200 kw., Mr. Long was placed in charge. In 1902 he resigned to become connected with the Pacific Gas & Electric Company, but returned to the Portman plant two years later as superintendent. When on two occa-



R. T. LONG

sions the Portman power house was destroyed by fire Mr. Long rebuilt it. In 1913 he was made superintendent in charge of operation of the Greggs Shoals plant and shortly after appointed superintendent in charge of plants and lines.

Murvyn W. Vye, who became vice-president and sales manager of the McKenney & Waterbury Company, Inc., Boston, on March 1, is one of the best-known sales executives in the New England electrical supply jobbing field. He is a native of Randolph, Mass., and entered the electrical field with the old Brockton Street Railway. After two years with that company he entered the purchasing department of the Fore River Shipbuilding Company, Quincy, Mass., and remained with that company for a decade, during the last three years of which he was assistant purchasing agent. In 1909 Mr. Vye joined the sales department of the Wetmore-Savage Company, electrical supply job-



M. W. VYE

ber in Boston. In 1917 he was made sales manager and since then has been a stockholder, director and clerk of the company. Mr. Vye is known throughout the New England territory for his comprehensive knowledge of trade conditions and his imperturbable good nature under stress of business. He is a member of the N. E. L. A.

Victor A. Ryan, who was recently appointed superintendent of the Irvington Varnish & Insulator Company, Irvington, N. J., was formerly production chemist with E. F. Houghton & Company of Philadelphia, and previous to that was connected with the Marden, Orth & Hastings Corporation of Chicago, as well as with the National Oil Products Company of Harrison, N. J., in a similar capacity. Mr. Ryan has been associated with the varnish and textile trades through the manufacture of oils and oil products for the last ten years.

Jacob Bunn, president of the Sangamo Electric Company, and R. C. Lanphier, vice-president, sailed Feb. 26 for London, England, to complete arrangements for the manufacture of Sangamo meters under the name of the British Sangamo Company, Ltd. A factory has been established which will produce both American meters and other designs required on the Conti-

nent. The sales will be handled through the Edison-Swan Electric Company, Ltd., except in Canada and New Zealand. S. B. Rogers, formerly production manager of the Sangamo Electric Company, is in charge of the British works. Mr. Rogers took up his new duties in November of last year.

George Holt Lukes, general superintendent of the Public Service Company of Northern Illinois, who recently died at the Ravenswood Hospital, Chicago, was born in Racine, Wis., Dec. 6, 1869. After graduation from the Massachusetts Institute of Technology in 1892 Mr. Lukes took up the engineering apprenticeship course at the Schenectady works of the General Electric Company and joined the staff of the old Chicago Edison Company as inspector



G. H. LUKES

in 1893. He was made night superintendent of the company about six years later. In 1902 Mr. Lukes left the Edison company to become superintendent of the North Shore Electric Company, with headquarters at Evanston, Ill., and when this company was combined with several others to form what is now the Public Service Company of Northern Illinois Mr. Lukes was made its general superintendent.

A. V. S. Lindsley has been appointed sales manager of the Connecticut Power & Light Company, succeeding B. H. Gardner. Mr. Lindsley is a graduate of Cornell University, where he received the degree of M. E. in 1909. He was with the Westinghouse Electric & Manufacturing Company until 1913, covering both engineering and sales work. He then became power engineer of the Syracuse (N. Y.) Lighting Company, remaining with that organization until 1917, when he enlisted in the United States Army. After serving a year in France as captain of engineers, he received his discharge in July, 1919, and in October of that year entered the employ of the Connecticut company as industrial power engineer at Waterbury, occupying that post until his promotion to sales manager, which became effective Feb. 1.

C. M. Young, superintendent of the power station of the Columbus (Ga.) Power Company, has resigned.

John Kiernan has been elected president of the Douglas County Light & Water Company, Roseburg, Ore., succeeding William Pollman.

R. M. Jennings has been appointed general manager, secretary and treasurer of the Douglas County Light & Water Company, Roseburg, Ore.

A. G. Sutherland has been appointed vice-president of the Douglas County Light & Water Company, Roseburg, Ore., succeeding J. B. Yeon.

J. G. Rollow has become associated with the Los Angeles (Cal.) Gas & Electric Corporation, having resigned from E. I. du Pont de Nemours & Company.

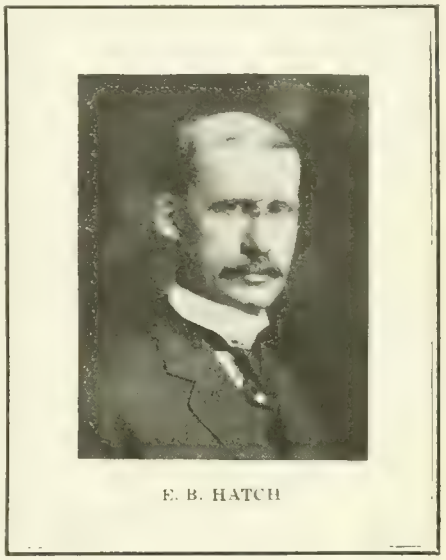
George J. Blanton has been appointed New York district manager of the Chain Belt Company, Milwaukee. For four years Mr. Blanton was connected with the engineering sales department of that company. Previous to joining the staff of the Chain Belt Company Mr. Blanton was for eight years connected with the General Electric Company.

L. C. Peterman, who recently entered the electrical department of Dwight P. Robinson & Company, is a graduate of Ohio State University. He entered the electrical utility field with the Columbus (Ohio) Railway, Power & Light Company, becoming distribution engineer, and later went to the Cleveland Electric Illuminating Company in the same capacity. In 1917 he became connected with the Ohio Utilities Company, Columbus, in charge of substation design and construction on the 40-mile Columbus-Camp Sherman-Chillicothe transmission line. This work included conversion of the steam-driven plant at Chillicothe to a remote-controlled reserve plant and the complete rebuilding of the distribution system. Later Mr. Peterman became electrical engineer for the same company in charge of design and construction of the electric railway and gas properties of the company in Chillicothe, Circleville, Delaware, Hillsboro and Galipolis, Ohio.

George J. Kirkgasser, who has been in charge of sales promotion work, advertising and publicity for the Cutler-Hammer Manufacturing Company, Milwaukee, since 1914, has recently resigned and established an office in Chicago under the name of George J. Kirkgasser & Company. This organization will furnish a service to industrial and engineering concerns in advertising, merchandising and the development of co-operation between works departments, selling departments, outside offices and distributers. Mr. Kirkgasser was graduated in electrical engineering from Syracuse University in 1907 and for three years following this was engaged in engineering work. In 1910 he became identified with the Cutler-Hammer Manufacturing Company as assistant advertising manager and technical writer, a position he held until he was made advertising manager in 1914. Mr. Kirkgasser has contributed many engineering articles to the technical press and is the author of "Electric Light and Motor Wiring," "Electric Control Engineering" and "Motors and Motor Control."

Obituary

Edward B. Hatch, president of the Johns-Pratt Company, Hartford, Conn., died suddenly on Feb. 18. He had been stricken only a few days previous with pneumonia. Mr. Hatch was born in



E. B. HATCH

Hartford, Dec. 20, 1861, and graduated from Trinity College in 1886. Very shortly thereafter he entered the employ of the Johns-Pratt Company in a clerical position, but was rapidly promoted owing to his great energy and executive ability. In 1888, in recognition of work he had already done, Mr. Hatch was appointed secretary of the company. Four years later he was appointed a director of the company and elected president in 1898, succeeding Henry W. Johns of New York, who was the first executive head of the company. Mr. Hatch was not only prominent in the electrical industry but was a director of many industrial concerns and financial institutions. Besides, he was interested in civic affairs of his own city, where the loss of his influence and interest in business and social matters will be keenly felt. It was during Mr. Hatch's administration of the business of the Johns-Pratt Company that the well-known "Noark" line of fuses, switches and meter protective devices handled through Johns-Manville, Inc., developed.

John Mullen, founder of the Shamokin (Pa.) Electric Light Company, one of the first municipal lighting plants in this country, died in that city on Feb. 22.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Possibility of Price Increase on Armored Conductor

THERE seems to be a pretty well-founded opinion among certain jobbers in the East that prices of flexible armored conductor are to undergo an upward revision in the near future. Rumors to this effect have been current for some time, and it is known that manufacturers too have not been unmindful of the possibility of higher prices.

Acting on this supposition, some of the Eastern jobbers reported to a representative of the ELECTRICAL WORLD this week that they are stocking all the armored cable they can obtain. As noted before in these pages, manufacturers will sell at present prices only for immediate shipment, forward orders being accepted at the price in effect on date of delivery. The present market on the whole is quiet both with jobbers and manufacturers.

Questioned regarding the possibility of a higher price going into effect several leading producers admitted that the matter was under consideration at the present time. What action will be taken is, of course, unknown, but the view expressed as representing the manufacturer's standpoint was that production at present prices entails little or no profit. With spring coming on and the prospect of more business developing in the cable market, therefore, it seems logical to believe that prices may increase later on. The current Pittsburgh base price upon which manufacturers are working is reported as $55.

Lower Steel Prices No Help to Higher Production

IN AN endeavor to provide employment for their workers and to work off inventories which have been marked down many independent mills have scaled down steel and iron prices so that the spread of prices between corporation and independent producers is becoming more marked. None the less this cutting has had little stimulating effect on buying. Large and small producers alike are feeling the effect of the buying decline. Even the ordinary run of business that comes from regular channels is being held up.

In virtually every section of the steel country furnace and mill operations are being reduced. Here and there are reports of an improvement in operations, but they are entirely local. At the same time, some independent mills are piling up stocks of iron for reserve. Sheet production is very low and tube production is rapidly declining. The latter fact may have some effect on electrical conduit, as at least one company has just put through a reduction on tubular goods of from $8 to $10 per ton. It is the hope of this producer that the reduction will bring in orders sufficient to run the plant at a little better rate than that existing, which is lower than ever before.

These price reductions in the independent mills have brought iron bars to from 2.70 cents to 3 cents, Pittsburgh, as against a former quotation of 3.06 cents. A cut of $2 a ton under the minimum price of ten days ago, offered on galvanized sheets, brings this quotation to 5.25 cents. The upper price is 5.70 cents. Black sheets can be had at 4.10 cents, a slight recession only from a former minimum of 4.15 cents. But the whole industry is so anxious for trade that it would not be surprising to find recessions even from these prices. Bar, shape and plate prices have held quite level for the last week, the minimum on bars being 2 cents, on shapes 2.20 cents and on plates 2.25 cents. These, it is believed, could also be shaded.

According to Judge E. H. Gary's statement at the February meeting of the American Iron and Steel Institute, steel prices will not be reduced at present, nor is a cut in wages in the steel industry being considered at this time by the United States Steel Corporation. Mr. Gary has had no comment to make so far on the letter from John Skelton Williams, Comptroller of the Currency, wherein Mr. Williams tried to point out the beneficial effects to the country that would result from the lowering of steel prices by the corporation. Even in view of the above it would not be surprising to find not only a reduction in wages but also in steel prices by the corporation in the near future.

Wages, it is generally known, have been very generally reduced throughout the independent steel industry, following which the mills reduced their prices. Consequently any reduction in corporation wages would be expected to presage a reduction in price of finished and semi-finished products.

British Lamp Prices Undergo Reduction

AN ANNOUNCEMENT in the *Electrical Times*, London, says that the Electric Lamp Manufacturers' Association of Great Britain, Ltd., has made substantial reductions in the prices of association makes of the electric lamps as of Feb. 1. These reductions range from about 18 per cent up to 28.6 per cent for the gas-filled type and from 8.3 per cent to 16.7 per cent for the vacuum type.

In the case of the gas-filled lamp the greater reduction of 28 per cent is for the larger size of 100 watts at both the 100-130-volt and the 200-260-volt ranges, while in the case of the vacuum lamps the greater reduction is for the smaller size of 10 watts to 30 watts at the 100-125-volt range.

The report goes on to state that up to the middle of January German lamps were not coming through in any appreciable quantity, but that pressure was bound to be felt sooner or later even with a 12½ per cent duty on exports at the German frontier. The British group of lamp manufacturers, it seems, is preparing to meet this German competition.

Spring Demand for House Meters Not Yet Lively

FROM a survey of the trade which has just been made stocks of the 5-amp. and 10-amp. types of house meters in the hands of jobbers, manufacturers' agents and central stations are quite spotty and range from low to full. Demand, too, is very uneven. In most cases there are sufficient meters on hand to take care of current needs, while reports show that deliveries are improving.

From the Northwest there is a good demand, residence building for the spring being well under way. Stocks are good and replenishments easy. The demand this year is expected to exceed that for several years past. The demand from California has moderated a bit as the result of past shipments, and deliveries are being regularly received again.

In the Intermountain districts there are plenty of meters. Here there is quite an extensive demand for three-wire 15-amp. sizes to handle range loads. The spring is expected to bring in a good call for meters.

Chicago reports a low stock and a light demand, with inquiries at a minimum. But there is a feeling of revival in the building industry. St. Louis has a fairly complete stock of meters, with more of the 5-amp. size. These

nicely balance the demand. There is a steady volume of sales to the rural and small city utilities. The central stations get most of the trade here direct, but jobbers are getting their shipments through satisfactorily.

Agents and jobbers in the Southeast can accumulate small stocks now, but they have only about a one-third normal demand to supply. A revival in business is expected in sixty days. Demand in the Atlantic States is off and stocks are still quite low. It is reported that some manufacturers have not yet supplied all back orders, but deliveries are coming in better. There is still considerable wiring of old houses going on. New England stocks are showing improvement under some rather quick shipments in lots of from fifty to a hundred meters. Demand is holding up well.

Price Reductions Not Yet a Stimulus to Trade

ALTHOUGH reductions in price of electrical supplies employing in their make-up large relative amounts of cotton and copper and some steel products were made before the past year came to a close, it was not until early in February that general reductions applied to electrical apparatus and equipment gave to the industry the evidence of a downward trend in prices that it had been looking for. Since that time, however, manufacturers of virtually all classes of motors, generators, control, transformers of the distribution type and other kinds of apparatus, both mechanical and electrical, as used in the power transmission and utilization field, and of items of supply and equipment, have experienced a reduction in price of approximately 10 per cent. The lower limit is in general 5 per cent, and it runs up to about 20 per cent on some items. At the same time former inquiries have been refigured, old prices giving way to substantially lower quotations.

Since the first of the year manufacturers producing for the electrical field have felt the seriousness of the hesitation in buying and have found it imperative to lower their working hours per week, or to curtail their working forces, or to make cuts in their wage scales. In many instances combinations of these expedients have been found necessary. As a result the manufacturers have revised their prices downward, thereby keeping faith with their workers in the matter of the reduction of wages and production.

But there has been no evidence of any resumption in buying. Here and there will be found new business, but much of the activity is still that of maintenance. However, the electrical industry is a basic one in the industrial and commercial life of the nation and the world, and it can be only a matter of time when all the work which is being left undone must be done. Then much of the equipment will be demanded in a hurry, and the producer with stocks will get the call. Raw materials now are low in price, and much electrical equipment is appreciably lower than it was the first of the year. Labor is plentiful, and producing capacity is ready to handle a large volume; but the starter with the gun is still slow in coming up to the line.

India Seen as a Market for Electrical Materials

THAT India has a bright future in the electrical field is very well shown from reports which have recently been brought back by a representative of one of the largest electrical manufacturers in the United States. Much of this optimism for the future, to be sure, is predicated on the stabilization of economic conditions in that eastern country. It has been asserted that, given a chance to grow —a chance to develop economically, socially, politically— India within ten years will become a very important factor in the progress of Asia and will be both a large industrial consumer and a large industrial producer. But if the conditions are reversed and the country is fettered economically, socially and politically it will go down hill fast.

India contains a number of water-power resources, some of which already have been developed. Virtually all the hydro-electric equipment recently installed, it is stated, is of American manufacture, and, as a matter of fact, the electrical apparatus in India includes a large quantity of American make. On the other hand, English wiring materials predominate because of the rulings of the installation code which permit of the use of materials manufactured in that country. These are in general said to be of a grade below the highest.

Exports of electrical materials and apparatus of all kinds from the United States to British India during 1920 amounted to approximately $4,250,000. There are great possibilities for electrification in the oil fields, in the mines, for agricultural work and in the industries. Besides, the natives are good users of electricity for light. Considerable jealousy and a spirit of competition among individuals and communities in respect to illumination have been found to exist. Consequently a field for electric signs and a need of illuminating engineers have been reported. There is some use for socket devices, but native cooks are cheap and wood for fuel is plentiful.

Besides the prospect of electrification of the oil fields, there is already a big development in the steel mills. The mica, copra, shellac and jute industries are some of the most important in India, while shipping plays a big part. Much raw material, especially cotton, is shipped to England to be fabricated and returned. Textile mills in India would provide an outlet for native labor. This is only one instance of the lack of finishing mills in India, but the opportunity for them is regarded favorably. The use of electricity in shipping provides still another outlet.

The Metal Market Situation

THE tone of the copper market is again easier, prices being fractionally lower than they were a week ago. Domestic demand remains light, but it seems that the lack of buying interest is not especially a question of price. In fact, copper at the present price is considered a good buy, but until the demand for finished copper products increases materially wire drawers, brass manufacturers, etc., will probably continue to purchase only for immediate needs.

Some small amount of copper for prompt shipment is reported to have been sold at 12.50 cents per pound delivered by producers, whose quotations for the second quarter range from 12.75 cents to 13 cents delivered. The outside market has reduced its prices in accordance with the drop in the major market, but there is little if any copper in dealers' hands at lower than producers' prices. Standard spot copper at London developed a weaker tone during the past fortnight and by successive drops fell £4 to £68 5s. per ton.

The market for zinc continues sluggish, and spot fell off another fraction of a cent the past week. The price of lead has been cut to 4 cents per pound by the leading interest, but as yet legitimate buying interest has not reacted strongly, though the speculative element in buying is more pronounced in view of this new low price.

NEW YORK METAL MARKET PRICE

	Feb. 28, 1921	March 4, 1921
Copper	£ s d	£ s d
London, standard spot	72 5 0	68 5 0
	Cents per Pound	Cents per Pound
Prime Lake	13 25	12 75
Electrolytic	12.50—12.75	12 50—12 62½
Casting	12.37½	12 00
Wire bars	15 75	15.25
Lead, trust price	4 40	4.00
Antimony	5 20	5 20
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 30	5 10
Tin	32 50	30 25
Aluminum, 98 to 99 per cent.	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.75–11.25	10 50–10 75
Brass, heavy	6.00– 6.50	6.00– 6.50
Brass, light	4 00– 4.50	4.00– 4 25
Lead, heavy	3.75– 4.00	3.25– 3 50
Zinc, old scrap	3 00– 3 25	3 00 3 12½

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

IT IS at least satisfying that the supply business is getting no worse than it has been. Reports from the different sections of the country give no assurance that business is any better, but they show that it is holding its own. The Northwestern States alone show an increase in trade. Here, it seems, the spring building is already under way, and February is shown to be ahead of January in sales made.

New price reductions are given on outlet boxes, cable boxes and switch boxes and on some small socket devices such as vibrators, drink mixers, etc. There may be an advance in armored conductor.

Stocks are being kept only large enough to meet present demand as a whole, and that means only a slow movement from manufacturers and jobbers. There's no difficulty reported in getting fresh supplies rather quickly from the factories. Collections show no change except that they are possibly a little easier around St. Louis

NEW YORK

Little if any actual change is evidenced in trade. It appears that the return of business has thus far been slower in its progress than had previously been expected. However, there has at least been no further recession in sales, and the general opinion prevails that the industry reached rock bottom some time ago. One or two houses that have consistently reported fairly good sales continue to assert that business is good, but several others, though optimistic in tone, are not experiencing much actual increase in demand as yet.

Price reductions on outlet boxes, switch boxes and cable boxes have recently been put into effect by manufacturers. There is a feeling among several jobbers here that schedule material manufacturers are holding up the movement of supply lines by not reducing prices. There are also pretty strong rumors that flexible armored conductor is due for a price increase before long.

Contractors are buying but sparingly, and apparently they do not have a large amount of work actually in prospect yet. There is a fair amount of business coming from isolated plants, however.

Rubber-Covered Wire.—Demand continues light, but stocks are at a fairly low level on the whole. No. 14 in 10,000-ft. quantities is quoted this week from $8 to $8.50 per 1,000 ft.

Schedule Material.—Except for occasional overstocks jobbers' supplies are fairly low. There seems to be a strong opinion in several quarters that prices are too high and must come down. Consequently buying is from hand to mouth. Manufacturers, however, state that immediate price reductions are not possible.

Lamps.—Lamp sales are holding up well, business in this line being much more favorable than general supply items. Shipments are good and stocks are well built up.

Dry Cells.—Sales, though fair, are not extra large, rather below normal if anything. The supply is good and prices are unchanged, No. 6 in barrel lots being quoted at 36 cents each.

Flexible Armored Conductor.—Demand, with a few exceptions, is light. Stocks are not large, but there is some tendency to stock up in view of rumors of price increases. No. 14 two-wire double-strip in 1,000-ft. lots is generally quoted around $65.

Outlet Boxes.—Sales are not active, and the supply is plentiful. An increase of five points in the discount on boxes, amounting to a price decrease of about 7½ per cent, is announced by several manufacturers, effective the latter part of last month.

Small Socket Devices.—A price decrease of 15 to 20 per cent on vibrators, hair driers, drink mixers, sewing machine and other small motors, etc., has been announced by the Hamilton Beach Mfg. Company, effective Feb. 15.

Conduit.—Several jobbers report active sales in small lots to isolated plants especially, though others state that demand is very weak. Stocks are generally at a favorable level. In 2,500-ft. quantities ½-in. black can be bought from several jobbers for $67 to $68 per 1,000 ft., though prices considerably above this are asked in some quarters. One-inch black quotations range all the way from $131.50 to $155 per 1,000 ft.

Cable and Switch Boxes.—Prices of cable and switch boxes are reported to have been reduced the latter part of February by several manufacturers. The only ones that have actually confirmed a drop at this writing are the National Metal Molding Company, effective Feb. 21, whose cable boxes, formerly listing at 22 cents each, now take a 25 per cent discount, and the Chicago Fuse Manufacturing Company, effective Feb. 23, whose switch boxes were reduced about 10 per cent. Other manufacturers who have not already fallen in line are expected to do so soon.

CHICAGO

While the entire electrical industry remains in a state approaching stagnation, an observer of business in general sees unmistakable signs of a gradual resumption of activity in various lines, notably construction. A marked increase in the number of building permits issued is noted. Last week's figure of $1,000,000 included over fifty dwellings and apartments, and this week's $1,500,000 covered a widely diversified assortment of small buildings and medium-sized apartment houses. The gradual resumption of industry in the Detroit district promises work for the auto-accessory people, and each one of these tendencies can be seen to have an indirect bearing on the trade in electrical goods.

Bare Copper Wire.—Recent fluctuations in the copper market have failed to have any effect on quotations on bare copper wire, $18.50 per 100 lb. still being the quoted figure on small lots of No. 8. In car lots $17 is named.

Insulated Wire.—Base is unchanged on all styles. Present price on No. 14 rubber-covered is $7.85 and $8 per 1,000 ft., depending on quantity, lower figures being available in carload lots. Weatherproof, on a 19-cent base, is 20½ cents per pound for No. 8 triple-braid in 500-lb. lots and 20 cents for No. 6. These prices are subject to variation by different jobbers, all being willing to transact any business which will show a reasonable profit.

Conduit.—Business in black conduit is confined largely to inquiries, reported fluctuations in the iron trade causing prospective buyers to feel like delaying purchases in the hope of obtaining better figures. Half-inch conduit is quoted, in 5,000-lb. quantity, at $64 per 1,000 ft., this price being subject to cutting by some of the smaller interests.

Flexible Armored Conductor.—There is a fair amount of trade at the prevailing figure of $62 per 1,000 ft. in 5,000-ft. lots.

Knobs and Tubes.—Stocks are reported as being ample to supply all calls, and business, especially from out of town, is good. Split "Nail-it" knobs in barrel lots are $32 per 1,000. Tubes, 3 in. x $\frac{5}{16}$ in., are $10.50 per 1,000. These prices are firmly held.

Sockets.—The great amount of alteration work that has been done this winter has kept demand on sockets lively, and trade remains good up to the present time. Quotations from ample stocks are, for keyless, 24 cents; key, $26.40, and for pull chain, 48 cents. These prices are for original package lots.

Tape.—Stocks in both dealers' and jobbers' hands are spotty. All have some goods on hand, but any real demand would send purchasers scurrying to the factory with rush orders. The present quotation on rubber tape in 100-lb. lots is 92 cents per pound; in less quantities, 97 cents. Friction tape is similarly quoted at 73 cents and 81 cents. These quotations are for the highest grade.

BOSTON

Business shows little change from week to week. Jobbers' stocks are meeting current demands easily, and buying from manufacturers is moderate, small orders predominating. Collections require close attention. Prices are easier on outlet boxes and non-metallic flexible conduit. Deliveries are prompt in virtually all lines. Manufacturers are filling many back orders for electrical products, and in the textile and leather industries improved conditions are evident. The Boston building-trades strike continues to curtail buying, but in New England as a whole building and engineering contracts for the week ended Feb. 22 totaled $2,796,300, reflecting some betterment of conditions. A good deal of quiet, steady buying by central stations is going upon the ledgers of jobbers and manufacturers.

Motors.—On account of the present moderate demand stock shipments can be secured easily, though not in all standard makes. Recent price drops do not appear to have stimulated much new business, though inquiries are active. The market for second-hand motors is dull.

Electric Ranges.—Manufacturing for stock is going on steadily in anticipation of the spring demand. Prices are sluggish. A good business is expected this year. Raw material is plentiful now, and at least one representative producer is operating with a practically unchanged wage scale five to six days a week.

Wire.—Rubber-covered wire is moving slowly with ample stocks. No. 14 sold at $8.75 in Boston Monday in 5,000-ft. lots. Weatherproof No. 8 sold at 26.5 cents per pound in 100-lb. to 200-lb. lots. Bare copper wire was bringing 16.5 cents per pound early in the week, with moderate demand.

Non-Metallic Flexible Conduit.—Easier prices rule, the ½-in. size selling around $22 per 1,000 ft. and the ⅜-in. at $24, both in 5,000-ft. lots. Demand is off.

Knobs and Tubes.—"Nail-it" knobs were selling Monday for $27 per 1,000 in barrel lots and 3-in. tubes at $11.35 per 1,000 in barrel lots. Good stocks of porcelain are now reported, but glass insulators are scarce.

Flexible Armored Conductor.—Prices are unsteady, No. 14 double-strip bringing around $60 to $65 per 1,000 ft. in 5,000-ft. lots. Stocks are liberal and the volume of business small.

Appliances.—Not much activity is apparent beyond staple sales, which are yielding a fair business in old-established lines and makes. Merchandising departments of central stations and other retailers are showing considerable life, however, and a good spring trade is looked for. Renewed attention is being given to intelligent salesmanship and service to the customer.

ATLANTA

Reports from jobbers indicate little or no increased activity on the part of the contractor or dealer, spring buying having as yet not made itself evident. Buying by industrial plants mentioned a few weeks ago has disappeared, and orders do not continue to hold up as indications seemed to promise in the earlier part of the month. Present conditions, however, have not created a spirit of pessimism among the more prominent jobbers. They feel certain that the advent of spring weather cannot help but bring with it orders from the industrial and retail trade, stocks having reached a low ebb from lack of buying. The shortage of homes is still acute in most of the Southern cities, though there is an increasing number of vacant commercial buildings. Office space, however, remains scarce. Home building will undoubtedly start as soon as weather conditions will permit.

Bank clearings in the principal Southern cities continue to run about 35 per cent below those of last year, but credit men report credit conditions as slightly improved.

Panelboards.—There has been little new business in panelboards in the past few months, but fill-ins and jobs being completed have tended to keep life in this line. Prices remain steady, and promises on shipments from factory of standard equipment have been materially reduced.

Oil Switches.—There is very little oil-switch business in the larger sizes, and the small business that is coming in is mostly from jobs being finished in the textile field.

Washing Machines.—After a protracted period of apathy in the appliance field, especially in the higher-priced articles such as washing machines, the tone is considerably improved and a slight increase in sales is noted this week. This will be further stimulated by the fact that one of the largest washing-machine manufacturers is running an intensive campaign in Georgia. Dealers have been looking forward to a reduction in the price of washing machines, but indications at present do not point to any appreciable change soon.

Air Heaters.—The sale of electric air heaters during the winter has been a keen disappointment to every one, and indications are that large stocks will be carried over. This is no doubt because this section had a very mild winter and the final users have not purchased appliances of this nature as freely as was the case last year.

Power-Pole-Line Switching Equipment.—Jobbers report business in this line picking up and better than for some time past. Stocks are in excellent shape and shipments are coming through promptly.

Farm-Lighting Outfits.—The increased movement reported several weeks ago remains about the same, though inquiries are coming in in greater volume. Stocks of large and medium sizes are rather low but plentiful in the smaller sizes. Shipments are reasonably prompt.

Fans.—Though it is a little early for much activity in this line, orders are reported in fair volume. Stocks are in satisfactory condition with shipments unusually good. A price reduction of 10 per cent was announced two weeks ago.

Lamps.—Sales are very good and will be further stimulated by the merchandising conference held in Atlanta in the past week. Stocks are in excellent shape and shipments are all that could be desired.

ST. LOUIS

Sales continue in sufficient volume to prevent discouragement on the part of jobbers, though they are not doing much ordering in turn from the manufacturers. Those manufacturers who sell direct report a fair amount of business. Demand for all items has been considerably stronger all through February than it was during January, and orders filled will probably run from 10 to 15 per cent over the previous month. The market has become more competitive than it has been for a long time, and price is the considered factor in most sales. This applies particularly to porcelains, upon which quotations vary, though all of them are still below replacement prices. Power sales have decreased, but they are still much higher than was the case two years ago. Jobbers report a good demand from small utilities through Missouri and the outlying trade territory of St. Louis to the Southwest. Numerous sales of lightning arresters to these utilities are a feature.

Employers of workmen in the building trades have prepared new blanket contracts calling for a 15 per cent cut in wages and are holding conferences with the men. If the contracts are accepted, many buildings will be started immediately. It is estimated that 50 per cent of the men in the building trades are out of employment at present.

Collections have become easier. The average is still around sixty days, but credit departments are not forced to work so hard. Some jobbers and manufacturers have notes and trade acceptances on their hands, but these are being liquidated as they come due.

Construction Tools.—Most jobbers keep part of their stock for use in emergencies on a rental basis. Just at present supplies of tools for sale are spotty, but jobbers report that they can replenish their stocks easily if demand quickens.

Wire.—Sales of weatherproof wire have picked up during the week, and jobbers have been moving fairly large quantities of the Nos. 6, 8 and 10. The market is extremely competitive, but quotations are nominally on the 18-cent base. Quotations on rubber-covered wire are showing more firmness, the lowest price during the week being $8.10 per 1,000 ft. of No. 14, in 5,000-ft. lots. Demand has dropped off to some extent. The market for magnet wire is practically dead, manufacturers having enough on hand to take care of their requirements for some time. It is quoted on the 18-cent base, while bare wire is quoted around 15½ cents.

Lamp Cord.—There is a fair movement here, with fixture manufacturers taking small quantities of the silk-covered cord. The cotton lamp cord is selling fairly well in a very competitive market. No. 18 twisted silk lamp cord is quoted at $33.45 per 1,000 ft. and the cotton cord at $17.50 per 1,000 ft., both in small quantities.

Rigid Conduit.—Demand was off against last week, and prices have been lowered in order to move stocks, which continue large. The ½-in. black is quoted around $65 per 1,000 ft., with the ¾-in. size priced in some instances as low as $73.

Schedule Material.—Price concessions have increased the demand to some extent, but stocks are not moving satisfactorily yet. Quotations of all jobbers are below those of manufacturers.

Washing Machines.—A large increase in the sale of washing machines has been noticeable during February. Some jobbers estimate that their February business in washing machines increased 100 per cent over that of January. Dealers report that the public is becoming convinced that it will not save much by waiting several months for prices to come down.

Vacuum Cleaners.—Demand has fallen off somewhat, and dealers are not ordering heavily from jobbers. Stocks are good.

SALT LAKE CITY—DENVER

The price tendency in electrical merchandise is downward. Rough lumber has had a decline of from 40 to 50 per cent, while finished lumber remains at a figure that makes building difficult. Some jobbers are suffering from overstocks in many electrical lines as the result of having pyramided orders last year. Jobbers who are not competent to forecast the future expect a big industrial expansion within the next six months. That there will be several more slow months in the meantime, however, is the general opinion.

The purchasing power of Intermountain farmers is at a low ebb, with no immediate prospect of alleviation. Stocks in nearly all lines are more than ample. Deliveries are excellent. Orders can be filled from Eastern factory centers in from fifteen to twenty days. The volumes, however, are from 20 to 40 per cent below normal, indicating a rather sluggish condition of the market. Collections are slowly improving.

Distributing Transformers. — Jobbers are plentifully stocked and looking forward to a good market after the beginning of the spring season. A price recession of 10 per cent has been noted.

Farm High-Tension Switches.—An accurate canvass of the territory revealed the startling fact that 95 per cent of the possibilities within reach of electric service are now connected. This means that the potential field for installing farm lighting and power plants is relatively small in this immediate territory.

Ranges.—The power companies have all placed large orders with their manufacturers, indicating their confidence in spring and summer business. The present stocks are good. There is some intimation in the trade of a fall in the prices.

SEATTLE—PORTLAND

Both jobbers and retailers in the Puget Sound district assert that business during February was in excess of that transacted in January this year or during February last. In fact, the past month, on account of weather conditions which permitted building construction without inconvenience, was unusual in many ways. According to every indication spring has arrived in this section and seasonal activities have begun. Stocks, with but one or two exceptions, are in excellent condition and replenishments are easy to obtain. The lumber mills and logging camps are gradually reopening and conditions are getting back to normal.

Jobbers in the Portland district report a material improvement in business. A slump in domestic appliances was offset by a greater activity in pole-line materials in February. Bare copper wire is the cheapest thing on the market at the present time. Insulated wires have also decreased in price. Lamp cord can be purchased one-third cheaper than it could last August. The urgent need of construction work, the announced drop in prices of many steel products and the prospects of a reduction in wages all point toward early activity in construction lines. Manufacturers report business quiet.

Ranges.—Sales in this territory, generally speaking, are languishing owing to prevailing high prices and costs of wiring. Stocks, both of jobbers and of central stations, are in good shape, but prices are holding firm and high. Both jobbers and central stations report numerous inquiries and prospects but state that business will not materialize until prices show considerable decrease.

Schedule Material.—Owing to an increasing amount of residence and business construction throughout this section this line of merchandise is showing a comparatively healthy movement, although sales are still below normal. Stocks are in fine shape and shipments are coming through entirely satisfactorily. Prices have declined from 1 to 5 per cent.

SAN FRANCISCO

Business conditions in general are mending very slowly. In fact, the month of February may be said to close with a more pessimistic note than that with which it began. Collections, however, are not much slower than usual, though they require vigilant following. New credits are being very cautiously extended. Electrical dealers who are availing themselves of the services of banks and financial agencies for carrying their customers on house appliances find that each contract and its references must be giltedged.

Ranges.—The delay in supplying new power, the conservation of present power for irrigation loads and the general attitude of the purchasing public have resulted in disappointing range sales for the year and the expectation that these conditions cannot improve within the next few months. It is reported that local jobbers have requested their factories to cancel several range carload orders. On the other hand, the campaign of education is being maintained and occasional demonstrations are being given by dealers.

Schedule Material.—Business is better than during the three previous months but is below the February, 1920, showing. On the other hand, just as the local steel people, in the face of decreasing business, are placing big Eastern orders so as to be ready for the building boom when it does arrive, so there is a disposition to accumulate schedule stocks for the same emergency. A feature of the February business has been an enormous sale of pull sockets, the bulk of the shipments going to southern California.

Household Devices.—There has been recently a series of bitter complaints among the electrical dealers over the profit margin allowed them on electrical appliances. This has been accentuated by falling business precluding the possibility of maximum quantity purchases to secure maximum discounts. A general sifting of overhead and other statistics is the result, in order to secure authoritative data for formal complaints to jobbers and manufacturers. The situation is not yet clear, but is being followed.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Mitchell-Rand Takes on Ebony Asbestos Wood Line

Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York, is distributing in the New York territory ebony asbestos wood for switches, panels and bases manufactured by Johns-Manville, Inc. A good assortment of stock will be carried in the company's warehouse to insure quick deliveries.

Supply Jobbers' Association's Publicity Campaign

In connection with its campaign of publicity the Electrical Supply Jobbers' Association has been following through a pretty vigorous line of advertising. The campaign began last September and will run through December, 1921. With the publishing of announcements of new electrical products by manufacturers, the questions arise in the buyer's mind: "Is this what I want?" and "Where will I get it?" The association answers these questions in its publicity matter by the slogan: "Ask your electrical supply jobber."

Sixteen months of advertising in the electrical trade papers covering the entire electrical field, 150,000 illustrated folders, 50,000 booklets, 3,000 plan books and broadsides, 15,000 letters to jobbers' salesmen, accompanied by exhibits, and 1,500 letters to association members, also accompanied by exhibits, will cover the scope of the campaign.

Brandywine Fibre Products Space Enlarged

In more than doubling its capacity in floor space and trebling it in equipment, the Brandywine Fibre Products Company, Wilmington, Del., announces that it is now in a better position than ever before to take care of hard vulcanized fiber tubing and standard mill lengths or parts machined to order.

Profit Sharing and Copartnership at the Blaw-Knox Works

With the reduced working schedule at the works of the Blaw-Knox Company, Blawnox, Pa., there are 449 men employed in the shops. Of this number 391 are stockholders. The amount they have invested totals $168,000. In addition to this the shop foremen own $56,000. There are 204 men and women employed in the general and district offices, and they have invested $400,000. Including the officers and the heads of the company who are actively engaged in the business, the investment of the entire group amounts to about $2,000,000, or 60 per cent of the entire outstanding capitalization, which is $3,417,825.

Japanese Engineers Visit Salt Lake

T. Nishioka and M. Nakamura of the commercial engineering department of the Tokio Electric Company, Ltd., Kawasaki Kanagawaken, Japan, were recent visitors in Salt Lake City. The company which these men represent is the Japanese branch of the General Electric Company, and their visit to America is for the purpose of obtaining new ideas in connection with the commercial branch of the industry.

Electrical Equipment Sales by War Department

Electrical equipment to the extent of $1,697,072 was sold as surplus property by the director of sales of the War Department prior to Jan. 1. This does not include electrical equipment transferred or sold to government departments or agencies.

Howell Motors Company Increases Distributers

In line with its policy of producing motors for national stock, as recently noted in these pages, the Howell (Mich.) Electric Motors Company has rapidly increased the number of its distributers. The latter now cover about twenty-four of the most important cities in this country and Canada, Howell motors being stocked in these cities. A complete list of the company's distributors follows: Electrical Machinery Sales Company, Chicago, Milwaukee and Minneapolis; W. L. Veit, Philadelphia; Carl Johnston, Grand Rapids, Mich.; Garland-Affolter Engineering Company, San Francisco; L. M. Sperry, St. Louis; H. J. Wittman, Toledo; Ohio Machine & Motor Company, Cleveland; D. W. Smith, New York City; A. H. Keleher (export for South America), 44 Whitehall St., New York City; Export office, 90 West Street, New York City; J. E. Hoffman, 280 Carolina Street, Buffalo; L. B. Gottschall, Dallas; Electric Supply Company, Saginaw, Mich.; Sperry & Bittner, Pittsburgh; Electric Motor & Machinery Co., Ltd., Montreal, Que., and Toronto, Ont.; Southern Electric Supply Company, Atlanta; Virginia Machinery & Well Company, Richmond, Va.; E. & M. Products Company, Boston; J. R. Purser, Charlotte, N. C.; Intermountain Sales Company, Denver; Machinery & Electrical Supply Company, Winnipeg, Man.; Power Machinery Company, Kansas City; W. W. Fraser, Vancouver, B. C.

Manufacture of Pelton Furnace Line Resumed

Announcement is made by C. R. Pelton, president of the Pelton & Crane Company, Detroit, that the company has resumed the manufacture of the Pelton electric furnace line, which was discontinued in 1916 when it was not possible to obtain certain materials necessary to the manufacture of the furnaces on a standard of past quality. Moreover, platinum had advanced in price to a point which made the furnace price too high to obtain a profitable volume of production. The furnace and pyrometer lines are intended primarily for use in the dental profession.

Carter Electric's Merchandising Conference

The merchandising conference of the General Electric Company and its subsidiaries, in collaboration with the Carter Electric Company, held in Atlanta on Feb. 21 and 22, proved a big success, especially as regarded attendance by contractor-dealers throughout the state.

The Carter Electric Company initiated dealer conferences of this nature four years ago, and it is interesting to note that there were twenty-five present at the first meeting and forty and sixty respectively at the second and third meetings, while actual signed attendance cards showed that 238 people attended the recent conference. All those attending were enthusiastic over the outcome of the conference, and many dealers have already requested the Carter Electric to take up with the General Electric Company the rearrangement of their stores.

Lighting Fixture Manufacturers Re-elect Officers

The National Council of Lighting Fixture Manufacturers at the close of its convention and market in Buffalo, the third week in February, re-elected Fred R. Farmer of Chicago as president, William Horn of Philadelphia as vice-president and Charles H. Hofrichter of Cleveland as secretary-treasurer.

Government Seeks to Dissolve Southern Pine Association

The United States government on Feb. 21 filed injunction proceedings in the federal court against the Southern Pine Association, sixty-one corporations and sixty-nine individuals, [illegible] Jacobs effort to end an alleged conspiracy to curtail the supply and increase the price of yellow-pine lumber.

The suit charged violation of the Sherman anti-trust law by the association and asked for a preliminary injunction to restrain [illegible] from recom-

mending or suggesting curtailment or restriction of production of yellow pine "or measures or acts tending to result in such curtailment or restriction."

This is a suit similar to that instituted against members of the American Hardware Manufacturers' Association, as discussed on page 100 of the July 10, 1920, issue of the ELECTRICAL WORLD.

Westinghouse Builds Experimental Laboratory for High Voltages

Recent advices from the Westinghouse Electric & Manufacturing Company state that owing to the trend toward higher voltages which is being initiated in the West and which will ultimately extend to all parts of the United States the Westinghouse company is building a complete, modern, high-voltage experimental laboratory. In this laboratory will be installed two transformers, one rated at 1,000,000 volts, 1,000 kva., the other rated at 500,000 volts, 500 kva., which can be connected to give 1,500,000 volts between terminals.

The laboratory will be 120 ft. long, 110 ft. wide and 50 ft. high, without columns of any sort. High-voltage insulators, transformer terminals and circuit-breaker terminals will be tested in this plant.

Apex Puts on Sales Contest

A nation-wide sales contest is being arranged by the Apex Electrical Distributing Company, Cleveland, in connection with the sales of its Apex electric suction cleaners, according to an announcement made by R. J. Strittmatter, sales manager. The contest began Feb. 19 and will close on the last day of March, after which prizes will be awarded to those making the best sales showing during the competition.

Crawford Motor Changes Hands

The William B. Durgin Company, manufacturer of Crawford motors at Concord, N. H., has been purchased by L. E. Wooton Company, Inc., New York City, the sole selling agent for Crawford motors. The new company has been reorganized and incorporated under New Hampshire laws with the name of Crawford Manufacturing Company, at a capitalization of $150,000. L. E. Wooton is president, J. J. Crawford vice-president, P. L. Gill treasurer and R. L. Blanchard secretary. Mr. Crawford was superintendent under the old company and Mr. Blanchard assistant superintendent. They will both remain at the Concord plant, while Mr. Wooton and Mr. Gill will make their headquarters in New York. The William B. Durgin Company has been manufacturing motors for its own use for the past seven or eight years, and after the war began the commercial manufacture of polyphase induction motors of ¼ hp. to 15 hp. was undertaken. The plant at present has a capacity output of about 300 to 350 motors per month with a sales value of approximately $30,000. The existing sales policy, motor design, etc., will remain unchanged, it is announced.

National Chain Buys Larger Factory in New Jersey

The National Chain Company, College Point, Long Island, N. Y., has purchased a building at Belleville, N. J., which will be remodeled as a factory for the production of chain for lighting fixtures. These new quarters will comprise about 30,000 sq.ft. of space, part one-story and part two-story, increasing the former factory capacity about two-thirds. Occupancy is expected about May 1. A resident sales branch will be established in Chicago soon. The company has just developed a real brush-brass finish on steel-plated chain, according to C. W. Smith, treasurer and sales manager, and a new "jap" bronze-plated finish.

More Space for Riddle Fixtures

The E. N. Riddle Company, Toledo, Ohio, has bought and remodeled an old hotel on Fourth Street and is now occupying it for the manufacture of lamps and lighting fixtures for residential use only. The new factory takes in 80,000 sq.ft. of working space, which is about three times that of the former factory on Broadway, Morris and Ottawa Streets. The company gave up the production of a glassware line during the war and is concentrating on the candelabra and candle-type designs.

Cutler-Hammer Increases Quarters for Clutch and Magnet Department

The Cutler-Hammer Manufacturing Company, Milwaukee, has transferred its clutch and magnet department from the main works in Milwaukee to a plant recently acquired in West Allis, Wis. This addition increases the total floor space by 100,000 sq.ft. The building housing the shops and office is 300 ft. x 300 ft. and is equipped with machinery for the manufacture of the various products of the department, including electric shoe brakes, lifting magnets, magnetic clutches, etc. A portion of the plant is devoted to making punches for the motor controllers put out by the main plant in Milwaukee. This branch plant employs between 250 and 300 persons and maintains a cafeteria and hospital on the grounds. B. T. Foote, formerly of the engineering department at the main works and later manager of the Boston district office, is manager of the new plant.

American Electric Vehicles Pushed in India

H. B. Stimpson, who was formerly the Boston district manager for the Milburn and Detroit electric pleasure cars and the Ward electric commercial truck, is now in Calcutta, India, to assist in opening up the market in that country for American electric vehicles and to impart American standards of sales and service. Mr. Stimpson is serving in the capacity of general manager of the Transit Engineering Company, Ltd., a British firm which has been organized especially for handling the Milburn and Detroit cars and the Ward truck. The agency for the Wotton electric charging apparatus, manufactured by the Electric Products Company of Cleveland, has also been secured.

McKenney & Waterbury Company Changes Hands

The McKenney & Waterbury Company, Boston, Mass., has been purchased by Murvyn W. Vye and Alfred J. Paine and since March 1 has been doing business under the name of the McKenney & Waterbury Company, Inc., wholesalers and retailers of lighting fixtures and supplies. This house is one of the oldest in the East, having been in business nearly three-quarters of a century. It is said that the first kerosene lamp marketed in Boston was handled by the founder, a member of the McKenney family. It has been conducting business for thirty-three years at its present site at Franklin and Congress Streets, and its slogan, "We Light the World," is known from coast to coast.

The Cleveland Electric Motor Company, 5213 Windsor Avenue, Cleveland, announces that D. Wilson, formerly sales manager for the Electro Dynamic Company, has returned to Philadelphia and will become associated with Harris & Evans, Real Estate Trust Building, in the distribution of the products of the Cleveland Motor Company.

The Runzel Lenz Electric Manufacturing Company, 1751-55 Northwestern Avenue, Chicago, manufacturer of lamp cords and wire annunciators, is considering the construction of a two-story factory, 50 ft. x 60 ft., to cost about $20,000.

The Celluloid Zapon Company, 200 Fifth Avenue, New York City, manufacturers of lacquers, insulating varnishes, lamp frostings, etc., announces the opening of its Philadelphia office at 520 Walnut Street, in charge of B. O. Clausen.

The Cincinnati Electrical Tool Company, Freeman Avenue, Cincinnati, Ohio, has been authorized to increase its capital stock from $75,000 to $225,000. The company, it is stated, does not contemplate any immediate extensions.

The Wunder Ice Machine & Refrigerating Company, Cincinnati, Ohio, has been authorized to increase its capital stock from $25,000 to $100,000. No definite plans, it is understood, have been made for extensions.

The Mar-Sla Manufacturing Company, Youngstown, Ohio, recently organized and with a plant at Hubbard, Ohio, will deal in chemically treated switchboards.

The Crane Company, 836 South Michigan Avenue, Chicago, is having

plans prepared for the erection of a two-story and three-story machine and repair plant on property recently acquired on Twenty-fourth Street, Pittsburgh. A six-story warehouse building, 72 ft. x 90 ft., will also be erected. The cost of the buildings, including equipment, is estimated at about $500,000.

The Wagner Electric Manufacturing Company, St. Louis, announces the removal of its Boston office and service station to 342 Newbury Street, where it will occupy the entire building. Brooks Faxon will continue in charge as district manager.

The American Insulator Corporation, New Freedom, Pa., announces the appointment of the Albert J. Cox Company, 564-570 West Monroe Street, Chicago, as its sales representative in the States of Illinois, Indiana, Missouri, Iowa, Minnesota and Wisconsin. The Albert J. Cox Company will handle the "Aico" line of products, consisting of cold-molded insulating parts for electrical and automotive units.

The Packard Electric Company, Warren, Ohio, manufacturer of transformers and starting, ignition and lighting cable, has moved into its new quarters in the Printers' Crafts Building, 461 Eighth Avenue at Thirty-fourth Street, New York City. J. E. Erickson, manager for the New York district, is in charge.

The Cutler-Hammer Manufacturing Company, Milwaukee, held a general sales meeting in Milwaukee from Feb. 14 to 19, which was attended by the office managers of the several district offices of the company. W. C. Stevens, sales manager, was in charge.

The Hazard Manufacturing Company, Wilkes-Barre, Pa., manufacturer of wire rope and electrical wires and cables, has opened a new sales office and warehouse at 1701-1703 First Avenue, Birmingham, Ala., in charge of R. J. Bravard, district manager.

Stuckeman Brothers, 18 Ruth Street, Pittsburgh, Pa., manufacturer of small motor-driven air compressors and other specialties, has recently been incorporated with a capital stock of $50,000, in order to facilitate expansion along other lines. W. F. Stuckeman is president.

The Jeffrey Manufacturing Company, Columbus, Ohio, manufacturer of coal-mining machinery, electric locomotives, elevating, conveying and crushing machinery, announces the removal of its Denver (Col.) office from the First National Bank Building to 421 United States National Bank Building.

McKay & Sherman, 741 Monadnock Block, Chicago, has been formed by Charles W. McKay and P. C. Sherman for the practice of engineering valuation of industrial and public utility properties.

Foreign Trade Notes

THE AMERICAN CHAMBER OF COMMERCE IN BERLIN, W-8, Equitable Building, Berlin, Germany, has established a branch office at 1939 Park Row Building, New York City, in the interests of the American manufacturer, exporter and importer. Information can be obtained on all matters pertaining to commercial intercourse between the United States and Central Europe. S. George Fremont, secretary and manager, is in charge.

TENDERS ASKED FOR ELECTRICAL AND PUMPING EQUIPMENT IN BUENOS AIRES.—The Department of Public Works of Buenos Aires, Argentina, according to the London *Electrical Times*, is asking for tenders (to be submitted by March 21) for two groups of water turbines and generators, with switchgear, etc. The Department of Sanitary Works in Buenos Aires is also inviting tenders (to be presented by March 21) for eleven sets of centrifugal pumps with electric motors and accessories.

THE SIMPLEX WIRE & CABLE COMPANY, 201 Devonshire Street, Boston, announces that it has made arrangement with the Eastern Engineering Company, with main offices in Tampico, Mexico, to handle its products in that country.

METERS REQUIRED IN MONTEVIDEO.—According to the London *Electrical Industries* the State Power House in Montevideo, Uruguay, has published tenders for the supply of 10,450 meters for private installations served by it in Montevideo, the supply comprising a three-phase, 50-cycle system. Tenders must be presented to the Secretaria del Directorio de las Usinas Electricas del Estado, Calle Dayman, No. 1471, by May 29.

ELECTRIC PLANT IN SAN SALVADOR.—The municipality of Santiago de Maria, Department of Usulutan, San Salvador, has granted a contract for the establishment of an electric light company which is to supply electricity in that city and also to the city of Berlin, in the same department. The population of the two cities is estimated at 10,000 and 9,000 respectively.

HYDRO-ELECTRIC DEVELOPMENT IN FORMOSA.—The general government of Taiwan, according to Consul Dooman, is now considering the advisability of sanctioning the erection by the Asano interests of a hydro-electric power plant to develop 100,000 hp. on the upper reaches of the Tiako River, in the south of Formosa. The Asano interests are promoting the project, assisted by American capital and American engineers, and the machinery is to be purchased in the United States.

DEMAND FOR ELECTRICAL EQUIPMENT AND MACHINERY IN SPAIN.—At present there is a good market for electrical appliances and machinery in Spain. Large power plants are now being built, especially in the provinces of Barcelona and Granada. Plants developing more than 750,000 hp. have been constructed lately.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A mercantile distributing company in Canada (No. 34,442) desires to secure an agency for the sale of electrical specialties, etc.

New Apparatus and Publications

TOOLS.—The Goodell-Pratt Company, Greenfield, Mass., is distributing its "No. 14 Tool Book," in which it describes and illustrates over 2,000 sizes and kinds of tools for toolmakers, machinists, carpenters and householders.

TRANSFORMERS.—The Pittsburgh Transformer Company, Pittsburgh, has issued bulletin No. 2010, covering its "Pittsburgh" distributing transformers.

STORAGE BATTERIES.—The Gould Storage Battery Company, 30 East Forty-second Street, New York City, has issued bulletin L-2, describing types L-149-A and L-149-B of Gould storage batteries for mining and industrial locomotives. Catalog V-7 covers its electric vehicle types of storage batteries with "Dreadnaught" plates. The company is also distributing three booklets giving instructions on the care and operation of the Gould locomotive batteries, Gould batteries in mine locomotives and Gould batteries in starting and lighting systems respectively.

PROTECTIVE APPARATUS.—The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, has issued bulletin No. 175, covering the Graton-Daniels and Keystone lightning protective apparatus.

INSULATORS AND LINE MATERIAL.—The Ohio Brass Company, Mansfield, Ohio, is distributing its 1921 catalog, No. 18. The book is cloth-bound and contains 638 pages.

BOILER PLANT ECONOMY.—The H-S-B-W Cochrane Corporation, Philadelphia, has issued a second revised edition of "Finding and Stopping Waste in Modern Boiler Rooms." The book is cloth bound and contains 414 pages.

ELECTRIC BOTTLE WASHER.—The Electric Specialty Company, Stamford, Conn., is distributing bulletin No. 227, covering the "ESCO" electric bottle washer and general household motor combined in one unit.

DIESEL ENGINES.—The Busch-Sulzer Brothers Diesel Engine Company, St. Louis, is distributing a bulletin describing its Diesel engines in large hydro-electric, stand-by and auxiliary plants.

CONNECTOR PLUG.—The Ideal Electric Manufacturing Company, 42 Walnut Street, N. J., is distributing a four-page leaflet describing its "Attachall" plug for irons, toasters, stoves, percolators and other heating apparatus.

ELECTRIC BUFFER.—The U. S. Electrical Manufacturing Company, Los Angeles, has recently developed a new heavy-duty Johnson electric buffer.

ELECTRIC MOTIVE POWER.—"Industrial Electricity" is the title of a booklet published by the Habirshaw Electric Cable Company, Yonkers, N. Y., which gives practical suggestions and data for the manufacturer regarding the use of electricity in industrial plants.

New Companies

CARNAHAN & DALZELL, INC., New York, has been incorporated by R. O. Carnahan, B. Gunn and R. N. Dalzell, Great Kills, S. I. The company is capitalized at $20,000 and proposes to manufacture electrical machinery.

THE LIGHTHOUSE CORPORATION, New York, has been incorporated by I. L. and B. Newland, 468 West Broadway, to manufacture brass and other metal lighting fixtures. The capitalization is $50,000.

HUNTER BROTHERS, INC., Elizabeth, N. J., has been incorporated by Joseph B., Richard J. and James F. Hunter, 334 Morris Avenue. The company is capitalized at $50,000 and proposes to manufacture electrical appliances.

THE ANGLE LAMP COMPANY, New York, has been incorporated by B. L. Hewitt, L. Whitcomb and W. V. McMahon, 110 West Fortieth Street, to manufacture electric lamps, fixtures, etc. The company is capitalized at $55,000.

THE MOTOR DRIVEN CLOCK CORPORATION, New York, has been incorporated by P. F. Casey, C. W. Landers and I. S. Lambert, 132 Nassau Street, with a capital stock of $50,000. The company proposes to manufacture electrically operated clock mechanisms, parts, etc.

THE NATIONAL ELECTRIC FIXTURE COMPANY, 15-17 South Clinton Street, Chicago, has been incorporated by William C. Duncan, Bernard M. Smith and William F. Higgins. The company is capitalized at $25,000 and proposes to manufacture electrical specialties.

THE WESTON BATTERY COMPANY, New Haven, Conn., has been incorporated by F. P. Hauser, Ansonia; J. H. Benedict, Westport; F. L. Barnes, Harry Weston, Jr., and others. The company is capitalized at $100,000 and proposes to manufacture electrical supplies.

THE R. B. N. ROTARY MOTORS CORPORATION, Grantwood, N. J., has been incorporated by William R. Krebs, P. E. Brulatour, E. W. Norton and others. The company is capitalized at $125,000 and proposes to manufacture motors and parts.

THE ILLUMINATING MANUFACTURING CORPORATION, Chicago, Ill., has been incorporated by James R. Hughes, 15 South Clinton Street; W. C. Duncan, Jacob Ahren and others. The company is capitalized at $25,000 and proposes to manufacture lighting fixtures.

THE BARABOO MANUFACTURING COMPANY, Baraboo, Wis., has been incorporated by Ferdinand Effinger, W. M. Ott, George W. Andrews and others. The company is capitalized at $100,000 and proposes to manufacture electrically operated refrigerating units for domestic and commercial use.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 8, 1921)

1,367,812. ELECTRIC FURNACE FOR TREATING GASES; Bruno Thomas, Seattle, Wash. App. filed April 30, 1917. Fixation of atmospheric nitrogen.

1,367,814. LAMP-VOLTAGE REGULATOR; William A. Turbayne, Niagara Falls, N. Y. App. filed July 18, 1917. Car-lighting system.

1,367,845. LAMP-VOLTAGE REGULATOR; William A. Turbayne, Niagara Falls, N. Y. App. filed July 23, 1917. Car-lighting system.

1,367,913. TROLLEY WHEEL; Raymond G. Larson, Owatonna, Minn. App. filed May 26, 1920. Spiral replacing grooves.

1,367,915. ELECTROMAGNETIC APPARATUS; Marius C. A. Latour, Paris, France. App. filed Aug. 2, 1917. For submarine telegraphy or telephony.

1,367,920. TROLLEY SHOE; Joseph S. O'Brien, Westfield, Mass. App. filed July 3, 1920. Non-rotary.

1,367,949. THERMIC TELEPHONE; Pieter de Lange and Robert Aernout, Baron van Lynden, Utrecht, Netherlands. App. filed Nov. 4, 1915. Carried upon the person.

1,367,953. HEATER; Edwin L. Emerson, Braintree, Mass. App. filed Nov. 15, 1919. For heating tools used in manufacture of shoes.

1,367,957. TRANSFORMER; Harry O. Garretson, New York, N. Y. App. filed May 28, 1918. X-ray..

1,367,967. TELEPHONE-EXCHANGE SYSTEM; George H. Heydt, New York, N. Y. App. filed March 21, 1917. Automatic.

1,367,982. MOTOR; Gustave Lidseen, Chicago, Ill. App. filed July 3, 1917. Toothed armature without windings.

1,367,988. SPARK COIL AND METHOD OF MAKING SAME; James B. Replogle, Detroit, Mich. App. filed Nov. 25, 1916. Amount of winding materially reduced.

1,368,006. TROLLEY WHEEL; Stanley Zelazo, Adams, Mass. App. filed Oct. 29, 1919. Two-wheel construction.

1,368,010. ELECTROLYTIC CELL; Herbert I. Allen, Portland, Me. App. filed April 29, 1920. Production of chlorine and caustic soda.

1,368,011. ELECTROLYTIC CELL; Herbert I. Allen, Portland, Me. App. filed April 29, 1920. Greater active surface secured.

1,368,019. PROCESS FOR FIXATION OF NITRATES; Charles H. Buettner, Cincinnati, Ohio. App. filed March 6, 1919. Simple commercial process.

1,368,062. RADIANT ELECTRIC HEATER; Milton H. Shoenberg and George J. Henry, San Francisco, Cal. App. filed Oct. 16, 1919. May be laterally oscillated.

1,368,083. GROUND CLAMP; Philip Windman, Perth Amboy, N. J. App. filed Jan. 20, 1920. Connects to pipe.

1,368,092. RECORDING INSTRUMENT; Oliver T. Alexander, Altonpark, Tenn. App. filed Oct. 4, 1919. For electric pushing and leveling machines of by-product coke ovens.

1,368,093. SEPARATOR FOR STORAGE-BATTERY PLATES; James M. Allen, St. Louis, Mo. App. filed Feb. 24, 1920. Resilient ribs on each side.

1,368,094. PROTECTING DEVICE AGAINST X-RAYS AND SIMILAR RADIATIONS; Pierre A. M. J. Angebaud, Nantes, France. App. filed Sept. 28, 1917. Silicate of potassium or sodium.

1,368,108. GUARD FOR HEATERS; Edmund N. Brown and Milton H. Shoenberg, San Francisco, Cal. App. filed Oct. 1, 1919. Easily detachable.

1,368,152. ELECTRICALLY HEATED CULINARY UTENSIL; William D. Huff, Lafayette, La. App. filed July 3, 1919. Used in kitchens, pantries, etc.

1,368,206. LARGE-CAPACITY CELL FOR GENERATING HYDROGEN AND OXYGEN; John B. Burdett, Glencoe, Ill. App. filed Sept. 27, 1920.

1,368,212. ELECTRIC STEAM GENERATOR; Francesco Revel, Turin, Italy. App. filed July 8, 1918. Water-resistance type.

1,368,224. RANGE INDICATOR; Elmer Meitner, Brooklyn, N. Y. App. filed June 13, 1915. Indicates range of distant object.

1,368,227. OSMOTIC DIAPHRAGM; Elmer A. Sperry, Brooklyn, N. Y. App. filed Dec. 26, 1918. Manufacturing white lead, or other lead salts, by electrolysis.

(Issued Feb. 15, 1921)

15,040 (reissue). AËRIAL CONDUCTOR FOR WIRELESS TELEGRAPH; Charles S. Franklin, London, England. App. filed Nov. 18, 1919. In conjunction with transmitting station for duplex telegraphy.

15,041 (reissue). AËRIAL CONDUCTOR FOR WIRELESS TELEGRAPHY; Charles S. Franklin, London, England. App. filed Nov. 18, 1919. In conjunction with transmitting station for duplex telegraphy.

15,043 (reissue). ELECTRICAL ATTACHMENT PLUG; Johann G. Peterson, Hartford, Conn. App. filed Sept. 17, 1918. Socket plug.

1,368,261. TRANSMITTER MOUNTING; George M. O. Jenkins, Paris, France. App. filed Nov. 3, 1917. For aviator.

1,368,265. ELECTRIC HEATER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed April 16, 1919. Luminous.

1,368,287. ARC-WELDING ELECTRODE; Harry R. Pennington and Ernest Wanamaker, Chicago, Ill. App. filed June 23, 1920. Distinguishing color for each electrode of given composition.

1,368,288. ELECTROMAGNETIC DEVICE; Ralph E. Pierce, Larchmont, N. Y. App. filed Dec. 13, 1918. Balanced relays.

1,368,307. EARPIECE; Fred D. Waldron, Brooklyn, N. Y. App. filed April 13, 1918. Telephone receivers.

1,368,323. ELECTRIC CONTROLLING DEVICE; Rudolph Contrader, Erie, Pa. App. filed Sept. 7, 1916. Pressure-actuated motor controls rheostat.

1,368,325. ARC-EXTINGUISHING DEVICE; Leslie N. Crichton, Wilkinsburg, Pa. App. filed Aug. 30, 1916. Does not disturb the operation of apparatus connected.

1,368,328. ELECTRIC HEATING DEVICE; Richard M. Eaton, Niagara Falls, N. Y. App. filed Oct. 6, 1920. Fan and heater.

1,368,336. ELECTROMAGNETIC BRAKE; Max E. Gysel, Wilkinsburg, Pa. App. filed June 13, 1917. For hoists.

1,368,339. MEANS FOR PROTECTING TRANSMISSION LINES; Ray P. Jackson, Edgewood Park, Pa. App. filed June 19, 1915. Abnormal potentials, resulting from reactance of line, precluded.

1,368,343. SUMMATING DEVICE; Walter E. McCoy, New York, N. Y. App. filed March 25, 1916. To combine plurality of forces into single resultant.

1,368,345. ELECTROMAGNETIC BRAKE; Chester B. Mills, East McKeesport, Pa. App. filed March 1, 1917. For hoisting apparatus.

1,368,350. COIL-SUPPORTING DEVICE; Raoul Prugger, Irwin, Pa. App. filed July 28, 1917. For supporting end turns.

1,368,360. TROLLEY EAR; William H. Siemon and Harry L. Garbutt, Wilkinsburg, Pa. App. filed Dec. 14, 1918. Pressed metal.

1,368,362. MACHINE FOR ELECTROCYANIDE CHLORINATION PROCESS; Rush T. Sill, Los Angeles, Cal. App. filed April 6, 1919. Pulp submitted to action of a cyanide solution in presence of an electrical current.

1,368,369. MOTOR-CONTROL SYSTEM; Wilfred Sykes, Pittsburgh, Pa. App. filed Dec. 14, 1915. Used in connection with saws, etc.

1,368,376. RELAY INTERRUPTER; Richard I. Utter, Oak Park, Ill. App. filed March 24, 1917. Telephone.

1,368,404. ELECTRIC OIL AND GAS PRODUCER; Nicholas R. Loftus, Beckley, W. Va. App. filed Nov. 25, 1919. Lowered in played-out well and heated.

1,368,412. ELECTRICAL HEATING PAD; Even J. Rohne, Minneapolis, Minn. App. filed Feb. 11, 1920. Flexible.

1,368,462. SYSTEM OF ELECTRICAL CONTROL; Charles F. Smith, Cle Elum, Wash. App. filed May 15, 1917. Mining.

1,368,479. PROCESS FOR PRESERVING DRY BATTERIES; Walter S. Brown, Seattle, Wash. App. filed June 11, 1919. Preservative coating.

1,368,481. TELEPHONE-ANSWERING INSTRUMENT; Warren D. Calvert, Altoona, Pa. App. filed Feb. 20, 1919. Phonograph answers telephone.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

HARTFORD, CONN. — The Hartford Electric Light Company has petitioned the State Legislature for authority to increase its capital stock to $20,000,000.

HARTFORD, CONN.—The Lincoln Dairy Company, 52 Lincoln Street, contemplates the construction of a power house in connection with its new dairy.

NEW MILFORD, CONN.—The New Milford Electric Light Company has petitioned the State Legislature for authority to increase the capital stock of the company to $200,000.

WATERBURY, CONN. — The Seoville Manufacturing Company, Bridge Street, contemplates the installation of electrical equipment in its proposed brass mill to cost about $100,000.

Middle Atlantic States

BUFFALO, N. Y.—Plans are under consideration to replace all gas street lamps with electric lamps.

BUFFALO, N. Y.—The Niagara, Lockport & Ontario Power Company, Marine Bank Building, has applied to the Federal Power Commission for permission to construct a hydro-electric power plant on the Niagara River below the falls.

CAMPBELL, N. Y.—Preliminary plans are under way for the construction of a hydro-electric power plant in the vicinity of Campbell. J. R. Pulsifer, 60 South Clinton Street, Rochester, is interested. W. S. Lozie, Cutler Building, Rochester, is electrical engineer.

HEMPSTEAD, N. Y.—The Village Board is considering submitting to the voters at the coming election the proposal to issue bonds to establish a municipal electric light plant.

LONG BEACH, N. Y.—Plans have been completed by the Long Beach Power Company, Park Street, for the construction of an addition to its power plant, to cost about $125,000, including equipment.

LONG ISLAND CITY, N. Y.—The Astoria Light & Power Company, 130 East Fifteenth Street, New York City, contemplates the construction of an addition to its plant to cost about $80,000.

NEW YORK, N. Y.—The New York Central Railroad Company, Grand Central Terminal, has had plans prepared for the construction of an electric substation at Park Avenue and 110th Street to cost about $22,000.

NEW YORK, N. Y.—The White Fuel Oil Engineering Company, 742 East Twelfth Street, plans to install electrical equipment in the foundry, 100 ft. x 103 ft., to be built at 732 East Twelfth Street, estimated cost about $75,000.

NIAGARA FALLS, N. Y.—The Federal Power Commission has granted the Niagara Falls Power Company a fifty-year license to use 19,500 cu.ft. of water a second from the Niagara River above the falls. Under the permit the company must hasten the extensive improvements and enlargements of its plants and erect a new transmission line across Grand Island to Buffalo and also another line to supply energy to the Niagara, Lockport & Ontario Company, which now purchases its power from Canada under one-year contracts. The additions required by the company will increase the output of the company's plant from 300,000 hp. to 400,000 hp.

TROY, N. Y.—The Federal Power Commission has granted Henry Ford, Detroit, permission to utilize water from the government dam at Troy for power development purposes in connection with a factory project involving an expenditure of $7,500,000. The cost of the power development is estimated at $2,500,000.

HANOVER, N. J.—The Hanover Township Committee is planning for the establishment of a new lighting district to include Hanover, Hanover Neck and vicinity. An initial installation of about 142 lamps will be made.

METUCHEN, N. J.—The General Ceramics Company, 50 Church Street, New York City, contemplates the installation of considerable electrical and mechanical equipment in the proposed addition to its local plant. The new building, including equipment, will cost about $400,000.

NEWARK, N. J.—The Board of Freeholders of the Overbrook Hospital, near Caldwell, contemplates the installation of electrical and mechanical equipment in the proposed industrial school.

TRENTON, N. J.—The City Commission has plans under way for the installation of a new street-lighting system in South Montgomery Street to include a underground conduit system. Prof. C. E. Clewell is consulting engineer for city street lighting.

DOYLESTOWN, PA.—The Bucks County Chamber of Commerce, recently organized, has tentative plans under way for the utilization of water from the Delaware River in this vicinity for power purposes. Plans include the establishment of a hydro-electric power plant for service in different sections of the county. T. B. Stockham, Morrisville, is president.

HARRISBURG, PA. — Ordinances have been approved by the City Council providing for the purchase of equipment for the installation of new underground conduit system in Walnut and Susquehanna Streets and new street lamps in Fifteenth Ward.

HUMMELSTOWN, PA.—Plans are under way by the Hummelstown Water & Power Company for the construction of an electrically operated filtration plant to cost about $35,000.

PHILADELPHIA, PA. — Considerable electrical equipment will be installed in a group of proposed two-story buildings to be built by the Anna T. Jeanes Memorial Hospital. Heacock & Homanson, Bailey Building, are architects.

PHILADELPHIA, PA. — J. D. Cassell, superintendent of school buildings, has recommended that the sum of $700,000 be appropriated for the installation of electric lighting in the various schools.

PHILADELPHIA, PA.—A bill has been presented to the State Legislature asking an appropriation of $350,000 for power plant for the Jewish Hospital.

PITTSBURGH, PA.—The West Power Company, West Penn Building, has tentative plans under way for the construction of a third generating unit, about 200 ft. x 900 ft., at its electric power plant at Springdale, estimated to cost, with machinery, $5,000,000.

BALTIMORE, MD.—Tentative plans are under way by the Consolidated Gas, Electric Light & Power Company, it is reported, for the construction of a large electric power plant at St. Helena. The proposed plant would be built on the unit system, and when completed would be considerably larger than the Westport plant, which has a capacity of from 140,000 kw. to 160,000 kw. The cost of the project has been estimated at $40,000,000.

BERWYN HEIGHTS, MD.—Negotiations are under way between the Berwyn Heights Association and the local electric light and power company for the installation of an electric system throughout this section. C. Stein is chairman of the light committee.

WESTMINSTER, MD.—The construction of a power plant is contemplated in connection with a group of new buildings being planned by the Board of Trustees of the West Maryland College. The cost of the entire project is estimated at $1,000,000.

FAIRMONT, W. VA.—The installation of electrical and mechanical equipment at its properties in Fairmont is contemplated by the Fort Grand Coal Company, Morgantown, recently organized with a capital stock of $80,000. W. T. Hughes is president and manager.

WILLIAMSON, W. VA. — The Coalton Coal Corporation, recently organized, plans to install electrical and mining equipment, etc., at its properties near Williamson. J. T. Jones, Cambria, Va., is secretary-treasurer.

WASHINGTON, D. C.—Complete development of the Potomac River, with dams at Great Falls and Chain Bridge, for water power and water supply purposes, has been recommended by the Federal Power Commission to Congress, and authority to start work immediately is sought. Major M. C. Tyler of the Engineer Corps of the United States Army is in charge.

North Central States

MARLETTE, MICH.—Plans, it is reported, have been prepared for the construction of an electric light plant and water works in Marlette. Clarence Hubbell, 2338 Penobscot Building, Detroit, is engineer

KENDALLVILLE, IND.—A bond issue of $70,000 has been approved by the City Council for improvements to the municipal electric power plant, including the installation of equipment.

CHAMPAIGN, ILL.—The installation of a lighting system in the business district from the Big Four tracks to Green Street and from Second to Randolph Streets is under consideration. The cost is estimated at $153,000.

CHICAGO, ILL. — The Public Service Company of Northern Illinois has applied to the Public Utilities Commission for authority to issue $2,000,000 in bonds, the proceeds to be used for improvemert of service.

CHICAGO, ILL.—Changes to the lighting system on Michigan Avenue between Pearson Street and Oak Street will be made necessary in connection with plans of the Lincoln Park Commissioners to widen that section of Michigan Avenue.

MILWAUKEE, WIS. — The Milwaukee Electric Railway & Light Company contemplates the construction of a second unit at its electric generating plant.

MILWAUKEE, WIS.—The installation of an electric lighting system in Kosciusko and Juneau Parks, similar to the one recently installed in Washington, is under consideration.

RACINE, WIS.—The plant of the Wisconsin Gas & Electric Company, it is reported, was recently damaged by fire, causing a loss of about $50,000.



OKANOGAN VALLEY (WASH.) POWER COMPANY PLANT

Construction of this 5,500-hp. plant on the Similkameen River has just been completed. The initial unit of 2,500 hp. is expected to suffice for two or three years.

RIVER FALLS, WIS.—Plans are under consideration by the Board of Normal Regents, Madison, for the construction of a power house, 50 x 85 ft., at the Institution at River Falls. The cost is estimated at about $25,000.

MINNEAPOLIS, MINN.—Improvements to the street-lighting in Minneapolis are under consideration, including extension of the ornamental system and the substitution of all gas lamps for electric lighting. The city has $340,000 available for carrying out the 1921 lighting program, which calls for the installation of 340 new arc lamps in various wards before July 1. G. H. Rentz is chairman of the lighting committee.

FULTON, MO.—At an election to be held in April the proposal to issue bonds to the amount of $75,000 for improvements to the light and water plants will be submitted to the voters.

INDEPENDENCE, MO.—Plans have been prepared for the construction of an electric lighting plant for the city. Black & Veatch, 701 Mutual Building, Kansas City, are engineers.

WORTHING, S. D.—The local electric light plant, it is reported, was recently damaged by fire.

LINCOLN, NEB.—Plans are under consideration for the establishment of a police signal station system for protection for outlying districts. City Commissioner J. D. Ringer is head of the police department.

TOPEKA, KAN.—Improvements in connection with the state penitentiary, including the construction of a new power plant to cost $125,000 and the installation of electrical equipment for the operation of coal mines, to require an equal amount, are named in an appropriation bill prepared by the ways and means committee of the Senate.

Southern States

WAYNESVILLE, N. C.—Plans are under way by engineers of the Natural Abrasive Mining Company of America, recently organized with a capital stock of $2,000,000, for extensive mining developments in the vicinity of Waynesville. The plans include the construction of hydro-electric plants.

CORDELE, GA. — The City Council is considering the construction of a light and power plant in connection with the municipal water plant to cost about $40,000. W. G. Webb is engineer.

JEFFERSONVILLE, GA.—The installation of a lighting plant for school building in Jeffersonville is under consideration. Happ & Shelverton, Macon, are architects.

LYONS, GA.—The Council is considering the construction of a dam across Pendleton Creek, to generate electricity for lighting and commercial purposes. The cost of the project is estimated at $1,000,000.

FORT PIERCE, FLA.—At an election to be held on March 15 the proposal to issue bonds to the amount of $60,000 for improvements to the electric light and power plant will be submitted to the voters.

ANDALUSIA, ALA. — The Andalusia Light & Power Company contemplates the installation of a turbo-generator with auxiliary equipment at its power plant.

MONTGOMERY, ALA.—A survey of the city is being made by H. A. Washington, city engineer, with a view of replacing many of the arc lamps now in use with incandescent lamps. The street lighting service is furnished by the Montgomery Light & Water Company.

WARREN, ARK.—The installation of an electric lighting plant for dormitory at the Walters Institute is under consideration. J. W. Eichelberger, Jr., is president.

ALEXANDRIA, LA.—The Gravity Canal Company is considering the construction of a hydro-electric plant in the Bayou Cocodrie district.

HOUMA, LA.—At an election to be held March 15 the proposal to issue bonds to the amount of $180,000 for the construction of a combined light, waterworks and filtration plant will be submitted to the voters.

BROKEN BOW, OKLA.—Improvements to cost about $50,000 to the municipal electric light plant are under consideration.

Pacific and Mountain States

ENTERPRISE, ORE. — The Enterprise Electric Company contemplates the construction of a power plant and an initial installation of a 1,000-hp. unit. The cost of the plant is estimated at $100,000.

ALTA LOMA, CAL.—The operation of the local pumping station by electricity is under consideration.

DENVER, COL.—J. E. Myser and E. E. Drach, 1133 Clarkson Street, have applied to the Federal Power Commission for permission to construct a series of nine small diversion dams and pipe lines leading to a succession of five power houses on the Frying Pan River.

Miscellaneous

GUANAJUATO, MEXICO.—The Guanajuato Light & Power Company, it is reported, contemplates important improvements and additions. Plans include increasing the capacity of its hydro-electric plants and extending its power transmission lines to various mining districts and industrial centers. The company's lines now extend throughout the states of Guanajuato and Jalisco.

MONTEREY, MEXICO. — The Dolores Mines Company, an American corporation, plans to construct a large electric power plant at Madera, State of Chihuahua, and an ore reduction mill at Dolores, in the same state. The company owns and operates gold and silver mines in the Guerrero district of Chihuahua. The cost is approximated at $750,000.

PANAMA.—Bids will be received by A. L. Flint, General Purchasing Officer of the Panama Canal, Washington, D. C., until March 12 for furnishing electrical supplies and equipment, insulated wire and cable fuses, etc.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 10.

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Printed in the First Issue of Each Month

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Importance of World's Markets to America

THE change in administration at Washington ought to bring about some beneficial changes to the nation. However altruistic we may be about these, we must not lose sight of the fact that we cannot meet or escape our obligations merely by that means. Neither can we effect economies—and heaven knows economies are sorely needed—by saving at the spigot and wasting at the bunghole. The nation's debts are met through taxes, and while our system of taxation may be faulty and changes in the excess profits tax are to be expected, yet, no matter how the burden may be spread out or adjusted, it is sure to weigh as heavily. Much as we might like to forget the war, we still must liquidate its costs. Within two years government war debts to the amount of over $7,000,000,000 mature, and the current expenses of the government are running at the rate of $5,000,000,000 a year. In fact, the internal tax collections and other current receipts are absorbed by current expenditures. Thus for some years to come internal taxes must net the government $4,000,000,000 annually and the fetish of government loans and bonuses must cease. The great task confronting the country is the reduction of the national debt. This means monetary deflation, and that is always to be feared because of its depressing effect on business. There is, however, a sensible way of bringing about monetary deflation without untoward effects, and that is by increasing our output enormously and maintaining earnings by this means on a lesser rate of profit. Prices will, of course, fall, but the total real wealth of the country will increase. An outlet will of necessity have to be found for our surplus product and the country's export trade must be expanded enormously. When the extent of our debts is finally realized, then, and probably not until then, will American industry and business appreciate as never before the importance of the world's markets to this country.

Pre-empting Commission Functions

IT IS an annual experience in legislative circles that advocates of bills introduce measures for consideration which, if passed, would withdraw from the regulating commissions a certain amount of jurisdiction over public utility matters. Unpopular commission decisions frequently lead to bills of this sort, and in their advocacy politicians find an outlet for attacks that yield at least a modicum of notoriety, and sometimes fame. At a hearing in Connecticut another aspect of this subject was presented by a representative of insurance interests who pointed out that if the State Legislature should pass a law prohibiting the use of the service charge the stability of investments in public utility securities made by insurance companies would be lessened. Such matters, it was contended, fall within the jurisdiction of the utility commission of the state, an expert tribunal competent to deal with these technical questions more satisfactorily than a general legislative body. There is no question that wise commission regulation tends to stabilize popular confidence in public utility securities, and by leaving to the commissions the task of determining the justice of particular or general rate structures and practices the probability of sound decisions is increased as compared with the treatment of these questions by a larger body composed of many individuals not possessing the special qualifications and experience required to deal promptly and equitably with them. The point made by the representative of the insurance companies is well taken, in our opinion.

Facing a Dilemma with Very Sharp Horns

WHEN the Muscle Shoals power project was undertaken early in 1918 it bade fair to yield important results under the then existing conditions. Now, however, different conditions have arisen. The entire $17,000,000 made available from the national defence funds for the construction of the plant will have been expended about June of the present year, despite the fact that it is now estimated to be only 30 per cent completed. The question is, shall more money be appropriated to give an immediate development of 100,000 kva. and a possible output of 700,000,000 kw.-hr. yearly, or shall the government stand the loss of the $17,000,000 already spent and give up the project? The government's action for the time being has been decided by the House of Representatives of the Congress just closed by its refusal to accept the Senate's amendment to the sundry civil appropriation bill granting $10,000,000 for the completion of the Wilson Dam at Muscle Shoals. The amendment was rejected by a vote of 193 to 182. Therefore, if anything is to be done to bring a return on the money already invested, new bills will have to be presented in the coming Congress. An exhaustive examination of the economic probabilities of this development is certainly needed, based now on roughly three times the original figure per kilowatt of output. The nitrate plant which formed a part of the original undertaking appears at first glance to be a vital part of the whole project, inasmuch as it would constitute a great and important outlet for secondary power. On the other hand, the whole problem of the fixation of nitrogen is rapidly being modified, so that to estimate the probabilities is no easy matter. With all this there stand out two fundamental facts—first, that it is bad judgment to drop $17,000,000 if there is a reasonable chance of pulling out of the investment on some decent sort of basis by continuing the

work; second, that it is certainly a pity to see the possibility of 700,000,000 kw.-hr. per year in primary power and possibly nearly twice as much in secondary power slip out of sight as a factor in the economic development of the country. We certainly hope that thorough investigation of the situation will show that it is the part of wisdom to go ahead, but the dilemma is unquestionably a very serious one.

A New Method of Measuring Flow in Pipe Lines

THE task of measuring the flow in penstocks, or its equivalent, the discharge of waterwheels connected thereto, has always been more or less troublesome, and hence the announcement of a new method which has the combined advantages of simplicity, high accuracy, speed and ease of application should be especially welcome to hydro-electric engineers. Such a method is explained and discussed on page 591 of this week's issue, particular emphasis being placed on its application to the measurement of diversion through the plants of the Niagara Falls Power Company. Aside from its commercial value in testing the efficiency of waterwheels and waterways and the possibility of applying it to continuous plant tests, the method is particularly interesting because of the principle involved. Stated briefly, it is that when water flow in a pipe line is retarded there is a rise in hydraulic pressure. Integrated over a time interval this change in pressure is a measure of the change in rate of flow.

Underpaid Professors and Other Engineers

CONCENTRATED efforts of universities and their alumni have been put forth during the past two years to raise large endowment funds to provide adequate salaries for their teaching staffs. Though much has been accomplished, it must be admitted that the goals striven for were usually not reached. Failure in that regard was somewhat alleviated by the sudden drop in business activity and the slow drop in prices. Nevertheless, it must be concluded that the public has not been roused sufficiently to the magnitude and the importance of the task and that continued effort will be necessary for complete success. Many plans are on foot, less spectacular perhaps than those previously tried, but, it can be hoped, foreshadowing satisfactory results.

There are, however, other places where the evils resulting from inadequate salaries are seriously impairing progress. One of these is on the engineering staffs of central-station companies. Just as in the case of their brothers in the teaching professions, these engineers have not known how to sell their services at a proper figure. Perhaps the fact that the public as a whole is wholly unable to gage the merits or the failings of a piece of engineering work is the cause of this condition. The fact remains that the engineering departments of central stations today are not attracting and developing the best engineers in the country. Worse still, electrical engineering as a means of making a living is not appealing to many ambitious and able young men who see richer pastures elsewhere, and some of the blame for this condition can be placed on the executives of central-station companies.

It would certainly be wisdom to educate the public to appreciate and to keep managers from forgetting the enormous difference between the capable engineer and the one who is satisfied with filling some minor clerical position. The first one will abound in new ideas; his efforts will accomplish economies, and he will be a leader in progress. The other may never bring a new thought to his work and may for years do the same thing in the same old-fashioned manner. No industry in the world has shown more public conscience than the central-station industry, to no industry has been given more confidence, for it is virtually without competition, and no industry should be more concerned with giving the best that is possible to those that it serves. Is it not the duty of the central-station industry to attract, develop and encourage the best engineering talent that is available?

Designing Stations with Reference to Load Factor

LOAD factor has always been somewhat of a nightmare to managers of central stations. The fundamental difficulty with proper design of stations for load-factor requirements is that load factor itself is definitely known only for particular epochs, up to the last for which data are available. In a certain sense one may extrapolate from such data and form at least a preliminary notion of what the load factor reckoned on a yearly, monthly or daily basis is likely to be for the next few years. During periods when the growth of station output is along definite and steadily increasing lines thus to forecast the future is comparatively easy. When, however, as in the last few years, there has been a radical change in the nature of station output, owing to an extraordinarily accelerated growth of industrial demand, it is no easy matter to judge for what future values one must be prepared.

The single definite fact which looms large in this matter is that the load factor is tending steadily upward like the cost of fuel, and hence on the whole preparation must usually be made for load factors higher than was indicated at an earlier period. Annual load factor has a far-reaching effect on fixed charges, which work all the year round, if not overtime, while the earnings are limited by the output. The effect of increasing load factor in keeping down in a general way the costs due to fixed charges may be demonstrated readily and is understood by all progressive central station engineers. There is another side to the question in that preparations for operating at a high load factor in the most economical way are expensive, so that too strenuous efforts at preparing for the future may temporarily prove uneconomical.

The extent to which central-station location is affected by load factor is not as familiar as it should be. In a first-class plant condensing water is so important a matter that it often outweighs other considerations in station location. There are, however, situations, particularly when operating under unfavorable load conditions, when a different design of station, perhaps with artificial cooling of the condensing water, might prove economical. Here again future growth is an all-important matter, for granting that a plant planned for artificial cooling might easily become uneconomical, its period of usefulness might easily extend to a time when the heavy load would be carried by a station designed for the highest possible efficiency, and the older plant might then serve only for emergency and peak work. In settling all these matters the daily load factor may prove to be quite as important as the yearly

figure, especially with respect to choice of the number and size of units, which again bear an uncertain relation to the future.

We are inclined to think that year by year difference in cost between a highly efficient station and one built with a keen eye toward fixed charges is likely to diminish, as experience is gained and builders of equipment more and more thoroughly standardize that of the higher efficiency. The size of units, steam pressure, superheat and various devices for economy have progressed regularly toward better standards, and with the swiftly growing demand for electrical energy there will be less and less occasion to build for minimum first cost. Even in the specific case where this is most often advisable, the construction of auxiliary stations for use with water power, experience indicates that the load factor steadily tends to drift upward.

Temperature Limits in Electrical Machines

IT IS interesting to note that the matter of high operating temperatures is being investigated both in this country and abroad. A recent paper presented before the British Institution of Electrical Engineers gives details of various tests made on class B insulation for which the general standard maximum temperature is 125 deg. C. These data were obtained as the result of tests on samples fitted in the slots of a standard machine and worked far beyond a regulation degree of final temperature. The actual figures were obtained by thermocouples placed directly on the copper. The tests were made with insulations made of fabrics and mica, paper and mica, and mica and shellac alone, and extended over a period of 7,000 hours at a steady temperature of 190 deg. C. After this protracted period, during which tests for insulation failure were daily made, the samples were submitted to a final voltage test for breakdown. The ultimate result was to show that the straight mica insulation held up to 50,000 volts, the normal voltage applied in the operating tests being 11,000. The composite insulators of the better class all held up above 30,000 volts, ranging as high as 50,000.

American engineers and designers as a whole have consistently taken the conservative side in all matters of operating temperature, which is perhaps one of the reasons for the extremely good reputation of American electrical machinery. More experience than that obtainable from tests already made would seem to be necessary prior to any general change of practice. Such may come later, but considering the large stake in the operation of big turbo-generators it would seem wise to "play safe" for some time to come.

Charging Current on Pit River Lines Sets Lower Limit of Generator Rating

TWO points brought out by A. H. Markwart in his article in this issue describing the Pit River project of the Pacific Gas & Electric Company should be of considerable interest to electrical engineers. The first is that the transmission lines are being designed to operate ultimately at 220,000 volts. This voltage has not been selected for any arbitrary reason, but because it offered the greatest economy in design and operation. It is understood that the lines will later carry approximately 150,000 kw. per circuit, which over the distance of transmission required is feasible only by the use of lines of this voltage. In addition to the economies of transmission there is always present the vital factor of right-of-way costs. By the use of double-circuit steel towers operating at 220,000 volts the total number of circuits transmitting the power from this project will be about four, whereas the use of a lower voltage would require considerably more circuits at a proportionately greater expense for right-of-way.

The second point of particular interest is that generators of a rather large size are being installed. The size of the generators is dictated largely by the voltage and length of the transmission lines, which require high kvas. for energizing them. In fact, in all large hydroelectric projects transmitting power over long distances at high voltages the charging current is a factor that determines the lowest limit of size of generators which can be utilized. Although a multiplicity of units of smaller size has some operating advantages in that a shutdown of one unit does not materially cripple the output, and although a satisfactory safety factor may be obtained by the installation of another of the smaller units at a proportionately less price than by the installation of a larger unit, yet the constants of the transmission line are the controlling factors and necessitate the use of large units.

International Electrical Communication

THE international conference on electric communications recently held at Washington, D. C., under the auspices of the State Department, was a necessary preliminary to a more generally international conference of the same type, to be held probably this year in Paris. A noteworthy feature of this conference was that for the first time in history it brought together, with great mutual advantage, representatives of wire and radio telegraph and telephone communication and also of visual signaling. In future it will probably be impossible to have separate conventions in any of these activities. At first thought flag signaling at sea might be regarded as dissociated from electric communication. Yet it is to be remembered that flag signaling may happen to be the last link in a message-transmission chain.

It is expected that a technical international council will be established under the forthcoming international convention to consider and recommend future world-communication developments. A technical international committee is also expected to be formed to advise upon technical questions in world communication.

As we understand the matter, the proposed international council and technical committee possess advisory powers only and are to have no executive functions. Perhaps that is a necessary condition at the outset. In the course of time, however, it will probably be necessary to invest either these or some other international body with executive powers for the policing of the ether. If international radio rules could always be obeyed, or if their infractions could always be promptly dealt with by the individual countries wherein they occur, then no internationl executive powers would be necessary. Such, however, is not yet the case in this possibly not best of possible worlds. It is therefore likely to be necessary for the various countries to agree before long upon the creation of an international communication police to help maintain world order in the atmosphere around the world.



Frank Whitney Smith

A vice-president of the N. E. L. A., and a central-station executive whose career embraces more than forty years of service in one organization in the development of alternating-current distribution in New York City

SEVEN years ago when The United Electric Light & Power Company of New York City placed in operation its Sherman Creek steam station, rated at 151,600 kw., it was expected to take care of the load until 1935. Conditions which were then unforeseen have now forced the company to start another plant, one of the largest in the country, with an ultimate capacity of 280,000 kw. The marked development of upper Manhattan Island during this time and a constructive policy in the extension of electric service facilities under the management of Frank W. Smith are reflected in such strides in station ratings. The history of this company embraces Mr. Smith's entire career. When thirteen years old he became office boy of the old United States Illuminating Company, the predecessor to the United company, and steadily advanced to the position which he now occupies as vice-president and general manager.

During his forty years of service in the central-station field Mr. Smith has applied his great energy and business acumen in administrative matters with telling results, significant among which is the fact that his company serves 70,000 customers, who in 1920 purchased 420,000,000 kw.-hr.

Likewise, Mr. Smith has been a builder in the industry to whom others have looked for whole-hearted co-operation in pushing any forward movement. He has been an active proponent of the electric vehicle and was the third president of the old Electric Vehicle Association of America. In reorganizing the N. E. L. A. along broader lines of activity Mr. Smith has taken an active part and at the present time he is its second vice-president. For a number of years he has headed the association's lamp committee, the annual report of which is a comprehensive chronicle of vital facts relating to electric lighting. Through this committee he is taking a very active part in the much-needed standardization of lamp voltages.

Mr. Smith was born in Alden, N. Y., June 22, 1867. From the time he was thirteen he has been continuously in the service of one organization. His first big advancement was to general clerk and then to paymaster. In 1891 he was made assistant auditor and eight years later he was elected assistant secretary of the company. In 1905 he became secretary and eleven years later was elected to the combined office of vice-president and general manager.

During Mr. Smith's administration of the affairs of the United Electric Light & Power Company he has built the Sherman Creek generating station already mentioned, which supplies 60-cycle service throughout the boroughs of Manhattan, Bronx and Queens and in part of Westchester County and also 25-cycle service for the New York, New Haven & Hartford and the New York, Boston & Westchester railroad companies. He has also built three substations in upper New York, including the one at West Farms through which the railway service is delivered, besides a substation on West Forty-fifth Street and a modern display and service building uptown in New York

Half Million Horsepower from Pit River

Contemplated Development Exceeding 450,000 Kva. in Northern California Will Utilize Flow of Unique Stream—First Station Now Under Construction—Line Being Built for 220,000 Volts

By A. H. MARKWART
Director of Engineering Pacific Gas & Electric Company, San Francisco, Cal.

THE Pacific Gas & Electric Company is now starting on a program which involves the ultimate development of a continuous output of about 322,000 kw. on the Pit River in northern California. The installed capacity will be upward of 450,000 kva., and in the next ten to thirteen years an expenditure of more than $90,000,000 will have been made to generate and transmit 3,000,000,000 kw.-hr. of hydro-electric energy annually to the northern and central parts of the state. This sum does not include the expenditures for distributing the energy to the farms, homes and industries of California. A study of the kw.-hr. output of this company from 1911 to 1920, inclusive, reveals a growth of about 100 per cent. If this growth continues, and, after making due allowances for increases resulting from the acquisition of various electrical properties, this increase carried forward indicates that the output, which was almost 1,500,000,000 kw.-hr. in 1920, will be about 3,000,000,000 kw.-hr. in 1929. An inspection of the load factors of the past shows that the 65 per cent which has been attained is not likely to be exceeded in the immediate future. Using this load factor in connection with future growth the average and peak loads, which were 168,000 and 259,000 kw. in 1920, will be 343,000 kw. and 526,000 kw. respectively in 1929. To meet this increase there is under way the comprehensive development of Pit River.



FIG. 1—FALLS ON PIT RIVER NEAR FALL RIVER MILLS

This unique river drains a basin of about 6,000 sq. miles (15,300 sq.km.) in Modoc, Lassen, Siskiyou and Shasta Counties, as shown in the accompanying map. Its principal tributaries are Fall River, Hat Creek, Burney Creek and the McCloud River. The basin is largely of volcanic structure and has varying amounts of annual precipitation, approximately as follows: The plateaus from 14 in. to 18 in. (35 cm. to 45 cm.), the lava areas from 18 in. to 34 in. (45 cm. to 90 cm.), and the mountains from 30 in. to 60 in. (75 cm. to 150 cm.), the maximum obtaining in the mountainous region on the headwater of the McCloud River. The run-off is a minimum in the plateau areas and a maximum in the mountainous areas. Although the porous lava areas and the mountain areas produce the bulk of the flow, the former is under much better regulation. The run-off in the basin streams is relatively uniform and is unlike the usual California streams, only the McCloud being similar. Recently, during several days of comparatively heavy precipitation, Hat Creek, Burney Creek and the Pit River below Fall River Mills showed no appreciable rise.

Altogether the Pit River is remarkable for its natural regulation, this being brought about by the existence of the many springs and subterranean flows originating in underground reservoirs occurring in the porous areas of Fall River, Hat and Burney Creeks. Some curious conditions prevail. Records of the flow of Fall River at Fall River Mills show an average annual run-off of 1,020,000 acre-ft. (1,254,600,000 cu.m.), which is equal to 28 in. (71 cm.) per year over the apparent drainage area of 676 sq. miles (1,750 sq.km.). This exceeds the actual average annual precipitation by 4 in. (10.4 cm.). From this it is apparent that there are large flows into the Fall River from other areas.

The Pacific Gas & Electric Company contemplates the full development in the basin from a point on Fall River above Fall River Mills to a point on the Pit below the "Big. Bend," a distance along the streams of 60 miles (96 km.). The total fall is 2,104 ft. (640 m.), of which it is expected to utilize 2,074 ft. (631 m.) in at least five stations. The area of the watershed above the diversion of the lowest proposed plant is 4,809 sq. miles (12,450 sq.km.). The discharge of the Pit at Henderson, a few miles below this diversion, is shown in the table. The minimum daily flow is 2,010 sec.-ft. (56 cu.m. per second) and the maximum 13,300 sec.-ft. (370 cu.m. per second). It is tentatively proposed to install at a point below Pecks Bridge a storage reservoir of sufficient capacity to regulate the river below to such a flow as may be desired. The hydrograph indicates that a storage of 62,000 acre-ft. (76,000,000 cu.m.) will regulate the river to 2,500 sec.-ft. in all but exceptionally dry years. Below this storage will be built at least three of the five stations. Above this reservoir there will be two plants, the upper one of which, Pit River No. 1, is now under construction and receives an average low flow of 1,400 sec.-ft. (39 cu.m. per second) from Fall

River. The lower station (Pit River No. 2) will use an average low flow of 1,500 sec.-ft. (42 cu.m. per second). In addition to the development of the Pit, two stations are now going in on Hat Creek. These will utilize substantially all the drop existing from the Hat Creek Valley to the Pit. Future plans contemplate increase in flow of Hat Creek which will benefit both plants on that stream.

At Hat Creek No. 1 the diversion is by means of a timber and rock-fill crib. Water control is by motor-operated radial gates. Protection against floating drift is effected by means of a floating boom of timber. The conduit connecting the diversion and forebay is a ditch having a bottom width of 17 ft. (5.18 m.) and a width at water surface of 45.5 ft. (13.8 m.) at a 9.5 ft. (2.8 m.) depth. The ditch is 2,750 ft. (838 m.) long, is excavated in lava rock and is

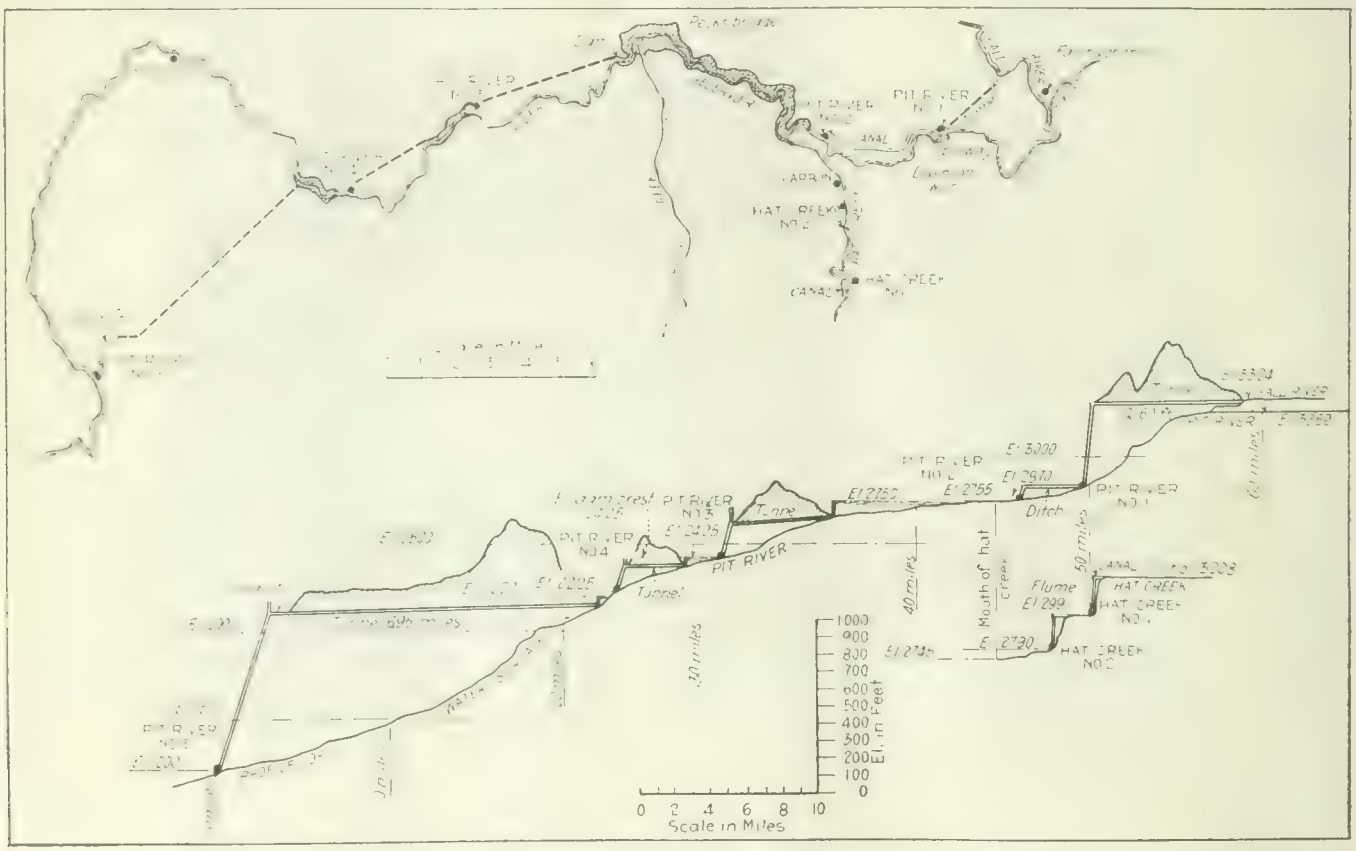


FIG. 2—COMPLETE UTILIZATION OF 2,070-FT. DROP IN PIT RIVER WILL BE ACCOMPLISHED IN NOT LESS THAN FIVE STATIONS (SEE TABLE BELOW)

constructed on a grade of 0.25 ft. per 1,000 ft. The excavated forebay has a nominal capacity of 12.5 acre-ft. (15,400 cu.m.). The penstock consists of a riveted pipe 1,700 ft. (518 m.) long, the diameter ranging from 10 ft. (3.04 m.) at the top to 8 ft. (2.43 m.) at the bottom, and has a 7.5-ft. (2.28-m.) turbine inlet. The maximum drop is 216.8 ft. (66.1 m.) from headwater to tailwater. The comparatively long penstock required the installation of a pressure regulator, which will discharge approximately 80 per cent of the maximum flow. A butterfly stop valve connects directly to the turbine inlet.

A reinforced-concrete building houses the hydraulic and electric equipment. The station contains one 15,000-hp. vertical turbine directly connected to a 12,500-kva. generator and operates at 225 r.p.m. With a normal flow of 450 sec.-ft. (12.6 cu.m. per second) this unit will develop 6,650 kw. Under this condition the effective head is 212.8 ft. (64.8 m.). The maximum power with 600 sec.-ft. (16.8 cu.m. per second) is 9,300 kw. For this condition the effective head is 210.5 ft. (64.2 m.). The high kva. rating of the generator is necessitated by heavy line charging current.

Excitation is derived from an impulse-wheel-driven 250-volt, 175-hp. exciter. The power is transmitted over a single-circuit line to Hat Creek No. 2, at the generator voltage, 6,600 volts, without transformation. This line is of 500,000-circ.mil copper cable and has lightning arresters at both ends.

Step-up Transformers at Hat Creek No. 2

The diversion for Hat Creek No. 2, down stream from Hat Creek No. 1, is effected by means of a pile and timber structure. The spillway is 282 ft. (85.9 m.) long. Water control and protection from drift are

Station	Intake Water El.	Tail-water El	Ave. Low Flow Sec.-Ft	Total Head	Ave. Hp Available
Hat Creek No. 1. .	3,208.5	2,991.7	400	216.8	7,900
Hat Creek No. 2. . ..	2,991.7	2,790 4	600	201 3	10,200
Pit River No. 1. ..	3,324.0	2,870.0	1,400	454 0	60,500
Pit River No. 2.. ..	2,870 0	2,755 0	1,500	115.0	15,400
Pit River No. 3 ..	2,750.0	2,425 0	2,500	325 0	73,500
Pit River No. 4.. .	2,425.0	2,225 0	2,500	200 0	46,500
Pit River No. 5.. ..	2,200.0	1,220 0	2,500	980 0	215,000
Total ..				.. .	429,000

similar to those used at Hat Creek No. 1. From the diversion to the head of the penstock a 4,469-ft. (1.362-m.) flume has been built on an excavated bench.

The flume is of timber, is 16.3 ft. x 7 ft. (4.9 m. x 2.1 m.) in dimensions and will carry 800 sec.-ft. (22.2 cu.m. per second) at the grade of 0.7 ft. per 1,000 ft. A spillway 550 ft. (167 m.) long is tentatively planned for the side of the flume at the lower end. The flume

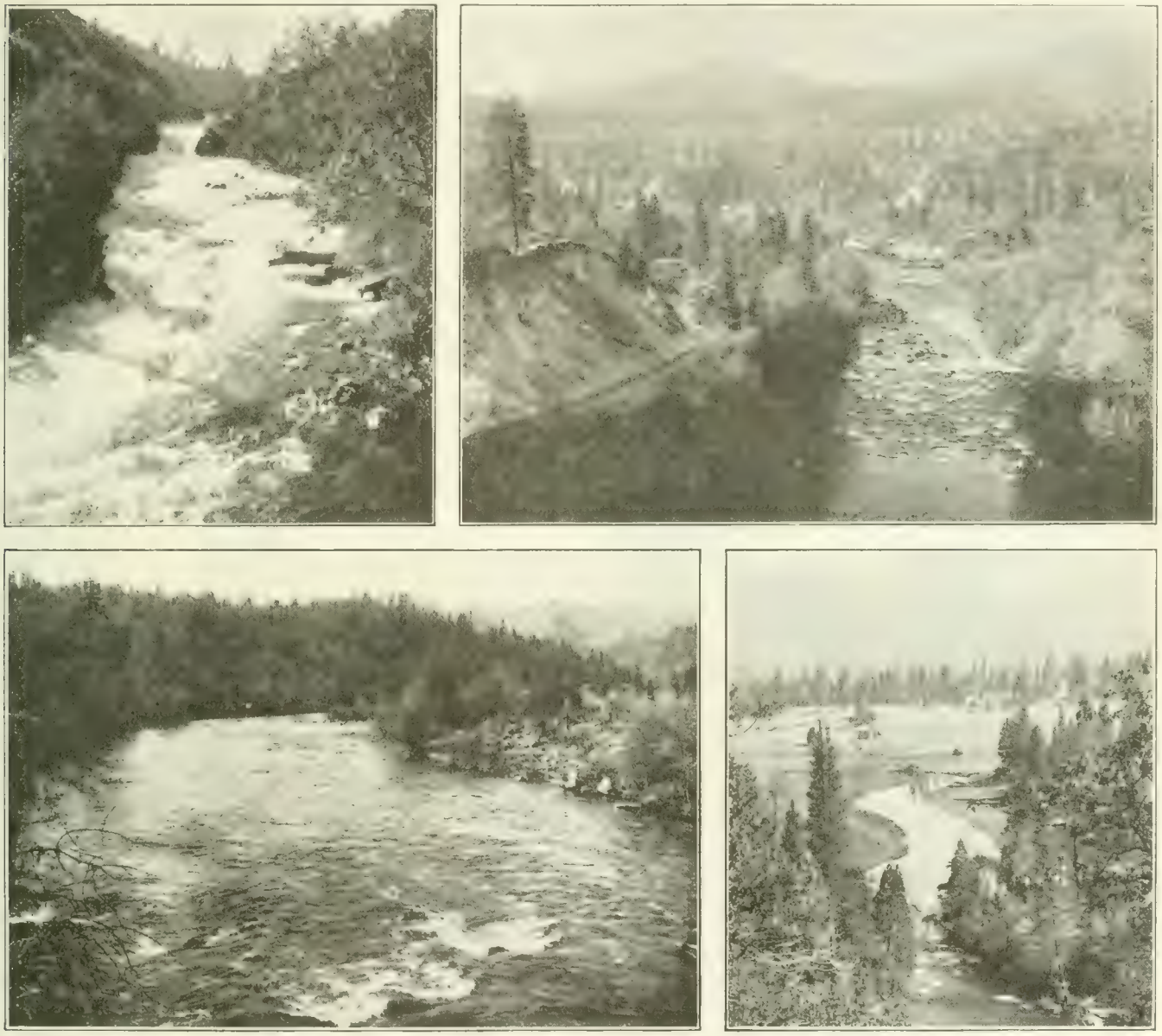
terminates in a concrete-lined forebay of negligible capacity, which is equipped with radial gates as at Hat Creek No. 1. The riveted steel penstock is 400 ft. (122 m.) long and of the same general diameters as Hat Creek No. 1. The head is 201.30 ft. (61.3 m.).

The power-house equipment is identical with that provided for Hat Creek No. 1, with two exceptions—transformers are added to raise the generator voltage to the present line voltage of 60,000 and there is no pressure regulator and stop valve as the penstock is short. These may be installed later if operating conditions require them. With a normal flow of 600 sec.-ft. (16.8 cu.m. per second) 8,630 kw. will be generated under an effective head of 195.8 ft. (59.5 m.). The maximum power with 800 sec.-ft. (22.4 cu.m. per second) is 11,200 kw. with 194.5 ft. (59.3 m.) head.

The four outdoor water-cooled transformers (one a spare) at Hat Creek No. 2 are rated at 8,000 kva. and will be wound for 6,600/63,000 volts delta. They will step up the output of the two stations from 6,600 volts to 60,000 volts for transmission to Cottonwood, where it is to be delivered to the reconstructed lines of the former Northern California Power Company for transmission further south. This line voltage will be increased later to 110,000 and finally to 220,000.

PIT RIVER NO. 1 WILL HAVE TWO 35,000-KVA. UNITS

Owing to the size of the generating units, Pit River Station No. 1 is perhaps the most interesting. The two units, which are rated at 35,000 kva. each, will be exceeded in size only by the 45,000-kva. generators under order for the Canadian Niagara Company. Pit River No. 1 diversion will be on Fall River about three-quarters of a mile above Fall River Mills. The diversion structure tentatively decided upon will be a pile erection of the same general design as that provided for Hat Creek No. 2, the idea being to replace it after the completion of a tunnel by a concrete structure. Storage is not provided, and the whole minimum flow of the river will be diverted by means of a conduit consisting of



FIGS. 3, 4, 5 AND 6—STREAMS THAT WILL YIELD NEARLY HALF A MILLION HORSEPOWER

Upper left—Falls on Hat Creek below intake for Hat Creek No. 2 station. Upper right—Pit River at Henderson gaging station. Lower left—Pit River No. 1 station will be built on right of stream at bend. Lower right—Site of Hat Creek No. 2 station near Carbon.



FIG. 7—AREA SURROUNDING PIT RIVER
Records of total annual run-off, precipitation and drainage area indicate a subterranean flow into the basin.

	Drainage Area in Sq. Miles	Average Yearly Run-Off in Acre-Ft
A	644	1,642,000
B	676	1,020,000
C	3,320	662,000
D	257	593,200
E	200	
F	153	121,700
G	453	1,116,000
H	460	475,000

1,150 ft. (350 m.) of open cut and 10,160 ft. (3,100 m.) of tunnel, the latter terminating in a combined surge chamber and spillway.

The open cut will have an average width of 60 ft. 18 m.) and a depth of 10 ft. (3 m.). The tunnel will have an area of approximately 154 sq.ft. (14.3 sq.m.) and will be built on a grade of 3 ft. per 1,000 ft. The capacity of the conduit will be 1,800 sec.-ft. (50 cu.m. per second).

The station will contain two vertical units of a maximum capacity of 40,000 hp., each connected to a 35,000-kva. generator running at 257 r.p.m. The output with 1,500 sec.-ft. (42 cu.m. per second) will be 64,500 hp. under an effective head of 429.3 ft. (130.8 m.). The maximum output with 1,800 sec.-ft. (50 cu.m. per second) flow will be 73,800 hp. under an effective head of 418.2 ft. (127.6 m.). The generating voltage is 11,000. In addition to the direct-connected exciters there will be a spare motor-driven exciter. The latter has an extended shaft opposite the motor end on which is mounted an impulse wheel for emergency operation.

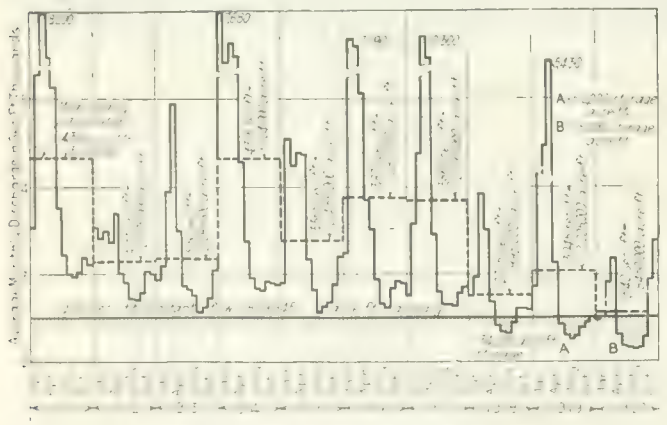


FIG. 8—ANNUAL AND MONTHLY FLOW OF PIT RIVER SHOWING STORAGE REQUIRED

Power from Pit River No. 1 will be transformed from 11,000 volts to 110,000 volts for transmission to the San Francisco bay district. At the time this station is placed in operation the transformers at Hat Creek will be connected for operation at 110,000 volts and a connection will be made to the Pit River No. 1 line. The seven transformers at Pit River No. 1 will be rated at 16,667 kva.

220,000-Volt Operation Is Contemplated

Later it is planned to raise the voltage to 220,000 volts. Since the transmission lines receiving the ouput of this and the Hat Creek stations will be operated at 110,000 volts for some time, it may prove inadvisable at this time to make the costly investment in 220,000-volt switching equipment.

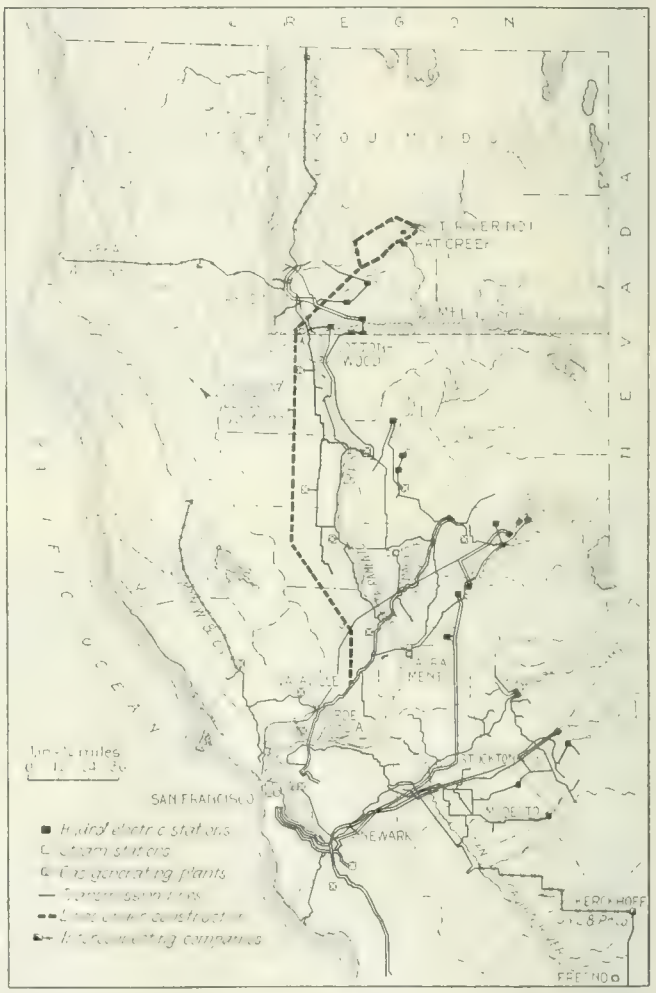
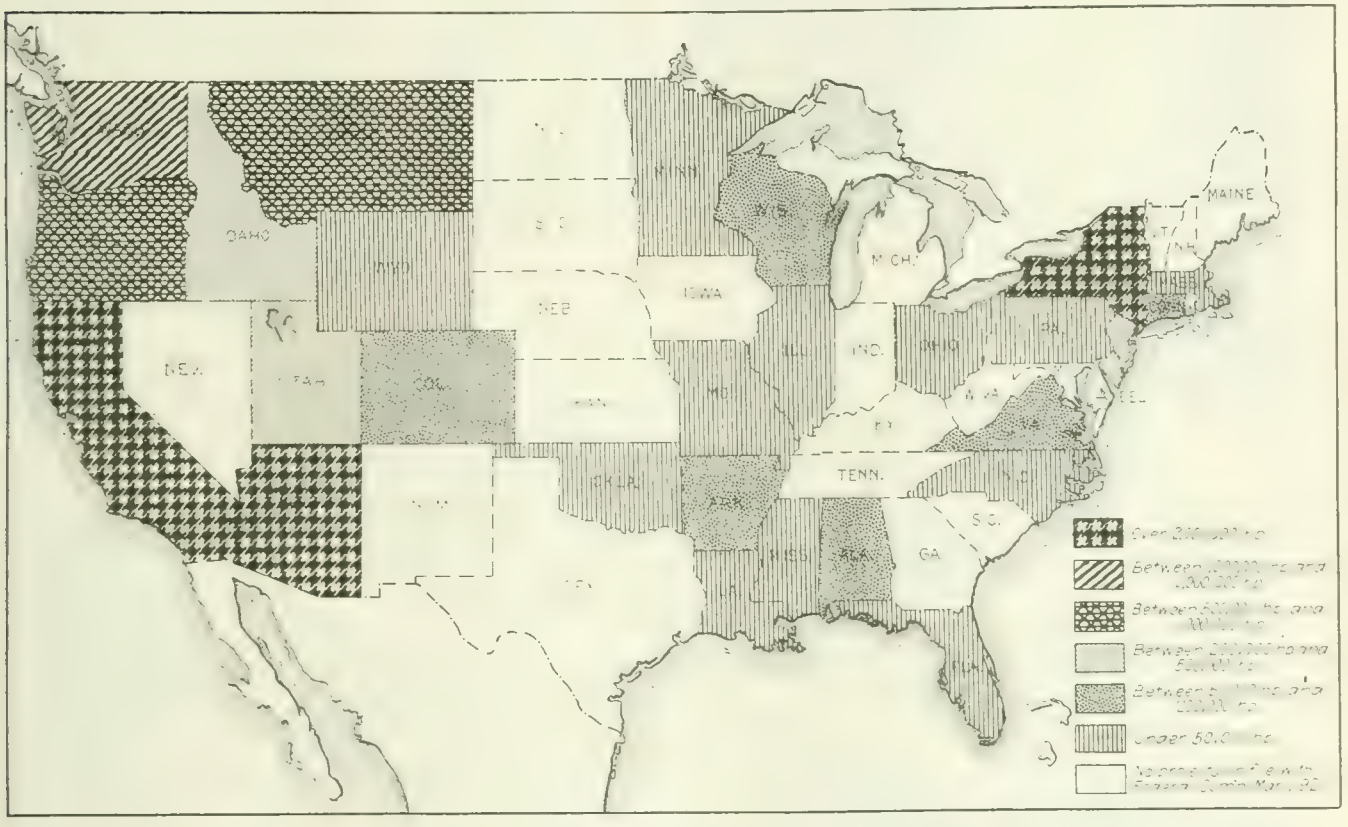


FIG. 9—RELATION OF PIT RIVER PROJECT TO PACIFIC GAS & ELECTRIC COMPANY SYSTEM

It is expected that 110,000-volt operation will continue until Pit River No. 3 station is completed, when additional line capacity will be required. To meet this condition the line voltage will be raised to 220,000 volts. At that time the 110,000-volt transformers at Hat Creek No. 2 will be removed and the power will be transmitted to Pit River No. 1, where it will be delivered to the 11,000-volt bus of that station and there transformed to 220,000 volts. It is expected that the 220,000-volt operation will be initiated in 1924, and the towers, conductors and insulation are being constructed now for operation at that voltage.

Applications for Preliminary Power Permits Continue to Grow

Federal Power Commission Reports the Receipt of 178 Up to Feb. 26—Ten Applications Filed During Month of February—Applications on File Involve Development of 13,725,166 Hp.



MAP SHOWING PROBABLE DISTRIBUTION AND INTENSITY OF HYDRO-ELECTRIC DEVELOPMENT IN THE UNITED STATES DURING THE NEXT DECADE

ON FEB. 26 1921, applications for permits or licenses on file with the Federal Power Commission under the federal water-power act numbered 178. A compilation from the data set out in the applications indicates that 13,725,166 hp. will be developed if the plans of the promoters are carried to completion.

The projects now under application range all the way from a small 10-hp. plant for a colony of summer cottages in the Wyoming mountains to the 3,570,000-hp. project of the Southern California Edison Company on the Colorado River in Utah and Arizona, which involves the storage of the waters of the upper Colorado River and its tributaries in a huge reservoir and a total hydraulic fall of 2,650 ft. (800 m.)

A general idea of the magnitude of the almost 14,000,000 hp. of contemplated hydro-electric development may be gained by considering that, if properly applied, it would furnish sufficient power for twenty-two cities the size of Chicago. It is probably 50 per cent more than the present water-power development in the United States and over 50 per cent of the present developed water powers of the world.

The development of the projects now on file, if carried to completion, will directly and indirectly result in the expenditure of more than eleven billion dollars for equipment and labor, distributed as follows:*

Cost of new generating-plant capacity—11,330,000 × $200	$2,266,000,000
Cost of transmission equipment—11,330,000 × $110	1,246,300,000
Cost of distribution equipment—9,200,000 × $100	920,000,000
Cost of customers' lamps, motors and appliances and of wiring houses and factories—9,200,000 × ($125 × 6)	6,900,000,000
Total capital required for probable hydro-electric developments and resulting service equipment	$11,332,300,000

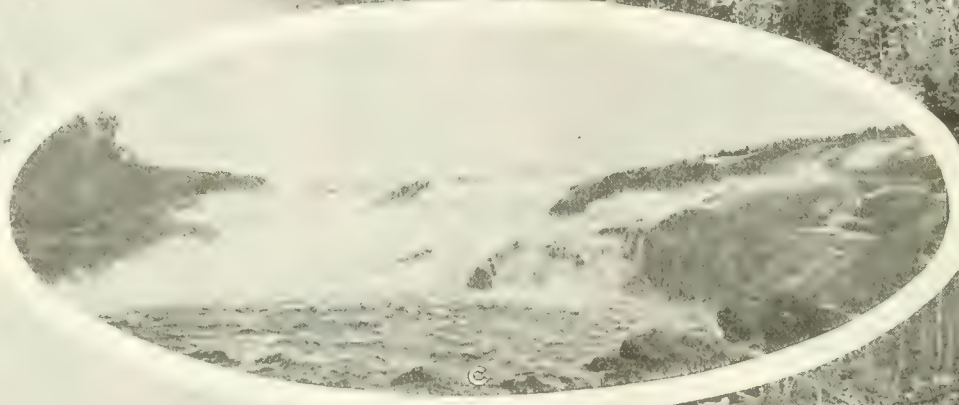
While some of the projects doubtless represent only the hopes of the applicants, a very considerable proportion of them will eventually be developed. Some of the larger ones will be constructed in stages, the work extending over a period of years as market requirements

*For details of basis for these estimates see page 3 of the ELECTRICAL WORLD, Jan. 1, 1921.

National Forest Waterpowers Probable of Immediate Development











A—Tallulah Falls, Tugaloo River, Savannah National Forest, Ga. About 64,000 horsepower possible of development.

B—Rainbow Falls, Chelan National Forest, Washington.

C—Looking from Curtain Falls into Iron Lake, Superior National Forest, Minn. These falls are included in a power project for which application for preliminary permit has been filed with the Federal Power Commission. About 6,000 horsepower possible of development.

D—Clear Creek Falls, Rio Grande National Forest, Col. These falls and rapids are included in a power project for which application for preliminary permit has been filed with the Federal Power Commission. About 11,000 horsepower possible of development.

E—Nocksack Falls, Nocksack River, Washington National Forest, Wash. About 3,300 horsepower possible of development.

Photos by U. S. Forest Service

demand. The applications indicate, nevertheless, a movement of capital toward water power as a reconstruction measure which at this time of depression in industrial, building, agricultural and other lines is significant.

The accompanying map shows the probable distribution and intensity of hydro-electric development in the United States during the next decade as indicated by the applications for power permits now on file with the Federal Power Commission. The 6,865,088 hp. credited to projects in California and Arizona, virtually all the energy resulting from the development of which will probably be used in California, is about five times the estimated new water-power development necessary to supply the total increased electrical energy market of California by 1930. On the other hand, the 2,883,750 hp. concerned in projects in the State of New York is only about 650,000 hp. in excess of the estimated increased rating of central generating stations necessary to accommodate the increased factory and manufacturing load of that state by 1930, and is more than 1,000,000 hp. less than the estimated total increase in rating of central generating stations necessary to meet all requirements of both light and power customers of the Empire State by 1930. It would appear, therefore, that while the Mountain and Pacific States have by far the greater proportion of horsepower involved in contemplated hydro-electric projects, yet it does not necessarily follow that the field of greatest immediate hydro-electric activity will be confined to that section of the country. Hydro-electric development will follow and not precede the market for electrical energy, and highly industrial sections of the country possessing available water powers may be expected to become the most immediate fields of intensive hydro-electric development activities.

LOCATION AND SIZE OF WATER POWER PROJECTS FOR WHICH APPLICATION FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM JAN. 29, 1921, TO AND THROUGH FEB. 26, 1921

Name of Company	Location of Project	Capacity, Hp
CALIFORNIA:		
Marcus Pluth, 424 Wilcox Bldg., Los Angeles	North and south forks of Whitewater River	
Harrison Albright, et. al., Laughlin Bldg., Los Angeles	Tahquitz, Snow and Little Morongo Creeks and Whitewater and Mission Rivers	5,100
Southern California Edison Company, Edison Bldg., Los Angeles	Transmission line	.....
San Joaquin Light & Power Corpn., Fresno	North and west forks of King River	188,260
Escondido Mutual Water Co., care H. Hawgood, Hellman Bldg., Los Angeles	San Luis Rey River and Bear Valley Creek	625
San Joaquin Light & Power Corpn., Fresno	Kern River	.....
WASHINGTON		
E. N. Tunn, Keechelus Inn, Hyak, Wash	Wolf Creek at Lake Keechelus	
LOUISIANA:		
Louisiana Gravity Canal Company, care Wellman Bradford, Alexandria, La	Bayou Cocodrie	15,000
CONNECTICUT:		
The Connecticut River Co., 50 State Street, Hartford, Conn	Connecticut River at Kings Island	32,000
FLORIDA:		
The Ocklawaha Reclamation Farms, care of J. D. Young, Ocala, Florida	U. S. Government lock and dam on Ocklawaha River, Marion County, Fla.	

In the table above is a list of the applications for preliminary power permits filed with the Federal Power Commission from Jan. 29, 1921, to and through Feb. 26. Lists of applications filed prior to Jan. 29 appeared in the ELECTRICAL WORLD of Jan. 1, Jan. 15 and Feb. 12.

Completion of Muscle Shoals Plant Urged

No Appropriation Made for Army Engineers to Continue Work on the Fifty-Million-Dollar Wilson Dam on Tennessee River at Muscle Shoals—$17,000,000 Has Already Been Expended

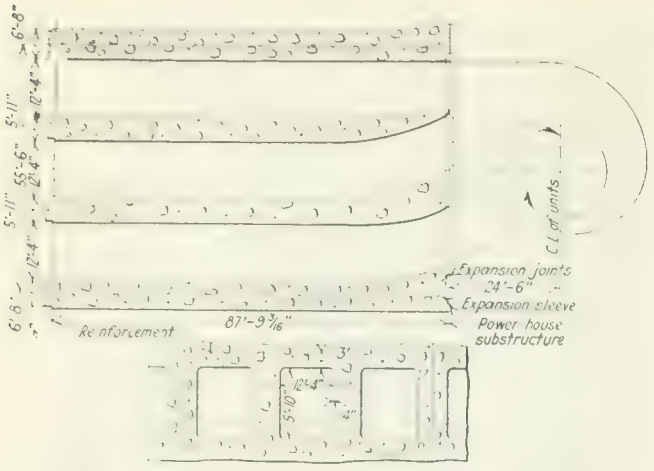
WITH 1,000,000 cu.yd. of concrete still to be poured and a schedule of operations calling for nearly 40,000 cu.yd. of this to be placed each month, the Engineer Corps of the Army seems to have a splendid argument for the appropriation of $10,000,000 which was requested in the last Congress for the work of the fiscal year beginning July 1. However, this appropriation was not granted and, therefore, this project, one of the largest ever undertaken by the federal government, will have to stand as now only 30 per cent complete until further appropriations are available. If the appropriations had been made as requested it was expected that the entire project would be so far developed as to begin generation of energy within three years. However, unless an item for this work is added to the army bill, which remains over for the new Congress, the work may be indefinitely delayed.

This project was really a war-time measure, for it was first authorized by the President when he set aside $13,000,000 from the national defence funds on Feb. 23, 1918, and authorized the construction of the dam and power house. Subsequently $4,000,000 additional was made available from these national defence funds, but it is believed that this amount will be entirely expended by June of the present year. The urgency of the request for the additional $10,000,000 to continue work during the following year is, therefore, evident.

The entire project as thus far authorized is now estimated to cost between $45,000,000 and $50,000,000. The original estimates of $17,000,000 to $20,000,000 were based upon the pre-war cost of labor and materials. As stated by General Taylor in commenting upon this situation, the original cost contemplated good labor at $1.50 per day, whereas now a minimum of $3.60 per day is paid for relatively poor labor. Corresponding increases in costs of cement and other materials which contribute largely to the total have also occurred, so that the present total estimate represents simply the original sum transformed into present cost units.

SCOPE OF THE PROJECT

The proposed dam and power house is a structure 4,200 ft. (1,280 m.) long, situated on the Tennessee River 2.7 miles (3.5 km.) above Florence, Ala. At this point there are now two channels separated by Jackson Island, and in one of the channels is the lock of the Muscle Shoals Canal. As a part of the new installation there will be locks providing for navigation past the dam, with a total lift of 90 ft. (27 m.) above level of proposed lower pool. The completion of the dam will also facilitate navigation above this point, for it is



THREE-PASSAGEWAY INTAKE TO WHEEL CHAMBER IS ONE RATHER UNUSUAL ARRANGEMENT

estimated that the storage will extend in sufficient depth for 17 miles (31 km.) above the dam to provide for navigation by typical canal barges requiring approximately 6 ft. (1.8 m.) of depth. The level above the dam will be closely controlled, only a very few feet of variation throughout the entire year being expected because of the ample provision of spillway gates along two-thirds of the length of the structure.

The principal characteristics of the dam proper will be seen from the illustration at top of page 589 of this article. The fixed dam is surmounted with movable crest gates 15 ft. (4.5 m.) high. It is estimated that these gate structures are ample to care even for the extreme flood stage, which is variously estimated at from 500,000 sec.-ft. to 700,000 sec.-ft. (14,150 cu.m. to 19,800 cu.m. per second), without excessive variation in forebay water level.

Present Status of Project

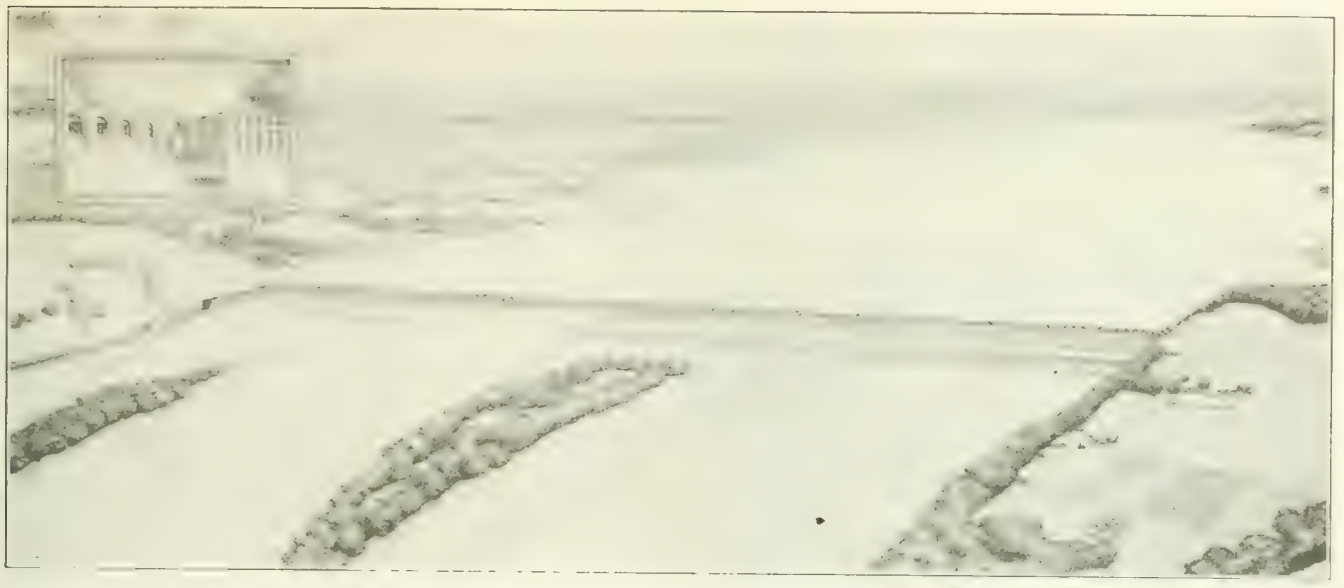
As indicated above, there still remains to be poured approximately 1,000,000 cu.yd. (764,560 cu.m.) of concrete work, and progress is being made at the rate of nearly 40,000 cu.yd. (30,580 cu.m.) per month. At this rate only twenty-five months would be required for completion. Whether this rate can be maintained will depend as much upon the availability of funds as upon the vagaries of the river or of the weather. Of the $17,000,000 thus far made available and other very limited sums which arise from miscellaneous allotment to the work, there remained only about $9,500,000 available at the end of the last fiscal year—July 1, 1920. This sum has been expended at the rate of nearly $1,000,000 per month thus far during the current year, but this large expenditure is in part the result of having placed a number of big contracts. It is estimated, therefore, that there are sufficient funds to extend into June of the present year.

The estimates made a year ago were that not more than $10,000,000 could be expended efficiently during the next fiscal year, and this sum was therefore requested of Congress. The House of Representatives considered this request in the sundry civil appropriation bill, but after debate on the floor of the House the item was dropped out. The Senate committee on appropriations also gave favorable consideration to the item, recommending it to the Senate, by which body it was adopted. However, the House of Representatives after vigorous effort on the part of those who opposed the bill still declined to agree to the item and in the closing days of the session the Senate finally agreed to abandon this appropriation for the present Congress.

As the money requested for continuance of the work next year was not granted, it may be essential to stop the present activity even before June, in order to conserve some funds for care of the project durnig the summer or until such time as additional funds are appropriated. This is deemed by all interested persons to be a most unfortunate possibility, for the organization is now built up for rapid work and more than 4,400 men have been working during recent months. To allow this going organization to be disbanded and to require that the work be held in abeyance for a year would seriously increase its cost. It has been estimated variously that the losses from suspension of the work one single year would certainly be between $4,000,000 and $10,000,000. The loss in interest upon the investments already made in the project and in the nitrate plant which is intimately associated with the entire development alone would amount to millions. One estimate made by the economists shows that the loss from a single year's suspension of activities may be



GOVERNMENT PROJECT ON TENNESSEE RIVER AT MUSCLE SHOALS, WHICH IS NOW 30 PER CENT COMPLETE—



PLANS CALL FOR AN ULTIMATE RATING OF 550,000 HP., MADE UP OF EIGHTEEN 30,000-HP. UNITS. THE DAM AND POWER HOUSE STRUCTURE IS 4,200 FT. LONG AND THE DEVELOPED HEAD WILL BE ABOUT 95 FT.

greater than the required appropriation for continuance of the work. However, even this argument did not suffice to get approval for continuance of the work.

In connection with the estimates of cost for interruption of construction work, the figures which have been furnished to the Engineer Corps by Hugh L. Cooper, the consulting engineer of the project, are particularly pertinent. Mr. Cooper states his opinion upon this matter as follows:

The second question, as to the cost of closing down the work at this time, is difficult to answer. It is not conceivable that the government would withdraw from this project entirely, in view of the more than $12,000,000 already invested and the showing in the foregoing paragraphs. In order to estimate the cost of a shutdown it would be necessary to have a basis as to the date when work would be resumed, so that the loss in interest might be computed. If the work should shut down at this time to be resumed in three years, I am of the opinion that the combined losses to the government would be around $4,000,000, and without any compensation therefor unless the government might claim there was a compensation to be expected in waiting three years for a lower interest rate than can be obtained at this time. This amount of saving would be very small as compared to the $4,000,000 loss. The $4,000,000 would represent a loss of interest during three years on $12,000,000, and on the construction side the loss of all the cofferdams which are now in place, the loss of the construction bridge, the removal and re-erection of a large amount of construction derricks, tracks, concrete mixers and rock crushers and other construction equipment. The job would also have to suffer the losses incident to the breaking up of the construction organization, which has been assembled at necessarily large expense, and I feel very certain that collectively the above losses would be a minimum of $4,000,000 and might easily amount to $4,500,000.

Power House Planned for Eighteen Units

The power house proposed is to consist of eighteen units. However, only four of these units are to be installed at once, and it is probable that only these will be needed within the first year or two of operation. It is realized that it will take several years to develop the market for the entire project, even assuming a very low selling price of 1.2 mills per kilowatt-hour for the secondary power and 4 mills per kilowatt-hour for the

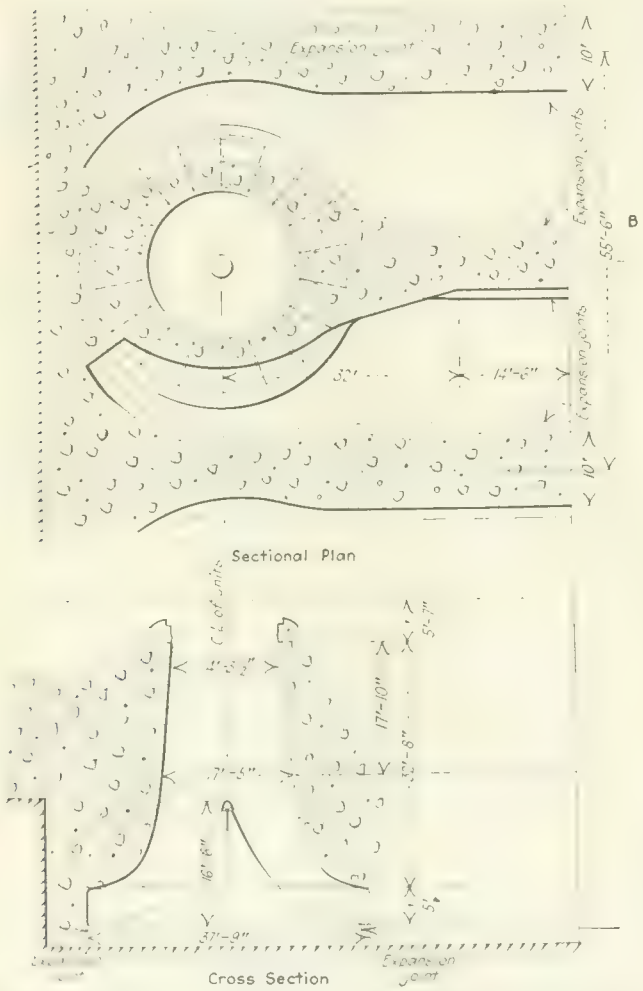


VIEW LOOKING UP STREAM. POWER HOUSE SITE ON THE RIGHT AND LOCKS AT EXTREME LEFT

primary power at the low-tension busbars of the generating station. On this basis Mr. Cooper estimates ten years as the time required to load the plant after it is completed and begins generation from the initial units. However, it is expected that the foundations for the entire power house will be built in the beginning, so that addition of units will be made at a minimum of expense and delay.

The initial installation of I. P. Morris waterwheels provides units of 30,000 hp. each. These wheels will be connected with Westinghouse generators of similar capacity. The later units will be of slightly larger size, it is hoped.

Work on the foundations has progressed so far during



ARRANGEMENT OF DRAFT TUBE AND PASSAGEWAY TO TAILWATER

the past summer that orders were placed for the four waterwheels required, and delivery of these is scheduled for Sept. 15 next. These units, it is estimated, will cost the government $129,500 each, or a total of $589,600.

According to the plans adopted the waterwheels will operate with 92 ft. (28 m.) head. The general plan for intake in relation to generator position is seen in the accompanying diagram, which also indicates the type of rectangular reinforcement which is used in inclosing the intake passages. The waterwheel foundation both in plan and section is shown in an accompanying illustration, and the draft tube and discharge passages to tailwater are also shown in plan and section. These are as planned by the I. P. Morris department of William Cramp & Sons, who are building the waterwheels for the initial installation.

In order to review the power estimates previously made, Mr. Cooper, as consulting engineer, has recently completed an exhaustive analysis of the proposed plans under the instructions of Gen. Harry Taylor, assistant chief of engineers. Mr. Cooper's report estimates 700,000,000 kw.-hr. per annum as the available primary production and 1,470,000,000 kw.-hr. per annum as secondary power production. In connection with his estimate Mr. Cooper has also estimated the coal equivalent and the conservation of fuel which can be expected. In this connection he makes the following statement:

In the territory reachable from the Wilson Dam the present coal consumption in steam-operated industries will be found in excess of 6 lb. (2.7 kg.) of coal per kilowatt-hour and is probably more than 8 lb. (3.6 kg.) per kilowatt-hour. Assuming 6 lb., the saving in coal by the complete installation of the works as now planned will amount to more than 6,500,000 tons per annum if this energy is used for standard normal domestic purposes. If the plant is used otherwise than above indicated (for fertilizer for instance), such other use will not, of course, be adopted unless the resulting benefits are found to be in excess of those incident to the conservation of 6,500,000 tons of coal per annum, and therefore you should be safe in submitting the coal-saving quantities as a basis for Congressional determination of future action.

General Taylor has summarized the power possibilities of the project in a somewhat different way in his testimony before the committees of Congress. He states that the extreme low flow of the river for ten years shows not less than 85,000 hp. (64,000 kw.) at any time recorded. But in only six of the nineteen recorded years did the low river discharge fall below the equivalent of 100,000 hp. In fact, it was below this figure only 1.3 per cent of the total time. Furthermore, it is believed that with the storage available at least 500,000 hp. additional can be generated for eight months of the year. This secondary horsepower, it was proposed by former Secretary of War Baker, should be applied to industrial operations, as the nitrate plant.

Cost of Power Production

In connection with his estimate of power capacity Mr. Cooper has also been asked to comment upon power costs. He reports on several phases of this question in a communication dated Nov. 27 as follows:

In determining the amount of power that should be developed at the Wilson Dam we have carried out your instructions to figure that ten years of time will be required to load the plant after it is completed, and that after the works are completed interest should be figured until the product of the plant is fully marketed. We have also carried out your instruction to use the unusually low selling price of 1.2 mills per kilowatt-hour for the secondary power and 4 mills per kilowatt-hour for the primary power at the low-tension busbars of the generating station, in order that Congress may always be certain that the final results will fully justify the money to be here invested.

Under your instructions we have figured that the plant when completed must earn 5 per cent for interest and 5 per cent for depreciation and operation, or 10 per cent of the cost of the power end of the enterprise. Both of these assumptions are conservative. The kilowatt-hours in paragraph 2 multiplied by the selling prices in paragraph 4 will produce a gross annual income of $4,554,000, which is 10 per cent of a cost price of $45,540,000. The best estimate that can be made at this time of the total cost of the project, including the two lift locks and all of the navigation facilities, is around $50,000,000, and thus leaves about $4,500,000 as amount applicable to the navigation account.

All of the above quantities are accurate and are not to be considered as assumptions or approximations. The values for the secondary and primary kilowatt-hours are about 50 per cent of pre-war steam costs in this territory.

New Method of Water Measurement in 37,500-Hp. Turbine Tests

Scheme Has Advantages of Accuracy, Short Time for Test and Inexpensive Apparatus—Discharge Is Measured by Pressure Developed in Penstock When Turbine Gates Are Closed—Method Has Been Applied at Niagara Falls

ON ACCOUNT of the restrictions placed by law upon the diversion of water from the Niagara River for power purposes, the measurement of the quantity of water used in the various power plants is a matter of extreme importance. One per cent of the present allowable diversion on the American side is sufficient to develop 4,000 hp. The installation of three new units at station No. 3 extension of the Niagara Falls Power Company, each capable of generating about 40,000 hp., made it necessary to determine accurately the efficiencies of the waterwheels. In carrying out these tests new inventions now known as the Gibson Method and Apparatus* for measuring the flow of water in penstocks have been applied after extensive laboratory experiments had been carried out to determine the accuracy of the method. The turbine discharge is measured by utilizing a record which is made of the changes of pressure that occur in the penstock when the turbine gates are gradually closed.

One of the most important reasons for the use of this new test method was that tests could be carried out without serious or prolonged interruption of the supply of power from the unit being tested. It requires a two-minute shutdown for each measurement, and measurements may be repeated about once every ten or fifteen minutes. A complete set of measurements at each tenth of gate opening from half to full gate may be made in less than two hours, and during that time the unit would be out of commercial service only about fifteen minutes.

ADVANTAGES OF METHOD ARE SUMMARIZED

The advantages of the new method of measurement may be summarized as follows:

1. Remarkable accuracy in the determinations of the velocity of flow, because small changes of velocity result in comparatively large changes in the pressure to be recorded.

*Patents applied for.

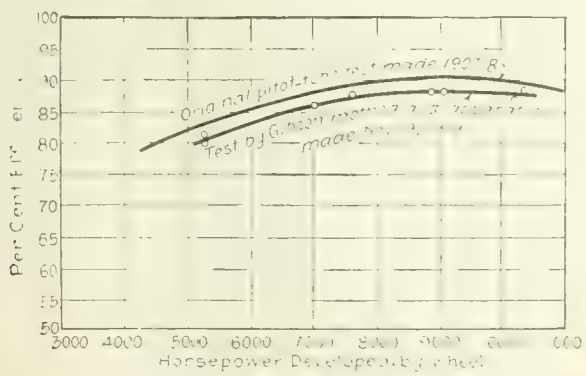


FIG. 1—EFFICIENCY CURVE OF OLDER UNIT CHECKED BY GIBSON METHOD (LOWER CURVE)

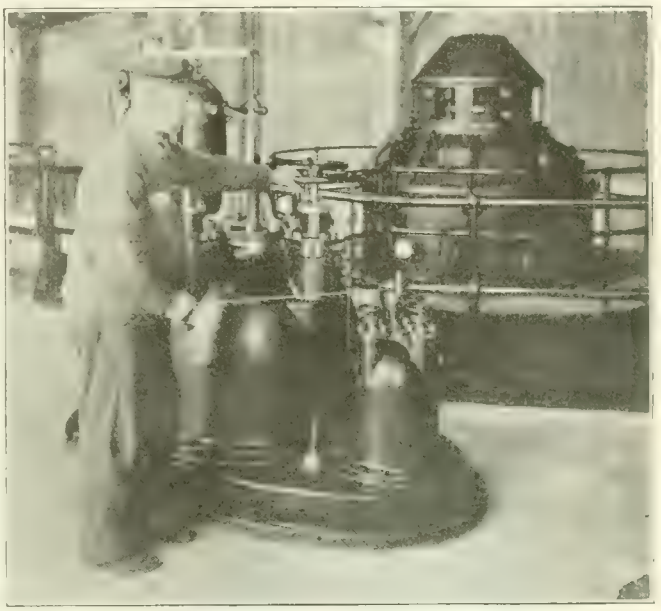


FIG. 2—STARTING THE GOVERNOR ACTION THAT CLOSES TURBINE GATES

2. Determinations of velocity may be made without serious or prolonged interruption of the commercial supply of power from the unit being tested.

3. Each determination of the velocity of flow may be made quickly in one operation. Tedious methods involving tabulation of observed results are avoided.

4. The process is essentially simple and inexpensive. Special appurtenances in the pipe line are not required.

No attempt is made in this article to describe the apparatus in detail or to give the mathematical proof of the method. This matter will be reserved for a future paper.

According to the terms of the treaty between the United States and Great Britain, each country is permitted to divert for power purposes a certain quantity of water from the Niagara River. In the United States this quantity is 20,000 sec.-ft. (560 cu.m. per second) and the company's allotment is 19,500 sec.-ft. (550 cu.m. per second). The terms of this treaty are being rigorously observed. To determine the relation between power and discharge of a unit it was necessary, therefore, to measure the quantity of water that was used and incidentally to determine the efficiency of the turbine.

When the three new 37,500-hp. turbines of the Niagara Falls Power Company were installed and ready for operation the company was then in a position to use all the water to which it was entitled and the regulating authorities fixed the efficiencies of the new units at a point which it was believed would not be greater than the actual efficiencies. Possibly the efficiency was

fixed low enough to make it worth while for the company to go to the expense of proving the exact efficiency. In any event the results were not disappointing, because after making the official tests, which received the approval of the government engineers, the allowable output from these three units when charged with the same quantity of water as formerly was increased nearly 5,000 hp.

The new method was invented and developed by Mr. Gibson as the outcome of studies of the changes of pressure in penstocks caused by the gradual closing of turbine gates. It is possible to determine the mean velocity of a column of water in a penstock by recording the changes of pressure at a point in the pipe line when the flow of water is gradually brought to rest by closing the valve or the turbine gates. The mean change of pressure recorded is a precise measure of the velocity destroyed. Practically, it is not always possible to stop the flow entirely because leakage usually occurs through the turbine gates, and in such cases the velocity determined is the difference between the initial and final velocities. The remainder, however, is readily determined.

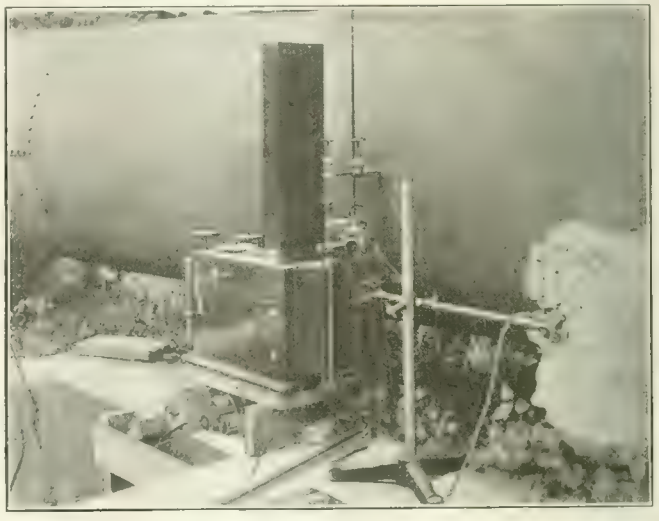
The apparatus comprises a new combination of simple elemental parts in which the pressure element is a U-tube containing mercury, the motion of which can be made to correspond in any desired ratio to the change of pressure in the penstock. The apparatus provides illumination and records photographically, to exact full scale, the motion of the top surface of the mercury in the tube, combining in the record the oscillations of a second's pendulum. The resulting diagram shows to exact scale a complete record of pressure changes and time.

The first experimental equipment comprised a headwater tank feeding a 3-in. (7.6-cm.) wrought-iron pipe 420 ft. (126 m.) long, near the lower end of which was placed a 3-in. globe valve. The flow through this pipe was made to discharge into a measuring tank, and by maintaining a constant level in the head tank and opening the globe valve varying distances, it was possible to produce a steady flow in the 3-in. pipe at various velocities up to 4 ft. (1.2 m.) per second. The results of experiments of this apparatus were remarkably satisfactory considering the nature of the equipment, and it was found that the variation of measurements by the new method from the volumetric measurements was seldom greater than one-half of 1 per cent.

Cornell University Tests Check Gibson Method

In order to obtain positive proof of the accuracy of the new method of measurement, however, arrangements were made to have a thorough test made at Cornell University by comparison with volumetric measurements at the laboratory at that university, where the equipment is adequate for such work. The results of these tests show that the average of all measurements made by the Gibson method agrees within less than 0.2 per cent with the average of all the volumetric measurements. The maximum variation of any one series is 0.8 per cent. A careful analysis of these results indicates that part of even the slight variations between the volumetric measurements and the measurements by the new method may be explained by a very slight unsteadiness of the flow, which is sufficient to account for some of the difference between the two measurements. It might be mentioned that the tests also proved that measurements can be made just as accurately when the conduit is made up of sections of various diameters, and that differential measurements can be made by using two sets of apparatus and the length of conduit lying between them.





FIGS. 3 AND 4—PROVISION FOR SHUTTING OFF WATER IN PENSTOCK AND GIBSON APPARATUS SET UP FOR TEST AT CORNELL UNIVERSITY

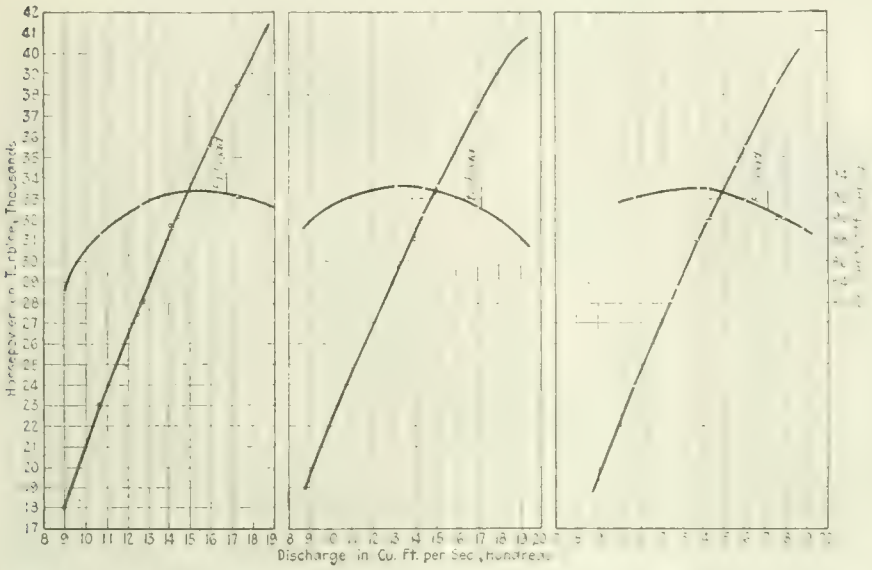
Fig. 1 shows the first efficiency curve of one of the Niagara Falls units obtained by this new method, and just above it the efficiency curve made by the Pitot tube methods some years previously on a similar unit. The two curves have the same characteristics, the new one being just a little lower than the old one, which was considered reasonable in view of the age of the unit.

Having thus established by careful experiments the accuracy of the new method, the official efficiency tests of the three new units in station No. 3 were undertaken. It should be noted that the lower end of the penstock tunnel is lined with steel plate and just before it connects with the Johnson valve the lining forms a steel pipe passing through a testing chamber which has been made at the rear of the power house. Originally this testing chamber was designed for the use of Pitot tubes, but it serves very well as a place in which the apparatus for recording the changes of pressure in the penstock may be set up.

The general procedure for the test by the new method was as follows:

1. The physical dimensions of the interior of the penstock were measured from field data and available drawings.

2. Prior to all the tests that were made on any one unit, a leakage test was made to determine the quantity of water that leaked out through the turbine gates when closed. This is necessary in the new method because only the flow actually shut off is measured, and whatever remains must be added to the total discharge.



FIGS. 5, 6 AND 7—POWER-DISCHARGE CURVES AND EFFICIENCY-DISCHARGE CURVES FOR THE THREE 37,500-HP. TURBINES NOS. 16, 17 AND 18

3. Having completed this preliminary work, the apparatus was attached to a ¼-in. (6.4-mm.) piezometer opening tapped into the wall of the penstock.

4. Headwater and tailwater float gages were placed in the forebay and tailrace for observing the elevation of headwater and tailwater during a test.

5. A system of electric signal bells was established, the control buttons being placed in the testing chamber near the operator of the apparatus. When ready the observer in the testing chamber could signal to the observers at forebay and tailrace and to the governor operator.

6. For observing the net head on the turbine a U-tube mercury manometer was set up with a connection to the penstock just at the entrance to the turbine casing. Two observers recorded the elevations of the surfaces of the liquid in the two legs of the U-tube. This gage was calibrated by reference to the total static head when the water was at rest.

7. The unit being tested was synchronized with other units in the plant and allowed to run on steady load with gates fixed for several minutes, and then it was shut down at a given signal by operating the hand-control pilot valve on the governor. A cord was wound around the stem of the valve and on a given signal the operator pulled the cord which spun the pilot valve wide open. The pressure fluid then flowed to the regulating cylinders which operate the gates, and they were closed just as fast as the fluid could flow through the connecting pipes into the regulating cylinders. The connecting pipes can be throttled to reduce the speed of closing if necessary. On other units the pilot valve is opened by means of a handwheel, but the effect is the same. The duration of closure was usually from about eight to eighteen seconds, depending upon the amount of gate opening.

Immediately preceding and during the closure of the gates and for a short time after the apparatus recorded the changes of pressure in the penstock, forming a diagram similar to that shown in Fig. 8. As the gates of the turbine closed the load on the generator was transferred automatically to the other units operating in synchronism with it, sufficient capacity having been left available for that purpose, and the unit under test being then driven as a motor at synchronous speed.

8. For two minutes prior to the shutdown the power output of the generator was determined by periodic readings of a calibrated indicating wattmeter attached to the generator leads through calibrated currents and potential transformers. The power output of the turbine was obtained by using the efficiency of the generator, which was determined by the company's electrical engineers.

9. Periodic readings of headwater and tailwater gages were also made for the two-minute period prior to the shutdown and for a short time thereafter.

After velocities had been calculated from the diagrams and discharges and effective heads computed the usual power-discharge and efficiency curves were prepared.

From the curves that were obtained for the three new units (Figs. 5, 6 and 7) there will be noted remarkable uniformity in the determination of the points along the power discharge curves, from which

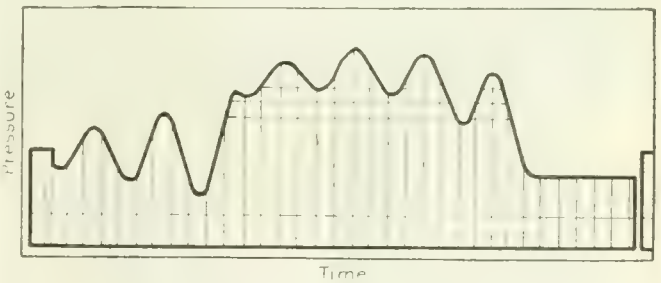


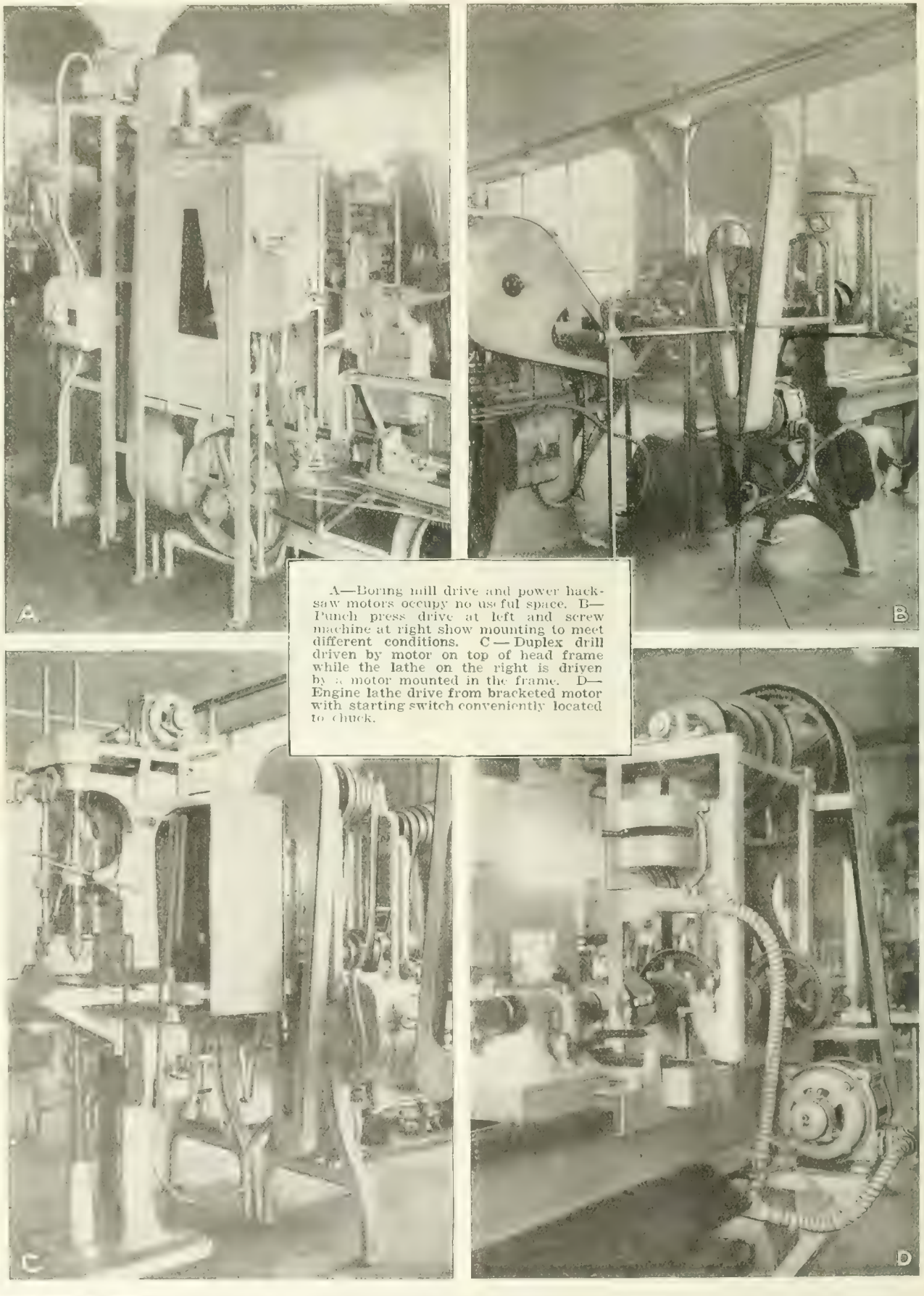
FIG. 8—SAMPLE OF PRESSURE CURVE OBTAINED FROM PENSTOCK DURING CLOSING OF GATE

it may be concluded that the errors of observation, or so-called variable errors, are extremely small. The absence of any inherent or consistent error was demonstrated by the tests that were made at Cornell University.

The theoretical reasoning to show how discharge data are derived from the pressure-time curves (such as Fig. 8) will be discussed by Mr. Gibson in the near future.

The foregoing was discussed more extensively by Norman R. Gibson, hydraulic engineer Niagara Falls Power Company, at a joint meeting of the Engineers' Club of Philadelphia and the Philadelphia sections of the American Society of Civil Engineers, American Institute of Electrical Engineers and American Society of Mechanical Engineers.

Fig. 1—Individual Drives Which Show Possibilities in Motor Location



A—Boring mill drive and power hack-saw motors occupy no useful space. B—Punch press drive at left and screw machine at right show mounting to meet different conditions. C—Duplex drill driven by motor on top of head frame while the lathe on the right is driven by a motor mounted in the frame. D—Engine lathe drive from bracketed motor with starting switch conveniently located to chuck.

Mounting Motors to Afford Convenience

A Study of Individual Drives Shows Methods of Mounting Motors to Increase Free Space in Shop—Starting-Switch Location Important—Installations Which Show Various Arrangements

By J. S. THOMAS
Superintendent Repair Shops Western Electric Company, Inc., Boston

IT IS well known that individual motor drives offer production departments a high range of flexibility in machine location; that these installations increase the free space in shops, help to secure the best lighting conditions and facilitate maximum output per tool. The variety of motor mountings useful in such work, however, is not always realized. The differing shapes of tools to be driven offer the electrical engineer a fascinating choice of methods of motor attachment, and even within a single shop one may find enough diversity of applications to justify considerable study. The accompanying illustrations show locally adapted individual motor drives at the repair shop of the Western Electric Company, Inc., 385 Summer Street, Boston, viewing these installations from the standpoint of convenient mounting.

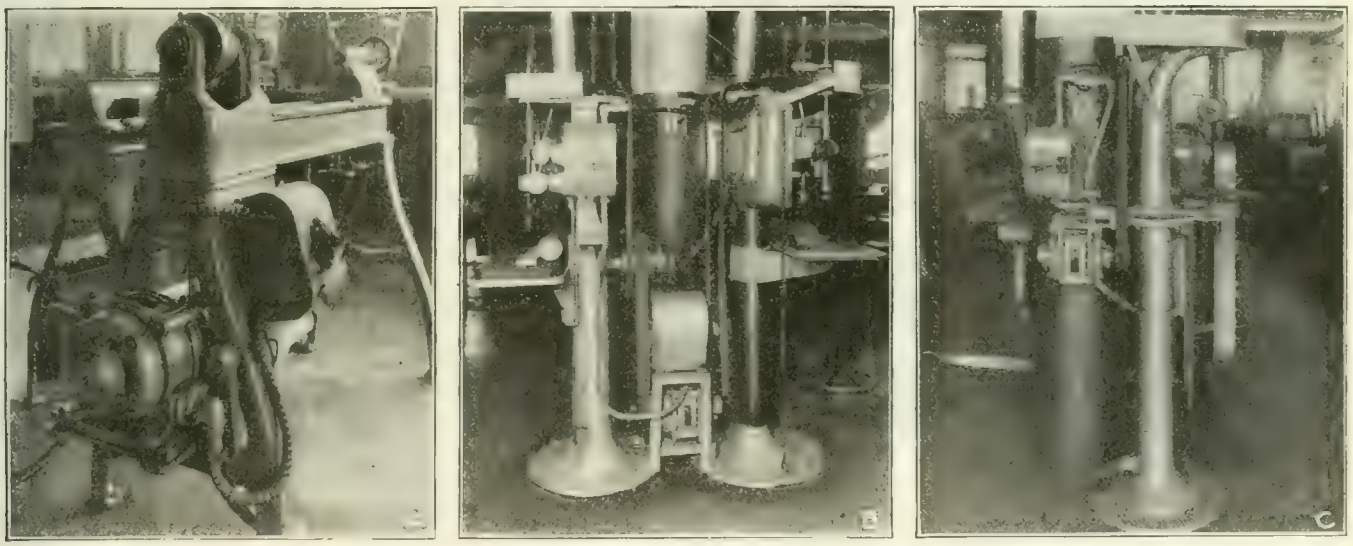


FIG. 2—CONVENIENTLY PLACED SWITCHES AID EFFICIENT OPERATION OF MACHINES

A—Accessibility of the starting switch is evident in this lathe drive. Belt adjustments are taken care of by mounting the motor on the hinged bracket. B—One motor is mounted above another in the case of these two drill presses. Switches are conveniently located. C—Underhung mounting of motor for a drill press, which offers a convenient arrangement for this type of machine.

Fig. 1-A illustrates two adjacent drives of compact arrangement. In this case a 1-hp. motor drives a boring mill from an angle-iron frame carried above the machine, the angles being 1½ in. x 1½ in. x ⅜ in. (38 mm. x 38 mm. x 5 mm.) in section. The location of the motor behind and above the operating head of this machine economizes space and facilitates inspection and maintenance. The individual belt drive from the motor is guarded by a continuous housing of No. 20 galvanized sheet iron, notwithstanding its location between the boring mill and the hacksaw. The angle frame provides a convenient support for the motor-starting switch, and a short, direct run of armored flexible conductor feeds the motor through the switch. A 1-hp. motor also drives the hacksaw. In this case the motor is mounted on two short horizontal straps attached to an angle-iron frame which houses the major portion of the belting and pulley equipment required to obtain the speed reduction necessary for saw operation. The motor is completely within the frame and thus occupies space of no other value from the production standpoint. A short feed by rigid conduit was used in this case in view of the narrow clearance between the driving mechanism and the riser. The starting switch is within easy reach of the operator, and a doorway in the housing affords instant access to the motor. These two machines, like many others in the shop, are placed back to back in order to conserve aisle space. Three-phase 220-volt motors are generally used in machine driving in this shop, which is occupied chiefly with the repair of telephone exchange and substation apparatus, electrical appliance maintenance and miscellaneous work. All conduit is grounded to the machine frames.

A punch press driven by a 1-hp. motor and a screw machine partially driven by a 1-hp. motor are shown in Fig. 1-B. To secure the proper height in mounting the motor for the punch press the simple expedient of placing it on two 3-in. x 1½-in. x ¼-in. (76 mm. x 38 mm. x 6.4 mm.) channel-irons was adopted, these being bolted to a bracket formed of 1½ in. x 1½ in. x ¼ in. (38-mm. x 38-mm. x 6.4-mm.) angles set on the pedestal face away from the working front of the machine. The starting switch is also mounted on another side of the pedestal, close to the operator's position. The projected area below this motor is of little value from the production standpoint. Another compact bracket

mounting is shown at the end of the screw-machine frame, where the motor is placed on a 1¾-in. x ⅛-in. (45-mm. x 6.4-mm.) strap iron carried by two 2-in. x ¼-in. (51-mm. x 6.4-mm.) straps at right angles, the latter being attached to a bracket made up of 1½-in. x 1½-in. x 3/16-in. (38-mm. x 38-mm. x 4.7-mm.) angles. Short runs of flexible conduit from the floor outlet to a starting box on the front pedestal of the machine and thence to the motor are convenient and economical of material.

A duplex drill and a lathe motor drive are shown in Fig. 1-C. Here the framing necessary to support the drill shaft bearings and connected belting and countershafting provides ample space for mounting a 1-hp. motor at the top of the machine, away from operator and passers-by and still within easy inspection reach. The motor is bolted to ½-in. x 1½-in. (13-mm. x 38-mm.) iron straps attached in the same way to U-shaped straps of the foregoing size that are bolted into the drill head framing. As in other individually driven cases in this main belt drive. The motor is mounted on 1¾-in. x ⅛-in. (44-mm. x 6.4-mm.) iron straps bolted to 1½-in. x 1½-in. x ¼-in. (38-mm. x 38-mm. x 6.4-mm.) angle brackets. In this case by mounting the starting switch on the side of the framing supporting the main driving pulleys toward the operator a firm and immovable support was obtained, leaving the apron of the lathe free to travel back and forth at the front of the machine. This location of the starting switch insures close relationship between the progress of cutting operations at the tool rest and the immediate control of the motor starting and stopping. The motor does not project into a main aisle.

The speed lathe shown in Fig. 2-A is driven by a ½-hp. motor mounted on a bracket that can be swung a short distance about a horizontal axis in order to facilitate changing the belt to obtain speed variations. Here the machine driven is relatively small and the low mounting of the motor stabilized the construction. Only a few speed changes are necessary. The motor is

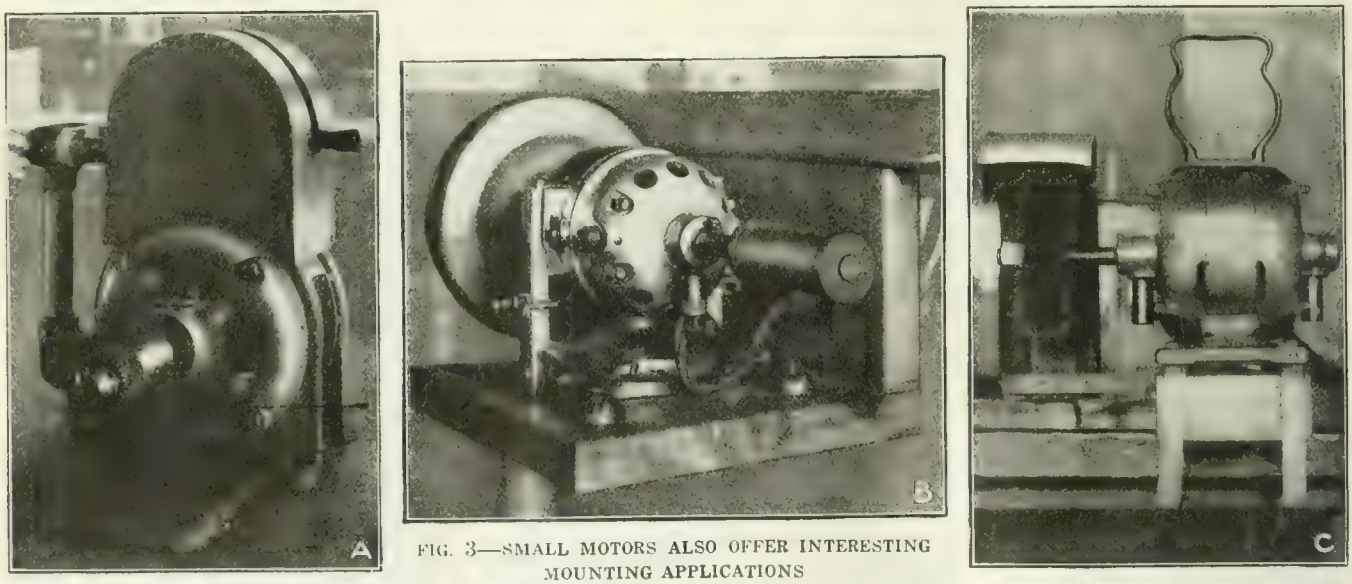


FIG. 3—SMALL MOTORS ALSO OFFER INTERESTING MOUNTING APPLICATIONS

A—Reversing switch mounted on top of motor frame saves wiring and speeds up operation of outfit for screw and nut removal. B—Convenient mounting pays even with a small motor for coil winding. C—A motor-driven polisher fitted with "U" brackets for easy mounting on bench. The arrangement permits the easy removal of the polisher to any bench location.

shop, an effort was made here to place the starting switch close enough to the working plane to render it unnecessary for the operator to step aside in order to start or stop the motor, and the drill pedestal offered the most desirable location. The lathe, at the right, illustrates maximum compactness in motor driving. The ½-hp. motor used is installed within the frame and so close to the end pedestal that it utilizes the open space in this framing for shaft and pulley connection, leaving ample space on the horizontal shelf at the right for the storage of extra lathe parts. The long belt connection employed here between the motor pulley and the pulleys at the top of the machine affords a flexible drive, easily protected by the guard shown and convenient for speed modifications. The motor is carried on 1½-in. x 1½-in. x 3/16-in. (38-mm. x 38-mm. x 4.7-mm.) angles.

Fig. 1-D shows the driving of an engine lathe by a 1-hp. motor mounted on a bracket projecting from the lower portion of the frame. In this case fairly heavy pulleys were required, and these are mounted on a vertical frame carried up from the working center line as shown. The back gears are well cleared by the bolted to 1½-in. x ¾-in. (38-mm. x 19-mm.) straps, which in turn are bolted to the casting forming the movable bedplate. A pedal is provided to raise the motor and pulley so that the belt can be loosened readily in making a speed change. The light frame of the lathe affords a convenient base for the starting switch.

Economy of material is illustrated in the "two-story" motor mounting shown in Fig. 2-B. Here two adjacent drill presses are backed up as close as possible to a column of the building; the bases are utilized to support the feet of an angle-iron framing for each of two 1-hp. motors set one above the other and connected by short belt drives to the drill-press pulleys. The angles are of 1½-in. x 1½-in. x 3/16-in. (38-mm. x 38-mm. x 4.7-mm.) section, and one motor is carried within the framing that supports the other. From conduit within the column a feed line is run to the starting switch of each drill press, with armored conduit connection to each motor as indicated. Maximum compactness is here associated with unusual convenience of motor access and facility of switch handling. The upper motor is carried on 1½-in. x ¼-in. (38-mm. x 6.4-mm.) straps.

A drill press capable of handling work about 12 in. (30 cm.) in diameter is shown in Fig. 2-C. This machine was originally designed for belt driving off a pulley carried at the left of the main column. It was conveniently equipped with a ½-hp. motor drive by bolting two ⅜-in. x ⅞-in. (9.5-mm. x 22-mm.) iron straps to a bearing housing extension as shown, the motor feet being bolted to the straps for an underhung suspension that provides a flexible belt run to the quarter-turn pulley shown at the top and thence to the main-shaft pulley within and at the right end of the housing.

Location of the drill press close to the column enabled the feed to the starting switch and motor to be short and economical, the starting switch for the drill being clamped to the vertical standard as indicated just below the working plane.

Saving in space by mounting a starting and reversing switch on top of a motor frame is shown in Fig. 3-A. Here a ½-hp. motor running 1,800 r.p.m. on 220-volt, three-phase supply is mounted on an iron base as shown, the motor being equipped with an adjustable-jaw extension piece on its shaft for the rapid removal of nuts. Another fitting resembling a screwdriver enables screws to be quickly removed from work. The switch on top of the motor is connected to reverse one phase when thrown to the right or left, and is provided with a 6-in. x 7-in. x 4½-in. (15-cm. x 17.5-cm. x 11-cm.) metal guard as shown. A short run of rigid conduit carries the necessary conductors for the motor supply.

The mounting of a motor of the sewing-machine type used to wind coils of wire at a bench is shown in Fig. 3-B. A simple right-angled bracket of wood ¾ in. (2 cm.) thick by about 7 in. (17.5 cm.) square forms the base, and an upright slab of the same thickness is attached to the bench by ordinary cast-iron brackets. The motor frame and brackets are grounded, and the motor is operated at 110 volts, single-phase. It is screwed into the slab and is controlled by a floor pedal.

A portable motor mounting that gives excellent service is shown in Fig. 3-C. The motor drives a polishing wheel and is provided with two ¾-in. x ⅝-in. (19-mm. x 8-mm.) U-strap brackets which can be fastened at the edge of a bench by setscrews for quick attachment at different locations. A 2-in. x 5-in. (5-cm. x 12.5-cm.) wooden base is provided for the motor, and this is surfaced by a sheet-tin grounding plate as indicated, a guard to prevent the throwing of metal grindings from the polisher being held in place behind the wheel by iron straps. A handle at the top of the motor enables the entire device to be carried without difficulty.

WE HAVE *had to sail on an uncharted sea, impressed with the duty of ultimately making that sea so well known and safe that the public, the public service corporations and the commission might voyage together, each without fear or distrust of the other, each certain that no carrying craft was financially rotten, each confident that no submarine of special privilege, secret rebate or unlawful practice could or would attempt suddenly to destroy the property of the honest mariner, each convinced that all the others are in a sense partners who are entitled to full information, fair treatment and a just share in whatever prosperity is being passed around.*—B. F. CLEAVES, chairman Maine Public Utilities Commission.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Maintenance of Live Conductors

To the Editor of the ELECTRICAL WORLD:

SIR: The maintenance of live conductors and the use of devices for this purpose have received much attention and study of late. If proper care were given to the method of using these devices by linemen, the expense of making high-tension repairs might be reduced. However, such a method of making repairs to high-tension lines must, in my opinion, be more or less dangerous even at the best, and where the system is used on lines carrying several circuits it appears that there are many chances for accidents.

The great trouble with the maintenance of live conductors is that the men who carry on such work are inclined to become careless after some experience, and just when they become careless is when an accident is likely to occur. The same observation might apply to the use of dynamite. It is a fact that miners and other craftsmen who handle dynamite become hardened to the danger and are therefore more or less careless. They come to the conclusion that there is no danger and do not take the necessary precautions. The result is an accident. More study should be given to the subject of maintaining conductors while alive, to the end that the greatest economy in operation may be achieved.

L. J. MOORE, Electrical Engineer.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: It is with much interest that I have read the editorial on "Danger of Valuations at Present-Day Figures" in your issue of Aug. 21, 1920, also the comments by Harold Almert in the issue of Dec. 4, 1920, and by C. Wellington Koiner in the issue of Jan. 29, 1921.

The proper basis of pricing for valuing utility property for rate-making purposes has been one of the most perplexing problems that have arisen from the war conditions. Yet the solution lies in finding a logical basis that can be followed consistently through varying changes of market prices which will at all times insure fair treatment to both the utility and the public.

If a utility manager has long vision, he will not desire to see a sudden great inflation in the physical valuation of the property under his control any more than he would wish to see a sudden deflation in this value. If one comes, so must the other be expected in due course of time. The manager who insists on a valuation based on the abnormal high prices that have prevailed recently is not looking far into the future. He may have been spending a great deal of money for plant and equipment at abnormal prices for which he should receive con-

sideration at a later period when costs have reached a lower level. It will not serve him at a later period to make claims that he is entitled to consideration for high costs because expansion of business forced him to make expenditures whether he would or not. When he asks for present-day prices for property installed at lower costs he is adopting a principle and must abide by it when future conditions reverse the order of things.

Public utilities are entitled to remuneration in some form for all expenditures wisely made for the public service, and when lower prices shall have become prevalent the management should be able to face the public or commission, as the case may be, with a record that entitles it consistently to ask for fair consideration of the high costs of property necessarily installed during the period when prices were abnormally high.

No doubt the cost of reproducing the property at a figure which reflects present prices is valuable information to have and should be given consideration by the public or by a rate-regulating body, but for the utility management to insist upon present-day prices as repre senting the true value of the property is a mistake which is likely later to have serious consequences.

It is true that it is not always possible to obtain from a company's books the actual cost of the property, but it is not necessary that this should be done. With data relating to costs during past years, which are a part of the stock of many engineers and of regulating bodies, it is possible to approximate very closely the actual cost, or an estimate of the cost of reproducing the property at costs prevalent prior to 1916 can readily be made.

One method of arriving at a fair estimate of the value of the physical property is known as the "split inventory" method. In using this method all property installed since the abnormal rise in prices began is inventoried separately and actual costs applied. The actual costs of property constructed during the last few years can usually be obtained from records, or if not can be readily estimated. All property which was in service before the abnormal prices prevailed is then listed and valued either at estimated cost or on the basis of prices prevailing for a period of years ending with the beginning of abnormal prices.

During the present stringency the concern of the utility operator is not so much with a return upon the value of the property as with operating costs. The latter are handled direct by regulating bodies and are in general of much more importance to the manager than the former. Considered from the point of view of its influence upon rates, one dollar of operating expense is eight or nine times as important as one dollar of property value, though the latter must not be neglected.

Just at this time the cost of money is high and utilities have more or less trouble financing new construction or refinancing old issues. It does not appear, however, that the proper method of obtaining relief is by means of placing high estimates of value on property which actually cost a normal amount. If prices continue high for many years so that a new permanent level is actually reached, then consideration should probably be given to that fact, but we have not yet arrived at that stage. Prices may become very low—in fact, some commodities used by utilities can now be purchased at prices practically equivalent to those prevalent before the war—and it is important to be in such a position that absolutely fair dealing can consistently be demanded should conditions reverse.

It would seem that the proper relief for high cost of money is to allow a rate of return high enough to correspond to the increase. This is the logical solution and recognizes an actual condition which is readily demonstrated. To ask for a value of $200 on property that cost $100 simply because it costs more to operate it or because interest rates are high is not logical. It is true that when this property has become worn out it may require more money to replace it, but when that additional investment is made, then allowance of a fair return on the added capital can be made and the utility need not suffer.

C. M. Larsen,
Engineer Railroad Commission of Wisconsin.
Madison, Wis.

Development in Cable Research

To the Editor of the Electrical World:

Sir: I agree most heartily with the editorial in the issue of Feb. 26 discussing the remarkable development in cable research both in this country and abroad. It seems to me that reference to some of the high lights of this development deserve a place in your columns.

R. W. Atkinson *(Journal A. I. E. E.*, September, 1920) gives valuable data on the heat path, especially that within the cable, and gives tables showing how the current-carrying capacity of all types of paper and cambric cable may be computed if the sheath temperature is given. This is the most definite statement on the thermal properties of cable insulation that I have seen. Messrs. Davis and Simons *(Journal A. I. E. E.*, January, 1921) discuss maximum electric stresses and their location in various types of cable. They emphasize the low value of the maximum stress now considered permissible in its relation to the dielectric strength of the insulation and urge an increase in the maximum permissible stress to 25 kv. per centimeter, presenting data. Of especial interest are computations of the maximum voltages of cables of standard diameters and the prediction that shortly, with greater uniformity of insulation and consequent increased permissible stresses, operating voltages up to 50,000 will be reached. Information on temperatures reached for different soil conditions and manners of laying is given in a report by the British Electrical and Allied Industries Research Association, briefly outlined in the *Electrician* (London) for Dec. 24, 1920. The relatively low temperature rise of cables buried directly in the soil or embedded in bitumen are very striking. The influence of depth below surface shows 7½ per cent less current possible at 4 ft. (1.2 m.) than at 1 ft. (0.3 m.) depth.

The influence of load factor on cable temperature is strikingly shown by the observations of Philip Torchio in the February number of the *Journal A. I. E. E.* He points out the inconsistency of the standardization rules for low-voltage cables. He demands higher permissible temperatures for low-voltage cables and as regulated by load factor, principally because they have the same class of insulation as machines, are never continuously loaded as are machines, and consequently should be allowed at least equal temperatures. He reports runs of cables at high temperatures; for example, over 150 deg. for 169 hours without damage. On the other hand, in the same number of the *Journal A. I. E. E.*, W. A. Del Mar opposes the increase on the ground of resulting weakening of the mechanical properties of the paper.

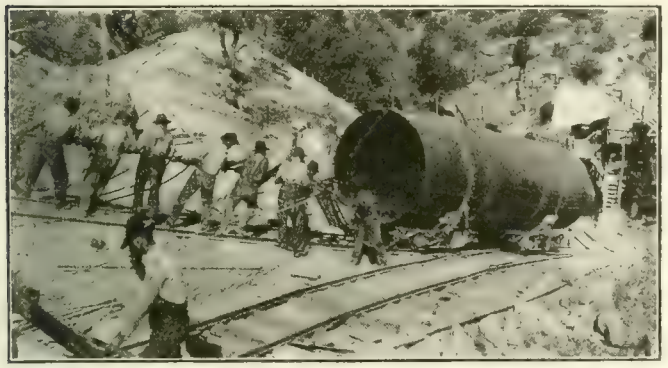
J. B. Whitehead,
Professor of Electrical Engineering.
Johns Hopkins University,
Baltimore, Md.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Lowering a Section of Penstock Into Place

A PLAN adopted for handling the heavy sections of penstock line for the new Kerckhoff power house of the San Joaquin Light & Power Corporation (see ELECTRICAL WORLD for Feb. 26, page 471) is shown in the accompanying photograph. This section of penstock



EIGHT-TON SECTION OF PENSTOCK LOWERED 1,500 FT. IN THIRTY MINUTES ON NARROW-GAGE INCLINE

was mounted directly on two double trucks such as are used on the cars of the narrow-gage inclined railway. The section was laid on curved blocks securely fastened to the trucks by means of chains. The section was then lowered with the cable from a 150-hp. electric hoist. By this method a section 8 ft. in diameter and 22 ft. long, weighing 8 tons, was lowered a distance of 1,500 ft. along the inclined railway, paralleling the penstock line, in thirty minutes. R. C. Starr is the construction engineer of the company.

FIELD EDITOR ELECTRICAL WORLD.

San Francisco, Cal.

Reducing Losses in a Boiler Room

ECONOMY obtainable in a boiler room is limited by the losses which are reducible and those which are non-reducible. The reducible losses are the larger class. They may be reduced by (1) better operation and (2) better equipment. Assuming that the equipment cannot be changed, there are a number of chances for improving economy by improving operation. Table I shows that fuel amounts to from 50 to 75 per cent of the production cost in a number of typical plants. Table II shows the reducible losses which occur in the combustion of this fuel. This table shows that good furnace design will be of little avail if cracks are allowed to remain open in boiler settings, baffles to remain warped and burned out, and tubes to be covered with soot.

After everything possible has been done in improving the combustion of the fuel and delivering its heat to the boiler tube, the next care is the inside of the tube. In its raw state hardly any water is good enough for boiler feed without purification. The proper treatment to be applied must be determined for each individual plant, as a chemical preparation which is effective in one place will probably not be effective in another, and even when used at the same place over an extended period will fail to give uniform results. The only sure way is to have frequent analyses made and apply the remedies which those analyses show to be necessary. However, boiler compounds cannot be depended on for universal relief. Another method of keeping scale out, in a condensing plant, is by evaporation of the make-up. The cost of this method may be obtained from the following figures showing the arrangement of evaporation equipment and the pounds of distillate produced per pound of steam: Quadruple effect, 2.81; triple effect, 2.28; double effect, 1.65; single effect, 0.9.

Losses in heat transmission will increase with the thickness of scale, and for thicknesses up to $\frac{1}{8}$ in. such losses may reach 12 per cent. It has been found that a thin film of grease is more harmful than thick scale, because it prevents contact between the water and the boiler surfaces. Every effort, therefore, should be made to extract oil and grease from exhaust steam used for heating feed water. The installation of an oil separator with open feed-water heater will give relief, but this piece of apparatus must be inspected in order to get the best results.

As the chief item entering into cost of production is fuel, the men in the power plant should be urged to

TABLE I—ELEMENTS OF PRODUCTION COST IN POWER PLANTS*

	Per Cent of Total						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fuel	51.2	61.8	67.9	68.7	70.4	75.0	69.0
Labor	29.5	18.8	11.0	19.4	17.9	17.4	18.0
Maintenance	15.8	14.3	17.3	6.7	8.1	3.5	9.0
Miscellaneous	3.5	5.1	3.8	5.2	3.6	4.1	4.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Plants Nos. 1, 3 and 5 are oil-burning and have 705,570 kw.-hr., 1,604,430 kw.-hr. and 1,710,410 kw.-hr. yearly output respectively. Nos. 2, 4 and 6 are coal-burning and have 681,230 kw.-hr., 2,208,220 kw.-hr. and 4,347,400 kw.-hr. yearly output respectively. Plant No. 7 is an average of large power-plant operation with approximate average yearly output of 79,000,000 kw.-hr. All figures are for twelve months ended November, 1920

TABLE II—HEAT LOSSES IN AN AVERAGE BOILER ROOM*
(In percentage of heat in coal)

		Per Cent Loss †
1.	Handling coal at plant	1.0
2.	In ash	2.5
3.	By radiation	2.5
4.	By incomplete combustion	0.7
5.	On account of air leakage in furnace and boiler	2.5
6.	On account of excess air through grates	4.0
7	Due to short-circuiting of gases in gas passages of boiler	0.8
8	Due to soot on heating surface	2.0
9.	Due to scale in boiler	5.0
10.	Due to incorrect draft for load	2.5
11.	Due to leakage of water and steam	0.5
	Total reducible loss	25.0

*About 15 per cent of the heat in the coal delivered to the power plant is lost non-preventably in the boiler; approximately 80 per cent of this is lost up the chimney in maintaining draft.

†These figures were arrived at by use of data contained in "Fuel and Combustion Engineering," by Joseph W. Hays, and from other sources

study the economical combustion of fuels. The day when any man who could wield a shovel was good enough to be a fireman has gone by. It is the duty of central-station executives to select men for the boiler room with as much care as for the engine room.

Since fuel is the largest item, care should be taken to see that the money expended for it purchases heat and not weight. The heat per pound in coal from various mines may differ greatly.

The necessity for covering with heat-insulated material all live-steam piping and exhaust-steam piping used for heating feed water is well appreciated. However, even with the most efficient covering there must be some condensation. The ill effect of wet steam on the economy of both the reciprocating engine and the turbine and the erosive action of wet steam on turbine blades are also well known. To overcome these difficulties the writer believes that a moderate amount of superheat—say at least 75 deg.—should be added to the steam so that the prime movers may be assured of dry steam.

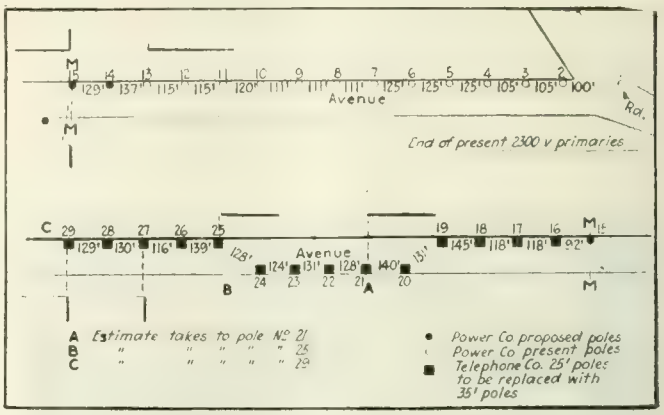
C. A. GREENIDGE,
Chief Engineer.

J. G. White Management Corporation,
New York City.

Cost of 2,300-Volt Single-Phase Extensions

AN ESTIMATE of the comparative costs of extending a residential primary 2,300-volt, single-phase line to serve seven, five and four proposed customers was recently prepared by an electric service company in the Northeast in connection with a discussion of the financing of such extensions. These data are based on construction and material costs prevailing about Jan. 1, 1921.

Estimate A involves serving seven customers, the last being 3,408 ft. from the end of the present primaries; estimate B provides for serving five customers at 2,894 ft. maximum distance, and estimate C covers four customers, with a maximum run of 2,373 ft. The extensions require the setting of two additional poles by the company, the addition of a primary circuit and the replacement of existing 25-ft. telephone poles by 35-ft. poles for joint occupancy, with rebuilding of the telephone line. The accompanying diagram shows the position and spacing of the poles and indicates where new poles must be set and old ones replaced.



LAYOUT OF 2,300-VOLT LINE, OF WHICH COSTS ARE GIVEN IN TABLE

The estimated cost of making an extension to serve seven customers totaled $1,186.34; to serve five, $938.41, and to serve four, $725.28, including overhead material, services, transformers and meters. On account of their engineering interest the detailed estimates are printed herewith. FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

COST OF EXTENSIONS ON 2,300-VOLT SINGLE-PHASE OVERHEAD SYSTEM
(Based on Jan. 1, 1921, prices)

Item	Unit Cost	Estimate A—3,408-Ft. Extension to Serve Seven Consumers: No. of Units	Cost	Totals	Estimate B—2,894-Ft. Extension to Serve Five Consumers: No. of Units	Cost	Totals	Estimate C—2,373-Ft. Extension to Serve Four Consumers: No. of Units	Cost	Totals
Poles and fixtures										
No. 6 weatherproof triple-braid wire (lb.)	$0 3124	900	$281 16		750	$234 30		625	$195 25	
4-pin crossarms	1 20	15	18 00		15	15 60		9	10 80	
2-pin crossarm	90	9	8 10		5	4 50		4	3 60	
½-in. x 9-in. crossarm pins	0404	78	3 15		62	2 50		44	1 78	
Pairs cross-arm braces	29864	24	7 17		18	5 38		13	3 88	
2½-in. x 2½-in. square galvanized washers	0268	48	1 29		36	90		26	70	
½-in. round washers	0538	48	18		36	14		26	10	
⅝-in. x ¾-in. machine bolt	02552							13	1 63	
4-in. x ½-in. lag bolts	0409				18	74		13	53	
14-in. x ¾-in. machine bolts	13302	24	3 19		18	2 39				
4½-in. x ¾-in. carriage bolts	0321	48	1 54		36	1 16		26	83	
Westinghouse insulators, S195146	2043	74	15 12		56	11 44		50	10 22	
35-ft. class A poles	20 00	2	40 00		2	40 00		2	40 00	
Labor, hours	75	175	131 25		150	112 50		140	105 00	
			$510 15			$431 61			$374 32	
Contingencies, supervision, etc., 10 per cent			51 01			43 16			37 43	
Attachments to N. E. T. & T. Co. poles			322 00			230 00			138 00	
Transportation (days)	6 00	4	24 00	$907 16	3	18 00	$722 77	3	18 00	$567 75
Services										
No. 2881G three-point spreader brackets	1 479	7	10 35		5	7 49		4	5 92	
No. 33 porcelain insulators	045	28	1 26							
Westinghouse insulators, S195146	2043				20	4 09		16	3 27	
No. 6 weatherproof triple-braid wire (lb.)	3124	125	39 05		60	18 74		50	15 62	
House hooks, No. 22 Beardsley brackets	2569	14	3 60		10	2 57		8	2 06	
Labor, hours	75	26	19 50	73 76	15	11 25	44 05	12	9 00	35 87
Transformers										
1-kva. transformer	35 28	2	70 56		3	105 84		2	70 56	
2-kva. transformers	49 56	1	49 56							
Labor, hours	75	12	9 00	129 12	15	11 25	117 09	10	7 50	78 06
Meters:										
10-amp., 110-volt 1-14 meters	9 40	7	65 80		5	47 00		4	37 60	
Labor, hours	75	14	10 50	76 30	10	7 50	54 50	8	6 00	43 60
Grand totals				$1,186 34			$938 41			$725 28

Spray Pipes in Superheated Steam Line Improve Engine Lubrication

THE use of superheated steam interfered with the lubrication of high-speed engines used during the peak load in the Cortland County Traction Company, Cortland, N. Y. Consequently it was necessary to install small spray pipes ahead of the steam separators in the lines leading to these engines for the purpose of cooling down the steam. In spite of the inefficiency of this scheme, it enabled the company to carry its load over the peak period.

F. A. Dresser, chief engineer of the company, mentioned this experience at a recent meeting of the Empire State Gas and Electric Association.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Cover Should Be on Meter While Testing

THAT covers should be in place on meters being tested on the customers' premises was recommended by the meter committee of the Southeastern Section, N. E. L. A., at the recent Miami meeting. The main reason for such practice is that the meters operate with covers on and that test conditions should duplicate service conditions as nearly as possible. Moreover, five companies of this section report that when testing large power meters with heavy cast covers the removal of the covers affected the results of the test. This change was not due to drafts, which might affect any meter, but was probably caused by magnetic shielding when the cover was in place. S. A. FLETCHER,
Alabama Power Company, Superintendent of Service.
Birmingham, Ala.

Keeping Records of Insulators Found Defective on Line

FOR keeping records of insulators on the lines found defective by tests the instructions shown here are carried out by the patrolmen of a large central station. These records show the exact location of the insulator, the kind of insulator, the type of line, etc. The records are kept in an engineer's level book carried by the patrolman, and the instructions are pasted in the book.

INSTRUCTIONS FOR KEEPING RECORDS OF INSULATORS FOUND DEFECTIVE ON LINES BY TESTS

These records should be kept in Dietzgen Engineer's Level Books No. 111.

A copy of these instructions should be pasted in the front of each book used for this purpose.

The name or number of the line should be placed at the top of the left-hand page.

The kind and number of the instrument used in test should be noted at the top of right-hand page.

Column 1, "Structure Number," should give the number of the pole or tower or its location.

Column 2, "Construction," should state whether wire arrangement is flat, vertical or triangular.

Column 3, "Wire," should indicate which wire was supported by the insulator.

For flat construction, indicate the wire as north, south, east, west or middle—N. S. E. W or M.

For vertical construction, indicate the wire as upper, middle or lower—U. M. or L.

For triangular construction, indicate the wire as upper north, south, east or west, or lower north, south, east or west, or upper or lower—UN, US, UE, UW, LN, LS, LE, LW, U or L—as the case may be.

In using the directions, use the one which most nearly applies. If two apply equally well, use the one which the general direction of line indicates as being correct.

Column 4, "Susp., D.S., D.E. or T.D.," should indicate whether the defective insulator was in a suspension, double suspension, dead end, or tie-down string.

Column 5, "Side of Support, D.E.," should show whether the defective insulator, if in a dead-end string, was north, south, east or west—N. S. E or W.—of the cross-arm or other support.

Column 7 should show the position of the defective units in the string, counting the one nearest the support—farthest from the conductor—as number one. Group together in this column all the defective units in one string of insulators.

Column 8 should indicate whether the insulator hardware is grounded or not grounded—"G" or "NG."

Column 11 should show date of installation. If day and month are not known, give year, if known.

Column 12, "Kind of Insulator," should give all that can be given to identify the failed insulator. If the insulator is stamped in the porcelain on the under side with a figure representing a three-petticoat pin-type insulator with the word "Victor" across it, or if the word "Victor" is anywhere on the insulator, write "Locke" in this column.

If there is an "O" with a "B" inside it anywhere on the insulator, write "OB."

If the manufacturer's number is known, it should be written after the "OB" or the "Locke."

If there is a number cast in the cap, such as 517, C-517 should be written in this column.

If there is a number cast in the pin, such as 312, P-312 should be written in this column.

If there is a letter or number, or both, stenciled on the cap such as the letters 1" then S-1A, should be written in this column.

If there is a gasket under the cap, the letter "G" should be written in this column.

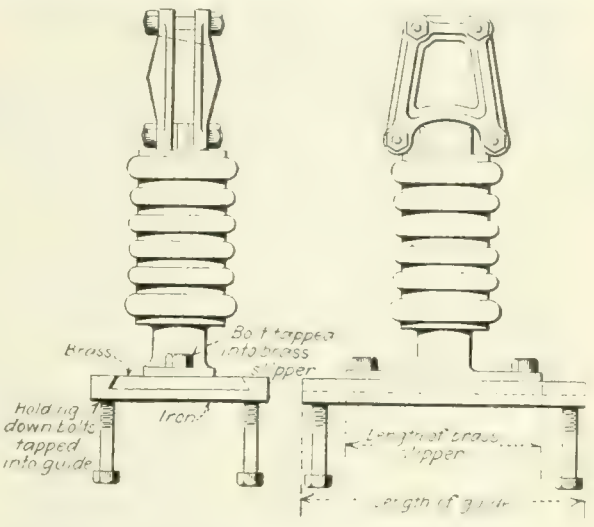
If the insulators are joined by a ball and socket connection instead of the pin and clevis connection, "B" should be written in this column.

If there are any remarks to be made which will give any information in regard to the insulators, they may be written all the way across the double page on the next line or lines below, continuing the tabulation below these remarks.

On other pages of the field book, tally in separate columns all the suspension insulators and all the dead-end insulators tested. Include tie-down insulators in the suspension insulator tally. Be sure to date these tallies.

Sliding Base Prevents Breakage of Post-Type Insulator

A SLIDING base to allow for the expansion of heavy buses has put an end to a considerable breakage of post-type insulators that had been customary in a Canadian power company's station. A heavy busbar of some length and supported rigidly on post-type insulators was giving trouble because of the tendency of the insulators to break off. Upon investigation it was found this was due to the expansion of the bus when operating heavily loaded. Many remedial schemes were thought of—such as expansion joints in the bus—but no other would have been so effective as the post-type insulator with the sliding base shown in the figure. The base consists of two separate parts, one the brass slipper which is attached to the insulator and the other the guide in which the slipper moves. The guide is of gray cast iron machined as shown. When the bus changes its length no strain is put on the insulator as it is free to slide with the bus. R. H. N. LOCKYER.
Trail, British Columbia.



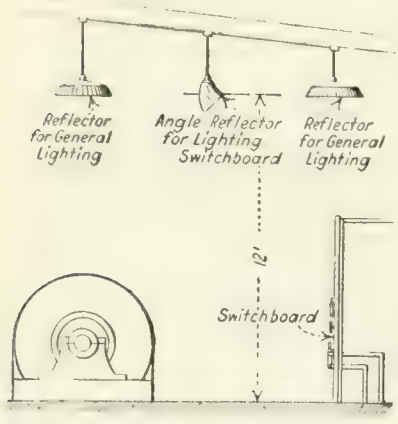
THIS INSULATOR SLIDES TO CONFORM WITH VARYING LENGTH OF BUS

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Directed Lighting Eliminates Shadows on Switchboard

GENERAL illumination is unsatisfactory for a vertical switchboard, because the lamps placed directly above the board cause shadows upon the instruments and relays. A better arrangement, which avoids the extra complication of bracket lamps over individual instruments, is to mount angle-type reflectors, as shown in the accompanying sketch, to throw the light directly upon the board from the front and above. If the lamps are installed near the roof, the clear space in the room is not obstructed and the operator does not cast a shadow upon the board. In the installation illustrated, which was made by Stone & Webster, Inc., at the Kokomo (Ind.) plant of the Pittsburgh Plate Glass Company, the special illumination of the board is provided by 200-watt lamps mounted 12 ft. above the floor, and the "line-up" does not mar the appearance of the station. H. B. WOOD.



ANGLE REFLECTOR LIGHTS FRONT OF SWITCHBOARD AND HAS PLEASING APPEARANCE

Boston, Mass.

Care of Control and Motor of Shop Tractor

TO KEEP electric shop tractors in good running condition the controller and the motor must constantly be looked over carefully to guard against troubles which may develop. The controller gets considerable wear every day owing to friction, stopping and starting, and inching along by degrees, and therefore it should be examined every few days, cleaned of copper dust, and a few drops of oil applied to prevent cutting of sliding parts. If the contacts or fingers are worn short or badly pitted, new ones must be put in as soon as possible or the tractor may stall in an inconvenient location. New contacts and fingers should always be kept in stock, care being taken when ordering from the manufacturer to give not only the part number but also the type and number of the machine for which they are intended.

The controller handle should be given a few drops of oil every morning as its shaft turns a great number of times in a day's routine. Some tractors have three speeds on the controller and two on the brake pedal obtained by means of resistance coils. In ordinary running this pedal must be held all the way down. The coils may become red hot if the controller receives too much current and the pedal is operated only partly down, thus allowing the excess current to be dissipated in heat instead of producing power. The pedal may also operate the main switch which is in line with the controller, and here, too, much wear of the contacts may be caused by careless operation. The switch, like other current-carrying parts, should be cleaned and oiled every few days, and when necessary be renewed to avoid burning and flashing.

All leads to the motor, controller and switch should be well taped together to prevent mechanical injury and painted to withstand water. Moreover, all leads must be tightly connected at their terminals or heating may result, as current higher than usual flows at times in order to attain sufficient horsepower at low voltage. The motor, being about 1 hp. or 1½ hp. in size and operating on perhaps 30 volts to 45 volts, will draw at the least 25 amp.

The bearings of the motor should receive a few drops of oil every few weeks. The commutator should be wiped clean and the brushes should be made to work freely in their holders. When in use the commutator end must be kept always covered by a sheet-iron band to prevent water and dirt from entering the motor. If the ball-bearing races in the motor are worn badly, new ones can be inserted in a short time. This will prevent the armature from striking the poles. When time cannot be spared to repair the motor it can be unbolted, slipped out readily and a spare unit put in its place. To try the motor with the tractor standing idle simply jack up one driving wheel, which will revolve through the differential when power is applied. H. S. RICH.

East Berlin, Conn.

Baking Partially Rewound Armatures and Fields

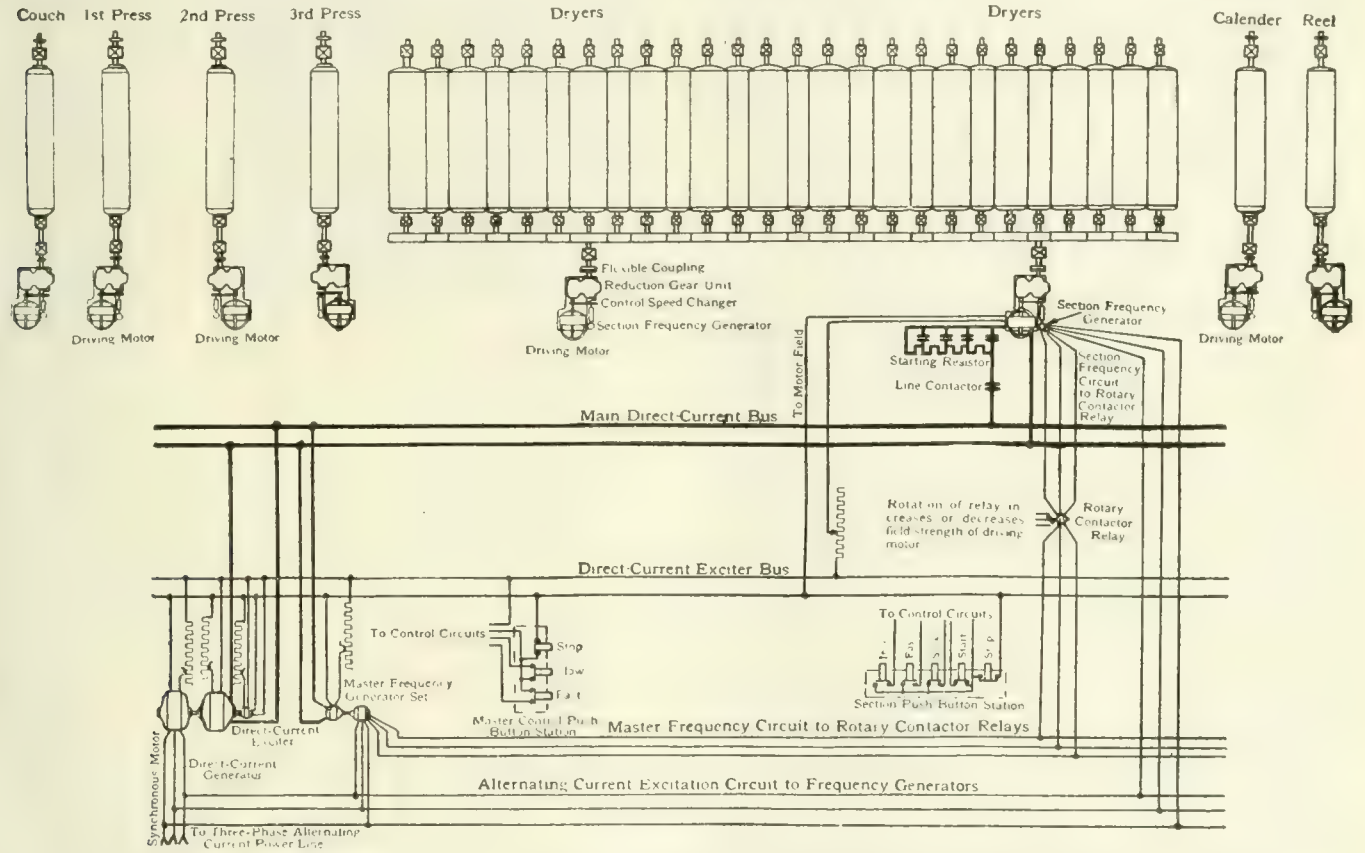
SPECIAL treatment is required when baking armatures and field coils which have been only partially rewound with new coils. In the plant with which the writer is connected they are first very carefully cleaned on the outside. They are then washed in a special "high-test" gasoline. Samples of all gasolines which are used for this purpose receive a distillation test, to make sure that they contain no considerable quantities of heavy "non-volatile" oils. After the old coils have been carefully soaked and washed out with this gasoline they are baked for at least twenty-four hours at about 100 deg. C., and if the parts are small they are baked in vacuum. The coils are then dipped hot in a standard baking varnish and baked for at least twenty-four hours on the first baking. They then receive a second dip hot and are baked for twelve hours, then given a coat of air-dry varnish. It is endeavored to keep the ovens at from 75 deg. to 100 deg. C. and well ventilated.

Newark, N. J. F. W. GAY.

Automatic Speed Control for Sectionalized Paper-Mill Machine Drive

TO MAINTAIN the fine gradations of speed in the rolls of a paper machine, particularly between the sections of a machine, has made the changing to electric drive a difficult problem. A somewhat novel method of automatic regulation of the speed of the sections has been employed successfully in the mills of the West Virginia Pulp & Paper Company, Tyrone, Pa., and the Gould Paper Company, Lyons Falls, N. Y. No difficulty has been experienced with speed variations.

The system of sectional paper-machine drive and control consists of an adjustable-voltage, direct-current generator, of sufficient capacity to drive the entire paper machine, with direct-connected exciter; a direct-current adjustable-speed motor for each section of the machine, suitable means for connecting the motor to each section of the paper-machine driving shaft, and a control system which automatically maintains the correct speed of each individual motor, together with push-button stations for starting, stopping and adjusting the speed of the paper machine as a whole.



AUTOMATIC SPEED-CONTROL ELECTRIC DRIVE FOR PAPER MACHINES WHICH GIVES CLOSE SPEED REGULATIONS

Heretofore mechanical drive has been used almost exclusively for the various sections of the paper machine. The reason motors have not been used for driving the individual sections was because no means had been found whereby their speeds could be controlled accurately enough to prevent breaking of the paper, most of the trials of sectional motor drive having resulted disastrously. From the fact that the relative speeds of the sections have to be adjusted from time to time, synchronous motors are out of the question, and induction motors, on account of their inherent regulation characteristics, are equally unsuitable. Direct-current motors, on the other hand, can be designed to operate over wide ranges of speed and offer great flexibility of control, and the only thing that has interfered with their general adoption has been the absence of a suitable type of speed regulator. Recent investigations have shown that to prevent breakage or undue straining of the paper as it passes from one section to another the variation of speeds between sections must be maintained, as an average value, within one-tenth of 1 per cent. It is also necessary to raise or lower the speed of the entire paper machine by small amounts from time to time, without interfering in any way with the draw or relative speeds of the various sections, and it is necessary when changing from one grade of paper to another to operate at widely different speeds, speed variations of seven to one or even ten to one frequently being encountered.

The generator usually forms part of a standard synchronous motor-generator set or turbine-generator unit, and is a 250-volt, adjustable-voltage, separately excited machine with a constant-voltage 250-volt exciter of sufficient capacity to furnish excitation for the synchronous-motor field, the generator and motor fields, and for the control circuit of the regulator. The motors are 250-volt separately excited machines and may be of any desired speed, dependent upon the particular requirements of the paper machine involved. Where a comparatively small range of speed for the paper machine is desired—that is, not more than three to one or four to one—this is accomplished by voltage control of the generator through a motor-operated field rheostat. Where very wide ranges of speed, such as ten to one, are required, both generator-voltage control and motor-field control are used, the same motor-operated face-plate controller or rheostat serving to

insert resistance in the shunt fields of the several motors uniformly, after the generator has been brought to full voltage.

The automatic control system consists of a small master frequency generator driven by a small direct-current motor operating in parallel with the section driving motors and separately excited; a small frequency generator driven from each of the section driving motors through a small speed changer consisting of two cone pulleys, to one of which the frequency generator is coupled; a powerful synchronous type of rotary relay for each driving motor, which serves to make an electrical contact in one direction or the other on the slightest unbalance of frequencies, and a motor-operated field rheostat, under control of the relay, in the shunt field circuit of each driving motor. The master frequency generator is common to all sections of the paper machine, whereas each section has its own section frequency generator, relay and motor-operated field rheostat, together with an effective anti-hunting device.

The small frequency generators are all excited by alternating current, but since the master and section frequency generators are excited from the same source, any variations in frequency or voltage of the exciting source have no effect upon the regulation, as they do not disturb the balance of frequencies at the rotary relay. Since no appreciable amount of power is required to operate the rotary relay, these frequency generators are small in size. The small speed changers referred to are of small size, as they do not have to transmit power, but simply to overcome bearing friction of the small frequency generator and the friction of their own ball bearings, which is practically negligible. By shifting the small belt on these speed changers by means of a handwheel, the relative speeds of the sections, or the draw of the paper, as it is called, is accurately and positively determined by the operator and is thereafter maintained automatically at the correct value. Any unbalancing of the two frequencies at the rotary relay caused by change in speed of the driving motor immediately causes a positive synchronous movement of the relay, making an immediate contact and thereby adjusting the field strength of the motor and returning the speed to the required value.

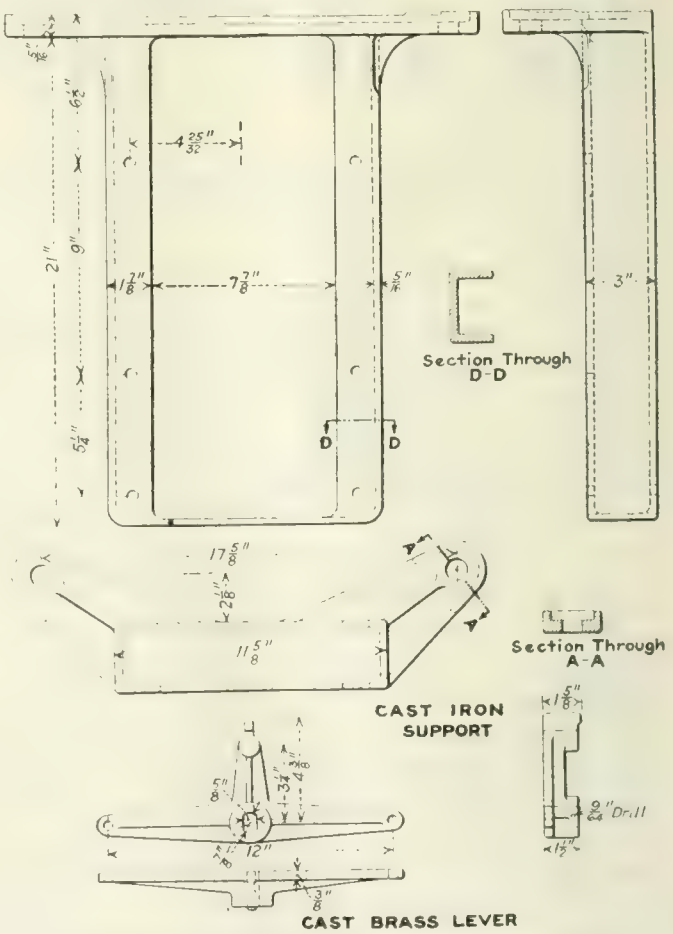
Before any governor or regulator can function, there must be a change of some kind in either load or speed, as otherwise there would be no occasion for the regulator to correct anything. However, these changes in speed need not be large enough to be perceptible to the eye or detectable by ordinary indicating apparatus in order to actuate this new regulator. In fact, the regulator will detect changes in speed of a few thousandths of 1 per cent and make the necessary correction immediately, and without any tendency to overtravel or hunt, so that no perceptible change will be found in the draw of any section.

A control board is provided in connection with each paper machine, having a master control panel for the paper machine as a whole, controlling the generator and master frequency generator, and a unit section control panel for each of the section driving motors. Starting equipment is provided on each of these panels, consisting of motor-operated cam-accelerating switches with line contactors under the control of suitable push-button stations for starting and stopping the individual motors and the entire paper machine as a whole. The master rheostat, under push-button control, provides means for adjusting the speed of the paper machine as a unit over the entire range of speed. The rotary contactor relay and motor-operated field rheostat for each section are also located on the unit-section control panel. The push-button stations, arranged conveniently on or near the apparatus, provide means for starting, stopping and obtaining any desired speed of the paper machine in the shortest time and in the most efficient possible manner. In this way and in the elimination of the cumbersome mechanical drive a great deal has been accomplished in increasing production and improving over-all efficiency and economy from every standpoint.

Stephen A. Staege,
General Engineer.
Westinghouse Electric & Manufacturing Company,
Pittsburgh, Pa.

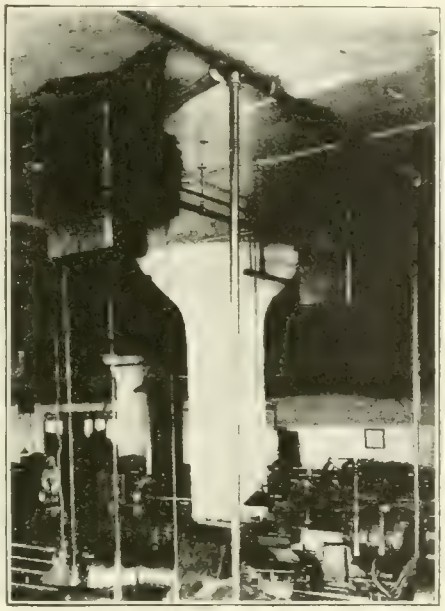
Supporting Frame for Mounting Compensators on Ceilings

In order to save working space and wiring expense in the plant of the Dayton Engineering Laboratories Company compensators are mounted on the ceiling by means of cast-iron supports. With the compensators so mounted, the motors are started by chains hanging down within easy reach of the operator. In this factory two different sizes of mounting supports have been found necessary. One is used for compensators up to 25 hp., rated at 220 volts or 440 volts, and this one is shown in the accompanying photograph and drawing. The other size is for motors of 30 hp. to 100 hp. It was described in Electrical World, Feb. 19, page 435.



CAST-IRON CEILING SUPPORT AND STARTING LEVER FOR LOW-VOLTAGE COMPENSATORS UP TO 25 HP.

The compensator, as may be seen from the photograph, is bolted to the support. Hanging from the compensator are three chains. Two of these hang from a brass arm mounted on the lever on which the starting handle of the compensator is usually mounted. By pulling these chains, first one and then the other, the motor is started and brought up to speed. The third chain is connected on to the lever for tripping the compensator. One of the reasons advanced for the use of automatic compensators is that manufacturing floor space is saved by mounting them overhead or at a distance. The same saving of space, however, is accomplished with these supports without the expense of the automatic feature. This method of mounting not only saves space, but practically the entire run of conduit from the ceiling to the floor is eliminated. It also facilitates inspection from a distance, as the inspector can see at once by the position of the starting lever whether the compensator is in the running, starting or off position. It has been found that this mounting does not materially increase the time required for periodical examination.



COMPENSATORS MOUNTED ON CEILING EASILY OPERATED BY MEANS OF THREE CHAINS

H. L. BURNS,
Chief Electrician.
Dayton (Ohio) Engineering Laboratories Company.

Operating Records of Electric Furnaces Refining High-Grade Steels

ENERGY consumption per ton of steel refined, time of melting, pounds of electrode consumed per ton, etc., are shown in the accompanying table, giving averages of a year's performance of electric furnaces operated by the United Alloy Steel Corporation, Canton, Ohio. This firm makes high-grade steel, steel castings and ferro-alloys, employing three Heroult furnaces and two Snyder furnaces. There are two 15-ton Heroult furnaces and one 6-ton furnace. All are operated on three-phase, 60-cycle energy at 110 volts from Westinghouse 3,000-kva. transformers. Thury automatic control is used. The two 1-ton single-phase Snyder transformers are operated through a 600-kva. Westinghouse transformer and are hand-controlled. The Heroult furnaces melt and refine steel and are charged with hot and with cold metal. The Snyder furnaces, used for making steel castings and ferro-alloys, are charged hot. The value of electric furnaces for refining purposes is indicated by the fact that steel containing only 0.008 per cent of sulphur and 0.015 per cent of phosphorus can be produced consistently in them.

It is seen from the table that the energy consumption per ton of metal produced is 568 kw.-hr. for the Heroult furnaces melting cold scrap and 168 kw.-hr. when the charge is already molten. The 2-ton furnaces require 1,002 kw.-hr. to melt and refine cold metal. The electrode consumption on the Heroult furnace was 26.6 lb. per ton of steel. This includes electrodes for both the cold-charge and the hot-charge processes. In the Snyder furnaces the consumption was 41.4 lb. of electrode per ton.

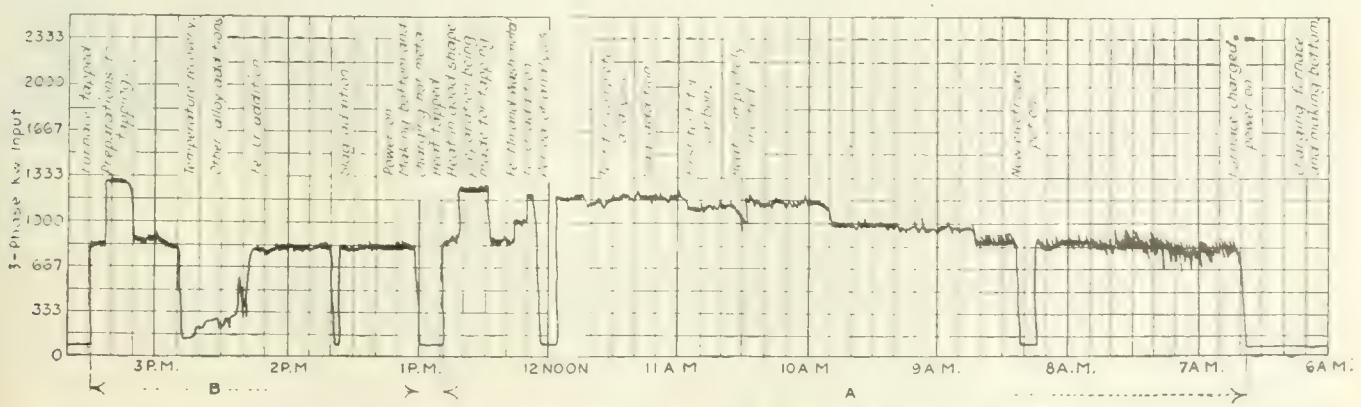
ENERGY CONSUMPTION, ETC., OF FURNACES MELTING AND REFINING STEEL

	Heroult Three-Phase Furnaces (Two 15-Ton and One 6-Ton)		Two 1-Ton Snyder Single-Phase Furnaces, Cold Metal Charge
	Hot-Metal Charge	Cold-Metal Charge	
Average kw.-hr. per ton (gross)	168	568	1,002
Average charging time (min.)	15	55	30
Average melting time (hours)		5	5
Average number of heats per ten-hour day	3	1	1 2
Pounds electrode per ton steel	26.6*	26 6*	41 4
Gross tons refined per year	10,209	7,580	329
Number of heats made in year	636	470	152
Arc voltage	110	110	110
Transformer rating (kva.)	3,000	3,000	600

* Average for hot-metal charging and cold-metal charging.

Load curves of one of the 15-ton furnaces melting cold metal for magnet steel and refining hot-charged metal for ball bearings are reproduced here. It has been this company's experience that a high melting-down current reduces the kilowatt-hour consumption and produces better steel as there is less time to absorb oxides. Moreover, better refining results from using a high current just before the heat is tapped.

United Alloy Steel Corporation, M. H. SCHMID,
Canton, Ohio. Metallurgical Engineer.



KILOWATT INPUT TO 15-TON HEROULT FURNACE PRODUCING HIGH-GRADE STEELS

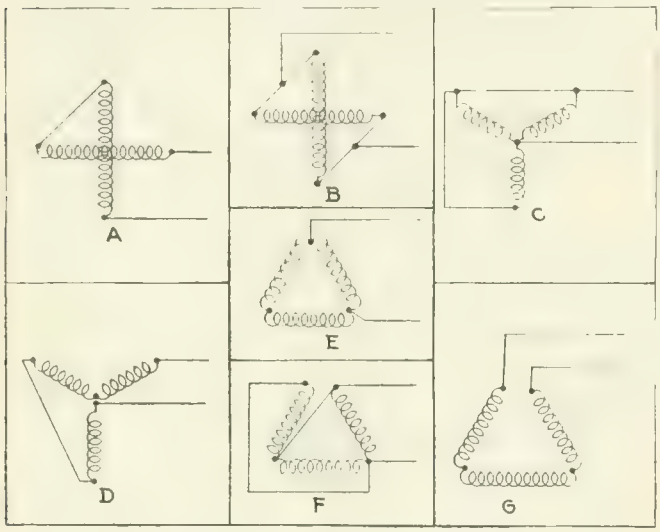
A—Furnace charged with 38,000 lb. of cold scrap, making magnet steel containing: C, 0.86 per cent; Mn, 0.[illegible]; S, 0.021; P, 0.022; Si, 0.28; Cr, 2.07; W, 0.90.

B—37,500 lb. of metal charged hot for making ball bearing steel of the following analysis: C, 0.96; Mn, 0.36; S, 0.020; P, 0.018; Si, 0.12; Cr, [illegible]; V, 0.17.

Drying Out Motors and Generators

TO DRY out a motor or generator it is only necessary to pass full-load current through the coils while the machine is standing still. As the ventilation is poor when the machine is not running, the temperature of the coils will quickly rise to 75 deg. or 80 deg. C.

In drying out alternating-current generators it is customary to short-circuit the winding and operate the machine at reduced speed and with just sufficient field to cause about one and a quarter times full load current to be generated. This is an excellent method, but has the objectionable feature that it cannot be used until the machine in all other respects is ready to put into service. It takes from two to six days to dry out a winding properly, depending on the length of time the machine has been exposed to moist air. When in pressing need of additional generator capacity this is serious



CONNECTIONS WHICH MAY BE USED WHEN DRYING OUT ALTERNATING-CURRENT MACHINES

delay. This delay may be avoided by starting the drying-out process as soon as the machine is assembled and without waiting for the prime mover to be in running order. To do this it is only necessary to connect the stator winding to the direct-current bus with the main-field rheostat in series and adjust the resistance so that not more than normal full-load current will flow in the winding. Thermometers should be inserted in several places and care taken that a temperature of 75 deg. or 80 deg. C. is not exceeded. If there is no direct-current bus, the necessary current may be secured by belting the exciter to a motor or gasoline engine.

Some slight changes may have to be made in the windings before applying current. If the generator is two-phase, connect the phases in series or parallel as *A* and *B* in the drawing. If three-phase star, bind the lead-in wires together and connect the line wires to these and the star, *C*, or disconnect one phase from the star point and connect in series with the others, *D*. If the winding is in delta, connect to any two terminals, *E*—which gives unequal circuits in parallel—and change connections occasionally so that all phases will get equal drying, or open the delta and put the phases in parallel or series, *F* and *G*.

The connection of the phases will depend on the size, speed and voltage of the generator and may be determined by trial or by measuring the resistance of a phase and calculating the current that would flow in a series or parallel connection.

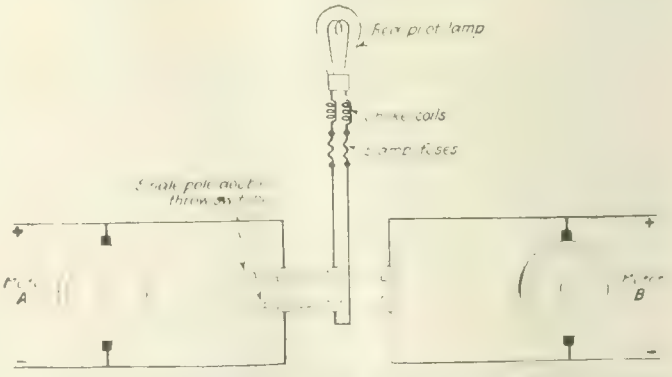
AMÉDÉE ANCTIL,
Brown Company, Electric Repair Department.
Berlin, N. H.

Pilot Lamp Indicates Operation of House Pumps

MUCH annoyance was caused some time ago by failure of the automatic devices on a pair of triplex house pumps in a St. Louis plant to operate promptly at proper times. Occasionally the pumps would not start when the water had receded to the normal low level, and no sign of this was evident.

To compensate for this defect, the engineer decided to install a red pilot lamp where it would show conspicuously on the switchboard in the engine room. Then, if the pilot lamp ceased to glow for more than a few minutes, the attendant would know that the pump motor had failed to respond to the demand for water and would correct the trouble accordingly. The pumps are operated by 110-volt direct-current motors. They are intended to work together or independently, as service conditions may require. They are installed in a remote part of the plant, removed from constant observation by the attendants. The motors which drive them are equipped with automatic starting and stopping devices.

The wiring of the pilot lamp is shown in the sketches herewith. The apparatus is connected to the positive and negative brush holders of each motor with wire of No. 14 B. & S. gage. When only one of the pumps is required, both of the single-pole, double-throw switches are thrown so as to close the pilot-lamp circuit through the armature of the motor which drives the pump. Thus, in the drawing, the pump motor *A* is in service while the pump motor *B* is inactive. Hence the pilot-lamp circuit is switched in parallel with the armature of motor *A*. But when both pumps are required the switches are thrown in opposite directions. The current then passes from the positive brush of one of the motors, through the pilot-lamp circuit, and thence to the negative brush of the opposite motor. If either motor fails



LAMP CONNECTED ACROSS MOTOR BRUSHES INFORMS DISTANT OPERATOR IF MOTOR IS NOT CONNECTED TO LINE

to start, when both are cut in for simultaneous operation, the pilot lamp will show no light.

The pilot lamp has a carbon filament, it being assumed that a carbon filament will better withstand the momentary increase of voltage which attends opening the motor circuit at full speed than will a metallic filament. Choke coils are provided, however, to protect the lamp from thes urge of current thus produced.

St. Louis, Mo. A. J. DIXON.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

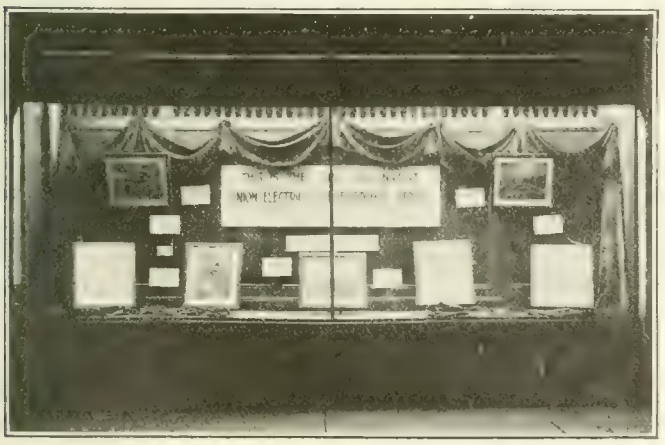
Utility Employees Acquaint Directors with Operating Details

TO EXPLAIN and discuss various features in connection with the design and operation of the company's properties and of its organization, the Southern California Edison Company has inaugurated a plan whereby different heads of departments and employees meet with the directors periodically. Papers are prepared which are read before the directors, after which there is an opportunity for the directors to ask questions and generally discuss the subjects brought up.

One subject in which the directors have shown particularly keen interest concerns the method of operating the many interconnected hydro-electric and steam generating stations to insure maximum economy and output. It is expected that these meetings will bring about the closest co-operation between all departments of the organization.

Continuous Sale of Preferred Stock at Par

THE Union Electric Light & Power Company of St. Louis has sold to consumers well over $3,000,000 of 7 per cent preferred stock at par since early in 1917, and from the beginning of its home financing activities the company has addressed itself to that large field of small investors ordinarily closed to the investment banker and broker. In commenting on the subject an official of the company stated that when the home financing of capital requirements was decided on the company found itself in a strong position. Its rates were equitable, its service was of a high order, and its



WINDOW DISPLAY WHICH PROMOTED STOCK SALES

outstanding capital was of a legitimate amount and character, as testified to by an appraisal of its property made by the Public Service Commission of Missouri. The desirability of having the largest possible number of home partners was recognized, and plans were laid along lines which are not comparable to those of the orthodox banker and investment broker.

The first step was an educational one, and through the daily press the public was told all about the company. The advertisements headed "On the Job Twenty-four Hours of Every Day" and "Getting Right with Our Employees," reproduced here, are fair examples of the good-will advertising.

To a field cultivated in this manner the company announced the offer of $500,000 of 7 per cent preferred

Getting Right With Our Employers

Our employers? That's you—the public—850,000 of you in St. Louis city and county.

Union Electric serves 881,000 of you and your families, employes and customers, under individual contracts. We serve all the rest of you in one way or another, under rules and contracts made by your city and state governments.

No doubt about our being public servants.

The public hires us for this job of supplying Electric Service because you believe we can do the work better and cheaper than any other agency, corporate or municipal.

Union Electric is dead willing to bet its job and its $31,105,000 investment on its ability to do that.

But to do it, we must have your good will so far as we fairly earn it.

As most of you know, this company has been hammered hard by some of the St. Louis newspapers for two or three years past. They denounced our "20% profits," our "robber Keokuk contracts," our "inside grafts," our "alien landlordism," etc., etc. About the only crime they didn't accuse us of was highway robbery.

True? Not a word of it!

But it robbed us of a share of public good will which we must have if we are to give you most and best Electric Service at least cost.

So we have decided, in your interest as well as our own, to use a little printer's ink telling you the exact truth about those matters.

Beginning tomorrow we'll show you every angle of the "robber Keokuk contract"—show you how those contracts are not a burden but a blessing to the city and county.

Perfectly good humored, we hope, but we'll get the facts

On the Job 24 Hours of Every Day

One of our technical friends says these Editorials have "got on his nerves." "Your language," he says, "is not technical and your explanations," he says, "do not deal with the fundamental principles of electrical science."

Guilty as charged. It isn't and they don't because that wasn't our intention.

What we are trying to do is to make clear to our public the main facts about this public service institution, the work we do and the pay we get for it and why the service our customers get and what it costs and why, the ways in which this service can be extended, improved and cheapened and how our customers, if they see fit, can help get these results.

The Electric Era in the life of mankind has only just begun. The boys and girls now in the grammar schools are going to see developments in the scope and variety of Electric Service which older folks today can only dimly imagine. So many of the boys and girls as these informal talks may send to the books, the laboratories and the lecture rooms for knowledge of electrical service will thank us for the inspiration. Because they'll be the better equipped to get most out of life on easiest terms in the wonderful Electric Age into which humanity is just now entering.

But that's only incidental to our purpose. What we're trying to get across, to every man, woman, boy and girl in the St. Louis district, is the fact

Union Electric is fully aware of its obligations as to kind and cost of service it must give, of its duty as a public service institution to lead the way in making St. Louis each year larger, cleaner, healthier and more prosperous, and is on the job smiling, with eyes wide open, 24 hours of every day.

TYPICAL GOOD-WILL PUBLICITY

stock at par, to its customers only, not more than $2,000 to any one buyer. The allotment was sold to 645 customers in seven business days. A second block of $500,000 was then offered under the same terms and was purchased by 747 customers in less than two weeks. This stock was bought at the offices of the company and no outside solicitation was done.

Since that time the stock has been offered and sold as requirements dictated. The plan has been broadened and enlarged until at this time there is a regular stock-selling department operating under the guidance of a manager. He has both office and outside salesmen to make the advertising program effective and maintain the continuous-selling feature of the plan.

Supplementing the work of this organization is the short competitive campaign selling carried on by other employees of the company. The competitive units are teams of from six to twenty employees operating under clearly defined rules. Commissions and prices are provided on the basis of gross sales.

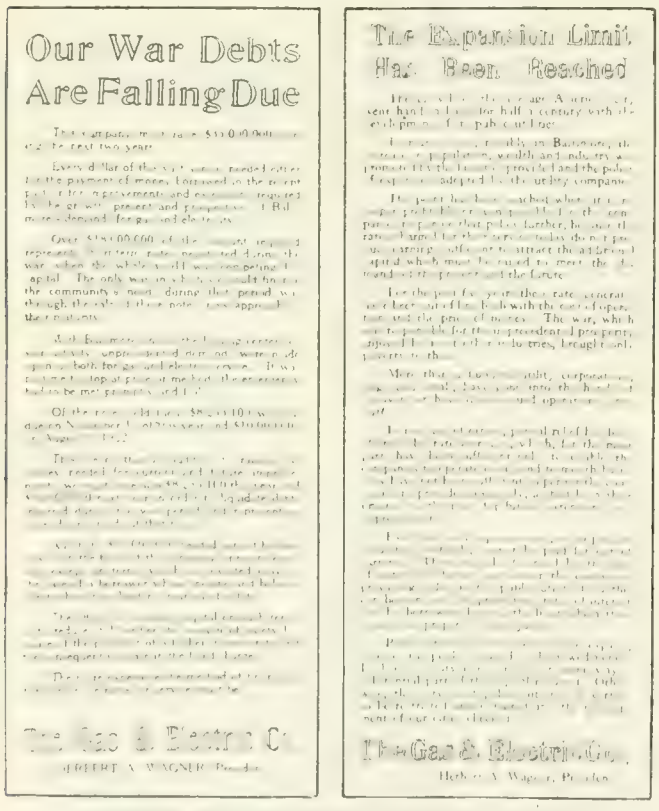
During the difficult year of 1920 a total of 13,479 shares of the stock were sold at par through all sources.

In one campaign covering sixty working days the teams sold $230,000 worth of the stock and earned commissions and bonuses of $6,886.50. Thirteen individual team members earned in excess of $100 each, and the high man gained a reward of $1,100. A window display was used in connection with this campaign and is shown in an accompanying illustration.

The company now has 4,800 home partners, and the number is growing daily. The sales of the security department continue at the normal rate after the short intensive campaigns described.

Baltimore Company Places Financial Problems Before Public

THE Consolidated Gas, Electric Light & Power Company of Baltimore has undertaken a comprehensive educational campaign bearing upon the credit problem of public utilities. It is the company's purpose to acquaint the public with the needs of public utilities in general and the Consolidated company in particular for money to provide facilities to meet the growing demand for service, the difficulties encountered in obtaining this money, and the necessity of co-operation



ADVERTISEMENTS DESIGNED TO EXPLAIN CLEARLY THE COMPANY'S FINANCIAL PROBLEMS

on the part of the public to enable the utility to attract new capital.

The campaign is being carried on largely through the advertising columns of the Baltimore daily newspapers supplemented by pamphlets which are being sent to customers, bearing upon the matters under discussion, while the *Gas and Electric News*, the company's house organ, is utilized to give the 3,300 employees an intelligent understanding of the campaign.

The financial rather than the operating side of the company's problems is emphasized in its advertising copy, specimens of which are reproduced here. The company believes that the complex character of the problems involved requires that they be presented in newsy style and simple terms which the public can readily understand.

To give the personal touch desirable in advertising of this character, each advertisement carries President Herbert A. Wagner's name under the company title.

To Promote Better Merchandising of House Wiring

IN AN effort to promote better merchandising practice as applied to residential wiring a subcommittee of the N. E. L. A. wiring committee, R. S. Hale, chairman, is preparing a series of articles designed to inject into the advertising given this matter something more than the stereotyped specifications and bare statements as to terms of payment which characterize a great deal of the material that is now used. The subcommittee consists of Arthur L. Nelson, Commonwealth Edison Company, chairman; Clarence Renshaw, National Metal Molding Company, and J. C. Tillman, Consolidated Gas, Electric Light & Power Company of Baltimore.

The first article, entitled "Merchandising House Wiring," points out that neither the number of houses wired nor the thoroughness of the work is up to the desired standard. Drawing an interesting comparison of merchandising principles as applied to electrical appliances and to house wiring, and suggesting changes in the latter, the article says in part:

"The common attitude of the electrical industry toward wiring as compared with its attitude toward the sale of appliances is illustrated nicely by two advertisements which appeared recently in the newspapers of a certain city. One of these advertisements bore the heading in large letters 'Wire Your House Now' and proceeded to tell about the monthly payment plan and to give prosaic specifications as to the kinds of fixtures which would be included, etc. This advertisement, no doubt, was very interesting to people who had already decided to have their houses wired and who were wondering where to go to get it done. There was absolutely nothing, however, to convince those who had not reached such a decision that they ought to have the wiring done.

"The other advertisement was a good one. It carried the heading in fancy letters 'Oh, Boy!' and showed a man with an electric fan blowing full in his face. His hair and tie were waving vigorously, and he wore a smile of pleasure and contentment. After looking at the picture a moment or two, one could almost feel the breeze. The text then began: 'Why go to the seashore or the mountains when the mere touch of your finger will bring cooling sea breezes into your office, your bedroom or living room?'

"This advertisement, of course, was intended to sell fan motors and not wiring, but no one can use fan motors unless his, house or office is wired. By the addition or the change of a very few words this bit of merchandising could have been made to sell wiring instead of, or in addition to, fans. This advertisement occupied less than one-half the space of the one previously referred to, yet I feel sure one insertion of it would have done more to persuade people to wire their homes than a week's run of the other.

"Persuading people to wire, however, is only the beginning. Having applied merchandising principles to interest prospective customers in wiring we must again apply them to persuade these purchasers to adopt the

right kind. Many contractors in quoting on wiring residences will begin in a very serious way, something like this:

"DEAR SIR: We hereby propose to furnish labor and material necessary to install wiring and switches in the two-story residence owned by you at 711 Blank Street.

"The work to be done under this contract will consist of wiring..... outlets for lights ..... outlets for single-pole switches, and ..... outlets for three-way switches as follows:

"Then follow a list of rooms and a table giving the number of ceiling, bracket, baseboard and switch outlets in each. Finally come the price and terms, and in curt, formal words a guarantee that the job will be done in a workmanlike manner, etc.

"When a proposal is presented in that manner the only thing the average householder can understand about it is the price. Regardless of how low the price may seem to the contractor, it looks high to the house owner. His first thought, therefore, is 'What are these outlets, anyhow, and why do I need so many of them?' and off the list come the baseboard receptacles and frequently some of the switches.

"If we would pause occasionally to consider the customer's viewpoint on matters of this kind, the remedy for the above situation would be obvious. There are mighty good reasons for the installation of baseboard outlets, switches and so forth, and if the contractor explains these properly in presenting his proposal, most people are glad to pay the additional cost to get them. Do you not think that if a contractor should present his proposals for house wiring on the following basis, they would almost invariably be accepted?

"DEAR MR. JONES: In wiring your residence to enable you to take full advantage of the comforts and conveniences which modern electric lights and appliances afford, we propose to arrange the outlets so that fixtures can be located as follows:

"1. *Porches.*—One ceiling outlet on front porch controlled by switch near the door in the hall, and a similar outlet on the back porch controlled by a switch in the kitchen. You will find it quite a safeguard to be able to snap on these lights and observe persons seeking admittance after dark before opening the door. Lighting the porches also makes them safer in bad weather and adds a bright, cheerful appearance when visitors are coming."

Similar explanations are given for the location and need of the outlets and switches throughout the house.

"With a proposal presented in this way," the article continues, "a man's interest is centered on the value he is to receive rather than on the price. There is no reason why electric house-wiring, if properly sold, should not yield a reasonable direct profit, as well as carrying with it future sales of lamps and appliances. The community needs the service which more wiring makes possible, and electrical contractors owe it to themselves and to the industry to apply to this branch of their business the same principles of merchandising which have proved so successful in selling appliances."

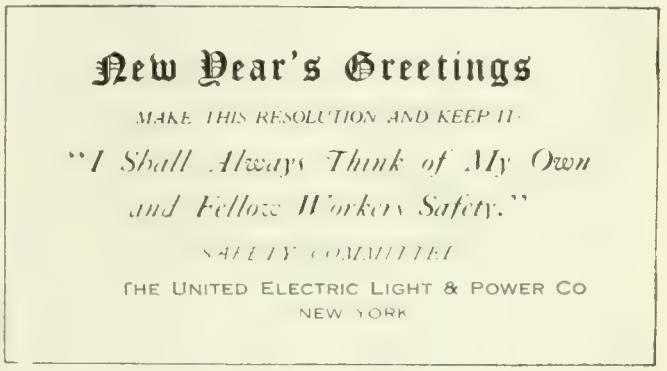
San Antonio Company Sells Stock Locally with Own Men

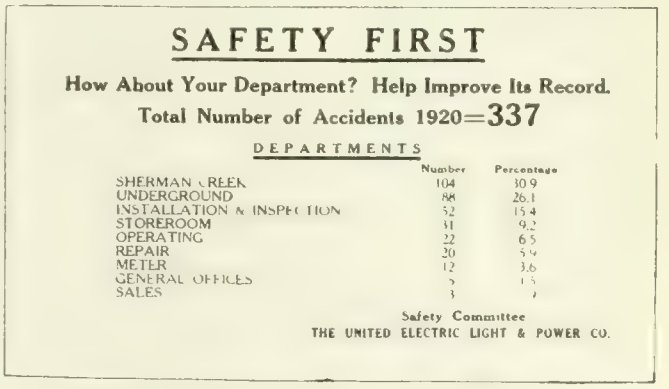
ANOTHER utility to engage in the sale of stock locally is the San Antonio (Tex.) Public Service Company, which has just placed on the market an issue of $2,000,000 in cumulative preferred stock with an 8 per cent yield. This stock is being sold principally by employees, who had disposed of approximately $80,000 worth in the first month. The company has organized an investment department in charge of S. J. Ballinger, commercial manager of the company. Just enough salesmen are kept in the investment department to take care of inquiries and insure the proper treatment. No effort is made to secure experienced stock salesmen. Employees who are familiar with the company's business and know how to be polite and courteous to the public are used as special salesmen.

Effective Method of Impressing "Safety-First" Ideas Upon Employees

ACTIVITIES in furtherance of "safety first," restricted to a large extent by important war obligations in the last few years, have been earnestly resumed by the United Electric Light & Power Company of New York. A general committee embracing every department of the company has been appointed to meet monthly, hear and consider the reports of subcommittees and devise ways and means of minimizing the so-called unavoidable, careless and all other classes of accidents by educating and instructing the company's personnel and by improving and safeguarding equipment that presents an injury hazard.

An interesting innovation intended to arouse the interest of employees in the movement and to make them think has been adopted. This is based on the utiliza-





SAFETY FIRST MESSAGE INCLOSED IN PAY ENVELOPES

tion of the weekly pay envelope to convey a safety message to every employee regularly. The first notice was in the nature of a New Year's greeting from the committee and was followed up by a notice showing the number and percentage of accidents happening during a given period in the various departments of the company. Both notices are shown here. It is hoped in this way to arouse departmental pride and rivalry. The committee intends to present pictorially the results of accidents by this method and bring the consequences of carelessness forcefully to the attention of every employee.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Temperature Limits of Large Alternators.—G. A. JUHLIN.—In considering the possibility of increasing temperature limits in alternators the author refers particularly to class B installations, including mica and asbestos, in which the maximum temperature at present allowed is 125 deg. C. Tests are described and summarized in the following table, in which is given the breakdown voltage of various classes of mica wrapped on copper bars after heating for 7,000 hours at 190 deg. C.

Description of Wraps on Various Samples	Breakdown Voltage Minimum	Breakdown Voltage Maximum
Empire cloth and mica, hand-wrapped	15,000	26,000
Cambric and mica, machine-wrapped	31,000	35,000
Paper and mica, machine-wrapped	42,000	45,000
Paper and mica, machine-wrapped	47,000	48,000
Mica and shellac only, machine-wrapped	50,000	52,000

In conclusion he states that mica insulations of the type employed in the construction of up-to-date alternators is capable of withstanding temperatures up to 200 deg. C. without losing its electrical or mechanical properties. The maximum temperatures could then be increased to 160 deg. C., based on embedded temperature-detector measurements for the stator winding and on the increase or resistance methods for the rotor winding. Allowing a correction of 10 deg. C. for the difference between the maximum temperature and the observable temperature, the latter would then be 150 deg. C. Assuming that no reduction in the margin of safety will result, the author says that there are considerable advantages to be obtained by adopting the higher temperature limits, namely: (a) In the case of machines running at the same speed, those with high temperature rating are cheaper, (b) higher efficiencies are obtainable, (c) larger units can be built, or (d) higher speeds can be adopted for machines of certain sizes, and (e) less space is required.—London *Electrician,* Jan. 28, 1921.

Vector Diagram for Salient-Pole Alternators.—E. B. SHAND.—The author proposes modifications in constructing the vector diagram for synchronous machines to take into account the effect of salient-pole construction. This, it is said, is of particular importance when operating synchronous machines at low excitations.—*Electric Journal,* February, 1921.

Lamps and Lighting

Flashing Speeds of Incandescent Signal Lamps.—A. G. WORTHING.—A study of the theory of signaling with incandescent lamps for the development of a unit for use in daylight. These conclusions are reached: (1) The time required for a filament to heat to approximately its maximum brightness exceeds greatly the time required in cooling to effectively zero brightness; (2) the higher the maximum temperature of a flash the greater the speed of the flash; (3) the smaller the filament the greater is the speed of the flash; (4) the less the resistance in a circuit external to a flashing tungsten lamp the greater is the speed of the flash; (5) the speed of flashing for a given filament at a given temperature in various atmospheres—including a vacuum—is greater the greater the gas loss; (6) for lamps of the same open-filament construction, the same luminous flux and the same average life at a fixed voltage the speed of flashing is greater the greater the gas loss. Both carbon and tungsten filament lamps were tested, also lamps with ribbon and wire filaments. Regarding ribbon filaments it is said that the quantity of material in a ribbon filament being less than in an equivalent wire filament it may be possible by going from a wire filament to a ribbon filament in gas-filled lamps to obtain either a considerable increase in signaling speed, or, without a reduction in speed, a higher efficiency through choosing an atmosphere involving a decreased gas loss.—*Journal,* Franklin Institute, February, 1921.

Generation, Transmission and Distribution

Voltage-Regulating Systems of Synchronous Converters.—F. T. HAGUE.—The writer deals with the origin of the booster-type converter, giving its development into the type now extensively used. Another well-known scheme is inherent regulation resulting from the out-of-phase or wattless current flowing through a reactor. This method has found extensive application in the railway field. The split-pole converter is also described, and it is said that owing to the complicated magnetic structure of a split-pole converter it is not practicable to make an ideal application of commutating poles that are inherently self-adjusting, while with the booster-type converter the addition of commutating poles presents no difficulties. A discussion follows showing how these types of converters meet operating conditions.—*Electric Journal,* February, 1921.

Utilizing Energy Accumulators in Connection with Hydraulic Power Stations.— DELLA RICCIA.— Most energy accumulators have a rather low efficiency. However, when used in connection with a hydraulic power plant with insufficient hydraulic regulation facilities even a poor energy accumulator may prove economical by making it possible to utilize much water power that is otherwise going to waste during off-peak hours. On the basis of this reasoning the author has investigated the economy of energy storage by a graphical method utilizing so-called monotone diagrams or symbolic load curves. In studying two practical cases, corresponding to an equivalent time of 1,860 hours and 4,060 hours a year (lighting and traction respectively), he found that the installation of an energy accumulator with a return efficiency of only 30 per cent makes it possible to increase the annual output of the station by 100 per cent in the first case and by 53 per cent in the second case. If the hydraulic station is co-operating with a thermal peak-load station and the energy accumulators are so proportioned as to reduce by 50 per cent the output of the thermal station on that day of the year when

the energy demand is at maximum, then, by virtue of the energy accumulator, the coal consumption is cut to a third in the 1,860-hour case, and in the 4,060-hour case it is cut in half. In concluding the author describes a thermal energy accumulator invented by C. del Proposto. In his device the surplus hydro-electric energy is used to heat oil to a very high boiling point. During peak-load hours the hot oil is pumped through a system of tube coils placed in big water tanks, so-called fireless boilers, and the stored heat is used for generating steam. The steam is superheated in another coil system, submerged in the hot-oil container and fed into the steam turbines of the peak station.—*Revue Générale de l'Electricité*, Oct. 23, 1920.

Coal Handling in the Power House.—GEORGE FREDERICK ZIMMER.—It is shown that the provision of one conveyor of the gravity-bucket type answers all or a number of handling purposes for many coal-handling and storage installations for power houses.—London *Electrician*, Dec. 31, 1920.

Traction

Development of Electric Trucks of the Hansa-Lloyd Works at Bremen.—The city of Bremen in 1906 introduced into its service several small electric trucks which were operated by two motors of 2 hp. to 5 hp. each, driving by single gears the two front wheels. These little tractors operated very well and some of them are still running after fourteen years of service. The desire of a higher electrical efficiency brought about the development of two new types—a 5-ton truck and a load tractor of 5 tons to 10 tons, both equipped with but one motor. Their drive is made with differential and side chains. The tractor replaces three heavy horse teams or eighteen ox teams. Including all expenses and the wages of the driver the operating expense per kilometer run is only 5½ marks. A further development of the Hansa-Lloyd works was a "unity electric driver"—a battery above two (front) wheels, driven by one motor. This front unit may be combined with a great variety of utility vehicles.—*Elektrische Kraftbetriebe und Bahnen*, Jan. 24, 1921.

Installations, Systems and Appliances

Electrode Holders for Metallic Arc Welding—L. W. WEBB.—The essential requisites for electrode holders are discussed, pointing out principal defects to be avoided. It is said that rational design and good materials should be employed regardless of cost.—*Power*, Jan. 25, 1921.

Cotton Spinning Mills.—L. MILLER.—In considering the type of drives for cotton spinning mills it is said that the following characteristics are most desirable: (1) Maximum production combined with uniform quality of product; (2) uniform speed without cyclical variations; (3) freedom from breakdown and ease of repair; (4) cleanliness and good lighting; (5) sectional working without loss due to running shafting light; (6) general convenience in layout of mill and in carrying out extensions.—*Beama* (London), January, 1921.

New Form of Section Drive for Paper Machines.—W. W. CRONKHITE, W. L. MERRILL and H. W. ROGERS.—The shortage of newsprint is said to have created a demand for high-speed paper machines. Several types of sectionalized electric drive have been offered for the consideration of the paper manufacturer in which some form of special governor is incorporated which cannot act until a change in speed has actually occurred. In other words, an undesirable condition must have happened before it can be corrected, and there is always a possibility of breaking the sheet before the governor functions. A new sectionalized electric drive is said to have been developed which prevents a change in speed taking place and is not subject to the difficulties mentioned above.—*General Electric Review*, January, 1921.

Electrophysics and Magnetism

An Electromagnetic Theory of Gravitation.—H. A. WILSON.—An electric system in a medium whose specific inductive capacity k varies from point to point tends to move in the direction of increasing k. It is suggested that if we assume the specific inductive capacity of the ether to vary near matter, gravitation may be explained as a result of this tendency. In a medium in which, at a distance r from a mass m, $k = 1 + m/r$, it is shown that a rigid electrostatic system would be acted on by a force directed toward m and equal to mm'/r^2, where m' is the electromagnetic mass of the system. But in order to explain the observed deflection of light by the sun we must have $k = 1 + 2m/r$; and this will not give the force mm'/r^2 unless the system contracts in the ratio of $1:1 - m/r$. A physical explanation of this assumed contraction is suggested. If the system with the mass m' is also supposed to modify k, it is necessary to take into account the energy changes in m and in the ether. The effect of gravitation on the frequency of the light emitted by an atom, which was predicted by Einstein, can be easily deduced from the present theory.—*Physical Review*, January, 1921.

Units, Measurements and Instruments

New Form of Standard Cell.—C. J. RODMAN and T. SPOONER.—A form of portable standard cell has been developed for which advantages are stated as follows: (1) Compactness; (2) the cathode is centrally located, holding the mercury in a central chamber; (3) stability of construction; (4) legs are kept at the same temperature, thus reducing emf. variations; (5) constant electromotive force is obtained over long periods of time.—*Electric Journal*, February, 1921.

Wireless Valve Circuits as Applied to the Measurements of Physical Quantities.—R. WHIDDINGTON.—The application of electron valves to the measurement of minute distances is described. It is said that it is possible to detect a distance as small as one two-hundred-millionth of an inch with apparatus that is fairly manageable.—*Wireless World*, Jan. 22, 1921.

Telegraphy Telephony and Signals

Wired Wireless Transmission.—PHILIP R. COURSEY.—The author likens this system to a case of ordinary radio transmission with an ideally perfect directive sending aërial. Receiving stations in other directions will under these conditions hear nothing of the signals passing between the two stations concerned. One advantage of such radio transmission is that in case of a leaky line or one in poor condition it will still be usable for radio transmission. Practical details of sending and receiving apparatus for such systems is described.—*Wireless World*, Jan. 8, 1921.

Output of Ringing Machines for Automatic Telephone Exchanges.—F. P. DUMJOHN.—A formula is offered for the output of the ringing machines providing for a maximum number of simultaneous demands at full-load voltage and frequency.—*Post Office Electrical Engineers' Journal*, London, January, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Action on Colorado River Permit Suspended Pending Investigation

THE Federal Power Commission has deemed it desirable to suspend further action on the application of the Southern California Edison Company for a license to undertake a development on the Colorado River in order that a more general investigation of the possibilities may be made. If this is done, it will mean that the possibilities of irrigation as well as the opportunty for power development will receive full attention before any single project is approved by the commission. This idea is in line with the legislation proposed by Senator Pittman at the last session of Congress, at which time he recommended that the several interested states, the Reclamation Service and the Federal Power Commission should jointly investigate the Colorado River from all important points of view.

It had been rumored that the commission suspended action on this application because state permits had not been obtained by the company. O. C. Merrill, executive officer of the commission, says that this is not so. It is considered essential, however, to wait to determine a general policy with regard to so important a river so that no single project which might now be approved will later be found a stumbling block in the general program most desirable for all interested communities.

N. E. L. A. Convention to Emphasize Management Topics

EMPHASIS will be placed at the coming convention of the National Electric Light Association at Chicago, May 31 to June 3, on public utility finance, service, public relations and regulation. In speaking of the program to an ELECTRICAL WORLD representative M. H. Aylesworth, executive manager of the association said:

"While it is, of course, too early to give out any details of the program, still the indications are that it will be unusually interesting this year. Never in the history of the electrical industry has there been such a demand for discussion and solution of vital problems which are inseparably connected with the national progress in industrial and home-building development.

"Among the guests of honor will be state public utility commissioners from different parts of the country, federal, state and municipal officials, as well as many of the leading bankers, manufacturers, jobbers and contractor-dealers.

"Among the most important addresses and discussions which will take place will be those dealing with finance, service, public relations and regulation. The national committee on water power will have an interesting report dealing with its many conferences with and appearances before the Federal Power Commission. The other national committees, including that on steam-railroad electrification, will also have very interesting reports.

"The national Technical, Commercial and Accounting Sections will hold section meetings throughout the convention as usual, while the proceedings of the Public Relations Section, which is composed of executives, will be merged with the general morning sessions.

"Advance applications for reservations indicate a record attendance of company executives and members of their organizations."

Muscle Shoals Work Suspended Following Congressional Action

IMMEDIATELY following the action of Congress in refusing to appropriate further for the Wilson Dam at Muscle Shoals telegrams were sent by the chief of engineers suspending all work which could be abandoned at this time without jeopardy. At Jackson Island the work will be continued until the cofferdam can be removed. By carrying forward for a few weeks more the work on the south abutment an important saving will be made. By suspending the work promptly it will be possible to keep on hand about $1,000,000 of the existing appropriation, which will be sufficient to look after maintenance work until August, 1922, the earliest date that any further appropriation probably will be made available.

Those favoring the continuance of the work on the dam at Muscle Shoals carried the fight for the ten-million-dollar appropriation into the closing hours of Congress. When the House voted a second time to maintain its stand that no appropriation for the project should be made it became evident that a continuation of the fight in the Senate could result only in the failure of the sundry civil bill.

Relation of Public to Utility Regulation

A PUBLIC utility regulation must be prompt, fearless and intelligent. This was the message of Campbell Russell, chairman of the Oklahoma Corporation Commission, to the Oklahoma Utilities Association, which met in convention in Oklahoma City on Tuesday to Thursday of this week. Mr. Russell said that the best public protection is a well-protected public utility and that the passage of the measures before the Oklahoma Legislature to curtail the powers of the present Corporation Commission would be the worst move that could be made and would lead eventually to the enactment of a more stringent and possibly more radical commission law. Returns should be based on the efficiency of management, and, he asserted, unless this principle is followed in commission regulation municipal ownership had best come at once.

Paul A. Walker, referee of the Supreme Court of Oklahoma, discussed the power and duties of the

Oklahoma Supreme Court in rate and service cases. C. J. Griffith of the Little Rock Railway & Light Company discussed the "rise and fall" of the Arkansas Corporation Commission, its present status being due, he said, to a combination of ill-considered actions on the part of some utility interests that antagonized the people of the state and to a political situation in which the utilities were not involved.

These two papers brought out a lively discussion of the problem of public utility publicity in which the opinion was voiced by several speakers that most of the publicity material that has been used has gone far wide of the mark because it did not present the problems in a manner that was of interest to the general public.

The criticism that was made was that the material appeals primarily to the banker and business man and that the large body of citizens whose support must be secured before the banker and business man could act were not reached at all. In the discussion President Shartel insisted that utilities and the public generally had failed to recognize the fact that the fundamental economic basis of the utility business was in no wise different from that of any commercial venture. Until this fact is realized, he said, there can be little progress made in clearing up the present difficulties.

Accident prevention was discussed by J. Smith Speed of Oklahoma City on Tuesday afternoon. Natural-gas and street-railway problems were also discussed, as the association is made up of all the utilities in the state. The annual banquet was held on Tuesday evening, and on Thursday the various division meetings at which the individual utility problems were discussed were held. The following officers were elected for the coming year: President, John W. Shartel; first vice-president, C. E. Devin; second vice-president, F. A. Willard; manager, H. A. Lane.

Timely Program for Eastern Jobbers' Meeting on March 15

FOR the regular quarterly meeting of the Atlantic Division of the Electrical Supply Jobbers' Association, which will be held March 15 at the Hotel Commodore in New York, an interesting and timely program is being arranged. Among topics to come before the meeting is the necessity of jobbers' maintaining stocks for service under all conditions. W. I. Bickford of the Iron City Electric Company, Pittsburgh, will lead the discussion of this subject. E. Donald Tolles, secretary of the association, will report upon his investigations of systems employed by jobbing houses in their receiving, shipping and charging departments. These investigations have been made with a view to ascertaining if it would be possible to formulate a uniform system of handling orders for use by electrical supply jobbers.

"How to Sell the Contractors" is the subject of an address to be given by Charles L. Eidlitz, president of R. B. Corey & Company, New York. In this address Mr. Eidlitz, from his personal experience as contractor, as manufacturer and as jobber, will take up the question of why contractors are prompted to do business with the manufacturers instead of the jobbers. William L. Goodwin, who recently became associated with the Society for Electrical Development, will deliver a message from the society.

There will also be an executive session of the Atlantic Division, at which time members will consider the advisability of modifying the requirements for membership to admit smaller jobbers. At the same meeting there will be an election of a new division chairman to serve out the unexpired term of A. M. Little of Syracuse, resigned.

A. I. E. E. Telephone Interference Rules Withdrawn After Misuse

APPROVAL of the A. I. E. E. rules on telephone inductive interference has been withdrawn by the board of directors of the Institute as the result of a protest by the National Electric Light Association. The "telephone interference factor" had been misused in the Homer Electric Light & Power Company's case before the Illinois Public Utilities Commission (ELECTRICAL WORLD, Feb. 5, page 336).

In addition to the rule on "telephone interference factor" definitions of the following terms have been withdrawn: "Generation noise," "commutation noise," "interference," "inductive interference," "leakage telephone interference" and "telephone receiver." The rules have been referred back to the standards committee of the Institute for further consideration and report.

Interest Shown in $25,000,000 Project on Columbia River

REMARKABLE interest has been manifested in the proposal to harness the Columbia River at Umatilla Rapids, which involves an ultimate outlay of $25,000,000 and necessitates joint co-operation by two states —Oregon and Washington. The project would develop 120,000 continuous horsepower and 200,000 horsepower during the irrigation season. The keen interest shown by railroad interests indicates that the transcontinental lines may have an eye on this project as a means of providing power for the electrification of lines east of the Cascade Mountains which now compete with the Chicago, Milwaukee & St. Paul's electrically equipped road.

Members of the legislatures of Oregon and Washington, representatives of railroads, business men of both states and city and county officials recently met at Walla Walla to discuss the possibility of developing the remarkable power available at Umatilla Rapids.

New Shawinigan Water & Power Issue Offered to Yield 6¾ per Cent

ANNOUNCEMENT was made this week of a new issue of $2,500,000 Shawinigan Water & Power Company first refunding sinking-fund 6 per cent bonds, due July 1, 1950, at 90½ and interest, yielding 6¾ per cent.

This yield is lower than that of any other utility security that has been placed on the market recently, and with two exceptions the return to the investor of 6¾ per cent is less than that of any new public utility security that has been publicly offered within the past twelve months.

Proceeds from the sale of these bonds, it is stated, will be sufficient to pay all present floating debt of the company and to provide for new construction.

Rhode Island Organizes Electrical Co-operative League

REPRESENTATIVES of the electrical industry in Rhode Island met at the Providence Chamber of Commerce Feb. 16 and organized the Rhode Island Electrical League for the purpose of securing co-operative development of electrical trade and interests in the state. Arthur B. Lisle, general manager Narragansett Electric Lighting Company, Providence, and a director of the chamber, presided. The following speakers contributed to the discussion of the opportunities for a comprehensive development of electrical affairs through appropriate organization: Robert W. Adams, General Electric Company; W. A. Huse, W. A. Huse & Son; F. W. Bliss, General Electric Company; E. L. Milliken, Blackstone Valley Gas & Electric Company, a Stone & Webster property; L. L. Levine, Belcher & Loomis; M. F. Falk, Union Electric Supply Company, and F. A. Gallagher, Jr., Narragansett Electric Lighting Company.

M. F. Falk was elected permanent chairman and F. A. Gallagher, Jr., secretary. Thirty-seven representatives from various branches of the industry were present, and the following committees were appointed: Advisory committee, A. B. Lisle, H. O. Phillips, A. W. Marcou, R. W. Adams, W. E. Sprackling and G. Rogers; working committee, M. E. Learned, A. H. Allcott, H. J. Pettingell, L. C. Crandall, F. A. Boss, W. M. Wilson, Albert Walker and G. Schneider. A co-operative advertising campaign will be launched shortly.

Turbo-Generator Electric Drive Proved Successful in Sea Trial of Freighter

ELECTRIC drive on the freight ship *Invincible* was pronounced successful after an eight-hour sea trial in and around New York harbor on March 5 under observance of the United States Shipping Board. The boat is intended for transoceanic service and has a displacement of 7,880 gross tons and 4,960 net tons. Power is supplied by a turbo-generator to a 3,000-hp. induction motor, both made by the General Electric Company. The electrical equipment was installed at the Tebo Yacht Basin plant (Brooklyn, N. Y.) of the Clark Shipyard Corporation. The ship will be operated by the Cosmopolitan Shipping Company.

Diesel-Engine Electric Drive for Ocean-Going Freight Ship

THE first ocean-going freighter in the United States to be equipped for Diesel-oil-engine electric drive will result from contracts just signed between the Todd Shipyards Corporation and the American Mediterranean Steamship Company calling for the conversion of the motorship *Fordonian*, a 2,200-ton vessel. More than usual significance is attached to this contract as pointing the way to the adoption of a new method of ship propulsion which, with the exception of a fishing trawler, has never been commercially adopted in this country before.

The *Fordonian* is a single-screw freighter 257 ft. long, 42-ft. beam, 26-ft. draft, with a dead weight tonnage of 2,200 tons. Her new equipment will consist of twin Ausaldo San Giorgic two-cycle, four-cylinder Diesel engines directly connected to two 240-kw., 250-volt, 200-r.p.m. compound-wound direct-current generators. The generators will furnish power to a double armature, pedestal-mounted, 850-b.hp. 120-r.p.m. motor, which will be directly coupled to the propeller shaft.

The control system will be of the same type as that installed in the Diesel electric trawler *Mariner*, with the exception that the pilot house control is omitted on the *Fordonian*. This control apparatus consists of a panel board, meters, switches, rheostats and protective relay for the propeller motor, grid resistors which form a starting rheostat, and control contactors. This group of contactors contains those for staring, stopping and reversing the propeller motor, and are operated by a master controller in the engine room. While they are normally magnetically operated, there is also a provision for manual operation in case of emergency. The electrical apparatus contract has been awarded to the General Electric Company.

Financial Plans of California Companies

APPLICATIONS are pending before the California Railroad Commission for approval of extensive financial plans prepared by two large electric systems. The California-Oregon Power Company desires to reduce its outstanding securities by $6,062,000. Its plan includes the organization of a new company which will issue $10,000,000 of bonds to pay for necessary extensions and to meet underlying bond issues as they mature. The San Joaquin Light & Power Corporation wishes to issue $7,000,000 in bonds. Of this $2,625,000 would be used to meet construction costs resulting from development work on the company's Kern Canyon power project and the steam plant at Buttonwillow. Among the immediate improvements contemplated are an 8,250-hp. unit at the Kern River plant, to cost approximately $857,000, and the addition of a 17,000-hp. unit to the plant at Buttonwillow, estimated to cost $1,654,850.

Elimination of Waste Great Opportunity for Engineers

DUPLICATION of effort, lack of co-operation in research work, disregard of standard design, inefficient utilization of power and transportation and defective methods in technical educational institutions are the chief causes of the waste occurring in our industrial activities today, declared L. W. Wallace, executive secretary of the American Engineering Federation, in an address, "Waste and the Engineer," before a conference of engineers and economists in New York on March 9.

The duty of the engineer, Mr. Wallace pointed out, is to devise and recommend ways of eliminating waste, but the best results cannot be hoped for until the technical schools operate at a higher efficiency by doing away with the present large percentage of idle time of both instructors and students.

Along the lines of scientific and industrial research much information that is of great value is already known but has not been made available to the general public. This, together with the vast amount of duplication of work, causes enormous losses annually.

In the utilization of power, Mr. Wallace said, great strides of increased efficiency have been made in recent years, especially during the war, and present indications are that still greater economies are soon to be effected. Closely related are the transportation problems, both

internal and external, for which means of solution in some cases are already available. An example of possible savings through adoption of modern apparatus was given of a railroad which installed industrial trucks in its freight terminal at a cost of $63,000. During the first year's operation of these trucks a saving of $51,000 was realized.

In conclusion, Mr. Wallace emphasized the importance of co-operation and co-ordination of effort by all industries and recommended that greater power and authority be conferred upon the engineer in order that his work may be more productive of results.

Worcester Company Reduces Power Rates

A REDUCTION in power rates went into effect March 1 on the system of the Worcester (Mass.) Electric Light Company, affecting about 1,200 power customers. This follows a reduction of lighting rates of from 9 to 8 cents per kw.-hr. which affected 20,000 customers. The new power rate is figured on a recent coal quotation of $8.60 per ton, although the company's present fuel supply represents an average cost of $10.54 per ton. The reduction effected by the application of the coal clause differential to the lower price quoted reduces the bills of power customers from 5 to 16 per cent according to their individual energy rates, which vary from 6 to 2 cents per kw.-hr., depending on the energy consumed. The company has received many expressions of appreciation from its customers.

Last N. E. L. A. Executive Committee Meeting of the Year to Be Held Tuesday

THE last N. E. L. A. executive committee meeting before the annual convention in May will be held Tuesday of next week at the Edison Building in Chicago, when there will be present representatives from all of the thirteen geographic divisions and the chairmen of all of the sections. Among those expected to attend this meeting from the Pacific Coast is Past-president R. S. Ballard.

Among the important subjects will be reports from the national section chairmen on the year's activities and a report on the association's national work, such as the good-will advertising and the work on public utility information. The manufacturers' committee on good-will advertising will also make a report.

Investment Department of Northern Illinois Company Proved Success

THE investment department established by the Public Service Company of Northern Illinois a year ago was successful in selling all of the 23,280 shares of preferred stock offered for sale to the company's customers. This accomplishment, the annual report of the company for 1920, just issued by President Samuel Insull, says, increased the number of stockholders by about 2,000, and when all the stock which has been subscribed for on the installment plan shall have been fully paid for the total number of stockholders will be approximately 13,000, as compared with 2,455 before the investment department began work. During the year the company received $1,341,020 from this sale of preferred stock, also selling $1,750,000 of 6 per cent three-year gold notes and $1,000,000 of 8 per cent ten-year gold notes. Operating revenues from electricity, gas, heating and water showed an increase over 1919 of $2,328,861, and 10,000 electrical customers were added.

In 1920 the company made only such extensions and additions to its system as were necessary to meet growing demands. The connecting of large power customers necessitated building several transmission lines. One of them was the 33,000-volt, three-phase line, 12 miles long, between the Blue Island generating station and Chicago Heights, which was put in service in the fall. Another was the 12,000-volt, three-phase underground extension from the city limits of Chicago to the National Malleable Castings Company in Cicero. The company also built a 12,000-volt, three-phase transmission line from the city limits of Chicago to the Evanston substation and raised the voltage of the transmission line connecting Crystal Lake with the Waukegan generating station from 20,000 to 33,000. New 12,000-volt underground cables are now being laid in the village of Oak Park, and in Chicago Heights the company is installing a 500-amp., 4,000-volt, three-phase feeder connecting the Calumet Steel Company with the new Chicago Heights substation.

Summary of Federal Power Commission's Work to March 4

FOLLOWING is an official summary of the work done by the Federal Power Commission from its organization up to the close of Congress on March 4, when a change in the membership of the commission automatically took place with the transfer of the portfolios of War, Agriculture and the Interior:

Number of applications received	178
Number withdrawn	4
Combinations of applications	2
Total effective applications	172
Number of complete applications	70
Number of applications advertised	84
Number on which advertisement has expired	34
Number of cases for which General Land Office has been requested to make land withdrawals	19
Number submitted to Departments of War, Interior and Agriculture for field report	68
Number on which field report has been received	14
Number of applications before this office for final action	25
Number acted upon	23
Number on which action is pending	2
Applications in conflict	57
Applications the Reclamation Service has asked to have held up pending joint study	17
Declarations of intention filed with the commission:	
Number received	5
Number complete	5
Number submitted for field report	5
Number on which report received	3
Number acted upon	3
Applications for restoration to entry of lands in power-site reserve under the provisions of Section 24 of the act:	
Number received	33
Number on which the Geological Survey has been requested to make a report	27
Number on which report has been received	2
Number acted on by the commission	6

Navy Makes New Long-Distance Radio Record

ALL previous records for long-distance radio transmission were broken this week, it is reported, from the Goat Island wireless station at San Francisco when the United States Navy sent messages within three minutes from Cavite, Philippine Islands, to Washington, D. C., a distance of 10,000 miles. The Cavite station sent the messages 7,000 miles to Goat Island, whence they were forwarded to San Diego and on to Washington.

It is reported that a new automatic control used in making this record eliminates all handling of messages between originating and receiving points.

Interconnection to Receive Attention of Ohio Operators

INTERCONNECTION of transmission lines is to be discussed at the meeting of the transmission and distribution committee of the Ohio Electric Light Association to be held at the Engineers' Club in Youngstown, Ohio, on March 17. J. C. Damon of the West Penn Power Company will discuss "Advantages and Disadvantages—When Does Interconnection Pay?" while the "Limitations of Interconnection" will be discussed by E. C. Stone of the Duquesne Light Company. A paper on load dispatching will be presented by T. J. Williams, chief load dispatcher of the Windsor power plant. An inspection trip to the Lowellville power plant will be a feature of the afternoon program.

A. C. Bedford Praises Open Conduct of Electrical Utilities

BEFORE the New England Geographic Division of the National Electric Light Association at Providence, R. I., on Feb. 24, Alfred C. Bedford, president Standard Oil Company of New Jersey, commended the frank and open methods of electric utilities in their conduct of affairs and expressed the wish that the interchange of experiences, costs and other information prevalent in the electrical field might become the practice in other industries. The importance of telling the electric utility story to the public in clear-cut fashion was emphasized by the speaker, who also took occasion to praise developments in the employee-representation principle and the participation of employees in the ownership of securities of the corporate organizations to which they belong. Mr. Bedford recounted his early connection with high-tension line development for the Portland (Ore.) company and expressed his pleasure at still being concerned in the affairs of a few electric utilities.

Bowen Tufts, president of the New England Division, called the meeting to order, about 160 representatives of various branches of the industry having assembled at the Narragansett Hotel for luncheon after an inspection trip through the South Street generating station of the Narragansett Electric Lighting Company and the electric shop of that organization.

Bill to Increase Powers of Rhode Island Commission

AT THE PRESENT session of the Rhode Island Legislature a bill is under consideration by the judiciary committee providing for the enlargement of the powers of the Rhode Island Public Utilities Commission to include regulative authority over the issuance of stock, bonds, notes and other evidences of indebtedness payable more than twelve months after their date for the purpose of meeting the cost of acquiring property necessary for utility service, conducting business, improving or constructing plant, maintaining or improving service or refunding outstanding indebtedness or securities issued for any such purpose. Public hearing is required before the commission can issue a decision on such matters; full exhibits of outlays for these purposes in stock issues are required, and in the face of additional stock issues new shares must be offered proportionately to the stockholders at such reasonable price not less than the par value thereof as shall have been determined by the stockholders and approved by the commission. It is understood that the bill as filed represents the viewpoint of the city of Providence and that a hearing will be held later at which the utility companies of the state will have an opportunity to suggest modifications.

Plan to Make Standby Plants Profit Producers

NEGOTIATIONS are under way between the American Gas & Electric Company officials and the city of Bucyrus, Ohio, for the use of the local plant of the Bucyrus Gas & Electric Company as a central heating plant under a service-at-cost plan. The city of Bucyrus is served with electricity from the transmission lines of the Ohio Power Company, and the Bucyrus plant is held merely for standby service.

The plan now being considered for Bucyrus would use the local plant for generating purposes throughout the heating season, feeding energy back into the system. The exhaust steam would be sent through a condenser, thereby producing hot water which would be piped to customers under a service-at-cost rate. Under the proposed plan the company would credit to the heating account all of the energy generated at the system cost, thereby reducing the heating cost.

Under this plan a standby plant would be a revenue producer, instead of being idle most of the time, and could be run at a profit to the company. It was stated at the offices of the American Gas & Electric Company, the parent company, that it is considering doing the same thing with two or three other similar standby plants.

Bell Telephone Service in 1921 to Be Best Yet, President Thayer Says

SO RAPIDLY has restoration of the telephone service to pre-war standards proceeded, according to the annual report of the American Telephone & Telegraph Company, issued last Saturday over the signature of President H. B. Thayer, that there are good reasons to believe that during 1921 the Bell system will give the best and most uniform service it has ever given.

For the whole Bell system, with all duplications excluded, the total gross income for the year was $85,264,976, from which more than $37,000,000 was paid in interest, rent and miscellaneous deductions from income and approximately $40,000,000 in dividends. The surplus earnings for the year were $7,785,486.

The capital stock, bonds and notes payable of the Bell system outstanding in the hands of the public at the close of the year 1920 were $1,107,417,623, while the book cost of the net assets devoted to earning a return on these outstanding securities amounted to over $1,551,000,000. Actual appraisals of the telephone plant in the Bell system made by regulatory bodies for rate-fixing purposes show that the true value of its property greatly exceeds this book cost.

The report contends that for rate-making purposes the value of the property itself and not the issued capital should be the basis of fixing the amount of the return, since otherwise conservative capitalization is penalized and a premium put upon overcapitalization

and stock watering. Mr. Thayer points out that the market value of money at the present time establishes 8 or 10 per cent as a fair return on the value of the investment, and that a return of 8 per cent on the investment of the associated companies as a whole would warrant 10 per cent dividends because the companies' assets so far exceed their capital stock. At present none of the associated companies pays more than 8 per cent dividends.

In commenting upon the upward revisions of rates that state commissions have granted many of the operating companies to make in order to meet the increased demands for telephone service, the report states that in every case there was little or no opposition on the part of the public to the increase granted. This is taken as evidence of the general realization that good and adequate service is a matter of first importance and that giving needed relief to utilities has public support. The report recommends that in order to keep the commissions constantly informed as to the requirements of the public and the problems of the utilities, and to enable them to act more promptly on rate questions, they should be provided with additional clerical and technical help.

Utility Information Bureau Planned for New York State

PLANS are being formulated by the publicity committee of the Empire State Gas & Electric Association to establish a public utility information bureau to handle publicity for member companies. It is expected that the work of this bureau will follow closely along the lines of the publicity bureaus which have been operating successfully in Illinois, Indiana and Ohio.

Horace L. Mann, chairman of the publicity committee, in his report to the executive committee of the association stated that the gross revenue of the gas and electric companies which might be expected to participate in the publicity campaign was approximately $120,000,000, and that the estimated cost would be approximately $30,000—being in the ratio of one-fortieth of 1 per cent. No definite statement has been received as yet from the Electric Street Railway Association as to whether or not it will participate if the bureau is created.

Kansas Passes Non-Par Stock Law

AN ACT providing a non-par value for stock of all new companies, including utilities, incorporated in the state has just been passed by the Kansas Legislature and signed by Governor Allen. While this will not affect the stock of corporations already formed, it will be possible under the bill for electric light and power companies, through a reorganization, to place existing stock on a non-par basis.

Another bill also has been passed by the Kansas Legislature creating the Kansas State Utilities Commission, which removes utilities from the jurisdiction of the Kansas Court of Industrial Relations. The new commission will be composed of three members entirely separate from the industrial court, which will now be free to devote its attention to labor and industrial problems.

Another bill affecting public utilities in Kansas and which has passed both houses of the Legislature and awaits the Governor's signature is an act increasing the possible life of a franchise from twenty years to thirty-five years. Heretofore the Kansas law prohibited either the State or a municipality from issuing any franchise of more than twenty years' duration.

Municipal Utilities of Washington May Be Put Under Commission Control

TACOMA and other cities in the State of Washington are seeking legislative authority to sell electric energy outside city limits. The enactment desired is in part opposed by the Stone & Webster interests in the state, and attorneys for these interests have drafted three amendments which the Legislature is to consider. These amendments provide, (1) that a city selling power outside its corporate limits would be required to pay a tax of 5 per cent on its gross receipts, both inside and outside the city, into the state treasury; (2) that such a city would be required to obtain from the Director of Public Works, who is to take over the present duties of the State Public Service Commission under the new administrative code, a certificate of necessity before making an extension or to allow it to maintain and operate outside its limits any service where another corporation is already serving the public, with the exception of places where city service is now being given, and (3) that any municipality selling or buying energy outside its limits would have to submit to the control of the Director of Public Works.

New 200,000-Kw. Steam-Electric Plant for Chicago Territory

DETAILS of the projected construction of a plant at Waukegan, Ill., to have an ultimate rating of 200,000 kw., have been announced by the Public Service Company of Northern Illinois. This plant will be tied in with the Commonwealth Edison system, and with the Calumet plant now under construction in the southern part of Chicago by the Commonwealth Edison Company it will form an additional link in the tremendous system centering in Chicago. The new plant will be just north of Waukegan on a ninety-acre tract of land fronting on Lake Michigan, and it is expected that between $4,000,000 and $5,000,000 will be spent on the first two units of 30,000 kva. each. These will be in operation some time in 1921.

The announcement of the construction of this new plant has brought out a discussion of an interconnection of systems that will involve Minneapolis, St. Paul, Milwaukee, Chicago, Keokuk, St. Louis and Louisville. The construction of approximately 100 miles of transmission line in the territory between Chicago and Minneapolis and St. Paul would tie all these properties together with transmission lines. The majority of the lines, particularly in Illinois, will be of 33,000 volts, so that much trunk-line construction will be necessary to make effective interconnection of the systems possible.

Transmission voltages of 60,000 volts to 110,000 volts already exist around Minneapolis and St. Paul, at Milwaukee and between Keokuk and St. Louis. The discussion of interconnection is interesting because of the revelation of interconnection possibilities in the territory and the fact that physical connection of the electric light and power companies in the territory has progressed so far.

Light and Power Industry Is Community's Heart, Says S. W. Childs

INSTANCING the temporary industrial paralysis that spread through a Middle Western town recently when something went wrong at the power plant and the electric plant shut down, Starling W. Childs, vice-president of Bonbright & Company, speaking before a gathering of bankers at the William Penn Hotel, Pittsburgh, recently, likened the electric light and power industry to the human heart. When the power house stops beating, he said, life dies out of the town; thus the claim of the industry to be a basic one is indispensable. Mr. Childs deprecated the use of the generic term "public utilities" when only electric light and power companies are meant as apt to cause confusion in the minds of hearers. The problems of different classes of utilities vary greatly, and electric companies are free from labor and other troubles with which public utilities of other kinds are beset.

"Aside from the physical importance of the industry," Mr. Childs continued, "we should realize fully the financial importance of its securities. At a meeting of presidents of insurance companies recently it was stated that there are more than a million investors in light and power securities. There is more than $11,750,000,000 invested in public utilities, or $65 for each of the 27,000,000 depositors in the United States. This business is not only basic from a physical standpoint, but also from a financial standpoint, and since it is a basic industry it is essential that it be a healthy business."

Mr. Childs expressed the opinion that advocacy of the operation of utilities by the government would not be heard again for a generation.

New Source of Revenue for Water-Power Company

THE Susquehanna River, flowing as it does through the anthracite coal regions of Pennsylvania, carries down stream quantities of more or less finely divided coal which in the past it has been the custom to dredge with small equipments at various points along the river below the coal fields.

The shortages in the supply of bituminous coal which occurred during recent years have promoted the development of methods of using this anthracite river coal under boilers for steam generation, and this new demand, coupled with an increased demand for anthracite coal for domestic purposes, has led to a greater activity in the recovery of such coal from the riverbed. The great reservoir formed by the Pennsylvania Water & Power Company's dam, it is stated in the company's annual report for 1920, is apparently acting as an efficient settling basin for the depositing of this water-borne coal and its separation from the lighter silt which is carried off further down the stream. Though no accurate survey is as yet possible, it would appear that there are, perhaps, millions of tons of such coal deposited in this reservoir and the company has made arrangements with a dredging concern looking toward the commercial recovery of river coal. The officials of the company feel it desirable that the operations necessary for the recovery of this coal be conducted slowly and in a conservative fashion until such time as the recovery has been demonstrated to be commercially important, and when that time comes it plans to arrange for the recovery upon a scale commensurate with the amounts of river coal brought down and deposited. It is expected that for a few years this recovery will probably remain in the experimental stage.

Electric Service Big Factor in Income of North American Subsidiaries

SEVENTY-ONE per cent of the net 1920 income of the subsidiary companies of the North American Company came from electric service and from heating, as compared with only 13 per cent from electric railways and 16 per cent from gas and coal operations. This significant fact appears in the annual report of the North American Company and its subsidiaries, just issued by Harrison Williams, chairman of the executive committee. The total net earnings less the usual deductions for interest and dividends were $5,396,288, as against $4,580,701 in 1919. The earnings of all of the subsidiaries increased owing to a larger volume of business and increased rates, and though the business depression caused a falling off at the close of the year, a gradual improvement is now looked for.

A striking feature of the balance sheet is the investment of $119,504,435 in property and plant, or about three dollars per dollar of gross earnings. Property and plant investment increased $12,376,041, while capital liabilities increased only $9,895,540, indicating that about $2,500,000 of construction expenditures were financed out of earnings and reserves. In addition to substantially increasing the reserves for depreciation, the subsidiaries expended $4,941,331 for maintenance and renewals. Net working capital amounted to $6,916,896, an increase of nearly $1,000,000 during the year. Accumulated reserves and surplus total $27,708,533, an amount in excess of 90 per cent of the entire outstanding stock of the North American Company.

Kilowatt-Hour Output for 1920 Placed at Nearly Forty-four Billion

FIGURES of electrical generation by public utilities for the month of December have just been issued by the United States Geological Survey. They show a total of 3,750,909,000 kw.-hr. as compared with 3,697,390,000 kw.-hr. for November. Hydro-electric generation was 45,493,000 kw.-hr. ahead of November, the December figure being 1,430,327,000 kw.-hr. Unlike the central-station statistics published monthly by the ELECTRICAL WORLD, the figures of the Geological Survey include electric railways.

Average daily production of electricity in kilowatt-hours by public utility plants for the year 1920, as reported by the Geological Survey, was as follows: January, 124,700,000; February, 119,800,000; March, 120,700,000; April, 119,100,000; May, 115,600,000; June, 118,800,000; July, 116,800,000; August, 119,700,000; September, 120,800,000; October, 120,700,000; November, 123,200,000, and December, 121,000,000. The total output for the year was 43,900,000,000 kw.-hr., an increase of approximately 13 per cent over 1919.

The output for November, 1920, involved the consumption of more than 3,200,000 tons of coal, more than 949,000 barrels of fuel oil and more than 1,837,000,000 cu.ft. of gas.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A Novel Suggestion on Commission Practice.—A suggestion has been made before the legislative committee appointed to investigate the procedure of the California Railroad Commission that a state "defender" should be appointed, either connected with the Attorney-General's office or maintained separately, whose duty it should be to appear before the commission in rate matters and cross-examine witnesses offered by the utilities in the presentation of the figures on which they base their applications for rate increases.

Power Supply in Japan.—Official figures issued by the Department of Communications of Japan put the number of central stations in the island at 715, the electric railways at 42 and the companies operating both central stations and railways at 53, making a total of 810 electrical enterprises, or an increase of 57 over last year. The total capital of central stations is put at 763,000,000 yen, of electric railways at 56,000,000 yen, and of central stations and railways which are combined at 453,000,000 yen—a total of 1,272,000,000 yen, indicating an increase over last year of 177,000,000 yen.

A Queensland Water Power.—One of the many projected water-power developments in Australia has just been made the subject of a report by a government engineer. The site of this potential undertaking is on the upper Danson River, in Queensland. The engineer reports that very expensive storage reservoirs are a requisite to hydro-electric development in this territory, as the fall in the river is small and in dry seasons would be of little service. He thinks, however, that there are few better sites in Australia for a combined irrigation and hydro-electric scheme and estimates that the necessary dam and plant would cost £160,000.

Kansas City Electrical Show.—Kansas City, Mo., will hold its first electrical show during the week of April 18 to April 23 in the Convention Hall of that city, which will permit a booth space of approximately 14,000 sq.ft. Fifty per cent of this space had already been sold on Feb. 23, and a highly successful exhibition is expected. Two associations—the Missouri Association of Public Utilities and the Kansas Public Service Association—will hold their annual conventions in Kansas City in the week mentioned, affording exhibitors an unusually good opportunity of reaching the utilities branch of the industry in these two states.

Water-Power Generation Four Times Steam Generation in South Carolina.—A report of the Commissioner of Agriculture, Commerce and Industries in South Carolina shows a 120 per cent increase in electricity generated by water power in the last decade as contrasted with an increase of 33 per cent in electricity generated by steam. The commissioner's figures are: 1910—steam-electric, 17,325 hp., and hydro-electric, 41,958 hp.; 1920—steam-electric, 23,040 hp., and hydro-electric, 93,697 hp. There are still 29,197 hp. generated by water and 61,740 hp. by steam without the aid of electricity, but these figures are under those of ten years ago.

Electrification Plans in Spain Reach New Stage.—A comprehensive project for electrical development in Spain has, according to a dispatch under date of March 6, just been presented to King Alfonso, who has given to it his approval. The plan, drafted, it is said, by the leading electrical engineers of Spain, contemplates the construction of enormous electric stations along the principal rivers and railroad lines, extending more than 1,200 miles. The cost is estimated at 200,000,000 pesetas (about $40,000,000 at the old rate of exchange). The intention is to utilize the water power in the rivers and at the same time to use the poorer quality of coal which abounds in many districts. In addition to furnishing power for the railroads, the project contemplates distribution of power for agricultural and industrial purposes.

Hydro-Electric Survey of India.—An official report on the water-power resources of India recently published under government authority contains summaries of data gathered in 1919-1920 from which it appears that Burma contains more power possibilities than any other province, including four sites on the Pan Laung River where from 13,000 hp. to 39,000 hp. might be developed and an estimated minimum production of 10,000 hp. from falls on the Zawgyi River. Reference is made to about forty rivers and sites in the Bombay Presidency, though in some of these areas irrigation has a prior claim on the water sources. Potential horsepowers in Bombay run between 200,000 and 300,000, and the majority of the sources could, the report says, be used without difficulty. Large possibilities are also reported from Madras, the Punjab and other provinces.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Schenectady Section, A. I. E. E.—"The European Economic and Industrial Situation" will be the subject of an address by D. B. Rushmore before this section at its meeting next Friday, March 18.

A. I. E. E. Meeting.—At the three hundred and sixty-eighth meeting of the Institute, held in New York last night (March 11), the subject of discussion was "Developments in Conversion Apparatus for Edison Systems."

New England Commercial Meeting March 18.—The New England Division of the National Electric Light Association will hold a commercial conference March 18 at the American House, Boston, with morning and afternoon discussions of topics of special interest to business men.

March Committee Meetings of Ohio Electric Light Association.—The station-operating committee of the Ohio Electric Light Association is scheduled to meet at Cincinnati on March 16. Henry B. Dates of Cleveland is chairman of this committee. The new-business co-operations committee meeting is to be at Dayton on March 15; chairmen, M. H. Lytle of Piqua and M. W. Arthur of Akron.

Electric Club of Chicago.—W. D'A. Ryan, director of the illuminating engineering laboratory of the General Electric Company, gave a talk on "Ancient and Modern Lighting" before a large gathering of members and guests of the Electric Club of Chicago on March 1. Mr. Ryan, with the aid of slides, showed ancient and modern methods of lighting. His slides showing the wonderful lighting at the Panama Exposition aroused the enthusiasm of his audience. At this week's meeting, on March 8, Charles Munroe, vice-president People's Gas & Coke Company, addressed the club on "Utility Securities from the Owner's Standpoint."

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Cleveland Section, March 14; Birmingham Section, March 19; Pittsburgh Section, March 19; Chicago Section, March 22; Philadelphia Section, April 4.

American Institute of Electrical Engineers—Providence Section, March 15; Schenectady Section, March 18.

Associated Manufacturers of Electrical Supplies—New York, March 15. (For program see issue of Feb. 26, page 501.)

Illinois State Electric Association—Chicago, March 15-17.

Wisconsin Electrical Association—Milwaukee, March 23 and 24. (For program see issue of Feb. 19, page 418.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section)—New York, March 25.

A. I. E. E. and A. I. and S. E. E.—Joint session, Pittsburgh, April 16.

Missouri Association of Public Utilities—Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society—Washington, April 23.

United States Chamber of Commerce—Atlantic City, April 27-29.

American Society of Civil Engineers—Houston, Tex., April 27.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Electric Service in the Philippines.—The Philippine Islands Public Utility Commission has forbidden the Tayabas Light & Power Company to charge an arbitrary amount against a customer in a case where the electric meter was found not to be registering accurately, or to discontinue service for non-payment where there exists an honest dispute over the amount due.

Street Lighting and Commercial Lighting Compared. — Overruling a charge of discrimination made by the city of Hermann, Mo., against the Hermann Electric Light Company because the rate charged the city for lighting the streets was higher than the commercial lighting rate, the Missouri Public Service Commission declared that the additional expense incurred by an electric utility in maintaining street lamps justified the increased charge.

Extensions of Service Into Rural Territory.—The Indiana Public Service Commission while ordering the Indiana & Michigan Electric Company to make certain demanded extensions into rural territory observed: "The commission is not unmindful of the difficulties incurred by public utilities in securing funds for extensions, or of the problems presented by extensions of a city electric utility into rural territory, and does not desire to involve respondent in a precedent which will require it to make future extensions in rural territory against its policy."

Combined Minimum and Service Charge.—In the case of a complaint against the Eastern Pennsylvania Light, Heat & Power Company on account of a service charge being included in its schedules in addition to a minimum charge the Pennsylvania Public Service Commission held that the application of the combined charge was inequitable. "The service charge in its widest scope," the commission said, "embraces the consumer's costs and a capacity charge. The minimum charge includes both and a charge for energy. The minimum charge based upon the connected horsepower includes the three factors and, in addition, recognizes, in a measure at least, the extraordinary requirements of the individual consumer, usually covered by a so-called demand charge. It is apparent, therefore, that the respondent by including in one schedule all these charges—namely, service charge, minimum charge and minimum charge based upon demand—is repeating the several items which constitute these charges."

Company Can Collect Legitimate Charge Accidentally Omitted from Statement of Account.—The failure of a utility, through oversight, to bill a surcharge which, in accordance with the order of the California Railroad Commission, was a proper part of its rates for electricity does not, that commission has asserted, absolve any customer from the payment of such surcharge.

Apportioning Valuation of Heating and Electrical Utility.—In a valuation for rate making the Illinois Public Utilities Company apportioned the boiler house, boilers and the greater part of equipment jointly used by the electrical and steam-heating departments of a public utility between these departments upon the basis of their respective maximum steam demands expressed in boiler-horsepower, and land used for coal storage was apportioned in the same ratio as the fuel stored there was divided.

Proper Proportion of Bonds to Stock.—The issuance of bonds under any form of mortgage of more than ten times the face value of the stock of a utility company has been declared against the public interest by the New Jersey Board of Public Utility Commissioners, which also held that the issuance of thirty-year mortgage bonds at 8 per cent interest for the purpose of paying existing indebtedness and providing for new construction would under present conditions create an unnecessary burden upon the consumers of a utility company. Short-term bonds, convertible into long-term obligations when the price of capital becomes less, were favored by the board of commissioners.

The Income Tax as It Affects the Rate of Return.—In declaring 9 per cent to be a reasonable rate of return to the Mutual Telephone Company of Hawaii, the Public Utilities Commission of that territory made this observation on the federal and territorial income taxes: "It has been vigorously contended that in determining the proper allowance for expenses of operation no allowance should be made for income taxes, on the ground that they are properly assessable to the individual and that the legal requirement of the payment of such taxes by the corporation is merely a collection of such taxes at the source. This view, we are aware, has been taken by certain other commissions. As we see it, the fallacy of this view is that it results in nothing more than indirectly reducing the net return determined upon as a reasonable return to the utility. In other words, if income taxes are disallowed as expenses of operation, the net result is that instead of being allowed the 9 per cent which we have determined upon as a reasonable return in this particular case, the return allowed to this utility would be 9 per cent less the amount of the income taxes." The commission therefore included income taxes as proper expenses of plant operation.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Rates Must Have Fair Trial Before Being Declared Confiscatory.—The city of Galveston, Tex., has won in an action brought against it by the Brush Electric Company for a permanent injunction to prevent the abolition of a 10 per cent surcharge on bills to consumers, the United States District Court having reversed a decision favoring the company that had been made by a master in chancery. The federal court rules that the rates prescribed by the city of Galveston have not been proved confiscatory and should have a fair trial to determine whether they will give a reasonable return.

Provision of Insurance Policy Barring Electrical Plant Employees Void When Occupation of Insured Was Clear to Company.—In Hungerford vs. Mutual Life Insurance Company of New York the insurance company sought to bar recovery of the amount covered by a policy because the insured was killed while engaged as stationary engineer in an electric power house notwithstanding that a clause in the policy specifically barred him from "handling electric wires or dynamos." The Supreme Court of Iowa found that inasmuch as the deceased had truthfully stated his occupation and it was common knowledge that men so employed must handle electric wires and dynamos the clause in the policy was void and the insured's heirs could recover. (180 N. W. 849.)*

Responsibility for Unprotected Transmission Wires Cannot Be Shifted from Power Company to Industrial Customer.—In a suit because of the death of a boy from contact with uninsulated high-tension wires entering a factory, damages were assessed equally against the North Carolina Electric Power Company and the French Broad Manufacturing Company. Subsequently suit was brought by the former against the latter to recover the share paid by it, on the ground that the accident was entirely the fault of the industrial company, because by constructing a fill alongside the transformer house it had made it possible for the boy to climb to the roof and reach the wires, which otherwise he could not easily have done. The Supreme Court of North Carolina reversed the verdict found for the plaintiff in the lower court, declaring that the duty of a power company properly to guard its dangerous wires is a primary duty which cannot be shifted to a consumer. (105 S. E. 394.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

H. A. Brody has been appointed manager of the Lindsay district of the Southern California Edison Company. Owing to the greatly increased business of the company and to provide the proper facilities for taking care of its consumers in that territory a new district was created recently, with headquarters at Lindsay, in the San Joaquin Valley. Mr. Brody has had



H. A. BRODY

ten years' experience in the public utility field, of which the last seven have been with the Southern California Edison Company organization. He was born in 1888 in Missouri and went to California in 1910, entering the employ of the Pacific Gas & Electric Company, with which he remained until he joined the sales force of the Southern California Edison Company at Santa Barbara. He was later transferred to the general office, commercial department, and in 1918 was appointed district manager at Lancaster. This position he held up to the first of this year, when he received his transfer to the new Lindsay district.

A. G. Moser, manager of the Ohio Power Company, Bucyrus, Ohio, has been appointed assistant manager of the Canton division of the company. Mr. Moser became associated with the Ohio Power Company in December, 1913.

E. Curtis has been appointed engineer of the power station of the Fort Smith (Ark.) Light & Traction Company. Mr. Curtis succeeds L. J. Noble, who has been made general manager.

Major G. Heustis has been appointed manager of the Vermont Hydro-Electric Corporation, Rutland, Vt., which is controlled by W. S. Barstow & Company, Inc.

C. S. Kennedy, formerly manager of the Southern Iowa Power Company, Chariton, Iowa, has been appointed manager of the Ottertail Power Company, Fergus Falls, Minn., to succeed the late C. B. Kidder. Mr. Kennedy is a graduate electrical engineer of the Ann Arbor University.

Victor Greiff, who joined the American Bosch Magneto Corporation of Springfield, Mass., a year ago, for the purpose of installing and putting into operation a research laboratory for the study and development of electrical automotive equipment, has completed the work and returned to his home in New York City. As a result of Mr. Greiff's efforts the company now has probably the most complete department for ignition research in the country.

C. O. Miniger, vice-president of the Willys Corporation and general manager of the "Auto-Lite" division of that corporation at Toledo, Ohio, has been appointed president and general manager of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., manufacturer of storage batteries, car-lighting equipment and electric arc welders, to succeed J. Allan Smith. Mr. Miniger will continue to be in charge of the "Auto-Lite" division of the Willys Corporation at Toledo. He is well known to the automobile industry. He was one of the original incorpora-



C. O. MINIGER

tors and organizers of the old Electric Auto-Lite Company, and when John N. Willys acquired control of that company Mr. Miniger was placed in charge of its affairs.

Robert M. Stanton, formerly test engineer for the Eastern Shore Gas & Electric Company, Salisbury, Md., has been transferred to the Citizen's Light & Power Company, Oil City, Pa., to assume the position of superintendent of electric operation, succeeding C. C. Christ.

H. W. Williams has been appointed special representative to the general superintendent of motive power of the Chicago, Milwaukee & St. Paul Railroad, with headquarters at Chicago. He was formerly assistant engineer in the electrical department, with headquarters at Seattle.

Herbert Knopf, who was recently promoted to the newly created position of electrical superintendent of the North Bay division of the Pacific Gas & Electric Company, has been engaged



HERBERT KNOPF

in various phases of the electrical industry since graduation from the University of California in 1907. Mr. Knopf was born in San Francisco in 1885. Immediately following graduation he was employed four years in electric train-lighting work by the Southern Pacific Railroad Company, after which, in 1911, he was employed by the Pacific Gas & Electric Company in the Oakland department of electric distribution. Following this he was transferred to San Mateo as assistant superintendent of electric distribution, and lately, as a result of a reorganization, he was made division electrical superintendent.

N. J. Garrison, manager of the El Reno division of the Oklahoma Gas & Electric Company, has been elected president of the El Reno Chamber of Commerce for a third term.

B. H. Clingerman, who has been a member of the engineering staff of the B. F. Goodrich Company at Akron, Ohio, for a number of years, has recently been appointed consulting engineer for the company. Mr. Clingerman was formerly associated with H. M. Byllesby & Company and was general manager of the Mountain States Power Company at Tacoma, Wash.

Frank R. Devlin, a member of the California Railroad Commission, has been elected president of that body by his fellow commissioners in succession to Edwin O. Edgerton. President Devlin was appointed to the commission by Governor Hiram Johnson, his term beginning Jan. 1, 1915. He succeeded John M. Eshleman upon the latter's election as lieutenant-governor. Previous to his appointment as commissioner Mr. Devlin had served the



F. R. DEVLIN

county of Solano as district attorney and as superior judge. Mr. Devlin has devoted much time to the study of power problems and has been responsible for many opinions of the commission on special contracts. During his six years of service he has presided over some of the most important cases in the history of American rate regulation. He has tended to specialization in power and hydro-electric matters, and his decisions in such matters as the Pacific Gas & Electric rate and finance cases laid down the lines upon which the future power development of California will proceed. Equality of payment among purchasers of service has been one of his outstanding economic policies. In 1918, with Commissioner Edgerton, he sat in the Pacific Gas & Electric surcharge case, out of which the decision developed that corporations must abrogate contracts giving special rates to certain consumers. Many of these contracts were of long standing. Mr. Devlin took the position that to favor one consumer is merely to penalize all the rest and that contracts of this sort were of the same illegal character as rebating.

Robert P. Sanborn has been appointed manager of the traction department of the Edison Storage Battery Company with headquarters at the factory and main office, Orange, N. J. Mr. Sanborn is well known to the industry through a connection of several years with the power and mining department of the Erie (Pa.) works of the General Electric Company.

S. N. Clarkson, associate Western editor of the ELECTRICAL WORLD, has resigned to enter business for himself as a consulting engineer and in a specialty sales field which will not conflict with his consulting practice. His office will be in the Star Building, St. Louis. Mr. Clarkson has had a broad experience in the industrial, manufacturing and central-station branches of the electrical industry and has a wide acquaintance both in this country and abroad. He attended the Sydney (Australia) Technical College and for about eighteen months after coming to this country confined himself to practical electrical and mechanical work in the Middle West. In the summer of 1906 he entered the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company as production clerk. Within a few months he was made assistant foreman and two months later obtained a transfer to the power division of the engineering department. Upon the formation of the company's general engineering division he was appointed to it. He continued in this work until he resigned in 1910 to become industrial engineer for the Union Electric Light & Power Company of St. Louis. The foundation was then laid for the marked growth of that utility's industrial power business which followed, and Mr. Clarkson was advanced to the position of assistant sales manager and sales engineer. When the Milwaukee Electric Railway & Light Company, another subsidiary of the North American Company, planned to build a new power plant in 1917 Mr. Clarkson was transferred to Milwaukee to build up a load for the proposed new generating station. However, the war made it necessary to postpone the building of the new power



S. N. CLARKSON

plant, and two years later Mr. Clarkson accepted an offer to become associate Western editor of the ELECTRICAL WORLD and *Electrical Merchandising*. He is a member of the American Institute of Electrical Engineers and he is also past-chairman of the St. Louis Section.

W. A. Darrow, for the last fifteen years Philadelphia district sales manager of the Elliott Company, Jeannette, Pa., manufacturer of power accesories, has been appointed special representative with headquarters in Philadelphia.

Charles H. True has become vice-president of the Locomotive Superheater Company, manufacturer of superheaters and boilers, in charge of production, with offices at East Chicago, Ind. He became associated with



C. H. TRUE

the Locomotive Superheater Company in 1912 as works manager. Previous to this he was mechanical engineer with the Railways Materials Company at Chicago and was engaged in the design of metallurgical furnaces.

Arthur Purdon has been appointed general sales agent for the Utah territory of the Ideal Electric & Manufacturing Company, Mansfield, Ohio, with offices at 615 Newhouse Building, Salt Lake City.

Obituary

Cecil P. Poole, for a number of years mechanical engineer for the city of Atlanta, Ga., recently died at his home in that city. Mr. Poole moved to Atlanta, May 1, 1912, to engage in engineering work in partnership with Lamar Lyndon, New York City. Later he became identified with the engineering department of the city of Atlanta in connection with the enforcement of the smoke ordinance, and has since been in charge of work of the department of inspection, which included the analysis of illumination gas, of which Mr. Poole had made a special study. Mr. Poole was author of several well-known works on mechanical engineering. His early life was devoted to editorial work, which included editorship of the *American Electrician*, associate aditorship on the staff of the ELECTRICAL WORLD and co-editorship of *Power* for several years.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Trend Toward Development of Low-Head Water Powers

WITH the volume of orders for waterwheels and generators placed last year it is interesting to note the large number of small units—from 625 kva. and below—that were sold. In the past small water-power sites have been neglected, it seems, because the larger and more spectacular developments attracted most of the attention. The development of these small projects is now being looked upon more favorably than ever before. This is particularly true among industrial concerns which have available low-head water powers.

The high fuel and transportation costs and the attention that is being given to water-power developments in general, it is felt, will have a great effect on turning public interest on the many little falls that could be developed for lighting and power purposes in small towns and factories. Machine developments are rapidly tending toward this end. From a financial point of view it is much easier at this time to promote several of these small developments than one of the large ones.

The hydro-electric outlook in general for the coming year seems to be favorable. Although licenses for many large undertakings have been applied for through the Federal Power Commission it is doubtful at this time that many of them, if their applications are approved, can get their finances in shape to go on with the ordering of apparatus this year.

Expect Good Sales of Pole-Line Switching Equipment

FOR the most part buying of farm-light and power pole-line switching equipment throughout the country to date has been curtailed by money tightness, a survey of the situation shows. Good prospects for business are reported by virtually every section of the country, however, and in fact increased sales are already noted in certain of the Mississippi border states. Deliveries are everywhere reported good. Prices of this class of equipment, except for a 10 per cent reduction by one manufacturer in January, remain unchanged. At least one producer is guaranteeing prices until May, but in many quarters lower prices are expected even before that time.

In the Northwest sales to date have been very light and consequently stocks are ample. It is generally expected that demand will pick up there during the next two months. California, it is reported, has presented comparatively little market for this class of material, but large manufacturers are said to be contemplating establishing sales offices in that state with a view to pushing sales.

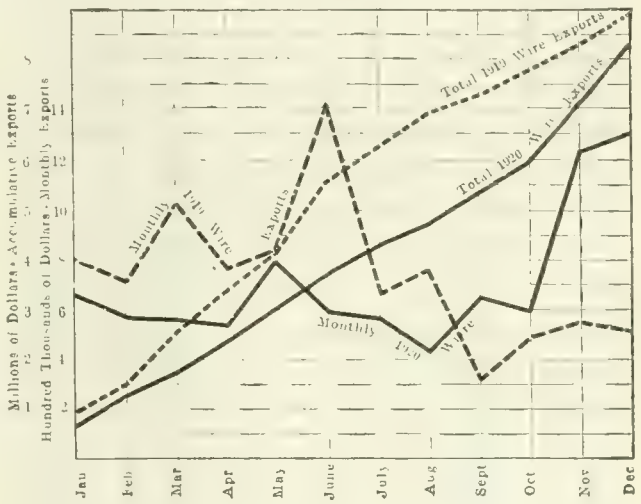
Chicago territory finds business dull. Inquiries have been frequent for equipment of farmer and municipal power distribution lines, however, but only in a few cases can the required financial arrangements be made. Hence no actual orders are being placed. St. Louis reports about a 25 per cent increase in buying over a month ago, with immediate shipments made from local stocks. The South, too, notes an increased movement, but the gain in the latter district is not so marked as it might be because of the farmers' inability to move their cotton.

Central stations in New England are pretty well supplied with material for short extensions and demand there is light. Jobbers' stocks, however, are not especially complete. The Atlantic States as a whole do not at any time present so fertile a field for sales as some other sections of the country, and just now money tightness has curtailed central-station buying. Sales are expected to increase, and customers entering the market will receive better deliveries than at any time since the war.

Wire Exports for 1920 More than Eight Million

WHEN the exports of insulated wire and cable from the United States for the year 1920 are totaled up they come to a value of $8,410,242. This value, however, is nearly $400,000 below the total for the year 1919, which came to $8,792,309.

Taken by the month a small peak of exports was noticeable in May of 1920, but it remained for November to show a radical increase of more than 100 per cent above the month of October, which was an average month up to



MONTHLY AND TOTAL WIRE EXPORTS FOR 1919 AND 1920

this time. In the year previous, however, the month of June showed the heaviest increase, although this was well under 100 per cent. Thereafter the exports fell off, and they finished the year at a little over one-third of June's peak. Those of the last four months of 1920 showed a definite trend upward.

1920 AND 1919 INSULATED WIRE AND CABLE EXPORTS FROM UNITED STATES

Country	Value of 1920 Exports	Value of 1919 Exports	Country	Value of 1920 Exports	Value of 1919 Exports
Brazil	$1,266,802	$981,757	Peru	$164,930	$143,861
Cuba	948,387	549,960	Chile	136,094	300,425
Norway	588,274	1,671,412	Sweden	125,400	138,649
Mexico	585,885	339,891	Italy	124,109	40,401
China	562,483	310,592	Dutch East Indies	111,833	292,207
Argentina	451,210	691,355	France	101,711	111,764
England	450,084	257,719	63 miscellaneous countries under $100,000	1,368,652	1,724,240
Philippine Islands	431,321	291,113			
Netherlands	298,490	473,082			
Canada	271,351	197,719			
Panama	237,619	84,140	Total wire and cable exports	$8,410,242	$8,792,309
British India	185,607	192,022			

Brazil took the most insulated wire and cable from the States, $1,266,802, with Cuba a good second at $948,387. Norway, Mexico and China came along together, then

Argentina, England and the Philippine Islands. The remainder were under $300,000 each. There were sixty-three countries taking less than $100,000 each, which made a total of $1,368,652, but their average was only about $22,000. The previous year Norway took the most cable, with Brazil second, Argentina third and Cuba fourth. The Bureau of Foreign and Domestic Commerce compiled the original figures.

January Exports of $15,332,955 Set New High Mark

WITH the month of January, 1921, returning a value of electrical exports amounting to $15,332,955, a new high mark in monthly exports has been set. The 1920 average was $8,550,000 per month. Exports for the whole year of 1910 amounted to only about $14,750,000, a figure below that of the past January alone. The following year, 1911, came up to about $18,750,000, while 1914 showed only $20,000,000. So in the last eleven years the exports have increased twelve times.

It is interesting to note the high rate at which electrical exports have been increasing since last September, especially in view of the decreases shown in the values of exports of all commodities over the last few months.

Exports of insulated wire and cable in January were nearly double those of any previous month, and the figure for motors is well above that of any other month. Miscellaneous exports showed just under the high figure set last December. Transformers, telegraph apparatus, magnetos, spark plugs, etc., carbon-filament lamps, arc lapms, generators, carbons and batteries also were less in January than in some months of 1920. The values of fans, heating and cooking apparatus, metal-filament lamps, meters and measuring instruments, switches and accessories, and telephones were the highest ever recorded. Particular attention is called to the value of fans exported and of metal-filament lamps, figures on which have increased very much.

The Bureau of Foreign and Domestic Commerce has compiled the figures in the attached table:

	January, 1920	January, 1921
Batteries	$374,730	$655,712
Carbons	139,640	70,823
Dynamos and generators	413,293	629,461
Fans	19,587	358,444
Heating and cooking apparatus	103,819	291,546
Insulated wire and cable	661,842	2,447,654
Interior wiring supplies	168,889	422,015
Arc lamps	90	1,430
Carbon-filament lamps	7,133	9,075
Metal-filament lamps	211,697	620,434
Magnetos, spark plugs, etc	261,542	303,900
Meters and measuring instruments	188,123	398,878
Motors	735,236	2,064,424
Rheostats and controllers	18,558	161,253
Switches and accessories	294,036	797,246
Telegraph apparatus	183,404	99,673
Telephones	230,186	659,373
Transformers	350,364	925,372
All others	1,968,152	4,416,242
Total electrical machinery	$6,350,321	$15,332,955

Spring Buying of Poles Is Light

PRODUCERS of Western red and Northern white cedar poles report that the market remains quiet. Spring buying has not yet been in evidence to any extent, though central stations are taking more interest, it is true. Their needs as yet have not advanced beyond the estimating stage, however, while electric railways have given no intention at all of buying. Despite this rather dilatory action of consumers in covering their needs for spring construction work producers are confident that the year as a whole will show good sales. Expectation of price decreases, it is said in some quarters, is one factor in delaying buying as present quotations of poles represent their peak price.

Production of poles this present winter has not been so large as in other seasons. For one thing, there has been a comparatively light snowfall in the regions where dependence is placed upon snow for hauling; and in the second place sizable stocks, light demand and the possibility of a price decrease are said to have operated against a heavy cut of poles.

Good stocks are held at distribution points at present so that shipments are made from stock. An Eastern consumer can therefore count on obtaining poles in from two to three weeks from the date of his order. Representative producers' prices for Western red cedar poles are as follows: 30-ft., 7-in. top, f.o.b. Chicago, $10.90, New York, $12.20; 35-ft., 8-in. top, Chicago, $16.25, New York, $18.30; 40-ft., 8-in. top, Chicago, $19.80, New York, $22.40. Northern white cedar prices are as follows: 30-ft., 7-in. top, f.o.b. Chicago, $11.60, New York, $12.50; 35-ft., 8-in. top, Chicago, $19.05, New York, $20.75; 40-ft., 8-in. top, Chicago, $23.95, New York, $26.15.

High-Tension Porcelain Insulator Prices Lowered

SINCE the middle of February four of the large manufacturers of high-tension porcelain insulators have reduced prices on their product approximately 10 per cent. Not all insulators are included in the drop, however, nor has every manufacturer fallen in line with this reduction as yet. The lower price applies to all suspension units and to all multi-part pin-type insulators. Single-piece pin-type units and strain insulators are not included in the price revision. The first manufacturer to announce a price reduction made the drop effective Feb. 15. Cuts by other producers followed at intervals of from four to six days until the last decrease to be announced thus far took effect on March 1. Other manufacturers are expected to take similar action before long.

Present buying in this field throughout the country, on the whole, is light. Deliveries as a consequence are improving, though but slowly. Stocks of the finished product apparently do not exist anywhere, and nearly all the manufacturers still have such a large volume of back orders hanging over from the previous period of strong demand that shipments will very probably continue to rule long for some time to come. In general, manufacturers are quoting deliveries of high-voltage pin-type insulators on an average of four to five months. Suspension units, on the whole, are in a little better shape as regards delivery. There are, of course, variations both considerably above and below this average with some manufacturers.

The Metal Market Situation

NO IMPROVEMENT is seen in the copper market. Prices are once more fractionally lower, but price cuts, instead of stimulating demand, seem actually to have had the opposite effect. Small producers have this week accepted orders at 12.25 cents delivered for prompt and March shipment; 12.37½ cents for April, 12.62½ cents for May and 12.75 cents for June shipment. Some of the large producers refuse to enter the market at these prices, however. Copper production, as indicated by the February reports of several operating companies, is being cut materially. Offerings in the outside market are small with slightly lower prices there.

NEW YORK METAL MARKET PRICE

	March 1, 1921	March , 1921
Copper	£ s d	£ s d
London, standard spot	68 5 0	65 10 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75	12 50
Electrolytic	12 50 12 62½	12 25
Casting	12 00	12 00
Wire base	15 25	15 00
Lead, trust price	4.00	4 00
Antimony	5.20	5 20
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5.10	5.30
Tin	30 25	27 50
Aluminum, 98 to 99 per cent.	28 00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 50 10 75	10 25 10 50
Brass, heavy	6 00 6 50	6.00– 6.50
Brass, light	4 00 4 25	4 00– 4 25
Lead, heavy	3 25 3 50	3 25– 3 50
Zinc, old scrap	3 00 3 12½	2 87 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

BUSINESS seems to be merely holding its own in the jobbing field. In the manufacturing field propositions are appearing over the horizon which were not there at the turn of the year. Inquiries of a price-seeking nature are keeping engineering offices and proposition departments very busy, but actual orders are slow to come in. Money is no easier to collect and no let-up in pressing for payment can be afforded at this time.

Jobbers' stocks are down pretty low and are being kept there as they feel that any renewed demand can be filled promptly from manufacturers' stocks. This may be the result on a larger demand of slight duration, but a protracted demand would soon clean out even producers' stocks.

NEW YORK

Conditions in the electrical market continue to vary. Here and there a jobber reports a slight increase in general demand, while others see no improvement. On the whole, it seems, it must be admitted that present business is quiet not only in staple wiring lines but also on large and small appliances too.

Jobbers are now in a better position to weather a protracted siege of depression, however. Stocks have been reduced until some houses say they cannot possibly get them any lower. Ordering in virtually every line of goods is being carried out on a cautious basis of immediate needs. Collections are pushed strenuously, and though some complaint is heard as to tightness of money the collection situation is not bad.

Competition continues to be strong, and the willingness to cut prices to gain an order remains. Contractors seem to be figuring on considerable work, but actual jobs in sight are lacking. Retailers report that it is hard to get the public to buy. Prices in the past week have not changed.

Conduit.—The average market on black conduit in 2,500-ft. lots this week ranges from $70 to $71.50 per 1,000 ft. for ½-in. and $135 to $137 for 1-in. A very few jobbers continue to hold as high as $80 on ½-in. and $155 on 1-in. black. Demand continues slow with adequate stocks.

Tape.—In 100-lb. quantities standard grades of friction tape are sold for from 45 to 52 cents per pound and rubber from 40 to 51 cents. Stocks are not large and demand is slow.

Flexible Armored Conductor.—Here and there sales are reported to have increased, but general demand remains light. Several jobbers are carrying stocks of between 25,000 ft. and 50,000 ft. From $60 to $66 per 1,000 ft. is asked for No. 14, two-wire, double-strip.

Rubber-Covered Wire.—On orders for 10,000 ft. No. 14 is held at from $7.75 to $8.90 per 1,000 ft. Sales continue very small, but most stocks are at a comparatively low level too.

Vacuum Cleaners.—A few jobbers report fairly good sales and state that demand has picked up. The majority, however, are finding a quiet market with little or no increase in orders. On the whole jobbers are well stocked for present needs, and the almost unanimous report is that spring buying will be done very cautiously. Prices are steady.

Washing Machines.—Very few machines are being carried in stock as the call is light. There is some talk of expected price reductions.

Knife Switches.—Jobbers are about evenly divided in reporting upon sales and the number of switches they carry. Several report either a good or fairly strong demand, while about an equal number say that sales are slow. Stocks, too, vary from small to large. A representative single-throw, two-pole, 30-amp. fused switch sells at $1.06 each, list, in small lots, with 10 per cent discount for an order of $100 value.

Lamp Cord.—One thousand feet of No. 18 cotton, twisted, ranges in price from $16.75 to $20, and No. 18 parallel from $18.75 to $26. Demand is small and, with few exceptions, so is stock.

Distribution Transformers.—Demand has picked up recently and is expected to improve further. One large manufacturer has accumulated a good stock in this territory and can ship any size up to 100 kva. from stock. Another producer still has back orders on hand, so that shipments on sizes under 50 kva. in this instance average sixteen to twenty weeks. Over that size a few units are in stock. Prices are steady since the 10 per cent drop a month ago.

CHICAGO

A marked increase in building activity is noted in Chicago and surrounding cities. The reported cessation of the practice of canceling orders is giving manufacturing interests added confidence and is causing them not only gradually to increase working forces but also to open for reconsideration plans for extensions and improvements which were shelved last fall.

Through recessions that have been made in material prices and improved labor efficiency contractors are able to bid from 15 to 20 per cent less on jobs than could be done last fall. Several hundred cottages and bungalows have been got under way in the past month, and many apartment buildings are being put under contract.

Actual trade has not yet felt the effect of these improved conditions. It will be a matter of weeks before the current dullness is greatly altered. Certain price-cutting operations in household appliance lines have damaged the sale of price-maintained lines. This condition is necessarily of temporary character as prices are felt to be reasonable on this class of material.

Bare Copper Wire.—Quotation on No. 8 bare of $16.50 per 100 lb. in car lots is unchanged, but no merchandise is moving at that figure. This commodity is felt to be the best "buy" in the market today, and each transaction is the result of price negotiation.

Insulated Wire.—As with bare copper, quotations on insulated are unchanged but are merely the basis on which trading begins. The price of $7.85 per 100 lb. on No. 14 rubber-covered is purely nominal, as is also 20 cents per pound for No. 6 triple-braid weatherproof, which is held for quotation purposes on a 19-cent base. Much business is being done.

Conduit.—Quotations are unchanged, $64 per 1,000 ft. being the current price on ½-in. black conduit in 5,000-lb. lots.

Flexible Armored Conductor.—Trade is very quiet, buyers apparently expecting reductions. Improved building conditions should quicken demand for this material before many weeks have passed. In 5,000-ft. lots No. 14, two wire, is quoted $62 per 1,000 ft.

Insulators.—High prices of the past few months still hold, but a decided tendency is noted to shade on special propositions such as high-voltage suspension types. The feeling is general that prices are too high and virtually no sales are being made. Smaller types are getting in better supply.

Washing Machines.—A reduction of overstocks is being accomplished by persistent salesmanship, and it is felt that slowness in the trade has passed the worst point. Manufacturers' operations in this territory average about 35 per cent of capacity. Some price cutting has been engaged in in isolated instances, and this has served to delay the arrival of a feeling of price confidence in the mind of the general public.

BOSTON

Business is marking time this week, and considerable variation is found between different localities in New England. In New Haven jobbing circles a quickening tendency is reported, with inquiries from firearms and silk-manufacturing concerns which have kept out of the market for a long time. The building trades strike is holding down trade at Boston and adding to the non-employment total, but in the leather and textile industries considerable improvement is apparent. Extremely active sales efforts are being made in the field by electrical representatives, and in the domestic appliance market these hard strokes of work are being rewarded. Heavy sales of appliances which can be marketed at low price on account of their being of earlier design are reported from Providence. Collections are carefully followed, and jobbers are not buying to any extent yet. It is said on good authority that if a sudden spurt in business should occur, serious shortages in many of the smaller electrical commodities would be threatened on account of the low production resulting from temporary curtailments in manufacturing plants and the failure of jobbers to buy for stock.

Pole-Line Hardware.—Orders are a bit slack at present, but inquiries are numerous from central stations and municipal plants. Before April a substantial increase in business is expected. Prices are about 10 per cent lower than a month ago and stocks are prepared for brisk trade.

Insulators.—Foreign shipments are absorbing so much of the current output that deliveries are slow and unsatisfactory from the domestic viewpoint. High-voltage construction abroad is keeping American manufacturers very busy, and only moderately good deliveries are being obtained on small quantities of ordinary line service supplies.

Wire.—Rubber-covered No. 14 wire sold at $8 per 1,000 ft. in Boston Monday on a 5,000-ft. basis. Weatherproof was steady at 26½ cents per pound in 100-lb. to 200-lb. lots, and bare copper wire was selling around 16.5 cents. The building impassé is holding down sales.

Non-Metallic Flexible Conduit.—Prices are a little uneven, ranging around $22 and $25 on ⅜-in. and ½-in. sizes per 1,000 ft., in 5,000-ft. lots, with sales running perhaps 75 cents above and 75 cents below these bases under close competition. Stocks are plentiful and demand easy.

Flexible Armored Conductor.—Plentiful supply and moderate demand have brought prices to about $60 per 1,000 ft., in 5,000-ft. lots, for No. 14 double-strip. Reduced production and uncertain demand have created a rather unstable market.

Lamps.—Despite the falling off in trade usual at this time of year distributers report an excellent business. In some cases the sales being handled exceed pre-war outputs very substantially, and one representative distributer declared Monday that business is virtually normal for this time of year. Stocks are very complete, two assemblies in New England exceeding 2,500,000 units the first of the week. Prices hold steady with the exception of a change in the discount on miniatures effective March 1 on ten-unit standard packages. This was formerly 40 per cent, and it is now 33⅓ per cent, with the requirement of purchasing a single kind or else a stated assortment of display cabinet units.

Distribution Transformers.—Stocks permit factory shipments on receipt of orders for most sizes. New England factories are running full time, and business is better than might be expected under present conditions. Raw material is in good supply, but there is no great excess on hand. Foreign business is slack. Prices are steady since the recent change.

ATLANTA

Building permits for Atlanta for the month of January numbered 189, valued at $587,000, while those for February numbered 232, valued at $554,000. The number and value of the permits, while considerably below that of last year, are sufficient to sustain a fair volume of business activities. Since there is still a shortage of housing facilities, builders express the opinion that building in cities and industrial centers must show an increase in the early spring and summer months. There are signs of activity in municipal construction lines, several of the larger cities having bond issues under consideration. Columbus, Ga., has just passed a large issue, while Atlanta voted on a bond issue of $8,850,000 on March 8. The break in the price of cotton to 10 cents is serving to check what apparently was a reawakening of business activities, but the general opinion is that, despite the further reduction in the price of the staple, conditions will take on a more favorable aspect just as soon as spring weather is here in earnest.

The Atlanta, Birmingham & Atlantic Railroad has been placed in the hands of a receiver by a federal judge, who ordered a sharp reduction in the wages of unskilled labor, and undoubtedly the wages of skilled labor in the employ of this road will follow suit. A strike has been called.

Poles.—Outside of a flurry of two weeks ago, the pole business is reported as stagnant at this time, even in the face of a number of inquiries regarding line extensions. Business is bound to pick up later as improvements are inevitable. Good stocks are on hand and shipments satisfactory.

Ranges.—While there has been little activity in this specialty for some time past, jobbers report a fair volume of sales at the present time. Good stocks are reported and shipments are coming through promptly.

Porcelain.—The completion of a large number of jobs, in Atlanta especially, has had a tendency to maintain the trade in porcelain material, and business is about as good as could be expected. Virtually no change in price is reported other than an uneven condition of heavy stocks.

Wire.—Both weatherproof and rubber-covered wire are moving well, and the attractive prices quoted on rubber-covered have particularly stimulated this line. Local stocks are in good condition in all sizes up to No. 3/0.

Schedule Material.—Conditions reported in this line a few weeks ago still prevail, all jobbers in this section reporting heavy stocks and practically no sales. Prices are steady.

Sewing Machines.—The demand for sewing machines is considerably below that of the same period last year, and jobbers report heavy stocks and little movement. Dealers have reported increasing activity but not sufficient to be reflected in the jobbers' trade as yet.

Vacuum Cleaners.—Jobbers are well stocked and, backed up by prompt shipments from factory, are in a position to handle dealers' trade on short notice. These are depending on concentrated stocks rather than placing orders. Every one, however, is looking forward to a brisk business beginning the middle of March, following national advertising campaigns.

ST. LOUIS

While there are unmistakable signs of business improvement, what increase there is in the trade is not favoring all alike, and as a result there are certain concerns that are somewhat discouraged over the present outlook and others that are perhaps too optimistic. Industry as a whole is not recovering from the general depression as was anticipated, but a number of industrials are resuming operation on a reduced basis. Others are making plans for starting up soon. Utilities are planning extensions to reach new business, and inquiries for prices on line materials for heavy construction are coming in. Almost no changes in prices have occurred during the past week. Stocks in general are complete and in some items, particularly porcelain, are considered too heavy.

Distribution Transformers.—Stocks are about complete in all sizes of distribution transformers for the first time in several years. The demand is slow but is gradually improving, particularly in the Central West and Southwest. One local manufacturer reports the transformer demand as 35 per cent greater than the month before, but explains that sales in the larger power sizes are largely responsible for this increase. Another reports a general increase in all transformer sales. The future is considered good.

Appliances.—Most appliances are moving slowly though

dealers are making heavy cuts to reduce stocks. Unexpected demand for washing machines and vacuum cleaners is developing. Sales in these items are being encouraged by demonstration displays in the surrounding territory.

Insulators.—This is about the only item on which stock cannot be maintained, and sixty-day deliveries are being quoted.

Poles and Cross-Arms.—Demand is light, though inquiries for prices in large lots are persistently coming in and considerable construction work this spring is anticipated. Deliveries can be made from stock. Cross-arm prices are lower than December prices by about 30 per cent. Pole prices are unchanged.

Schedule Material.—Stocks are still topheavy and are not moving satisfactorily, although price concessions have been made and nearly all jobbers are selling below replacement costs. No further reductions in selling prices are anticipated.

Wire.—No material change for the week is noted. Demand is fairly good and stocks are full in both weatherproof and rubber-covered. No. 14 is being quoted at $8.10 per 1,000 ft., in 5,000-ft. lots.

SAN FRANCISCO

A study of the building permits issued for the month of February, 1921, compares very favorably with those issued for February, 1920. In the face of complaints over the paucity of jobs it is seen that, generally speaking, 1921 shows an advance over 1920. The exact figures for February, 1921, are: San Francisco, $3,126,581; Oakland, $966,203; Los Angeles, $3,131,670; San Diego, $909,775; Fresno, $189,650. The exact figures for February, 1920, are: San Francisco, $2,330,395; Oakland, $921,502; Los Angeles, $3,286,415; San Diego, $138,977; Fresno, $594,200. The reverses in the case of San Diego and Fresno are startling but not typical of actual conditions in those cities.

An exceedingly strong advertising association has just been formed to promulgate the advantages of northern California, which includes San Francisco, the bay region and the Sacramento valley. It is now proposed not only to attract tourists and capital to northern California but also to make practical efforts to care for them when they arrive.

Transformers.—California offers a very fertile field for transformers because of the long transmission lines with distributing networks that are now being rushed to completion or actually ready for service. Deliveries on large orders placed last year are coming through in good shape. Present business is good and no difficulty is being experienced in getting equipment through.

Farm Plants.—Sales on farm-lighting outfits have dropped considerably for a variety of reasons. The 1920 crops in a number of sections are still unmarketed because of the refusual of packers to pay the prices asked by various fruit and nut associations. Other crops were sold at considerably less than the growers' expectations. This left little spare money for new purchases and a general spirit of retaliation which has manifested itself in a refusal to buy anything until prices are materially reduced. New distributing systems by which the power companies will take care of hitherto isolated farms are being installed. Local stocks are very good and one or two new companies have made their appearance. The sale of 32-volt devices has been very disappointing, being still far less than it should be even in the case of plants just sold, to say nothing of the immense field awaiting agents who will vigorously canvass those who already have plants.

SEATTLE—PORTLAND

From present indications and according to authorities on conditions the peak of depression in the Puget Sound country specifically and the Northwest generally has been successfully passed. Banks, business, agricultural and manufacturing interests are optimistic, and the reopening of industry, including mills, logging camps and mines, coincident with the return of spring, justifies the optimism. The Seattle Board of Public Works has just awarded contract for furnishing hydro-electric machinery and equipment for the Gorge Creek unit of the Skagit River power project to the Westinghouse company for $1,164,804.

Portland manufacturers report business simply marking time waiting for bottom to be reached in wages and material costs. It is freely predicted, however, that this period of waiting will be passed within a comparatively short time. Jobbers report business improving a little. There has been another reduction in wire and in pole-line material, but porcelain registered a recent advance. Generally speaking, electrical contractors in Portland territory report business very quiet and that only small jobs are being handled. Plans for all large construction projects are being held up temporarily pending the outcome of a conference relative to voluntary wage reductions. The credit and collection situation remains unchanged.

Distributing Transformers.—Stocks on hand, carried mainly by Central Stations, are very light and in keeping with demand which, owing to slackness in building construction of consequence, is at a minimum. Present prospects for spring and early summer demand are more or less dubious, depending almost entirely on the action taken by prospective builders of business buildings. Replacements are not hard to obtain.

Farm-Lighting Plants.—Movement of this merchandise throughout the Northwest generally is practically at a standstill. Farmers have neither money nor credit to buy, owing to decreases in prices of wheat, fruit, potatoes and other products. Many farmers are still holding out for a return of high prices. Jobbers are heavily stocked with plants, many of them overstocked. No shipments are coming in from the East because they are not needed. Prices show no change, but it is anticipated that a drop will be made during the summer.

SALT LAKE CITY—DENVER

The curtailment of lumbering and mining in the Intermountain region has created considerable non-employment during the winter just drawing to a close; resumption of operations, however, is expected with the coming of spring. The need of employees on farms will also absorb thousands of the unemployed and relieve the situation greatly. The best statistics available indicate that business in the wholesale field is equal to if not better than business in the corresponding period of 1920. Liquidation of member banks in the twelfth Federal Reserve district has proceeded rapidly in the last four or five weeks, a reduction of $20,000,000, or 12.6 per cent, having occurred. Business failures are far more common than they were a year ago, but the situation is not critical.

Certain sections of Idaho and Montana have been particularly hard hit. Many electrical firms, both wholesale and retail, are in a critical condition right now. The demoralized condition of the agricultural market is held responsible for the bad state of affairs now existing. In spite of difficulties, however, business men are optimistic and are doing everything in their power to stem the tide. Co-operative leagues are being resorted to in several sections.

Vacuum Cleaners.—The rate at which dealers are stocking indicates their confidence in a flourishing business in vacuum cleaners. Easy-payment plans and complete demonstrations are the two things chiefly relied on to stimulate sales. More attention is being paid to cleaner attachments than has been apparent heretofore.

Washers.—Intensive advertising campaigns are the outstanding feature of the trade in washing machines. One concern obtained fifty signed contracts on the first day of its drive. As little as one dollar down is being accepted on contracts that will run for twenty or more months. Stocks are plentiful. No further price reductions have been reported.

Lamp Standards.—Renewed interest is taken in street lighting installations after a long period of small activity due to municipal retrenchment. One jobbing house recently secured a contract calling for 112 metal standards, each to be equipped with three 2,000-cp. lamps.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Stanley Insulating Company Changes Hands

The Stanley Insulating Company, Great Barrington, Mass., has been acquired by new interests, including officials of Landers, Frary & Clark, New Britain, Conn., manufacturers of electrical cooking and heating equipment. Operations, it is understood, will be conducted as heretofore and no change is contemplated in the personnel of the company at the present time.

Reorganization of Electric Equipment Company

The Electric Equipment Company, Spokane, Wash., with stores at Colfax, Lewiston and Walla Walla, has been reorganized, A. M. Cash, of Lewiston, becoming president and manager. Vice-president K. G. Harlan has resigned. A plan to separate the management of the stores was voted down. The headquarters will remain at Walla Walla.

Locomotive Superheater Changes to Superheater Company

On March 1 the name of the Locomotive Superheater Company, 30 Church Street, New York City, was changed to the Superheater Company. A realization of the necessity for greater conservation of fuel in other fields in addition to that represented by the steam locomotive has resulted in the expansion of the organization to serve in all fields where steam is used for power.

The original company had recently acquired the patents and business of the Locomotive Feed Water Heater Company in order to conduct the further application of the apparatus for preheating feed water through its regular engineering, inspection and service organizations, to which has been added the operating organization of the Locomotive Feed Water Heater Company.

Piedmont Electric's Plan to Help Dealers' Dishwasher Sales

In an endeavor to help its dealers introduce and sell dishwashing machines, the Piedmont Electric Company, electrical supply jobber of Asheville, N. C., is asking its dealers to send in lists of their best customers so that it can introduce the machine to them. The Piedmont company states that it will arouse the customer's interest first with a convincing mail campaign; then, following that up, will send its salesmen out with the dealer's representatives to assist them in closing sales. A machine on the dealer's floor for demonstration is advocated as a clinching evidence of practicability.

Bacharach Instrument Moves to Larger Quarters

The Bacharach Industrial Instrument Company, Pittsburgh, has moved to 7,000-7,006 Bennett Street, Homewood Station. This new building is a two-story brick structure of 18,000 sq.ft. floor space, the additional space acquired by this purchase giving considerably increased facilities in production and service. The company has added a new line of monometers and engine indicators, the monometers being of an entirely new design.

Charles Eisler Buys National Machine & Tool

Charles Eisler, consulting engineer, 159 Clifton Avenue, Newark, N. J., has purchased the assets of the National Machine & Tool Company, Newark. The firm's name has been changed to the Charles Eisler Engineering Company, and it will manufacture gear testing machines as well as incandescent lamp machinery in addition to its regular consulting engineering and machine designing. The factory and offices are at 15 Kirk Place, Newark.

Dudlo Acquires Land for Future Expansion

The Dudlo Manufacturing Company, Fort Wayne, Ind., has just purchased five acres of ground near its present buildings, although there are no immediate plans for erecting buildings on this space. The company during the last year put up two new buildings at its present plant and also established branches at Peru and New Haven, Ind., but it has sufficient space at hand to take care of the present low demand for magnet wire, etc.

Los Angeles Dealer Turns to Specialty Distributer

The Woodill & Hulse Electric Company, Los Angeles, Cal., announces the closing of its retail store, established in 1891. The company will confine its efforts in the future to the distribution of specialty electrical appliances at wholesale exclusively.

Coonley Predicts Big Business After Liquidation

Howard Coonley, president of the Walworth Manufacturing Company, Boston, in an address on March 4 before the Associated Industries of Massachusetts on "The General Business Outlook," forecast several years of intense business activity following the completion of the present liquidation period. He pointed out that until liquidation is completed in the ferrous-metals field and in the labor market business cannot go ahead at full speed. By the end of the first half of 1921, Mr. Coonley said, he expected this process to be ended. The absorptive power of the domestic market, including the tremendous building program and the volume of buying by the railroads essential to their proper development, insures an era of industrial greatness once the present transition period is concluded.

Western Electric's 1920 Sales Were $206,000,000

Sales in 1921 Expected to Show Larger Volume of Company's Products and Smaller Volume on Products of Other Manufacturers

From figures given in the annual report for 1920 of the American Telephone & Telegraph Company, the sales billed by the Western Electric Company during the year 1920 amounted to $206,000,000. Of this, $114,000,000 were to the Bell companies and $92,000,000, largely electrical jobbing business, were to other customers. This is an increase over the previous year of 62 per cent to the Bell companies and 41 per cent to other customers, or a total increase of 52.6 per cent.

Unfilled orders on hand at the end of the year aggregated $83,000,000, as compared with $47,000,000 on Dec. 31, 1919. The company's estimates for 1921 as compared with 1920 indicate a larger volume of business in its own manufactures and a smaller volume in its sales of the manufactures of others. Important additions were made to the Hawthorne plant, chiefly for the purpose of providing facilities to produce machine-switching telephone equipment in large quantities.

Maker of Heavy Penstocks Adds Mill Capacity

The M. W. Kellogg Company has in process of construction a three-million dollar plant adjacent to its present plant in Jersey City, N. J. When it is put into operation in the early fall it will increase the company's capacity for producing welded steel pipe about six times. It will be especially equipped to handle very heavy material for penstock work—material of high head and large diameter and thickness. On the forty-two acres of ground the new

buildings will occupy about 250,000 sq.ft., including space under cranes.

An interesting feature of two recent orders which this company has taken for penstocks for the Pacific Gas & Electric Company and the Southern California Edison Company is the heavy tonnage in lap-welded steel pipe involved. For the former company's Pit River No. 1 installation two 1,026-ft. lines, 8-ft. diameter at lower end and 9-ft. at upper end, $\frac{13}{16}$-in. to $\frac{1}{2}$-in. thickness, 875 tons of steel will be used. The operating head is 425 ft. For the latter company's No. 8 Big Creek development there is a single 2,225-ft. line, 6 ft. at lower end and 7 ft. at upper end with $1\frac{1}{4}$-in. to $\frac{3}{8}$-in. thickness. The tonnage required is 650 tons with operation on a 717-ft. head. This is in addition to a certain amount of riveted pipe.

Pole Producers Hold Quarter-Century Meeting

The twenty-fifth annual meeting of the Northern White Cedar Association, held in Minneapolis, Minn., on Feb. 8 and 9, was attended by thirty-two firms representing producers of poles, ties, logs, etc. Regarding the outlook for the present year, genuine work and sales effort are seemingly going to be required to maintain sales. "We are starting 1921 with January, as a whole, the poorest business month in years. February should be better, and along later in April and the first of May we should be acquiring a full head of steam and be going ahead on a real normal basis," president Furlong said.

L. A. Page, Jr., of Page & Hill Company, speaking for the pole advertising committee, said: "Let us suggest that there will be no reward in 1921 for the man or concern who 'quits cold' or 'lays down.' The customers of the members of your association will be somewhat more careful as to prices and more critical regarding quality. Business will be good this year—for the man who thinks and digs for it. The intelligence of your sales effort and extent of your advertising will determine the size of your 1921 crop of sales."

Membership of the association increased from forty-four to forty-nine companies in 1920. Seven new companies were admitted to membership while two others withdrew.

Western Electric Salesmen's New Motor School at Lynn

The Western Electric Company in conjunction with the General Electric Company has organized a power apparatus class at the factory at Lynn, Mass., to acquaint the members of its sales force with the manufacturing conditions which prevail in the production of motors, generators and other electrical apparatus. Classes are being conducted each month with an average attendance of fifteen salesmen. J. L. Ray, power apparatus sales manager of the Western Electric Company, is the originator of the new school. The personnel of the first classes were members of his company's sales organizations at New York, New Haven, Boston, Syracuse and Philadelphia.

Increase Production to Decrease Prices

In speaking of prices and wages, *Trumbull Cheer* for February — the house organ for the Trumbull Electric Manufacturing Company, Plainville, Conn., says: "Generally speaking, the lines that have come down the most are those on which the greatest profit has been taken. A general average must be reached, the attaining of which will cut some prices in two and other prices in much less proportion, among which is electrical material, for the very simple reason that profit has been less than normal on the average and a big saving in production cost must be obtained before any material reduction in selling price can be expected. We with all others in the electrical trade will welcome the time when prices can be reduced and a normal profit enjoyed.

"The situation regarding wages is exactly like that surrounding prices. There has been the same inequality in wages as in commodities. The product of a factory must be sold in competition with similar products of other factories, and if the other fellows reduce prices these lower prices must be met or the concern that fails to meet them will soon be out of the running.

"The way to keep wages up when prices fall, or, better, the way to enable prices to fall without reducing wages, is to increase production and stick to a normal profit. The employer cannot increase production all by himself; the workman can and must thoroughly learn that he is the only one who can keep his wages up by turning out more material which can be sold at a profit without the necessity of putting more men on the payroll."



NEW YORK EDISON COMPANY'S FIRST ALL-ELECTRIC VEHICLE SHOW OF JAN. 31 TO FEB. 12 BROUGHT TOGETHER 265 FOR THE LUNCHEON AT THE HOTEL ASTOR

The Conveyors' Corporation of America, 326 West Madison Street, Chicago, formerly the American Steam Conveyor Corporation, announces that the Power Equipment Company, 131 State Street, Boston, has been appointed as New England representative for the sale of its American trolley carrier, monorail equipment for handling coal, ashes, sand, etc. Colwell & McMullin, 79 Milk Street, Boston, are the New England representatives for its American steam ash conveyor.

The Stewart Manufacturing Corporation, 4500 Fullerton Avenue, Chicago, announces the establishment of a permanent Cleveland office, 419 Bangor Building, 942 Prospect Avenue, in charge of E. P. Grismer. The company manufactures die-molded castings and bronze-back bearings.

The Bleadon-Dunn Company, 213 South Peoria Street, Chicago, has appointed the Western Agencies Company, 285 Minna Street, San Francisco, as its Pacific representative. The latter company has branch offices at 125 East Ninth Street, Los Angeles, and 923 Pine Street, Seattle.

The Automotive Electric Service Corporation, 206 Amsterdam Avenue, New

York City, has filed notice of increase in capital stock from $10,000 to $50,000.

Tennant Brothers, Dallas. Tex., successor to the Texas Battery Company, has filed notice of increase in capital stock from $20,000 to $25,000. The company manufactures batteries.

The Stenman Electric Valve Grinder Company, 42 Southbridge Street, Worcester, Mass., contemplates taking additional space in the Stevens Building, which it will equip for the manufacture of a new combination electric drill and valve grinder.

The Shaw Metal Manufacturing Company, Seattle, Wash., has leased a site at Twentieth Avenue and Madison Street, where it will establish a plant for the manufacture of copper and brass tubing, sheets, lighting fixtures, roadlight reflectors, etc. It is expected to have the copper and brass plant in operation within six months. Copper and brass sheet rolling machinery will be installed four months later. Henry A. Shaw, 524 New York Block, is president.

The Mid-State Battery Manufacturing Company, 615 West Grand Street, Oklahoma City, Okla., recently organized, is planning to establish a local plant to manufacture storage batteries and accessories.

The American Insulator Company, New Freedom, Pa., it is reported, is asking for bids for the erection of a local plant on Main Street for the manufacture of electrical insulating products, to cost about $75,000.

The Connecticut Electric Manufacturing Company, Bridgeport, Conn., has filed notice of increase in capital stock from $200,000 to $450,000.

Foreign Trade Notes

EXTENSION OF LIGHTING SYSTEM IN SINGAPORE. — Vice-Consul Donoghue reports that the Legislative Council has approved a loan of $385,000 to the commissioners of the municipality of Singapore for the extension of the electric lighting system to the Tanglin district.

IRRIGATION AND POWER DEVELOPMENT IN BRITISH INDIA.—A very important irrigation development, known as the Sutlej Valley Project, is to be undertaken in the Punjab, an agreement having been reached between the government of India and the native states of Bahawalpur and Bikanir, according to an announcement from the Guaranty Trust Company of New York. The project will irrigate an area of more than 9,000,000 acres and greatly increase the wheat-growing possibilities of India, and will be the means of generating electric power for industrial and domestic purposes to the amount of about 300,000 hp. The work to be undertaken involves an estimated expenditure of fourteen crores rupees (1 crore is equivalent to 10,000,000 rupees, and 1 rupee equals $0.486 at par).

ELECTRICAL MANUFACTURING PLANT AT BILBAO, SPAIN.—The Sociedad Ibérica de Construcciones Eléctricas (S. I. C. E.), according to the London *Electrical Industries*, has been formed by the Thomson-Houston Company of Paris and the General Electric Company of the United States, with the co-operation of the principal local banks and hydro-electric concerns, for the purpose of manufacturing electrical equipment. The company plans to erect a plant in the vicinity of Bilbao.

FOREIGN TRADE CONVENTION.—The eighth national trade convention called by the National Foreign Trade Council will be held at Cleveland on May 4, 5, 6 and 7. The American Manufacturers' Export Association, it is said, will take a prominent part in the convention. The office of the National Foreign Trade Council is at the India House, No. 1 Hanover Square, New York City. O. K. Davis is secretary.

AMERICAN CHAMBER OF COMMERCE IN EGYPT.—According to information received by the Foreign Commerce Department of the Chamber of Commerce of the United States the American Chamber of Commerce of Egypt has been organized, with headquarters at Alexandria, by business men of Alexandria and Cairo. It is intended that the office shall be used as headquarters for American commercial travelers, who will be placed in communication with local firms dealing in their lines. The American Consul at Alexandria was elected honory president of the chamber.

HYDRO-ELECTRIC PLANT IN ICELAND CONTEMPLATED. A message from Reykjavik to the *Berlingske Tidende*, according to the London *Engineer*, states that the Islandske Ingenicer-Forening has requested the government and the Alting to institute investigations with a view to defining the possibility of establishing an industry in Iceland, using the waterfalls as the motive power. The Forening also requests the government to receive applications for a concession to construct a large hydro-electric station.

ELECTRICAL MACHINERY PROPOSED FOR THE PORT OF SAVONA, ITALY.—The Savona (Italy) Harbor Board is reported to be considering the installation of electrical discharging machinery at the port of Savona at an early date. The erection of four electric bridges for the unloading of coal is also under consideration.

GERMAN INDUSTRIAL COMPANIES CONSOLIDATE. — The Allgemeine Elektrizitats-Gesellschaft of Berlin, it is reported, has merged with the locomotive works of Linke Hofmann of Breslau, whose share capital has been increased from 64,000,000 marks to 120,000,000 marks. The Allemeine Electrizitats-Gesellschaft receives 30,000,000 of the new shares in exchange for shares of the original company.

New Apparatus and Publications

EXPORT PACKING.—C. C. Martin has just written "Export Packing," a guide to the methods employed by successful shippers. It comprises over 700 pages and is published by the Johnson Export Publishing Company, 370 Seventh Avenue, New York City. Considerable attention is given to the packing of electrical material.

HICKIES AND BRACKET HOOKS.—The B. & L. Stamping Company, Inc., 155-9 Jamaica Avenue, Brooklyn, is distributing a leaflet describing the "Belmet" stamped hickies and bracket hooks.

CONTROL.—"Increasing the Press Output" is the title of publication 888 distributed by the Cutler-Hammer Manufacturing Company, Milwaukee, describing the C-H pre-set motor control for platen, cylinder, offset, sheet-feed rotary and small web presses.

CORDS AND FIXTURES.—The Inland Electric Company, 15 North Franklin Street, Chicago, has issued a folder on "Steelite" armored portable extension fixtures.

MOTORS.—Bulletin No. 1 of the S. A. Woods Machine Company, Boston, on its new general-purpose induction motors is being distributed.

METALLIC FLOORING.—The Irving Iron Works Company, Long Island City, N. Y., have issued catalog 3A on their fireproof ventilating flooring.

CELL TESTER.—The Sterling Manufacturing Company, 2845 Prospect Avenue, Cleveland, has issued bulletin No. 10-A, describing the "Sterling" No. 600 high-rate cell tester.

WAFFLE IRON.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has placed on the market a new electric waffle iron.

INDEXES.—The General Electric Company, Schenectady, N. Y., has issued two indexes to its descriptive bulletins, sheets and supply part bulletins dated January, 1921.

STATIC CONDENSERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 49,714C, superseding bulletin No. 49,714B, covering its static condensers.

HYDROELECTRIC STATIONS.—"Automatic Hydro-Electric Generating Stations" is the title of bulletin No. 40,604, published by the General Electric Company, Schenectady, N. Y., in which two types of control are described.

BUS SUPPORTS.—The Delta-Star Electric Company, 2433-53 Fulton Street, Chicago, has recently developed a new multi-type extra-heavy busbar support.

FIRECLAY PRODUCTS.—The "Refractories Book" is the title of a booklet issued by Laclede-Christy, St. Louis.

AUTO-TRANSFORMER STARTER.—The Cutler-Hammer Manufacturing Company, Milwaukee, has developed a new auto-transformer starter for standard squirrel-cage motors of various capacities ranging from 5 hp. to 100 hp.

INSULATING MATERIALS.—The John C. Dolph Company, Newark, N. J., has issued a catalog describing its insulating varnishes and compounds.

BANK PROTECTION SYSTEM. — Edwards & Company, 110th and Exterior Streets, New York City, manufacturer of electrical signaling apparatus, is distributing a bulletin describing the Edwards "bank hold-up alarm system."

INSULATION.—A new slot insulation, which is a combination of fibrous paper and varnished-cambric put together with an insulating binder, is being placed on the market by the Irvington Varnish & Insulator Company, Irvington, N. J.

FARM-LINE EQUIPMENT.—The Railway & Industrial Engineering Company, Greensburg, Pa., has recently placed on the market a horn-gap switch, triangular choke coil, lightning arrester and horn-gap fuse, all combined as a single unit on one base.

PORTABLE ELECTRIC PLANT. — The Home Electric Lighting Company, East Orange, N. J., is distributing a folder describing its "Homelite" portable electric plant for the home, farm and summer camp.

UNIT PANEL EQUIPMENT.—Bulletin L-110 issued by the Allen-Bradley Company, Milwaukee, describes its type L-120 unit-panel battery-charging boards for electric vehicles.

TIERING-LIFTING TRUCK.—The Automatic Transportation Company, Buffalo, has issued bulletin No. 25, describing its electric tiering-lifting truck.

SCRAPER CONVEYORS. — The Jeffrey Manufacturing Company, Columbus, O., has issued catalog No. 257, in which it describes the "Jeffrey" standardized scraper conveyors.

ELECTRIC FURNACES.—The Pelton & Crane Company, Detroit, is distributing a pamphlet describing the "Pelton" porcelain outfit and the Pelton dental electric furnaces.

POST DRILLS.—The Black & Decker Manufacturing Company, Baltimore, has designed a post drill especially for adapting its portable electric drill for use as a drill press for heavy drilling or precision work.

CRANE CAB.—The Pawling & Harnischfeger Company, Thirty-eighth and National Avenues, Milwaukee, has developed a new crane cab in which all controller and current-carrying parts are inclosed.

COMPRESSORS.—The Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City, has issued bulletin No. 607, covering the Chicago pneumatic oil-engine-driven compressors.

New Companies

THE PROVIDENT PRODUCTS CORPORATION, Wilmington, Del., has been incorporated by Charles B. Bishop, A. M. Fox and R. H. Ochletree. The company is capitalized at $300,000 and proposes to manufacture lighting devices.

THE RADIANT ELECTRIC COMPANY, Binghamton, N. Y., has been incorporated by H. J. Bowen, and G. E. and V. D. Sturdevant. The company is capitalized at $5,000 and proposes to manufacture electrical supplies.

THE METER SERVICE CORPORATION, New York, N. Y., has been incorporated by S. A. Gafvert, F. W. Fouglas, G. E. Scobal, 1790 Broadway. The company is capitalized at $25,000 and proposes to manufacture electrical instruments.

THE ELECTRIC LIGHT & POWER COMPANY, Remington, Va., has been incorporated with a capital stock of $25,000 to take over the plant and property of the Electric Power & Milling Company. A. L. Hord is president of the company and C. W. Hoffman is secretary.

THE COTE BROTHERS MANUFACTURING COMPANY, Chicago, has been incorporated by Thomas F. Cote, Hubert N. Stronck and Elmer H. Greaves, 4670 West End Avenue, with a capital stock of $60,000. The company proposes to manufacture electrical devices, etc.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 15, 1921)

1,368,507. ALTERNATING-CURRENT ARC-WELDING SYSTEM; Johannes Kjekstad, Brooklyn, N. Y. App. filed May 27, 1919. Compensating automatically for variations in resistance.

1,368,536. WINDING MACHINE. James C. Anderson, Rutherford, N. J. App. filed Aug. 13, 1919. Coil winder.

1,368,560. OZONE GENERATOR. Edward L. Joseph, Westminster, London, England. App. filed July 19, 1920. Electrode consists of a metallic sheet.

1,368,576. ELECTRIC POWER PLANT; Johannes C. Ruths, Stockholm, Sweden. App. filed Aug. 5, 1916. Reserve steam tank.

1,368,584. CATHODE FOR AUDIONS; Samuel S. Torrisi, Philadelphia, Pa. App. filed July 10, 1918.

1,368,590. ELECTRIC LAMP BASE; Edson B. Wilcox, Meriden, Conn. App. filed June 30, 1919. Means for automatically severing connection in case of short circuit.

1,368,599. TYPEWRITING MACHINE; Harry Bates, New York, N. Y. App. filed Jan. 29, 1919. Automatic carriage return.

1,368,622. AERIAL SYSTEM EMPLOYED IN WIRELESS TELEGRAPHY AND TELEPHONY; Charles S. Franklin, Buckhurst Hill, England. App. filed Aug. 26, 1920. For directional working.

1,368,635. ELECTRIC STARTING SYSTEM FOR INTERNAL-COMBUSTION ENGINES; Franz Kratz and Gottlob Honold, Stuttgart, Germany. App. filed Aug. 1, 1918.

1,368,657. WIRELESS DIRECTION FINDER; Henry J. Round, Muswell Hill, London, England. App. filed Sept. 13, 1920. Used on board ship.

1,368,659. TESTING APPARATUS; Charles S. Sapp, Jr., and Ray Sapp, Mount Vernon, Ohio. App. filed Feb. 26, 1920. Internal-combustion engine.

1,368,677. SIGNALING DEVICE; Walter S. Woodward, Great Falls, Mont. App. filed Oct. 11, 1919. Set for any time.

1,368,678. RESISTANCE UNIT; William Zabel, Swissvale, Pa. App. filed July 15, 1919. Mounted on small insulating drum.

1,368,686. SPARK INTENSIFIER FOR GASOLINE ENGINES; William G. Bennett, Adrian, Wash. App. filed June 12, 1920. Auxiliary gap.

1,368,694. STARTING RHEOSTAT FOR ELECTRIC MOTORS; Arthur H. Buckley and Reginald A. Buckley, Paddington, New South Wales, Australia. App. filed Sept. 4, 1919. Direct current.

1,368,700. PORTABLE ELECTRIC LAMP; De Witt C. Conkling, New York, N. Y. App. filed June 9, 1917. Without batteries.

1,368,728. STYLUS PICKER; Benjamin F. Hutches, Jr., Allendale, N. J. App. filed Oct. 6, 1919. For phonographs.

1,368,741. ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES; Albert H. Midgley, Acton Vale, England. App. filed July 10, 1915. For motor cars.

1,368,755. SPEED-CONTROL SYSTEM; John H. Roddey, Charlotte, N. C. App. filed May 14, 1919. Prime mover.

1,368,791. BURGLAR ALARM; Kuwakichi Fujita, Hazleton, Pa. App. filed Oct. 10, 1919. Cartridge-firing mechanism.

1,368,798. TRAFFIC REGISTER; Gabriel Henry, Quebec, Canada. App. filed March 9, 1920. For photographing the traffic on a street.

1,368,811. PROTECTIVE SYSTEM FOR ELECTRICAL CONDUCTORS; Karl Kurda, Nuremberg, Germany. App. filed Jan. 14, 1915. Equalizes strength of electric field between conductors carrying high-potential currents.

1,368,817. STORAGE BATTERY; Paul M. Marko, Brooklyn, N. Y. App. filed July 5, 1918. Level of electrolyte easily and quickly ascertained.

1,368,828. TIME-CONTROLLED STARTING AND STOPPING MECHANISM; Jose A. Oca Balda, New York, N. Y. App. filed Aug. 8, 1919.

1,368,850. AUTOMATIC TELEPHONE SYSTEM; Arthur B. Smith, Evanston, Ill. App. filed June 13, 1917. Automatic calling between exchanges.

1,368,916. VIBRATOR; Joseph C. Field, Orange, N. J. App. filed Dec. 29, 1919. High-frequency tone.

1,368,946. ELECTRICAL SYSTEM; Joseph K. Leibing, Newark, N. J. App. filed Nov. 19, 1917. Ignition of gas engines.

1,368,955. APPARATUS FOR ELECTROLYZING SALT SOLUTIONS; Tadao Matsushima, Kanagawken, Japan. App. filed March 18, 1918. By mercury process.

1,368,990. PROCESS OF PRODUCING ARTICLES OF QUARTZ GLASS; John Scharl, New York, N. Y. App. filed Sept. 18, 1918.

(Issued Feb. 22, 1921)

15,047 (reissue). ELECTRICAL HEATING DEVICE; Francis Boardman, New York, N. Y. App. filed July 13, 1916. For melting snow and ice in vicinity of railway switches.

15,048 (reissue). TELEPHONE EXCHANGE; Frank A. Lundquist, Portland, Ore. App. filed April 13, 1915. Automatic.

1,369,003. SEMI-MECHANICAL SWITCHBOARD; William G. Blauvelt, New York, N. Y. App. filed Jan. 29, 1919. Office keyboard arrangement.

1,369,019. SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed Nov. 26, 1917. Selectively operated signaling system.

1,369,022. CALLING DEVICE; Charles L. Goodrum, New York, N. Y. App. filed Sept. 14, 1917. Automatic telephone.

1,369,025. AUXILIARY SPARK DEVICE FOR IGNITION SYSTEM; Raymond Hawley, Cambridge, Mass. App. filed Nov. 15, 1919. Covered.

1,369,060. DISPLAY APPARATUS; Ralph L. Tedesco, Rockland, Mass. App. filed July 17, 1919. For exhibiting series of announcements.

1,369,066. TYPEWRITING MACHINE; John Waldheim, Elizabeth, N. J. App. filed May 10, 1919. Automatically returns carriage and line spaces.

1,369,094. ELEVATOR; Ernest L. Gale, Sr., Yonkers, N. Y. App. filed Dec. 28, 1916. Automatically levels elevator car with landing.

1,369,128. CAR-LIGHTING SYSTEM; Harry D. Rohman, New York, N. Y. App. filed April 16, 1917. Railway and other vehicles.

1,369,148. ELECTRIC CHANGE-SPEED GEARING; Thorsten von Zweigberck, Lancaster, England. App. filed Dec. 13, 1916. For use on an automobile.

1,369,167. LOCKING MEANS FOR SHELLS; Victor R. Despard, Hinsdale, Ill. App. filed April 6, 1918. Lamp socket.

1,369,168. LOCKING MEANS FOR SHELLS; Victor R. Despard, Hinsdale, Ill. App. filed April 6, 1918. Lamp socket.

1,369,204. PROCESS OF MAKING CHROMOUS CHLORIDE; Maurice C. Taylor, Niagara Falls, N. Y. App. filed Dec. 15, 1919. Electrolytic reduction of chromic chloride.

1,369,218. TELEGRAPHY; William M. Bruce, Jr., Springfield, Ohio. App. filed May 13, 1916. For lines where resistance and capacity have tendency to start signals.

1,369,220. ENGINE-STARTING SYSTEM; William A. Chryst, Dayton, Ohio. App. filed Sept. 30, 1915. For internal-combustion engines.

1,369,271. CLEANING OF METALLIC SURFACES; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed July 3, 1919. Previous to plating.

1,369,281. ELECTROMAGNETIC-WAVE-TRANSMITTING SYTEM; Oscar C. Roos, Brooklyn, N. Y. App. filed Nov. 4, 1918. Continuous oscillations.

1,369,284. AMPLIFYING RELAY; August J. Kloneck, New York, N. Y. App. filed March 8, 1915. For telephone.

1,369,288. AUTOMATIC TELEPHONE EXCHANGE; Frank A. Lundquist, Chicago, Ill. App. filed Aug. 21, 1900. Improved switch operation.

1,369,297. COMMUTATING DYNAMO-ELECTRIC MACHINE; Edward G. Parvin, Roselle, N. J. App. filed April 9, 1920. Simple and effective interpole.

1,369,298. PRODUCTION OF FERROSILICON ALUMINUM; William B. D. Penniman and Roy S. White, Baltimore, Md. App. filed June 9, 1919. Electric furnace.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PATTEN, ME.—The Katahdin Electric Company, recently incorporated, contemplates the erection of a transmission line from Houlton to Patten, connecting up Smyrna Mills, Island Falls and other towns along the route. At Houlton connection will be made with the high-tension line of the Gould Electric Company.

PORTLAND, ME.—The William Underwood Company, 50 Fulton Street, Boston, Mass., will install considerable electrical electrical equipment in its new plant to be built in Portland at a cost of about $150,000.

SPRINGFIELD, VT.—Gilman & Son will install electric motors and considerable electrically operated machinery in their proposed two-story machine shop, 50 ft. x 150 ft.

NORWOOD, MASS.—Bids, it is reported, are being received by E. C. Brown & Company, engineers, 220 Devonshire Street, Boston, for the construction of a power house, 133 ft. x 300 ft., for the Hollister Mills Company, Lenox Avenue, Norwood. The cost is estimated at $200,000.

PROVIDENCE, R. I.—The United Electric Railways Company plans extensions and improvements to its power plant on Manchester Street, including the installation of new equipment. The company also contemplates extensions to its substations and improvements to its lines.

GOSHEN, CONN.—The incorporation of the Goshen Electric Light & Power Company to supply electric light and power service in this village is provided for in the bill introduced in the State Legislature. The company plans to purchase energy from the Connecticut Power Company, Falls Village, whose high-extension line runs through Goshen.

Middle Atlantic States

BUFFALO, N. Y.—Plans are under way by the Lower Niagara River Power & Water Company for the construction of a hydro-electric power plant. Preliminary permit has been granted the company by the Federal Power Commission to utilize 20,000 cu.ft. of water per second from Whirlpool Rapids for operation of the new plant.

GRAHAMSVILLE, N. Y.—The Ulster-Sullivan Electric Light & Power Company, recently incorporated with a capital of $40,000, contemplates the operation of a local electric light and power system with transmission lines to extend to various municipalities in Sulliyan and Ulster Counties. S. W. Krum and others are incorporators.

GRANVILLE, N. Y.—The construction of a power plant is planned by the Telescope Cot Bed Company, 535 East Seventy-ninth Street, New York City, in connection with its proposed local factory to cost about $100,000. R. G. Gory, 50 Church Street, New York City, is engineer.

NEW YORK, N. Y.—The Central Catskill Light & Power Company, recently incorporated with a capital of $50,000, plans to operate an electric light and power system in Ulster and Delaware Counties. J. Hollander, 601 West 184th Street, and others are incorporators.

SARANAC LAKE, N. Y.—The erection of a high-tension transmission line in the vicinity of Saranac Lake, Tupper Lake and Lake Placid is under consideration by the St. Lawrence Transmission Company of Potsdam.

SYRACUSE, N. Y.—The Franklin Automobile Company will establish a new power plant for general works service in connection with its new plant addition now under construction. The cost, including machinery, is estimated at $500,000.

MORRIS PLAINS, N. J.—Bids will be received by the Department of Architecture, 142 West State Street, Trenton, until March 22 for the construction of a psychiatric clinic reception building, including electric work, etc., at the State Hospital at Morris Plains. F. H. Bent is state architect.

NEWARK, N. J.—The International Coal Products Company, Irvington, is negotiat-

...ers with the Irvington Town Council for permission to reconstruct its power plant and primary oven, recently damaged by fire, at its fuel briquet plant, causing a loss of about $100,000.

NEWARK, N. J.—The Board of Education will install considerable electrical equipment, heating and ventilating apparatus, etc., in several new school buildings.

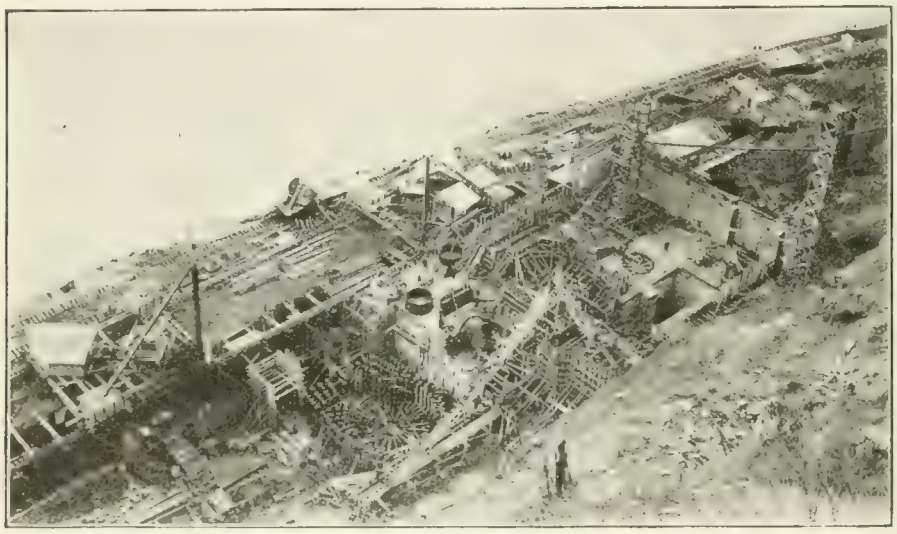
PERTH AMBOY, N. J.—A power plant will be constructed by the Burnrite Coal Briquette Company, 543 New Jersey Railroad Avenue, Newark, in connection with its new plant at Perth Amboy. Conveying and hoisting machinery and other electrically operated equipment will be installed.

LANCASTER, PA.—The Conestoga Traction Company has applied to the Public Service Commission for authority to issue $160,000 in bonds, part of the proceeds to be used for extensions and improvements.

LANSDALE, PA.—The Borough Council has postponed bids for equipment for the municipal electric light plant.

NEW CUMBERLAND, PA.—W. A. Dromgould, 143 West Market Street, York, has obtained preliminary permission from the Federal Power Commission to build a water-power plant at Marsh Run, York County. Present plans provide for a development of 88,000 hp.

PHILADELPHIA, PA.—Bids, it is reported, will soon be received by the Department of City Transit, 1211 Chestnut Street, for the construction of a one-story sub-station at Front Street and Fairmont Avenue, in connection with other buildings to be constructed at this location. W. S. Twining is director.



BIRD'S-EYE VIEW OF CONSTRUCTION UNDER WAY FOR 500,000-HP. HYDRO-ELECTRIC PLANT BEING BUILT BY THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO AT QUEENSTON

SCRANTON, PA.—Arrangements have been made between the city officials and the Scranton Electric Company for a new street-lighting system under a ten-year contract. Plans include 200 new lamp installations and replacing and relocating the present arcs and incandescents with 400-cp., 250-cp. and 100-cp. lamps, totaling 1,554 lamps. The contract also provides for an initial installation of a boulevard lighting system on sections of Spruce Street, Lackawanna and Wyoming Avenues. W. A. Schunk is city engineer.

YORK, PA.—The transformer station and toolhouse of the Delta Lighting & Power Company, it is reported, has been damaged by fire, causing a loss of about $10,000.

YORK, PA.—Arrangements are being made by the City Council for an issue of $1,000,000 in bonds for municipal improvements, including the enlargement of the sewage disposal plant and the installation of new electrically operated machinery.

WILMINGTON, DEL.—The Bowers Beach Corporation will establish an electric lighting system and install other electrical equipment in connection with the development of Bowers Beach into a pleasure resort. W. H. Durborough is president.

BALTIMORE, MD.—Plans have been approved by the Public Improvement Loan Commission for the installation of a new electrically operated pumping plant at the [illegible] disposal plant to cost about [illegible].

BALTIMORE, MD.—The Union Memorial Hospital plans to install considerable electrical equipment in the proposed group of buildings to be constructed in the University Parkway district. Plans are under way by the board of directors.

WILLIAMSPORT, MD.—The W. D. Byron Company has plans under way for the construction of a power plant at its local works to cost about $50,000. Quigley Hafer, 155 Garfield Street, Chambersburg, Pa., is architect.

BRISTOL, VA.—The Electric Transmission Company has increased its capital from $500,000 to $1,200,000. L. B. Herrington is president.

COLEMAN, VA.—The Bedford Pulp & Paper Company, 909 East Main Street, Richmond, has plans under way for an addition to its electric power plant, including a complete new unit, in connection with its works at Coleman.

North Central States

WHITEHALL, MICH.—At the spring election to be held soon the proposal to issue bonds to the amount of $33,000 for a new electric light and water plant will be submitted to the voters.

CLEVELAND, OHIO.—The City Council has passed an ordinance authorizing an issue of $200,000 in bonds for improvements to the municipal electric lighting system.

DELAWARE, OHIO.—The Fairfield Paper Box Company, Baltimore, Ohio, will build a one-story power plant in connection with its new paper mill and box factory in Delaware. The total cost is estimated at $160,000. T. D. Griley is manager.

DAWSON SPRINGS, KY.—Bids will be received at the office of the supervising architect, Washington, D. C., until March 28 for the complete construction, excepting mechanical equipment, of a power house for the United States Public Health Service Sanatorium at Dawson Springs. Plans and specifications may be obtained at the above office.

LEXINGTON, KY.—The City Commissioners have been petitioned to install an ornamental lighting system on Short Street.

PADUCAH, KY.—The Paducah Electric Company has plans under way for the construction of an addition to its power plant and remodeling the present building. A turbo-generator, switchboard and considerable other equipment will be installed. The cost of this work is estimated at about $200,000. Other improvements, including line extensions, will be made at a cost of about $50,000. Stone & Webster, 147 Milk Street, Boston, Mass., are engineers.

TERRE HAUTE, IND.—The Terre Haute, Indianapolis & Eastern Traction Company, it is reported, contemplates improvements to its local power plant to cost about $600,000. Plans include the construction of an addition to power plant, installation of additional equipment, extension of service lines and placing wires under ground, etc. E. M. Walker is general manager.

CHICAGO, ILL.—The Floyd Manufacturing Company, 522 South Clinton Street, manufacturer of tools, has awarded contracts for the construction of a two-story plant, 122 ft. x 240 ft. and a power house, 32 ft. x 60 ft., at Diversey and North Harding Avenues. The cost is estimated at about $160,000.

DANVILLE, ILL.—The installation of a boulevard lighting system on Vermilion Street has been approved. E. K. Wolgamot is president of the commission.

EAU CLAIRE, WIS.—At an election to be held April 5 the proposal to purchase the local distribution plant of the Wisconsin-Minnesota Light & Power Company will be submitted to the voters. The cost of the plant is estimated at about $350,000.

MANITOWOC, WIS.—Enlargement of the municipal power plant and extension of the transmission line is contemplated. H Groth is in charge.

MINNEISKA, MINN.—The Wisconsin-Minnesota Light & Power Company plans to erect an electric service line from Kellogg to Minneiska.

COLBY, KAN.—Bonds to the amount of $60,000 have been voted for improvements to the electric lighting plant. The plans include the installation of two 175-hp. and 200-hp. horizontal return tubular boilers, two 175-hp. and 200-hp. simple non-condensing Corliss-type engines, direct-connected to 2,300-volt, three-phase, 60-cycle generators, with complete boiler room accessories, motor-driven boiler-feed pumps, motor-driven deep-well pump and complete switchboard equipment. C. E. Reid, Manhattan, is engineer.

MINNEAPOLIS, KAN.—At an election to be held April 5 the proposal to issue $60,000 in bonds for the construction of an electric light plant will be submitted to the voters.

WILSEY, KAN.—Bonds to the amount of $18,000 have been authorized for the establishment of an electric lighting system in Wilsey. The plans include the erection of a 6,600-volt transmission line to Council Grove, a distance of 11 miles, and the installation of a distributing and street-lighting system. C. E. Reid, Manhattan, is engineer.

Southern States

MOUNT OLIVE, N. C.—Bonds to the amount of $30,000 have been issued for improvements to the electric lighting system.

LAKE ARTHUR, LA.—Bonds to the amount of $50,000 have been voted for the installation of an electric light plant.

SKIATOOK, OKLA.—Charles Page of Sand Springs contemplates the installation of a lighting system at Skiatook. R. Harris is representative.

ELECTRA, TEX.—The power house of the Gladiolus Oil Company, it is reported, has been damaged by fire, causing a loss of about $10,000. The plant, it is understood, will be rebuilt.

Pacific and Mountain States

MARSHFIELD, ORE.—The construction of an electric light and power plant in Marshfield to cost about $110,000 is under consideration.

OAKDALE, CAL.—The Oakdale Irrigation District Board is considering the question of utilizing the water power of the new Melones dam to generate electricity. H. H. Wadsworth is consulting engineer. H. B. McMath of Riverside is director of board.

SAN FRANCISCO, CAL.—The Great Western Power Company, 14 Sansome Street, has completed plans for the construction and completion of its new hydro-electric plant at Plattsville, Plumas County. The cost is estimated in excess of $1,000,000.

WOODLAND, CAL.—The City Trustees have authorized new bids to be asked for the installation of an electrolier system.

PARAGOULD, ARK.—Bids will be received by the Commissioners of the Paragould Water District No. 3, at the office of W. R. Heagler & Sons, Engineers, Bertig Office Building, Paragould, until April 12 for the construction of a power house and for power plant and pumping equipment in connection with waterworks project. The cost is estimated at $120,000.

Canada

ST. THOMAS, ONT.—Residents of Yarmouth and Southwood are petitioning for the extension of electric service lines from St. Thomas to the two townships.

AMOS, QUE.—The Temiscaminque Company will soon ask for bids for the development of water power on the Megiscane and Bell Rivers.

Electrical World

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Taxes on a War Basis in Peace Times

WITH the paying of the first installment of income and excess-profits taxes on Tuesday of this week attention was again vividly directed to the cost of wars and preparations for wars. At the same time, the official estimates of revenue this year from income taxes—two and a half billions of dollars—when compared with nearly four billions (70 per cent of all taxes) collected in 1920, furnish an index to the extent of deflation in industries and the vanishing of profits created by military needs, thus making the taxing of incomes on a war basis obsolete and ineffective. Every breadwinner, together with those who are responsible for the management of the industries and business of this country, is confidently looking to Congress for a new program of reductions in the costs of government and revised methods for raising revenue that will make it possible to amend the income-tax laws so as to eliminate excess-profits taxes and the higher surtaxes. Such a revision would have a prompt and stimulating effect on all lines of business, acting like a tonic on an emaciated convalescent.

Nothing to Fear in a Falling Market

MANUFACTURERS must be prepared to meet the cry for lower prices, not necessarily because their prices are unduly high, but because other commodities, which have hitherto been almost out of reach, are beginning to approach normal. The public is inclined to believe that all manufacturers have profiteered, and the burden of proof therefore will be thrust on the producer. Moreover, in a buyers' market every intelligent manufacturer and jobber will want to be on the right basis with his customers. Now, while prices in many industries have soared skyward and production likewise, those in the electrical industry have as a rule been conservative, and very markedly so. We must not, however, assume a "holier than thou" attitude on that account, but must scrutinize our business and methods to make sure that we are ready to serve our customers as they want to be served and not just as we want to serve them. Very surely, unreasonable demands will be made on the industry, and these will have to be dealt with sympathetically but firmly. If it is possible to grant reductions or better terms, these should be given, and if business can be restarted by taking some losses, it may be the part of wisdom to bear them. But it is short-sighted to put artificial props under trade and industry in an attempt to prevent readjustment. It will also avail nothing to offer goods at cost or less if there are no takers. First determine if there is a market and then ascertain what must be done to satisfy the demand. The electrical industry has been too sane during the flurry and bluster of the war to be stampeded now into instability and error because of temporary depression. Having acquitted ourselves nobly and honorably, there is nothing to fear.

Carrying the Utility Message to the People

A GENERATION ago every one became familiar with the exhortation to "carry the message to Garcia." Today, within the perspective of the public utilities there is a multitudinous Garcia, physically tangible though mentally remote, known as the people, and to carry their message to the people is an object deserving and requiring all the tact, ardor and perseverance that utility men can bring to the task. In its own way it is as difficult an undertaking as pursuing an elusive general through the unmapped regions of his native Cuba. The technical and industrial journals, with their specialized circulation, cannot reach the people directly. The daily press, from the utility point of view, may be roughly divided into two classes—the conservative newspapers, which the public is prone to class as organs of the "interests," and the radical sheets, which carry chiefly the counterfeit and truculent messages of the demagogue. It is refreshing therefore to find a popular national weekly acting as a volunteer messenger from the electric light and power industry to its millions of readers, and the editorial printed in *Collier's* for March 12, to which we make more extended reference on another page, will be hailed as a promising sign of the times by all branches of the great electrical industry.

Public Ownership of Securities Will Offset Agitation

IN THOSE communities where there prevails agitation for home rule or municipal ownership public utilities are benefiting by encouraging the purchase of their securities by the local public. It is not sufficient merely to offer the securities for sale. They must be offered in small enough denominations or on the easy-payment plan so that all can buy. They must be made readily available across a counter, like bread in a grocery store. They must be advertised and the easy-payment plan featured. Above all, the public's whim should be met by pointing out that here is an opportunity for the citizens to own the local lighting company. Perhaps the proportion of the total securities taken by customers will be small, but that is not important if the portion which is taken is well distributed. Every holder of securities will take a new interest in the company. Because he has money invested in it he will be anxious for its prosperity, and the desires of many citizens, even if their holdings are small, will naturally

lead public utility commissions to consider an increased rate of return on public utility investments more impartially.

Aside from the fact that distribution of securities among the townspeople will make them more sympathetic, it will make the securities more attractive to outside investors. These will have more confidence in an investment that is attractive to the local public; they will have less fear of municipal-ownership agitation; they will feel that they have a better opportunity to get a reasonable return on their investment. Ownership of utility securities by company employees should also be fostered as the surest method of increasing their loyalty and aiding economical operation. Old as these ideas are, they are not everywhere appreciated, and hence their constant reiteration needs no apology.

Load Factor and Fuel Cost Determine Importance of Economy

EXPERIENCE has shown that few hydraulic privileges can be developed to anything like their proper value without occasional aid from steam auxiliaries. In rare instances storage sufficient fully to equalize the flow of a stream is available, and then aid from steam is necessary only for the purpose of emergency protection against breakdown. Very frequently this reserve is obtained by leaving intact some displaced steam plant with electrical equipment enough to aid in emergencies. Aside from this unusual condition steam may be needed for brief periods to carry a system peak over a considerable portion of the year, as in the development of streams for something over the minimum flow, for a considerable part of the operating hours and at variable load when a larger amount of secondary power from the hydraulic standpoint is developed, and finally for a large service all the time. In the latter case the tail is apt to wag the dog, and the real auxiliary is hydraulic instead of steam.

The design of plants to meet these varying requirements is perhaps a task for the prophet rather than the engineer, but the paper by E. B. Powell in this issue gives a very clear notion of the way in which these various types of auxiliary have to be worked out to give the best economic result. The broad general principle underlying it all is, of course, that the less an auxiliary plant is used the heavier relatively become its fixed charges per kilowatt-hour furnished and the less important relatively the running or fuel charges. This indicates a cheap and relatively inefficient plant, or at least a plant in which operating efficiency is sacrificed to insure low fixed charges. As the probable use of the plant increases the operating and fixed charges change in relative value until finally a point is reached where it is necessary to build for relatively heavy steam service obtained on the most economical basis possible.

With rising costs of fuel and rising costs of labor the importance of a plant which can be run economically becomes relatively much greater than it was fifteen or twenty years ago or even prior to the war. In earlier days it was easy to make the mistake of overestimating the probable use of an auxiliary plant and providing a very beautifully worked out steam station which proved from lack of use a liability rather than an asset. Such mistakes can be made today, but much less frequently, and we are disposed to think that the emergency plant will gradually become more elaborate and refined as fuel costs increase until in the majority of instances a very small part of its pristine simplicity will be left. However, as we have previously remarked, the real solution of the problem primarily requires the vision of a prophet.

Recent Attainments in Wired Radio

A NUMBER of interesting results based on studies and practical tests made by Signal Corps officers during recent months, such as telephonic communication between a fixed terminal station and a railroad train moving parallel to the line wire employed, were described in the *Journal of the Franklin Institute* for January last, by R. D. Duncan, Jr. The frequencies used in the test alluded to were relatively high (300,000 to 600,000 cycles per second), or such as ordinarily are used in radio telegraphy. The amount of power developed at the generating end was surprisingly small considering the distance to which communication could be carried.

An important question which presents itself at such frequencies is the value of the hyperbolic angle subtended by a line of given length and size of wire. The electrical constants of the line, such as the linear resistance, inductance, capacitance and leakance, are not necessarily the same as at ordinary low frequencies. It is pointed out that, according to existing theory, the linear resistance rises considerably toward high frequencies, partly owing to skin effect and partly owing to radiation. The linear leakance also increases considerably, partly owing to radiation; but the linear inductance and capacitance remain fairly constant. The vector sending-end impedance of a line is thus compelled to execute a series of spirals as the frequency is changed.

Misuse of Engineering Data for Legal Purposes

THE misuse of engineering data in either court or commission proceedings is a rather common occurrence. From the standpoint of professional ethics, if for no other reason, such practices should be severely condemned. It is to be regretted that there is not some method of calling to account individuals who will indulge in them. A recent conspicuous instance is the testimony of witnesses before a state commission regarding the telephone interference factor, on which the American Institute of Electrical Engineers has presented reports of studies. One witness under examination said:

"The interference factor is something that is the meter or the means for measuring the interference between a power line and a telephone line, something that is not at all private property as far as the telephone company is concerned, but came out in the last two years by the American Institute of Electrical Engineers, who have spent a lot of time in these kinds of investigations, and it is a means agreed upon by them as satisfactory of measuring the effect that certain power lines have in certain voltages, current and machinery on telephone lines."

Another witness said: "I would also like to point out that the American Institute of Electrical Engineers has investigated this question of telephone interference factor, not as a telephone company but as an institution of unbiased engineers, and that means that the representatives of the power companies were interested in this

investigation and took part in it just as much as the telephone engineers did, and these tests show, as I have studied them in the *Transactions* of the American Institute of Electrical Engineers, that any such telephone interference factor as we have here, of 173, is considered—must be considered—very high in comparison to other known measurements of telephone interference factors."

These are verbatim quotations from a transcript of the evidence, and the impression throughout the testimony is that the telephone interference factor is an established standard providing a definite and complete means for evaluating inductive interference. Reference to a review of the committee's work as presented to the Institute in February, 1919, shows that the factor is far from a definite one in the sense that such units as "horsepower," "kilowatt" and other like terms are definite. The report was presented to "encourage the trial use of telephone interference factor and the collection of information by any who are interested," and the determination of limiting values was deferred because of the lack of definite information on which to base a conclusion.

At the present moment the inductive interference committee of the National Electric Light Association and the wave-shape sub-committee of the Institute are carrying on studies designed to provide definite information from which further conclusions can be drawn. The factor as so far defined does not furnish a quantitative measure of the interference of a power line with the telephone service, but is more correctly a measure of the sensitivity of the present standard telephone receiver to the wave shape of periodic induction currents flowing through it, regardless of their source. An analysis of the committee reports does not furnish any reason for assuming that the data on which the rule is based justify the application of the factor in such a case as the one in question with any hope of obtaining a correct basis for important decisions. The rule does not consider the effect of balance of the power and telephone circuits, the degree of co-ordination of the transposition systems, the dimensions of the parallel or a number of other factors that are equally important. In short, as defined, it is not in any sense a standard for the complete measurement of inductive interference.

It is regrettable that such testimony should be injected into a national question which has already been the subject of a great deal of controversy. Whether justified or not, the conclusion is bound to be drawn in some quarters that improper use is being made of actions of the American Institute of Electrical Engineers clearly intended to help in the working out of an admittedly difficult situation. In the particular case involved the result has been to drag into a commission hearing not only the incomplete work of the Institute committee but also the investigations that are being carried on by the National Electric Light Association inductive interference committee in the endeavor to advance the study. None of these investigations is in any way complete enough to admit of conclusions. For that reason the information is practically valueless in arriving at decisions.

The men controlling the destinies of both the power and telephone industries can well pause and consider the end to which this sort of thing leads. The public is just as vitally interested, and if such incidents are allowed to occur a conflict will develop in which the public will ultimately take a part that will not be welcome to either of the two industries. There was never a better time to about face than right now. The solution of the problem must depend on co-operation between the power and telephone industries exercised in such a way as to solve the problem with the least total interference to the service of either utility.

House-Wiring Contracts Obtained at $6.57 Each

"SERMONETTES" have appeared in the ELECTRICAL WORLD at frequent intervals during the last forty years with house wiring as the text. The conviction consistently maintained can still be emphasized, namely, that central-station companies can increase their gross revenue in no more permanent way than through an aggressive policy aimed at increasing both the percentage of residence service connections in the territory served by the distribution network and the degree of use of electric service from each connection. Not long ago a comprehensive report was published in the ELECTRICAL WORLD (May 15, 1920) showing the number and distribution of houses that are now wired—a report that indicated commendable activity in some sections and sins of omission in many others. In this issue L. J. Wilhoite gives an instructive account of the work of the Chattanooga (Tenn.) company during the past two years that furnishes inspiration and much useful information on this familiar subject.

When the campaign was started early in 1919 the program was laid out for an indefinite period, with a grim determination to get all the business in sight irrespective of previous theoretical data. The customary difficulties were promptly found—conservatism on the part of the customer, sluggishness on the part of the contractor and little precedent in determining the most desirable lines of attack. In picking out the needed salesmen a somewhat unusual, if not unprecedented, course was followed in which "push and snap" in ringing doorbells was given preference over a knowledge of the central-station business or technical experience, such fundamental instruction as the salesmen might need being furnished through an impromptu night school. The results obtained, however, amply justify the departure from former practice since by means of this campaign the company has taken on something like three thousand residence customers with more in sight. Moreover, the tentative allowance of about $10 per customer which had been figured out as the probable cost was reduced a little more than one-third.

To pessimistic central-station men who still have lurking doubts about the cost and value of house-wiring campaigns the Chattanooga results are a practical object lesson. As to the possibilities of residence connections as revenue producers, we may also casually mention that a good many gas companies live, move and have their being and pay dividends on residence business; while from the electrical service standpoint Mr. Wilhoite pungently remarks, "We know of a man who owns a central-station system with less than half this number of customers on its lines and is making a very good living out of it." Good effects from a really energetic house-wiring campaign in face of all the difficulties that go with the wiring of old houses are not peculiar to Southern cities—the idea can be applied with profit almost anywhere in times like these, when buying needs stimulation of a healthy sort and business is not dead but just hard to get.



Willis Rodney Whitney

A profound scientist whose practical conception of research work and the results of whose labors have furnished inspiration to investigators of all nations

THE opportunity and the resources to create a great research laboratory dedicated to investigations in pure science on a large scale have come to few scientists. Such an opportunity was offered Dr. W. R. Whitney more than twenty years ago when he was asked to become director of industrial research for the General Electric Company. Endowed with marked ability as an investigator and with a vision of the practical needs of industry in the unsurveyed fields of pure science, Dr. Whitney has applied organized research with results that have been of great benefit to civilization in all lands.

To the electrical industry Dr. Whitney is well known for his work in perfecting electric lamps. The first radical improvement in the carbon incandescent filament since Edison was due to his personal work. He devised a filament which had a new form of carbon that gave 25 per cent more light for the same wattage than the standard carbon-filament lamp. Dr. Whitney also did valuable work in the development of the use of wrought tungsten for electric light filaments and in perfecting the gas-filled electric bulbs. Among other investigations made by him have been the study of the laws of heat conduction and radiation, the dissociation of gases at high temperatures and the transformation of other forms of carbon into graphite. From the general public Dr. Whitney's work has received wide recognition because of his having perfected a detector for giving warning of the approach of submarines which was put into practical application during the European war at the Nahant station of the United States Navy. As a member of the Naval Consulting Board he did much for the war development of radio telephony and radio telegraphy.

Dr. Whitney was born in Jamestown, N. Y., Aug. 27, 1868. He was graduated from the Massachusetts Institute of Technology in 1890 with the degree of bachelor of science and in 1896 received the degree of Ph.D. from the University of Leipzig. Since 1900 Dr. Whitney has been director of the research laboratory at Schenectady. Part of his early work, which was done in conjunction with Prof. A. A. Noyes, was the invention of a process through which alcohol and ether can be recovered from collodion. This invention insured the commercial success of the present photographic film. In 1909 Dr. Whitney served as president of the American Chemical Society and in 1912 as president of the American Electrochemical Society. Results of his investigations have been officially recognized by many learned societies through the award of medals and other honors. Among these are the award of the Perkin medal last month by the American Section of the Society of Chemical Industry, the Chandler medal by Columbia University and the Willard Gibbs medal by the Chicago Section of the American Chemical Society.

Design of Relay Power Stations*

Low Construction Cost, Adequate Dependability and Low Attendance Requirements Are Important Factors—Skilled and Well-Trained Operators Are Equally Essential

By E. B. POWELL
Consulting Engineer Stone & Webster, Inc., Boston

SUPPLEMENTAL power in some form is essential to the commercial development of virtually all of the unused water powers in the eastern part of the United States and, with the possible exception of the Niagara and St. Lawrence systems, is essential to the further development of water powers that are now utilized in part. The nature and extent of this supplemental or relay power will be governed in a large measure by the character of the stream, the amount, character and location of the load and the importance of continuity in power supply.

In many instances the required relay may be provided by adding reservoirs, or merely pondage, to give some artificial control of the flow. In other instances the electrical interconnection of water-power systems may afford sufficient relay power. In general, however, the fullest commercial utilization of water power can only be had by the aid of an independent relay, which in the greater part of the country today is most satisfactorily and economically provided by the steam power station.

The capacity and design of such a relay station should be determined by the particular functions it is intended to perform. Although they may vary widely, the functions are of two general types—flow or head-deficiency make-up and emergency reserve. For either type of service the capacity required will depend upon the amount and characteristics, initial and prospective, both of hydraulic development and of load. The design of relay stations, though broadly determined by the usual factors, such as location, power market, water and fuel supplies and fuel costs, is less dependent upon considerations of operating economy than base-load plants on account of the low load factor usually involved in the former.

Character of load and dependability of delivered hydraulic power are factors of prime importance. The design should also be governed in many important features by the characteristics of the hydraulic development and the relation of that development to the load.

Flow or Head-Deficiency Type of Relay

Considering first the station intended solely to compensate for power deficiencies of the hydraulic development, its functions may include any one or more of the following: Seasonal operation to make up deficiencies in hydraulic power from low water or flood, absorption of load growth between stages of hydraulic development, and operation as the main source of power. As reflected in the functions of the relay station and as affecting its design, hydraulic developments may be grouped as under four general classifications:

I. *Minimum-Flow Development.* — Developed hydraulic capacity is equal to or exceeds maximum system load. Resultant minimum available flow occurs for brief period in the year and is only slightly below corresponding load requirements. Reserve is provided in hydraulic station.

II. *Medium-Flow Development.*—Developed hydraulic capacity is equal to or exceeds maximum system load. Resultant minimum available flow is below load requirements for considerable period (40 per cent or more) of the year. Reserve is provided in hydraulic station.

III. *Continual-Relay Development.* — Available hydraulic capacity is slightly below system load requirement throughout greater part of the year.

IV. *Supplemental Development.*—Hydraulic development is merely an adjunct to the steam-power station, which carries the bulk of the load.

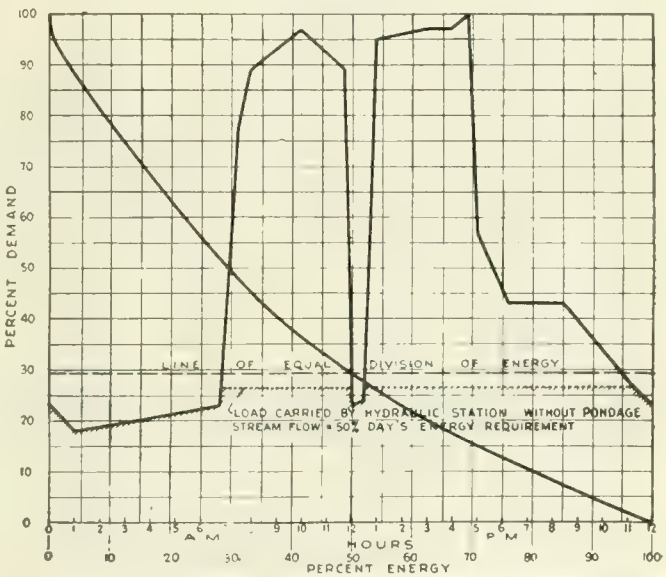


FIG. 1—TYPICAL DAILY LOAD OF MANUFACTURING TOWN WITH 53 PER CENT LOAD FACTOR

The type of reserve referred to in classes I and II is for relay against failure of equipment within the hydraulic station itself. Under the conditions outlined this reserve may often advantageously be installed as part of the hydraulic station rather than in the steam station. As is well known, from 50 to 75 per cent of the cost of the average hydraulic development is fixed and independent of the capacity installed, so that sufficient capacity for this type of reserve may frequently be included at comparatively low unit cost.

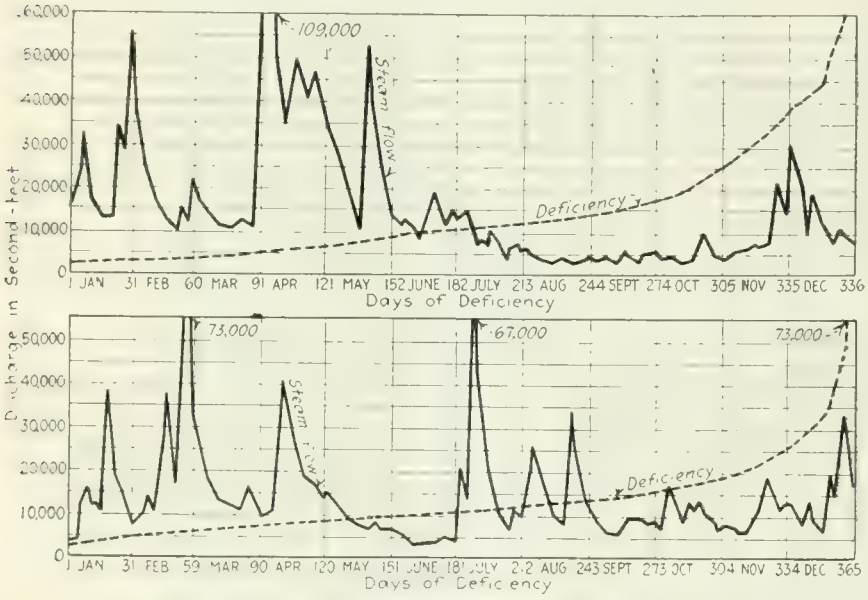
Effect of Growth of Load

It will usually be found that the conditions represented by classes I, II and III are merely stages in approach to those of class IV, where the hydraulic development is merely an adjunct to the steam power. Therefore the entire project should be studied broadly in the beginning, both as to the ultimate physical possibilities and limitations of the hydraulic development and

*Discussed at joint meeting of the Boston Sections of the American Society of Mechanical Engineers, American Institute of Electrical Engineers and Boston Society of Civil Engineers.

as to the character and probable growth of the market for power.

The seasonal flow of the Hudson River in New York is so variable that the hydrographs of two successive years, 1915 and 1916, with their corresponding deficiency curves, may be used in illustrating developments of all four of the classes just referred to. In Fig. 2 it will be seen that if this hydrograph is assumed to represent the year of minimum flow and if a flow of about 3,000 sec.-ft. (85 cu.m. per second) would supply the maximum power requirement, a development providing proper equipment reserve at this flow would approximate the conditions of class I. If growth of load raises the daily power demand above the capacity of the available minimum stream flow and this growth of load is accompanied by a corresponding increase of generating capacity of the hydraulic station to utilize say 8,000 sec.-ft. to 10,000 sec.-ft. (226 cu.m. to 284 cu.m. per second), with proper reserve, the conditions become those of class II. Turning to Fig. 3, development of the hydraulic plant to utilize a flow of say 10,000 sec.-ft. to 12,000 sec.-ft. (284 cu.m. to 340 cu.m. per second) with daily load demands somewhat in excess of the mean available flow would give the conditions of relay service under class III. Continued growth of load with a single hydraulic development as applied to either type of stream flow will ultimately bring about the conditions represented by class IV.



FIGS. 2 AND 3—DAILY HYDROGRAPH AND DEFICIENCY CURVE OF HUDSON RIVER FOR 1915 AND 1916

In the case of many streams it would be feasible to provide sufficient reservoir storage to smooth out the stream flow to a considerable extent, thus raising the minimum or primary capacity of the potential development beyond the maximum load demands considered under classes I and II at least, and possibly beyond that considered under class III. For purposes of the present discussion, however, reservoir storage, as distinct from pondage in the usual sense, will not be further considered, since the effect of adding reservoir capacity in the development will introduce no new conditions of relay service distinct from those applying under the four groups discussed, but may merely shift the development on the scale of the present classification, or possibly remove the occasion for independent relay, from a capacity standpoint. Pondage, on the other hand, does not affect the seasonal variation of the stream; it provides regulation of the daily flow.

Effect of Pondage

The effect of pondage upon the relay station requirements may be judged from reference to Fig. 1, which shows a typical manufacturing town load with the "per cent load" curve superimposed for convenience of interpretation. If the minimum flow is assumed equivalent to 50 per cent of the day's energy requirement, with full twenty-four-hour pondage provided, the hydraulic station could take off the upper 70 per cent of the demand, permitting the relay station to carry the base load at a daily load factor approximating 90 per cent with a demand only 30 per cent of the total. On the other hand, in the absence of pondage, the relay station must be designed to carry about 75 per cent of the total demand, and on this basis its daily load factor would be reduced to about 40 per cent. It is apparent that, in the absence of pondage, higher capacity will in general be required in the relay station and the relay station load factors, both daily and annual, will tend to lower values than where full pondage is provided.

Relay Station for Minimum-Flow Development

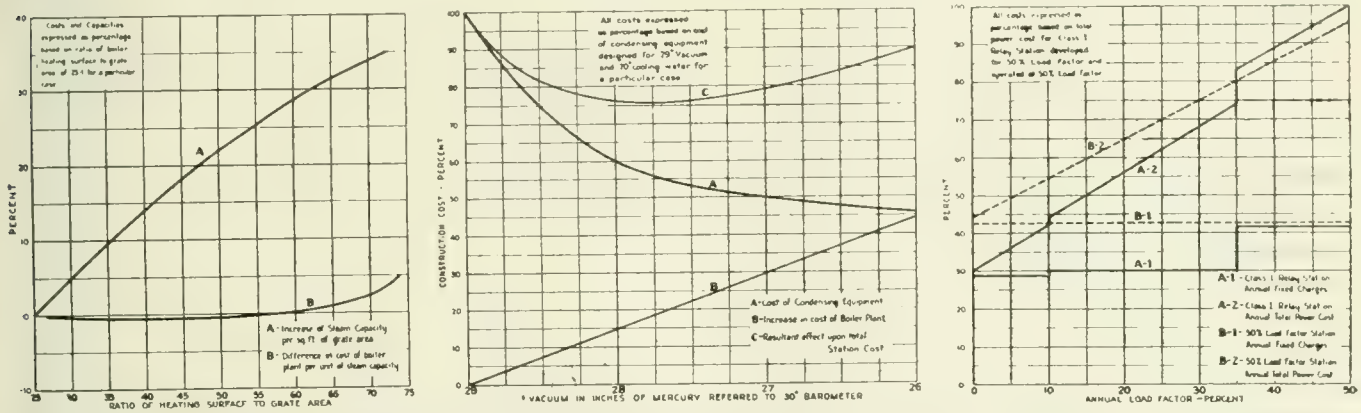
Referring again to Fig. 2 it will be seen from the deficiency curve that if the maximum load demand is within the capacity of the 3,000 sec.-ft. flow which is the developed capacity considered for class I the relay station, except for conditions of equipment failure, should not be called upon for operation in excess of 5 per cent of the year. It is not uncommon for relay stations under such conditions to stand idle an entire year. Obviously, for service of this character the actual operating economy of the relay station is of small moment. Important considerations are low fixed costs and dependability. As the load demands increase and the operating conditions for the relay station approach those of class II steam power production costs are of slightly greater moment, but in general are still tremendously outweighed by fixed charges and other costs independent of production. Usually it is only when the conditions of class III are reached that the annual load factor of the relay station rises to a value sufficient to make fuel economy an important factor in design.

For the extremely low load-factor conditions of class I type of equipment, dimensions and arrangement must all be studied with a view to attaining the desired output with the minimum investment compatible with simplicity of station and low cost of attendance. Type of combustion equipment and the arrangement of furnace must be governed by the character of fuel available. Oil is the ideal fuel for any type of steam relay station, but is not widely available commercially in sufficiently dependable supply. At the present stage of development pulverized fuel involves a greater degree of complication than is usually warranted in the station designed for the extremely low load-factor conditions of this case. Coal in its more ordinary form will in general be the

most satisfactory fuel. The stoking equipment should be of the forced-draft type for high capacity, either underfeed or chain grate, depending upon the class of coal.

Draft facilities should be designed to take care of the maximum rate of combustion that can safely be maintained by furnace and grate over the period of peak load on the station. Economizers cannot be justified for the conditions of class I, but it may be advisable to make provisions for their later installation to meet higher load-factor conditions in the future.

The selection of type and size of boiler, decision as to total rated boiler capacity to be installed and the proportioning of combustion equipment to boiler heating surface must take into account not merely the cost of that equipment but also the costs of building and all related equipment, such as facilities for handling fuel and ashes and mechanical draft. The cost curve of Fig. 4 shows that for the particular case considered, when all related factors are taken into account, boiler heating surface may be installed to the comparatively high ratio to grate area of fifty to one without appreciable increase of total boiler-plant cost. Higher ratios are



FIGS. 4, 5 AND 6—BOILER-PLANT CONSTRUCTION COST AND CAPACITY AS AFFECTED BY RATIO OF BOILER-HEATING SURFACE TO GRATE AREA; RELAY STATION CONSTRUCTION COSTS AS AFFECTED BY CAPACITY OF CONDENSING EQUIPMENT; ANNUAL POWER COSTS OF STEAM RELAY STATION AS AFFECTED BY LOAD FACTOR FOR WHICH PLANT IS DESIGNED

accompanied by some increases of cost. The use of a lower ratio will result in needless waste of fuel.

Equally broad considerations should be applied to the design and proportioning of the condensing equipment. Considering the net increment cost of the boiler plant per unit of effective steam capacity and the increment cost of condensing plant for unit change of vacuum at the turbine exhaust, the condensing equipment should be designed to give the degree of vacuum under conditions of the required maximum load which will result in the lowest construction cost for the plant as a whole. In Fig. 5 the curves show, also for a particular set of conditions, at *A*, the relative construction costs for condensing equipment to attain different degrees of vacuum, the cost of the 29-in. (737-mm.) design being taken as 100 per cent; at *B*, drawn to the same scale, the increase in boiler-plant cost resulting from the increased total steam demand which is had from different degrees of vacuum less than 29 in., and at *C*, which is a summation of *A* and *B*, still expressed in terms of 29-in. condensing-plant cost, the resultant effect upon total station cost of designing the plant for different degrees of vacuum.

These two charts, Figs. 4 and 5, are correct as to detail for the particular conditions only for which they were estimated, but they clearly illustrate the interdependence of equipment costs and the importance of taking all related factors into account in deciding upon the type and size of apparatus. Similar considerations should be applied to the selection of generating units and to the determination of steam pressure and temperature.

It will usually be found advantageous to provide electric drive for one complete set of essential auxiliaries to permit starting these without waiting for steam. Instrument equipment for mechanical apparatus such as boilers and condensers should be complete in so far as required as guides to efficient combustion, not because low fuel rate is of special importance in this service but that it is an essential to the attainment of maximum output.

Relay Stations for Higher Load-Factor Conditions

If the period of relay station operation is permanently lengthened the higher load factor attained thereby may justify greater consideration of actual operating economy, condensing equipment may be of more liberal design and boiler capacity may be added in greater ratio to steam demand, thus permitting reduction of combustion rates.

Further growth of load and extension of the operating period for the relay station into the conditions of class III will justify still further consideration of operating economy in new equipment. When the conditions of class IV are reached practically the same factors govern as in the usual independent type of central station. If properly designed in the first instance, the low load-factor relay station may be readily converted to a high load-factor station and should operate with but a fraction higher total costs than the station specially designed for the higher load factor. The reasons for this are chiefly: First, boilers and furnaces properly designed for class I relay service are of very efficient type, being driven to extreme ratings only under the low load-factor conditions. Second, the class I low load-factor relay station should include no reserve capacity in generating units beyond that actually required to carry the anticipated maximum demand. Growth of load factor to proportions where operating economy becomes of importance in design, even though unaccompanied by growth in demand, will call for the addition of reserve equipment as a measure of insurance. Such a new unit with its auxiliaries may be designed for whatever degree of economy is warranted and may then be operated to take the base of the relay load. Third, more efficient auxiliaries may be introduced for the older units; as, for example, larger capacity and more efficient circulating pumps on the condensers and increased cooling facilities where spray ponds or cooling towers are employed.

The power costs for two types of station operating on the same conditions of load are shown in Fig. 6. Station *A* is designed initially for relay service under class I conditions. Improvement in load factor is accompanied by the installation of such additional equipment and of such economic characteristics as may be warranted. Station *B* is designed for continuous operation at 50 per cent annual load factor. Its first cost is nearly 50 per cent higher than that of the initial step of station *A*, and while more economical at the load factor for which it is designed the higher efficiency of its equipment is insufficient to balance the higher fixed charge on the lower range of load factor. Accordingly, where there is doubt as to the actual load factor at which the relay station may be called upon to operate it will in general be advisable to design for the minimum probable load factor rather than risk unnecessary expenditure in providing for load conditions that may require years to attain.

If the fundamental design is right the initially high operating charges characteristic of the low load-factor station are readily outgrown, whereas the fixed charges, essentially higher for the high load-factor station, are inescapable and remain until amortized a permanent burden on the development.

Emergency Reserve Type of Relay

The service required of emergency or break-down reserve stations may vary from floating capacity for instant availability to merely providing against interruptions of several hours or days. The requirements in any particular case will be governed in a large measure by the character and importance of the load served.

Miscellaneous power service and lighting should in general be completely protected against more than momentary interruption. For some classes of power, such as that applied to electrolytic processes, longer interruption of service is not sufficiently serious to warrant the expense of full relay. On the other hand, an extensive direct-current network, such as found in large metropolitan cities, must be absolutely safeguarded against interruption, however brief.

When the steam relay station is to serve as an instantaneously available reserve the necessary excess capacity in generating units must be maintained on the line and actually under steam at all times. Station design to provide most economically for such service must afford, for minimum investment, a maximum of flexibility in capacity with minimum stand-by charges. Characteristics in equipment peculiarly favoring these requirements are:

1. Combination electric-steam drive on the larger auxiliaries, such as circulating pumps, and mechanical draft fans for the units operated as floating stand-by.
2. Turbo-generating units with direct-driven exciter and with overspeed-controlled steam bypass for turbine-blade cooling independent of normal governing valves.
3. High ratio of turbo-generator capacity in comparison with point of lowest water rate.
4. Wide flexibility with quick response in control of boiler output and rate of combustion.
5. High ratio in capacity of combustion equipment versus area of boiler heating surface.

The first two of the characteristics mentioned are of advantage chiefly where the steam station is used exclusively for relay. In this case they tend to reduce the stand-by fuel costs by permitting the reserve units to float on the hydraulic system with but negligible consumption of steam. The importance of the third characteristic is particularly evident in steam stations which normally operate in parallel with hydraulic stations. Under such conditions the excess capacity may be carried by the units under load without serious loss of operating economy. The fourth and fifth characteristics are essential to maximum service from the stand-by station under any condition.

Considering again the general characteristics and requirements of the steam relay station, the feature which should be regarded as secondary only to low construction cost and adequate dependability is that of low attendance requirements, and not merely for the non-operating period but for actual operation as well. With this object the design should tend to large units and, as far as compatible with thorough simplicity, to automatic control. Where feasible, combining the functions of distributing station with those of the hydraulic relay assists materially in holding down both construction costs and attendance for the relay station. It should be borne in mind, however, that maximum returns on the investment in any type of steam power station can be had only through skilled and well-trained operators. It is true that it is often possible during periods of plentiful water supply to distribute men from the steam stations through other departments, but the number of men that may actually be employed in this way is limited. Where men are held over long periods without really effective employment there is invariably loss of efficiency and of morale.

Ratio Between College Standing and Engineering Success

A CLOSE correspondence between good scholarship in college and eminence in engineering is shown in an investigation made under the auspices of the American Association of Collegiate Registrars by Prof. Raymond Walters of Lehigh University, who presents a report in the current issue of *School and Society*. It was found that among 392 distinguished engineers, graduated from seventy-five technical schools, colleges and universities, 182, or 46.4 per cent, stood in the highest fifth of their classes scholastically upon graduation; 109, or 27.8 per cent, stood in the second highest fifth; 72, or 18.3 per cent, in the middle fifth; 14, or 3.6 per cent, in the next to lowest fifth, and 15, or 3.8 per cent, in the lowest fifth. Figures for a group of 189 alumni of five Eastern engineering schools were somewhat different in the upper classes, the second highest scholastic fifth having the largest percentage. In all groupings of the eminent engineers there were less than 4 per cent in each of the two lowest scholastic fifths.

Of 730 names on the Registrars' Association list of distinguished engineers virtually 80 per cent were found to be collegiate graduates, 16 per cent men of secondary school education and practical training, and less than 5 per cent men who started in college but did not finish. The arbitrary basis of eminence in this study of a professional group was taken to be the holding of office, membership on important committees and service as representatives of the four "founder" engineering societies—civil, mechanical, electrical, and mining and metallurgical—for five years, 1915-1919.

Simple and Compact Hydro Station*

Considerations that Influenced Layout and Equipment of 50,000-Hp. Station Erected on Steep Mountainside in San Joaquin Valley with Outdoor Transformers and Switches

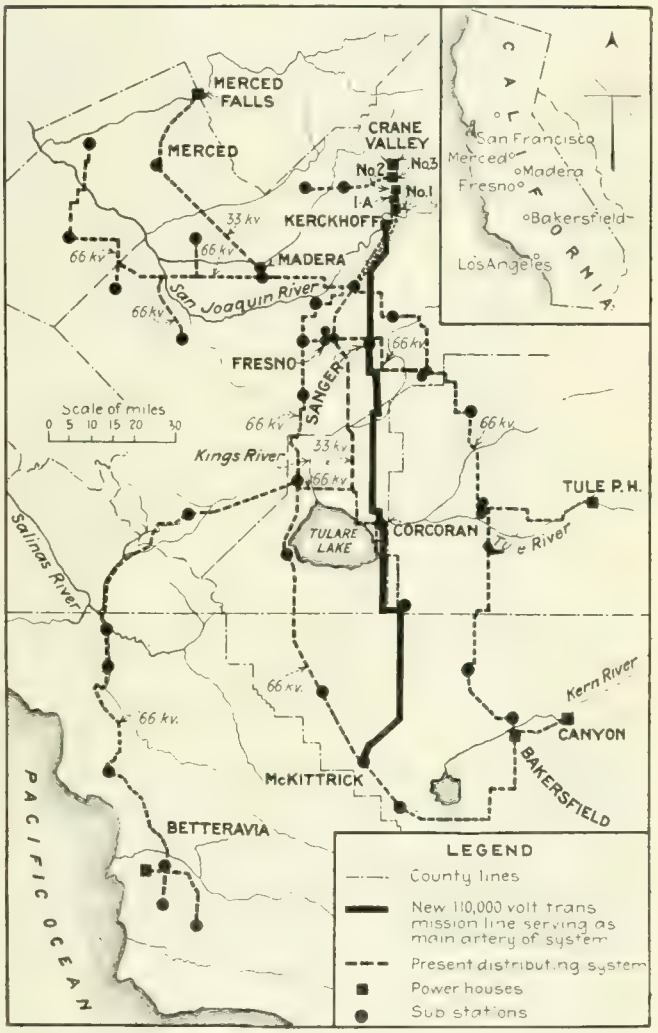
By R. C. STARR
Construction Engineer San Joaquin Light & Power Corporation, Fresno, Cal.

FACTORS which were taken into consideration in designing the hydraulic portion of the 50,000-hp. Kerckhoff development on the San Joaquin River and methods which were employed in hastening the construction to relieve a power shortage resulting from postponement of such work during the war were discussed in the Feb. 26, 1921, issue of the ELECTRICAL WORLD. Among the subjects considered were the power available, most economical and quickest way of providing storage, method of drilling a 17,000-ft. tunnel in which a speed of 453 ft. a month was attained, method of bringing construction materials to a site which was difficult of access and factors determining dimensions of surge chambers. In the current number attention is directed to considerations involved in laying out and equipping the generating station as distinguished from the hydraulic portion.

The power house is in a box canyon through which the San Joaquin River flows and is made of reinforced concrete. It has 100 ft. x 36 ft. (30 m. x 10.8 m.) floor space and is 70 ft. (21 m.) high. The unusually small floor space provided for three units of such large capacity is rather striking and causes considerable comment, but all the equipment is so compactly built and placed that there is ample room in the building for all purposes. In fact, the design is a striking example of compactness, efficiency and economy in every way and is credited to the power company's construction department on this project, of which B. F. Jakobsen was chief designing engineer. The building is built into the solid granite side of a mountain, and access thereto is obtained by an inclined railway 1,000 ft. (305 m.) long with a maximum grade of 100 per cent. A retaining wall extending 15 ft. (4.5 m.) above the floor forms the lower part of the river-side of the building and serves to protect the machinery from the maximum high water which could be caused by a flood due to a drift jam or other causes below the power house.

The maximum floods will raise the river approximately 30 ft. (9 m.) for short periods, and stop logs are raised in the tailraces so that it is possible to pump the waterwheels out by means of drains in the waterwheel pit to a sump, no matter what the elevation of the water in the river may be.

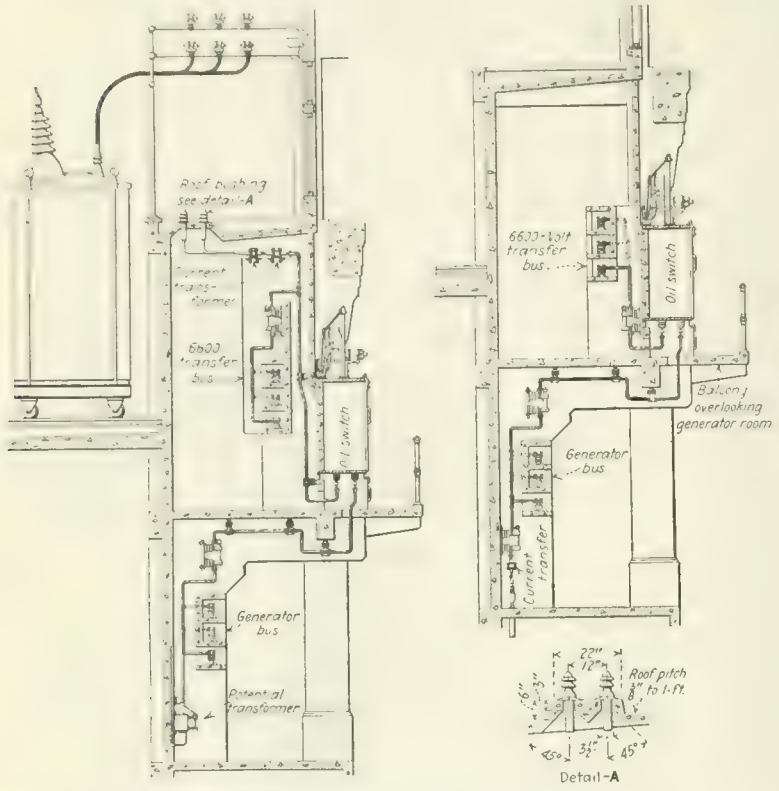
The building, from floor to roof, was constructed in thirty-seven days, and the crane was installed while forms were still under the roof. During this same period two of the waterwheels were erected and grouted in. The most important factor determining the total generating capacity was the economical development of the water resources of the power site. This involved the comparative costs of a large and a small tunnel and the comparative speed with which the two could be driven. After all these factors had been thoroughly analyzed, a plant capacity of approximately 55,000 hp. at full load was chosen. The equipment consists of three 15,000 hp., 360-r.p.m. vertical-shaft, single-runner, Francis-type turbines, designed for an effective head of 315 ft. and directly connected to 14,200-kva., 6,600-volt, 60-cycle, three-phase generators; two 500-hp. turbines of similar type running at 900 r.p.m. and directly connected to 300-kw., 250-volt exciters with 15-kw., 125-volt control-current generators mounted on top. Ventilation of the generators is accomplished by taking air from the room at the top and from the turbine cavern below and discharging it out through the sides of the stator's frame into a sheet-steel casing which surrounds the yoke and conducts the air outdoors, openings being provided for warming the power house in the winter.



KERCKHOFF IS AT THE NORTHERN END OF A 110,000-VOLT TRUNK LINE THAT RUNS DOWN SAN JOAQUIN VALLEY AND SERVES AS ARTERY TO EXISTING DISTRIBUTION SYSTEM

*Conclusion of article entitled "Hydro-Electric Plant Built in 15 Months." See page 471, Feb. 26, 1921, ELECTRICAL WORLD.

Special credit should be given the Allis-Chalmers erectors for installing the complete hydraulic, generator and exciter equipment in less than ninety days, the first twenty days being devoted to erecting two waterwheels without the aid of the crane. Allis-Chalmers winders



FEATURES OF 6,600-VOLT CIRCUITS AND CELL CONSTRUCTION BETWEEN THE GENERATOR BUSES, OIL SWITCHES, TRANSFER BUS AND OUTDOOR STEP-UP TRANSFORMERS

wired the stators in the field in fourteen days per machine.

The generator units are operated with the latest type of Kingsbury bearings mounted on top of the unit and supporting the entire weight of the rotating part as well as offsetting the reaction caused by the water passing through the wheel. The bearings were especially designed, and the method of installing the cooling coils to keep the temperature of the oil within proper limits is considered more efficient and economical and is used for the first time in the Kerckhoff machines. This system eliminates the possibility of foreign particles and scale from the pipes getting into the oil, which usually occurs when the oil is circulated through cooling coils; furthermore, it eliminates the necessity of expensive filters which would otherwise be required.

Complete Control from Switchboard

The governors are of the latest type, manufactured by the Allis-Chalmers Company, in which the governor weights are mounted on the main shaft and mechanically connected to the relay and floating valve which admit oil pressure to the gate-operating cylinders.

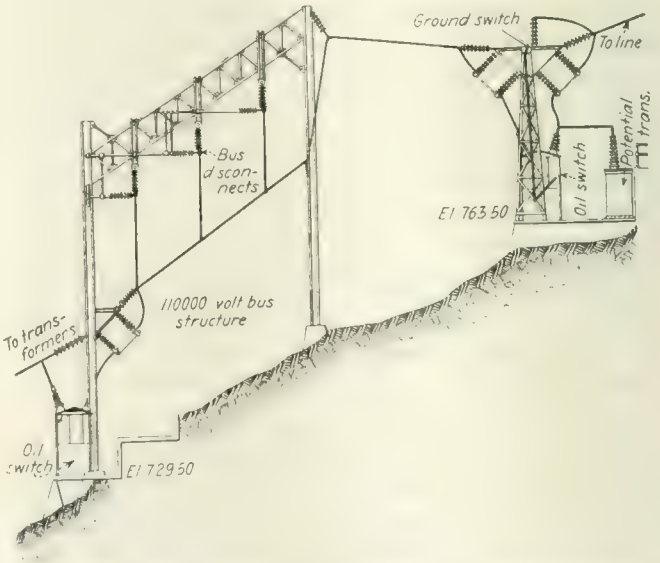
The main gates on both the main turbines and the exciter sets are electrically controlled from the switchboard, so that the machines may be started up and brought up to speed directly by the switchboard operator. The main waterwheel units are provided with pressure-relief valves which are operated automatically by the governor or by an excessive increase in pipeline pressure due to surges during load changes.

The main-control switchboard consists of a General Electric benchboard with pedestal-type Tirrill voltage regulator. This was wired completely in the field in fourteen days by the employees of the San Joaquin Light & Power Corporation's construction department. Watt-hour meters and relays are placed on the back of the panels. Temperature-exploring coils are provided in the generator windings with indicators on the switchboard, enabling the operator to read temperatures of generators at any time.

Simple Bus and Switching Arrangement

The 6,600-volt system involves one main bus and a transfer bus which permits operating any generator directly connected to its bank of transformers on a unit system or through the bus to other banks if its bank is out of service. A switch is provided for separating the main bus into sections, from either side of which the station service may be taken. The generators and step-up transformers are protected by differential relays which open all switches to isolate the faulty apparatus. The generator and exciter-field rheostats and the generator-field switches are remote-controlled from the switchboard.

Nine step-up transformers rated at 5,000 kva. each are connected 6,600 delta to 12,700 Y in banks of three. No spare transformer is provided, as the capacity provided will permit putting the load of three generators on two banks without seriously overheating them. The units are out-of-doors but close to the power house building and are supported by concrete beams over catch basins so that oil from any of them will quickly run away. The high-tension switching structure consists of three bays of steel structures erected on the mountainside back of the power-house building. The braces and sup-

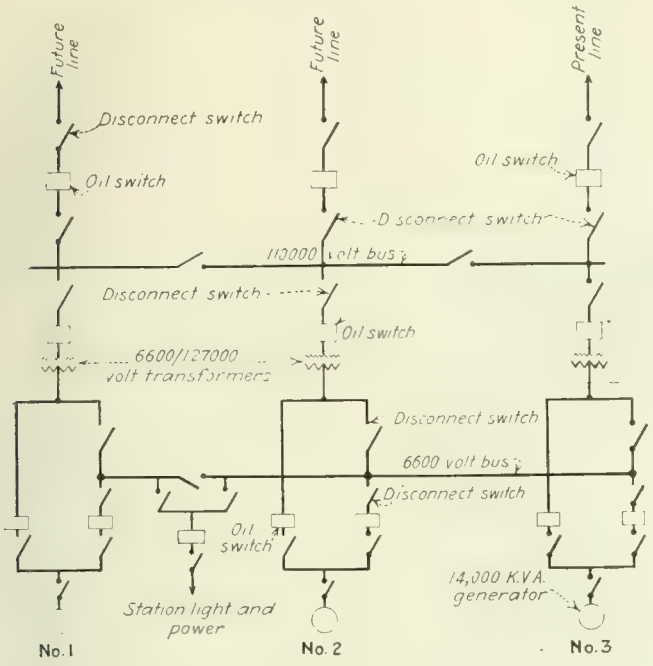


110,000-VOLT SWITCHING EQUIPMENT ON MOUNTAINSIDE BACK OF KERCKHOFF STATION

porting trusses are at an angle of 45 deg. and parallel to the slope of the mountainside. The high-tension buses are also in a plane of 45 deg., this being necessitated by the nature of the ground. Kelman high-

tension switches of the four-break type are used on the 127,000-volt circuits and are equipped with Ohio Brass compound-filled bushings.

The 110,000-volt tranmission line is approximately 110 miles (177 km.) long, extending from the Kerckhoff



SIMPLE SWITCHING ARRANGEMENT THAT AFFORDS EXTREME FLEXIBILITY OF OPERATION

power house to Sanger and Corcoran and later to McKittrick, connecting with the steam generating station at Bakersfield. The conductors are of aluminum cable having a cross-section of 266,000 circ.mil and are spaced 10 ft. (3 m.) apart and insulated with seven insulator disks at suspension points and eight at strain positions. The poles are 60-ft. (20-m.) cedar and have channel-iron cross-arms of the wishbone type. Poles are spaced about 580 ft. (176 m.) and have creosoted butts.

Railroad Electrification in France

THE work of electrifying certain French railroads, which started in 1920, has made rapid progress. The Midi company, for instance, has 150 km. of double-track electric line in operation, and the work of electrifying 3,000 km. additional is actually in progress. The reconstruction of two hydro-electric plants, which will furnish 150,000 hp. each to this road, is nearly completed. The road has placed orders for fifty new electric locomotives of the type used by the Chicago, Milwaukee & St. Paul Railway. Two other French railroads have undertaken the electrification of sections of their lines—the Orléans, which is electrifying 3,000 km., and the "P. L. M.," which is electrifying the same extent of track. The electric power for the Orléans road will be furnished by the waterfalls of the Upper Dordogne and that for the "P. L. M." by the falls of the French Alps.

The cost of electrifying these railroads will be in the neighborhood of 5,000,000,000 francs. The saving in coal will exceed 3,200,000 tons per annum, which, supposing the price of coal per ton to be above or equal to 100 francs, will, at the current rate at which money may be borrowed in France for such work, more than pay the interest on electrification bonds issued.

Standardizing the Distribution Voltages in Switzerland*

Alternating-Current Voltages of 125, 220 and 380 Decided Upon, While 110, 220 and 440 Volts Will Be Used for Direct Current

BY A. GRÜNHUT
Editor *Elektrotechnik und Maschinenbau*, Vienna

GREAT strides toward the standardizing of voltages have been made by the Swiss Electrotechnical Society. It has been considered wise to standardize first the low voltages, and in planning this such voltages have been decided upon as make it possible to maintain existing transformers, motors and other apparatus, making them suitable for the new voltage by rearranging or reconnecting their windings. In establishing voltage standards the three-phase system has been mainly considered, as direct-current plants are very scarce in Switzerland. One possibility is to subdivide a transformer winding into six half coils each, together with phase and Y voltage, with delta, Y and zigzag connections, giving voltages of $1:\sqrt{3}$ and of $1:2:3$. The most suitable ranges for three-phase systems have been found to be as follows: (1) 220/380 volts; (2) 250/440 volts; (3) 145/250 volts.

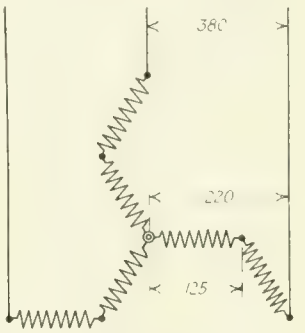


FIG. 1 — CONNECTIONS OF STANDARD DISTRIBUTION TRANSFORMER ADOPTED IN SWITZERLAND

A circular letter sent out to the power plants did not result in a definite decision. In general the second system has been found too high, and as between the first and the third system opinion was more favorable toward the first. It was suggested that for special purposes a lower and a higher limit be established. The first could be obtained by division by $\sqrt{3}$ (125 or 145), the latter by multiplication by 2 (760 or 880).

The Swiss Electrotechnical Society laid before its members the following alternatives to select from:

		Volts	Volts	Volts	Volts
I.	A.C.	125	220	380	760
	D.C.	110	220	440	500
II.	A.C.	145	250	440	880
	D.C.	125	250	500	750

At a general meeting held June 5, 1920, at Lucerne, the majority decided for the first alternative. It was therefore resolved to adhere in future in all plants to the voltages of 125, 220 and 380 for alternating current and 110, 220 and 440 for direct current.

The exact reasons why the members finally settled on system I are not known. It may be assumed that the old-established 125-volt systems were conservatively adhered to, that a large number of rural 220/380-volt lines are in existence, that lamp factories have standardized lamps of 110 volts and 220 volts and do not want to take up a third type, and, finally, that electrical factories can easily change a transformer from 125/220 volts and 145/250 volts to the new standard of 220/380 volts. The standard transformer of the future will

*Prepared exclusively for the ELECTRICAL WORLD.

have a Y primary and a zigzag secondary, as shown in Fig. 1. The association of the Swiss electrical manufacturers suggested for the interim a subdivided transformer winding according to Fig. 2.

For motors now connected to 250 volts a change over to 380 volts may be made by a winding of about 235 volts delta, corresponding to 410 volts Y. Motors with six poles may be divided in three groups for 250

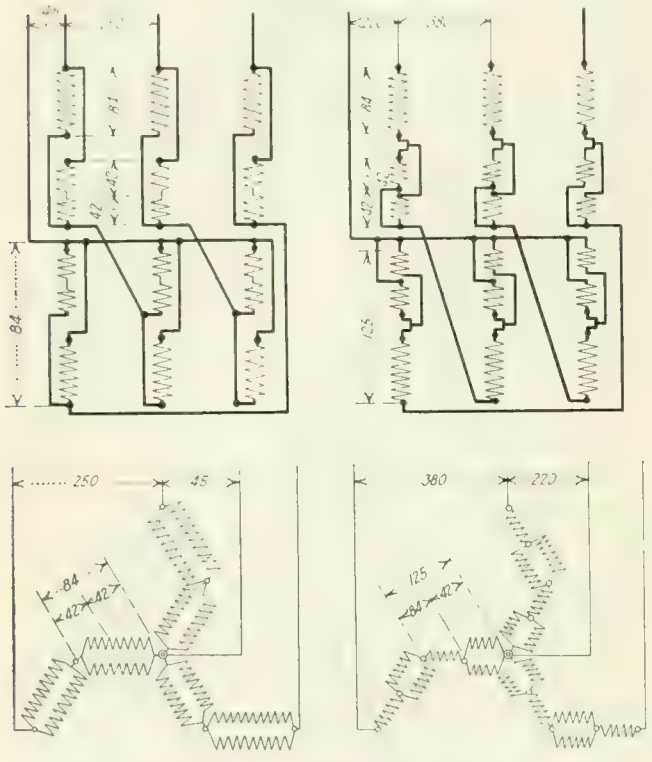


FIG. 2—SUGGESTED BY SWISS MANUFACTURERS FOR USE WHILE STANDARD IS BEING ADOPTED

volts and in two groups for 380 volts. Twelve-pole motors may be divided in a similar way. The future standard for motors will be 125/220/380 volts and must be of simplest construction, suitable for Y 220/380 volts and changeable to 125/220 volts.

At the next meeting the upper standards (760 volts alternating current and 500 volts direct current) will be discussed further.

Statistical records of the electric power plants of Switzerland for the year 1916-1917 show that in the existing 163 plants, with a total rating of 600,000 kw., thirty-six different distribution voltages are used. The widest use is made of 125 volts and 127 volts. Twenty-four per cent of all illumination, making up 38½ per cent of the total load, is fed with this voltage.

Second in rank for lighting is found 140 volts and 145 volts, totaling 18½ per cent of the output, while within the range of 218 volts and 225 volts 8½ per cent of the output is transmitted. Of all the connected motors, 35½ per cent of the load is 500-volt, three-phase; 27 per cent is 240 volts and 250 volts. A large use is made of three-phase voltages of 145/250 and 125/220, where motors are connected to the 250-volt and 220-volt wires and illumination to the phase voltage, 145 and 125.

For the distribution of larger amounts of power, such as are frequently used for agricultural purposes, 110 volts and 125 volts are too low, 220 volts phase and 380 volts having been found more suitable.

The climbing prices of gas made electric cooking very popular, which in turn made a higher voltage in the residential districts desirable. On a 110-volt line, as a rule, one hot plate at the most at 800 watts may be connected to the house wiring, which is not enough for cooking.

To connect two hot plates is impracticable on account of a 10-amp. fuse in the circuit. It is possible, however, on 220-volt wiring. In many house installations cable connections of 220 volts and 380 volts are already brought into the cellars. In others 110-volt wiring is made, with a later possible change-over to 220 volts. Therefore only a few old installations would have to be altered. The general desire is to have one network in which power is connected in Y and light and small heating loads to the single-phase voltage.

Special Truck for Warehouse and Depot Service

READY handling in confined spaces and ability to turn on the ground it stands on are features of a three-wheel electric road truck used in depot and warehouse hauling on Chicago streets by Carson, Pirie, Scott & Company. The truck shown in the illustration is driven by the front wheel, inside of which the motor is mounted. The motor pinion engages a circular rack on the interior of the wheel. The remainder of the chassis is made up of stock truck trailer parts. Steering is accomplished by turning the front wheel, the connection between the steering column and the wheel being by means of a pinion on the lower end of the column which engages a circular rack. The elimination of steering knuckles, differentials, chain drive and auxiliary parts reduces the motor and drive mechanism to the simplest possible form and eliminates the maintenance expense that the presence of these parts would incur. The truck has been in use for two years in place of the teams formerly employed. It was originally developed from an old horse-drawn truck, the motor wheel and battery having been attached to the truck for experimental purposes. Loads of four and five tons are



THREE-WHEEL ELECTRIC ROAD TRUCK FOR WAREHOUSE AND DEPOT HAULING

handled, and in nearly 12,000 miles of travel no tendency to upset has been observed. Its maneuvering ability has proved superior to that of the four-wheel truck. R. Macrae, electric vehicle engineer of the Commonwealth Edison Company, developed the motor wheel, which is the vital part of the truck and gives the possibility of use in confined spaces.

How 3,000 Southern Homes Were Wired—I.

Details of the Sales Plan, the Training of the Salesmen, Actual Cost of Contracts Obtained and the Combination of Advertising and Sales Efforts that Has Produced Best Results

By L. J. WILHOITE
Lighting Contract Agent Chattanooga Railway & Light Company

ON JAN. 1, 1919, according to the Chattanooga city directory, there were 21,571 families within that uncertain geographical domain referred to by our engineering friends as "our service districts." Twenty per cent of the population of Chattanooga, according to the city directory, are colored folks. We therefore concluded that about 17,256 white families were residing in our service districts on Jan. 1, 1919. Upon looking at our customers' ledgers we found that there were 9,673 residence connections. There were thus at that time 7,483 white families without the comforts and conveniences of electric service. In our arithmetical calculations we unceremoniously put the "colored brother" into the so-called unavailable class. This we found to be an entirely unjustified and unwarranted indictment of his progressiveness.



L. J. WILHOITE

As the sales engineer would say, we had on Jan. 1, 1919, a customer saturation of approximately ninety per 1,000 of population, although, according to the presumably unassailable statement of the leaders of the industry as reported in the proceedings of the National Electric Light Association, the possible saturation per 1,000 of population is around 200. When we compared our actual figure of ninety per 1,000 with this possible figure of 200 per 1,000 we decided that it was high time to get out after business. The only consolation that we had to fall back on for our poor record was the doubtless illogical supposition that the authorities who had figured out the 200 per 1,000 index to customer saturation had never spent much time in a community where much of the population ranges in color from light brown to bituminous. However, after making all due allowances for the color range and other probable ineligibles, we concluded that our possible wired houses per 1,000 should register around 128. While this figure was perhaps a trifle low, it made our actual saturation of ninety per 1,000 look bigger and kept us from feeling that the last eight years had been spent entirely in vain.

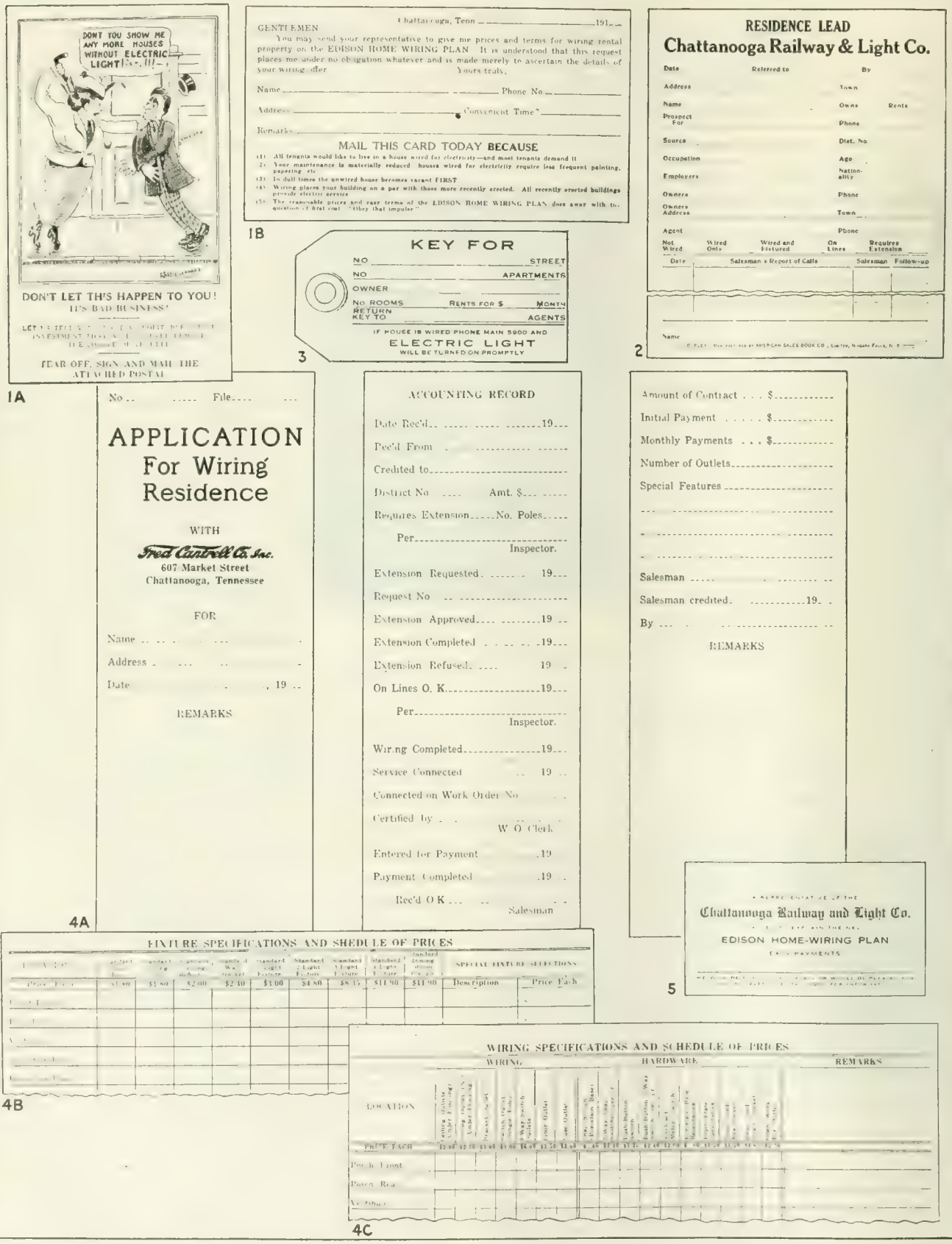
The population of Chattanooga, together with its suburbs and in-between rural communities, is, regardless of Uncle Sam's stingy statistics to the contrary, just about 107,000. That is, it was on Jan. 1, 1919. Therefore there were about 4,066 available house-wiring contracts which should earn a central station approximately $80,000 per annum. At this point we again referred to the reports of the National Electric Light Association and there discovered that only about 20 per cent of all houses are wired for electric lights. This statement made us feel a little better when we compared it with our own 43.3 per cent. Furthermore, according to the reports, these towns with only 20 per cent of their houses wired were getting an annual increase of less than 10 per cent in the number of wired homes. It was further indicated that the higher the percentage of wired homes to begin with, the greater the annual percentage of increase per year, other things being equal. We therefore assumed that if an ordinary town with a 20 per cent start could enjoy an increase of 10 per cent per annum, certainly a town with a 56.7 per cent start ought to produce in a year a 25 per cent increase in number of old houses wired. Based on these calculations the goal set was therefore a 25 per cent increase, or 2,416 old-house-wiring contracts in twelve months.

The next question to be considered was the method to be adopted in this new business. The company did not do wiring and would not do it; the company did not finance wiring and would not finance it; contractors said they really didn't care for the business of wiring old houses and couldn't afford to do wiring on the installment plan, and we knew that our possible customers couldn't afford to do wiring on the cash plan. This, in brief, was the situation that was faced.

At this point some of the amusing experiences which we had with the local electrical fraternity in our attempt to get them interested in participation on an equal basis would be interesting. But this is another story and shall be passed with the bald statement that after three or four weeks were spent in unsuccessful attempts to get the electrical men in line they simply refused—for reasons, we suspect, that are pretty well known to every central-station man in the United States.

All through these preliminary diplomatic negotiations with the local firms that do wiring one contractor had evinced a willingness to do business, and as nobody else cared to accept our service as free selling agents unless we financed the business, we signed up with this contractor and agreed to give him our moral, business, social and ethical support on house wiring for the year 1919. Briefly, we agreed to assume all selling expense, do the advertising, employ the salesmen and pay them and hand the business to him all signed up ready to be worked. He agreed to do the wiring promptly and in a satisfactory manner on the deferred-payment plan, assuming all credit risk and collecting the money.

Advertising Material, Contract Forms and Follow-up Blanks Used in the "Edison Home-Wiring Plan"



1A and 1B—Strenuous appeal in the form of a return post card sent to the landlords of unwired houses.

2—Prospect slip used in the salesmen's follow-up system.

3—Key tag. The real estate men used a large quantity of these, as it saved them printing cost.

4A—Three-panel cover of wiring contract, which provides space for the accounting and sales departments' records of transaction. Contract is folded for convenience in handling and in filing.

4B—Page 2 (inside) of wiring contract form giving fixture specifications and schedules of prices.

4 C—Page 3 (inside) of wiring contract form with wiring specifications and schedule of prices.

5—How salesman's calling card was utilized to advertise the "Edison Home-Wiring Plan."

With this working agreement completed, we started in to get advertising matter printed, mailing lists compiled, newspaper copy ready and salesmen hired and trained for the campaign. The following displayed advertisement was inserted in a 30-in. space in the Sunday morning paper: "Wanted—Large local corporation requires the services of seven men capable of earning on a combination salary and commission basis from $200 to $250 per month. Address, giving full experience, reference and present employment, Box 90, care Times." From the responses this advertisement brought us twenty-four of the applicants were notified by letter to meet us and talk the matter over. Twenty came as requested. The time was 8 o'clock in the evening at our company's office. Those who came early were requested to be seated and those who came late found the door locked. Of course, nobody expected to see the others and each naturally regarded his neighbor with more or less suspicion. In an hour the plan was unfolded to them and each knew it much better than if time had been wasted in interviewing them separately. "Now, gentlemen," we concluded, "you know what the job is that we propose to do. You know what it will pay you if you can deliver it. You know that you will starve to death if you don't deliver it. Starting promptly at 8 o'clock tomorrow night and continuing thereafter every night for five nights, we are going to tell you how this job is going to be done. If you are interested, be here. If you are not interested, don't waste your time and ours. Attendance here does not obligate us to give you a job, and neither does it obligate you to take one if we should offer it to you. The question of jobs will be decided after the fifth night. We hope to see all of you tomorrow night at 8 o'clock."

The five evenings that followed proved to be the meeting time for a lively class in "how to do house wiring." Several of our own men from other departments, as well as our sales force and the electrical contractor's men, were present at these meetings in addition to the usual quota of canvassers, and we had with all of them a very pleasant and profitable time. On the last evening we closed our house-wiring course with a statement something like this: "Boys, you know pretty well now what we want. You know what it will take to get it. If you think you have got what you think it takes to get it, fill out one of these applications and leave it here with us. If we agree with you, you will hear from us tomorrow." Ten applications were left with us.

Types of Salesmen Selected

Going to school with these men for a week had given us a pretty fair idea as to whom we ought to hire out of the group. From the ten applicants we selected seven and requested them to report for work the following day. The experience of these seven men in our business was limited to what had percolated into them during six strenuous sessions of about one hour each. The line-up and the final outcome is indicated in the following tabulation.

Salesman No. 1.—Former detective and correspondence course salesman; age fifty, nationality French; now holds the world's record on house wiring.

Salesman No. 2.—Former wholesale liquor dealer (who saw the handwriting on the wall); age thirty-nine, Jewish; now holds the second world's record.

Salesman No. 3.—Former tobacco salesman; age unknown, nationality American (Georgia); not meteoric but a constant business getter.

Salesman No. 4.—Former adding machine, dictaphone, iron-safe and calculator salesman; age thirty-three, nationality Irish; a regular business whirlwind when right, but a barely perceptible zephyr when otherwise—a sort of "get-them-when-the-other-fellow-couldn't."

Salesman No. 5.—Former sailor in the United States Navy and a general all around ladies' man; age twenty-nine, nationality plain American; a salesman with strong parlor influences.

Salesman No. 6.—Former college man, an athlete; age twenty-eight, nationality American (Chattanooga); later found to be suffering from sleeping sickness, hookworm and inertia.

Salesman No. 7.—Former clerk; age thirty-five, nationality completely melted; could find them but could not close them.

We wanted seven men because a good house-wiring salesman averages about twenty calls a day, including both his missionary and closing visits. House-wiring "prospects" ought to be called on at least once a month; otherwise they have a tendency to become decidedly satisfied with the wrong kind of light. We had thirty-eight good prospective customers to 1,000 of population, according to the city directory, so that one salesman, figuring twenty-six working days a month, could canvass 13,000 persons without difficulty and 15,000 under a little pressure. We also knew that all seven men would not bring in equal numbers of house-wiring contracts with the signatures affixed, and we decided that even if the city's population had been overestimated seven men would not be too many to start with.

The first day of the campaign was spent in giving the seven salesmen details of the job—not "how-to-sell-it" talk but simple elementary facts about the tools and how to use them. That evening every man left the office with a big bag that contained the following: (1) a supply of our standard lighting application forms; (2) a supply of house-wiring contracts; (3) business cards; (4) a set of photographs of fixtures to be used; (5) a supply of booklets telling all about the Edison home-wiring plan; (6) copies of all publicity material, including proofs of newspaper advertisements that would appear; (7) a convenient book of lead forms for reporting "prospects"; (8) estimating blanks; (9) "lead follow-up" book properly indexed; (10) order forms for application; (11) a bulletin binder for filing and retaining instructions to be issued from time to time regarding the work. The next day was spent in precisely the same manner, and many times thereafter reference was made to the same subject, the mechanics of the business. A salesman without tools and a complete knowledge of how to use them is worse off than a carpenter in the same fix, and a salesman with tools that he does not know how to use is worse off that either.

Agreement with Salesmen

In each man's bulletin binder was a summary of the conditions and agreement under which we were going to work. These printed rules saved a lot of argument in the future. Among many other things these stipulations set out the following conditions, which are briefly summarized here because they have proved of inestimable value in our work:

1. For his services from March 15 to April 1 each man would receive just $37.50; that was all.

2. For the first full month each man would have a guaranteed salary of $100, the second month $125, the third month $150, the fourth month $175, and each month thereafter $200.

3. During the first full month each man was expected to deliver not less than twenty old-house-wiring contracts, the second month not less than twenty-five, the third month not less than thirty, the fourth month not less than thirty-five, and each month thereafter not less than forty.

4. On each contract taken in excess of the required quota a commission of $5 would be paid regardless of the amount or size of the contract.

5. It was expressly understood that any man who failed to make his quota was out of a job forthwith unless for good and sufficient reasons we decided to give him a further trial. With arrangements like this the unpleasant business of discharging was taken care of automatically.

6. It was set out that the salesmen would receive full credit for all business coming from their respective districts regardless of whether or not they had had anything to do with signing the contract. This provided, of course, that the contract for wiring was placed with the Fred Cantrell Company, the contracting firm with which we had completed arrangements for handling the business. On business going to other contractors no credit would be allowed to the salesman under any consideration. This decision was necessary for obvious reasons, and incidentally it may be said that the regulation had the desired effect.

The Preliminary Survey

Our service districts were divided as equally as possible on a basis of prospective business. Each man was assigned to a territory and credit was arranged according to districts. When somebody broke over the fence he simply boosted his neighbor's average; therefore breaking over was infrequent. All salesmen were required to attend to their own knitting exclusively, and in their knitting bag they carried just one needle—"old-house-wiring contracts." They were not permitted to handle anything else, such as lighting, ranges, washing machines or other appliances. With this clear-cut understanding of the rules of the campaign, coupled with a fair knowledge of the tools to be used, along with six nights of house-wiring school instruction the men began to think in terms of house wiring.

The details of the preliminary survey, results of the campaign by months, costs per contract, value of the business secured, relative values of different phases of the campaign and general conclusions will be given in a second section of this article.

Progress in Reconstruction of French Light and Power Plants

CONSIDERABLE progress has been made in reconstructing the French electric light and power plants destroyed during the war, according to information received by the French High Commission in the United States.

Thirty-two plants were destroyed, which had a combined capacity in 1913 of 201,500 kw. out of a total in the devastated area of 300,000 kw. Since the armistice twenty-four of these plants, with a combined rating of 104,000 kw., have been rebuilt. It is expected that by spring all of the electric plants will again be in operation and with the new machinery will be rated at 322,000 kw.

Form 314

SALES DEPARTMENT

Salesman's Daily Report of Business Retained, Solicited and Secured 19

Name (Business Closed)	Address	X	Class	Business	LIGHTING			MOTORS		APPLIANCES		Total 50 W. Equiv.	Rate
					Mazdas	Arcs	Incds.	No.	H. P.	Fans	Misc.		
X-Make √ Mark in Column if New Call	Totals												

UNSUCCESSFUL CALLS

Name (Not Closed)	Address	X	√	Business	Using	Remarks	Call Again
X-Make √ Mark if New Call							
√-Make X Mark if Customer							

COMPLAINTS INVESTIGATED

Name	Address	Nature of Complaint	Adjustment

No. Contracts Closed No. New Calls No. Old Calls

Total No. Calls Signed Salesman

SALESMAN'S DAILY REPORT FORM, WHICH THE AVERAGE SALESMAN DISLIKES TO FILL OUT, BUT WAS FOUND OF GREAT VALUE IN KEEPING THE WORK FROM LAGGING

Rural and Other Service Costs Compared

Analysis of Actual System Shows that Higher Investment Charge and Line Losses for Rural Service Make Cost Double that for Urban Service

UTILITY men have worried more over rates than over any of the other problems which affect the rural service situation. But the rate problems are dependent on the financing, construction and operating problems, and until those problems are satisfactorily solved the rate problem cannot be solved. Some utilities have tried to solve the rate problem first. The result, according to Prof. D. D. Ewing of Purdue University, has been confusion in both thought and results. Professor Ewing recently discussed the subject in a paper read before the Indiana Engineering Society and the Indianapolis-Lafayette Section, A. I. E. E., his conclusions being based upon an analysis of data obtained from an operating company serving rural communities.

On the basis of equal efficacy of investment and quality of service the ultimate cost of serving the rural consumer will be the same whether the lines be owned by the rural consumers or by a utility. In any event the cost of serving the rural consumer will be several times the cost of serving the urban consumer. This cost will be made up of (1) fixed charge, (2) consumer charge and (3) energy charge. All of these charges will be much higher than for the urban consumer. The investment, upon which the fixed charge largely depends, will be from four to twelve times larger. Because of the wide distribution of consumers the consumer charge will be from two to four times larger. As indicated in Table I, the energy lost in transit is likely to range from 40 to 60 per cent of the total energy supplied to the line at the power house. The energy charge, therefore, will be roughly twice that for the urban consumer.

TABLE I—CONSUMPTION DATA FROM RURAL LINES IN THE MIDDLE WEST *

Class of Service	Location	No. of Consumers	Average kw.-hr. per Month	Per Cent of Energy Loss	Remarks
Village and farm	Indiana	372	24	54	Single line, 1919
Farm	Kansas	5	13	58	Single line, 1919
Farm	Wisconsin	146	29	..	Thirteen lines, 1919-20
Farm	Iowa	25	40	38	Single line, 1919-20
Farm	Ohio	25	30	45	Several lines, 1919-20
Farm	Ohio	300	15	..	Several lines, 1919-20
Village and farm	Wisconsin	738	40	..	Rural lines in Wisconsin Reported in 1917
Farm	Indiana	145	16	..	Several lines, 1915
Village	Indiana	74	11	..	Several lines, 1915

* This table, as well as Tables II, III and IV, is compiled from analyses made of actual rural lines in service. Tables II, III and IV are taken from the practice of an Indiana company and present some figures on rural service that are all too scarce. Note the manner in which rural service bulks large in line losses and comparative costs.

Rate practice for rural lines is in a state of dire confusion. Some companies charge rural consumers the urban rate. Such is the practice of the company in the small Indiana city whose consumer and service cost data are set forth in Tables II, III and IV. It will be noted that on the time-honored but seriously incorrect measure of service, namely, the kilowatt-hour, the cost of serving the rural consumer is nearly twice that of the urban consumer. The column headed "Investment" is really not investment but appraised value at cost of reproduction less depreciation, which is materially less than the original investment. It will be noted that the energy loss to the rural consumer was 54 per cent. The rural consumers are those receiving service from a 12-mile, 6,600-volt, single-phase transmission line, and a considerable number of them are villagers rather than farmers. The consumer's charge for rural consumers was undoubtedly much higher than for the urban consumers, but the accounting did not permit segregation of these charges. It may be here noted that there should be a distinction between the farmer and the villager.

TABLE II—RURAL LINE CONSUMER AND LOAD DATA AS COMPARED WITH OTHER CLASSES OF SERVICE

Class of Service	No. Consumers	Peak Load, Kw.	Per Cent Peak	Kw. Generated	Per Cent Total	Kw.-Hr. Sold	Per Cent Total Sold	Per Cent Kw.-Hr. Losses
Residence	2,293	250	20 8	790,000	28 4	650,000	27 9	17 6
Commercial	402	330	27 6	534,000	19 2	510,000	21 9	4 5
Municipal	1	80	6 6	372,000	13 4	334,000	14 3	10 2
Power	169	480	40 0	848,000	30 6	727,000	31 2	14 2
Rural	372	60	5 0	234,000	8 4	108,000	4 7	54 0
Totals	3,237	1,200	100 0	2,778,000	100 0	2,329,000	100 0	

On the basis of 7 per cent interest, 2 per cent taxes and insurance, 8 per cent maintenance and depreciation and $500 investment, the fixed portion of the cost of service would be $85 per year, or about $7 per month.

TABLE III—RURAL LINE INVESTMENT AND SERVICE COST DATA COMPARED WITH OTHER CLASSES OF SERVICE

Class of Service	Investment	Per Cent Total Investment	Cost of Energy: Fixed Charges	Consumer's Expense	Energy Expense	Total Cost	Investment per Consumer
Residence	$84,776	28 9	$15,900	$2,940 00	$19,550	$38,390	$37
Commercial	69,021	23 6	12,950	514 00	13,150	26,614	172
Municipal	29,747	10 1	5,580	1 28	9,130	14,721	29,747
Power	89,758	30 6	16,850	217 00	20,850	37,917	530
Rural	20,171	6 8	3,780	478 00	5 750	10,078	54
Totals	$293,473	100 00					

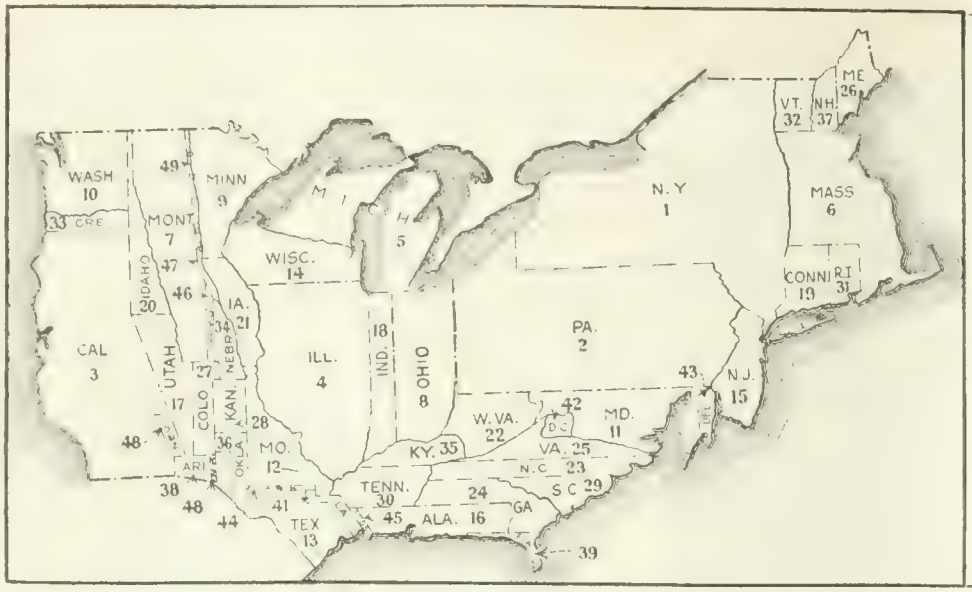
If the consumer prefers to carry his own investment and let the utility operate and maintain the line, the fixed cost would be about $30 per year, or $2.50 per month. Increasing the fixed cost by the portion of the energy charge incident to transformer core losses is practiced in a number of places. It seems to be a move in the right direction because the apparent energy charge will be reduced and the consumer will be induced to increase his consumption. A flat charge per year covering all energy consumption up to, say, 500 kw.-hr. is used in some places. Excess energy used is then charged for at a low rate. From the farmer's point of view Professor Ewing thinks this scheme a most excellent one.

TABLE IV—ELEMENTS OF COST OF SERVICE FOR RURAL LINES AS COMPARED WITH OTHER CLASSES OF SERVICE

Class of Service	Per Consumer Fixed Charges per Month	Consumer's Expense per Month	Energy Charge, Cents	Total Cost per Kw.-Hr. Cents
Residence	$0 578	$0 107	3.00	5.90
Commercial	2.69	107	2.58	5.20
Municipal	46.50	107	2.73	4.40
Power*		107	2.87	5.20
Rural	847	107	5 32	9 25

* Power fixed charge pro-rated on a demand basis.

Rank of States as Users of Electrical Energy

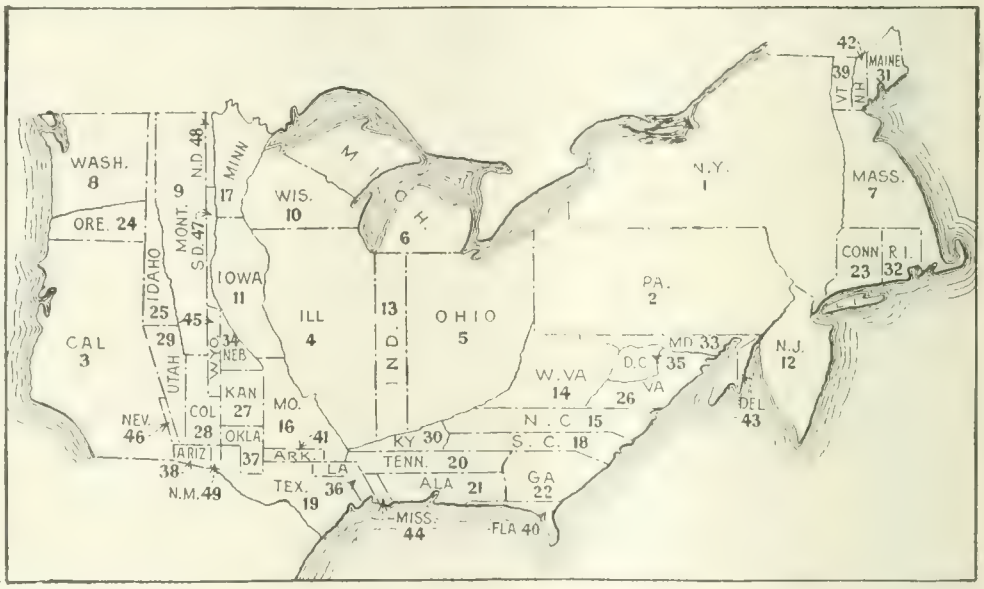


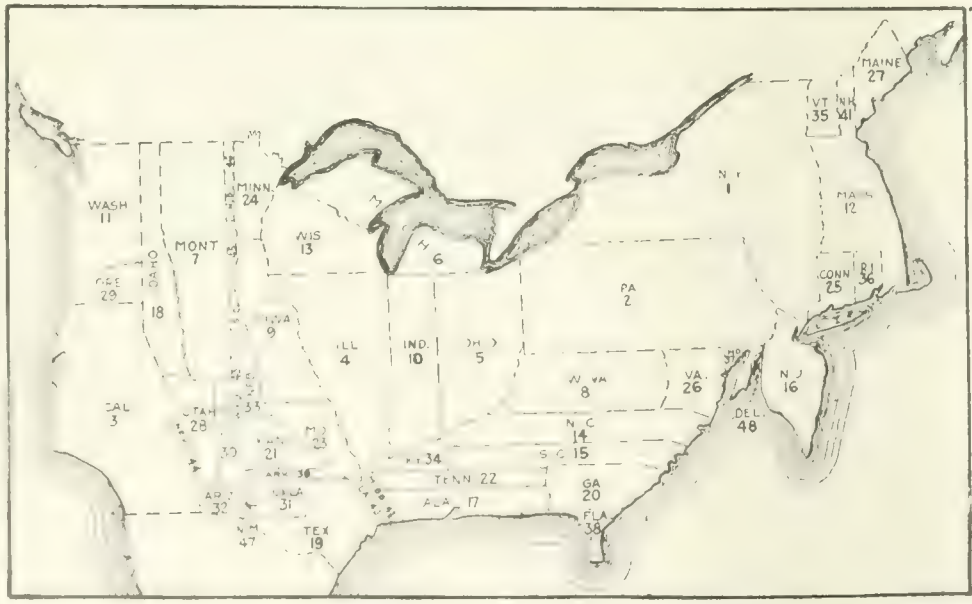
Relative Size of States Based on Electrical Energy Sold to Power Customers

Rank	State	Kilowatt-Hours	Per Cent of Total
1	New York	3,475,000,000	15.30
2	Pennsylvania	2,905,000,000	13 20
3	California	2,095,000,000	9 50
4	Illinois	1,590,000,000	7.30
5	Michigan	1,470,000,000	6.76
6	Massachusetts	978,000,000	4.43
7	Montana	898,000,000	4 07
8	Ohio	720,000,000	3.36
9	Minnesota	568,000,000	2.59
10	Washington	509,000,000	2 31

Relative Size of States Based on Electrical Energy Sold for Light and Power

Rank	State	Kilowatt-Hours	Per Cent of Total
1	New York	5,707,000,000	14 70
2	Pennsylvania	3,681,000,000	9 46
3	California	3,449,000,000	8 85
4	Illinois	2,860,000,000	7 38
5	Ohio	2,785,000,000	7 16
6	Michigan	2,040,000,000	5 20
7	Massachusetts	1,216,000,000	3 12
8	Washington	1,180,000,000	3 03
9	Montana	1,133,000,000	2 90
10	Wisconsin	965,000,000	2 50





Relative Size of States Based on Electrical Energy Sold for Light and Power, but Excluding Energy Consumed in Cities with Population Over 100,000

Rank	State	Kilowatt-Hours	Per Cent of Total
1	New York	3,439,100,000	13 45
2	Pennsylvania	2,498,000,000	9 79
3	California	2,215,200,000	8 65
4	Illinois	1,365,000,000	5 35
5	Ohio	1,257,000,000	4 93
6	Michigan	1,213,000,000	4 75
7	Montana	1,133,000,000	4 44
8	West Virginia	940,000,000	3 69
9	Texas	838,000,000	3 28
10	Indiana	744,500,000	2 93

Electrical Importance of the Various States

Map Indicates that Almost 80 per Cent of the Electric Light and Power Industrial Field Lies East of the Rocky Mountains -New York and Pennsylvania Lead in Amount of Electrical Energy Consumed

MAPS indicating the relative importance of the various states as users of electrical energy are shown on the opposite page. Actually only 60.7 per cent of the area of the United States is east of the Rocky Mountains, but if the areas of the various states were based on the percentage of the total electrical energy sold to power customers, then 79.2 per cent of the total area of the country would be east of the Rockies. A study of the 1920 population indicates that 91.7 per cent of the American people live in states east of the Rocky Mountains. These maps would indicate that at the present time almost 80 per cent of the market for electrical manufacturers lies in the Central and Eastern States. The importance of the western section, however, is rapidly increasing, the present rank of the Pacific States being third and the Mountain States ranking fourth; but there seems to be little doubt that the big field of electrical activity will remain in the eastern portion of the United States for some time to come.

RELATIVE IMPORTANCE OF THE STATES OF THE UNION FROM THE VIEWPOINT OF THE ELECTRICAL INDUSTRY

States	Kw.-Hrs. Sold to Power Customers (1919)			Total Kw.-Hrs. Sold for Light and Power (1919)			Kw.-Hrs. Sold for Light and Power Excluding Cities of Over 100,000 Population (1919)			Population of States (1920)		
	Rank	Kilowatt-Hours	Per Cent of Total	Rank	Kilowatt-Hours	Per Cent of Total	Rank	Kilowatt-Hours	Per Cent of Total	Rank	Population	Per Cent of Total
United States		22,046,900,000			38,875,000,000			25,510,000,000			105,709,771	
New England:												
Maine	26	193,700,000	0 88	31	232,000,000	0 60	27	232,000,000	0 92	35	768,014	0 73
New Hampshire	37	94,800,000	0 44	42	68,500,000	0 18	41	68,500,000	0 27	41	443,083	0 42
Vermont	32	148,200,000	0 67	39	142,700,000	0 37	35	142,700,000	0 56	45	352,428	0 33
Massachusetts	6	978,000,000	4 43	7	1,216,000,000	3 12	12	713,900,000	2.80	6	3,852,356	3 64
Rhode Island	31	161,000,000	0 73	32	230,000,000	0 59	36	137,500,000	0 54	38	605,397	0 57
Connecticut	19	280,300,000	1 27	23	470,000,000	1 22	25	277,300,000	1 08	29	1,380,631	1 31
Middle Atlantic												
New York	1	3,475,000,000	15 30	1	5,707,000,000	14 70	1	3,439,100,000	13 45	1	10,384,829	9 81
New Jersey	15	360,000,000	1 63	12	900,000,000	2 32	16	553,250,000	2 17	10	3,155,900	2 98
Pennsylvania	2	2,905,000,000	13 20	2	3,681,000,000	9 46	2	2,498,000,000	9 79	2	8,720,017	8 25
South Atlantic:												
Delaware	43	38,000,000	0 17	43	61,700,000	0 16	48	8,800,000	0 04	47	223,003	0 21
Maryland	11	418,000,000	1 90	33	227,500,000	0 59	37	114,000,000	0 45	28	1,449,661	1 37
Dist. of Columbia	42	32,500,000	0 15	35	216,000,000	0 55	49		0 00	42	437,571	0 41
Virginia	25	205,700,000	0 93	26	420,000,000	1 08	26	272,500,000	1 07	20	2,309,187	2 18
West Virginia	22	242,000,000	1 10	14	940,000,000	2 05	8	940,000,000	3 69	27	1,463,701	1 39
North Carolina	23	235,000,000	1 07	15	665,000,000	1 72	14	665,000,000	2 60	14	2,559,123	2 42
South Carolina	29	174,000,000	0 79	18	590,000,000	1 52	15	590,000,000	2.32	26	1,683,724	1 59
Georgia	24	206,900,000	0 94	22	510,000,000	1 32	20	374,700,000	1 46	12	2,895,832	2 74
Florida	39	70,800,000	0 32	40	110,900,000	0 29	38	110,900,000	0 44	32	968,470	0 92
East North Central:												
Ohio	8	720,000,000	3 36	5	2,785,000,000	7 16	4	1,257,900,000	4 93	4	5,759,394	5 45
Indiana	18	311,300,000	1 51	13	880,000,000	7.26	10	744,500,000	2.93	11	2,930,390	2 77
Illinois	4	1,590,000,000	7 30	4	2,860,000,000	7 38	5	1,365,000,000	5 35	3	6,485,280	6 14
Michigan	5	1,470,000,000	6 76	6	2,040,000,000	5 20	6	1,213,000,000	4 75	7	3,668,412	3 47
Wisconsin	14	388,500,000	1 86	10	965,000,000	2 50	13	694,000,000	2 73	13	2,632,067	2.49
West North Central:												
Minnesota	9	568,000,000	2 59	17	609,000,000	1 60	24	280,700,000	1 10	17	2,387,125	2 29
Iowa	21	256,100,000	1 16	11	933,000,000	2.40	9	838,500,000	3 28	16	2,404,021	2 27
Missouri	12	397,400,000	1 80	16	639,000,000	1.64	23	286,400,000	1 13	9	3,404,055	3 22
North Dakota	49	6,900,000	0 03	48	29,600,000	0 08	46	29,600,000	0 12	36	645,680	0 61
South Dakota	47	12,800,000	0.06	47	44,500,000	0 11	45	44,500,000	0 18	37	636,547	0 60
Nebraska	34	117,800,000	0.53	34	222,000,000	0 57	33	150,500,000	0.59	31	1,296,372	1.23
Kansas	28	174,500,000	0 79	27	385,000,000	0 99	21	314,900,000	1 23	24	1,769,257	1 67
East South Central:												
Kentucky	35	103,100,000	0 47	30	252,000,000	0 69	34	145,100,000	0 57	15	2,416,630	2 28
Tennessee	30	173,200,000	0 79	20	550,000,000	1 40	22	289,500,000	1 14	19	2,337,885	2 21
Alabama	16	356,200,000	1 61	21	531,000,000	1.38	17	477,500,000	1 88	18	2,348,174	2.22
Mississippi	45	21,500,000	0.10	44	59,300,000	0.15	42	59,300,000	0 23	23	1,790,618	1 69
West South Central												
Arkansas	44	23,400,000	0 11	41	103,000,000	0 28	39	103,000,000	0 41	25	1,752,204	1.66
Louisiana	41	53,600,000	0 24	36	192,500,000	0 49	40	71,100,000	0 28	22	1,798,509	1 70
Oklahoma	36	96,000,000	0 44	37	179,000,000	0 46	31	179,000,000	0 70	21	2,028,283	1.92
Texas	13	391,000,000	1 77	19	592,000,000	1 50	19	417,350,000	1 64	5	4,663,228	4.42
Mountain												
Montana	7	898,000,000	4 07	9	1,133,000,000	2 90	7	1,133,000,000	4 44	39	548,889	0 52
Idaho	20	258,600,000	1.17	25	426,000,000	1 10	18	426,000,000	1 68	43	431,866	0 41
Wyoming	46	15,700,000	0 07	45	53,300,000	0 14	43	53,300,000	0 21	48	194,402	0.18
Colorado	27	188,000,000	0 86	28	381,000,000	0 98	30	200,300,000	0 79	33	939,629	0 89
New Mexico	48	7,600,000	0 03	49	15,800,000	0 04	47	15,800,000	0 06	44	360,350	0 34
Arizona	38	90,000,000	0 41	38	160,000,000	0 41	32	160,000,000	0 63	46	333,903	0.32
Utah	17	355,000,000	1 61	29	342,000,000	0 88	28	221,000,000	0 87	40	449,396	0 43
Nevada	40	59,400,000	0 27	46	45,700,000	0 12	44	45,700,000	0 18	49	77,407	0.07
Pacific:												
Washington	10	509,000,000	2 31	8	1,180,000,000	3.03	11	729,600,000	2 85	30	1,356,621	1 28
Oregon	33	118,800,000	0 54	24	450,000,000	1 16	29	210,600,000	0.82	34	783,389	0 74
California	3	2,095,000,000	9 50	3	3,449,000,000	8.85	3	2,215,200,000	8.65	9	3,426,861	3 24
Sections												
New England	5	1,856,000,000	8 4	7	2,359,200,000	6 1	7	1,571,900,000	6.2	7	7,401,909	7 0
Middle Atlantic	1	6,740,000,000	30 5	1	10,288,000,000	26 5	1	6,490,350,000	25 5	1	22,260,746	21 0
South Atlantic	6	1,622,900,000	7 3	4	3,741,100,000	9.6	4	3,075,900,000	12.1	3	13,990,272	13.2
East North Central	2	4,479,800,000	20.5	2	9,530,000,000	24 5	2	5,274,400,000	20 5	2	21,475,543	20 5
West North Central	7	1,533,500,000	7 0	5	2,862,100,000	7 4	6	1,945,100,000	7.7	4	12,543,057	11 9
East South Central	8	654,000,000	3 0	8	1,392,300,000	3.6	8	971,400,000	3 8	6	8,893,307	8.4
West South Central	9	564,000,000	2.5	9	1,066,500,000	2 7	9	770,450,000	3 0	5	10,242,224	9 7
Mountain	4	1,872,900,000	8.5	6	2,556,800,000	6 6	5	2,255,100,000	8 8	9	3,335,842	3 1
Pacific	3	2,728,800,000	12 3	3	5,079,000,000	13.0	3	3,155,400,000	12.4	8	5,566,871	5.2

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Resuscitation from Electrical Shock by the Prone-Pressure Method

To the Editor of the ELECTRICAL WORLD:

SIR: Confidence in the Schafer or "prone-pressure" method of resuscitation and objection to alleged mechanical means or any modification of the published and authoritative prone-pressure method have been established, first, by the personnel, research, deliberation and report of the third resuscitation commission representing the American Medical Association, the National Electric Light Association and the American Institute of Electrical Engineers, with which commission the accident prevention committee of the National Electric Light Association was in conference and accord, and, second, by the experiences of the companies constituting the membership of the National Electric Light Association with successful cases of resuscitation from electric shock by the prone-pressure method, both before and subsequent to the report of the commission. These two reasons for confidence are obviously of such reputable and representative character that no one, and particularly no public utility, would be justified in modifying the commission's conclusions or violating the text of its instructions. Such departure from the text, if justifiable, should only be presumed or encouraged after some commission of like personnel, reputation and acknowledged ability has again officially passed upon the subject and recorded its recommendations for changes in the rules now in force. These statements would seem to make it unnecessary to present a detailed argument against the modification of the approved method.

During the study and research of the commission evidence was produced that a considerable number of successful cases of resuscitation from electric shock were reported where the injured man fell from a pole or structure. A representative advocating mechanical means of resuscitation proposed as a supplement to the treatment afforded by his device traumatic shock, either by giving the body a jolt or by tapping the foot or other parts of the body. The National Electric Light Association committee incorporated this feature of traumatic shock as an auxiliary or detail of the prone-pressure method, believing that in certain cases it might be helpful toward restoration, but it should be remembered that this feature is incorporated as one of the details of the entire recommended treatment. Whatever theories or scientific deductions may have prompted the committee in arriving at its conclusions and recommendations, the electrical industry must certainly be convinced that the practice of the published rules is indispensable as a part of the operation of electric properties.

It would be interesting to know how many lives have been saved by the prompt and proper application of the method since the committee met in May, 1918. Such failures to resuscitate as have been reported are comparatively few and mostly due to one of two causes: (a) Failure to apply the method promptly, (b) failure to apply the method properly. Circumstances and conditions may make the necessary promptness impossible, but improper application is nearly always inexcusable.

Until some properly constituted and reputable body of experts shall decide upon a better method, electric power and light companies should carefully train all employees to administer the method in strict accordance with the published text.

CHARLES B. SCOTT,
Chairman Accident Prevention Committee, N. E. L. A.
Manager Bureau of Safety,
Director National Safety Council.
Middle West Utilities Company, Chicago.

Unsymmetrical Illumination

To the Editor of the ELECTRICAL WORLD:

SIR: In any working space using general illumination the light is commonly well distributed with reference to objects seen so that the two eyes divide the work with reasonable fairness, one being in about the same circumstances as regards direction and intensity as the other. Unless one can preserve this reasonable symmetry in illumination of all kinds serious trouble may follow, particularly if the eyes are normally under any slight strain. This I have recently experienced several times to my sorrow. For example, it is quite possible so to arrange a reading lamp that a book held in the hand will be fairly well illuminated as regards one eye and rather badly as regards the other. Similarly a condition may be reached where there is some specular reflection of a unilateral sort. The effect of such inequality in lighting makes itself manifest in various ways. The two eyes may be forced to work at somewhat different apertures, introducing a slight difference in refraction. For this reason, or in an attempt at equalizing things, one eye may be under a muscular strain of accommodation or position which will quickly make itself felt. In cases of astigmatism the difference in condition as respects eyes may be very much aggravated and a considerable amount of strain appear very promptly. It is, I think, mostly in the attempt of the eyes to equalize errors of refraction under differing illuminations that trouble most easily arises. It appears as simple eye strain, with the ordinary symptoms of more or less pain and a feeling of sand in the eyes, lasting for some hours if the conditions which have been experienced have been bad.

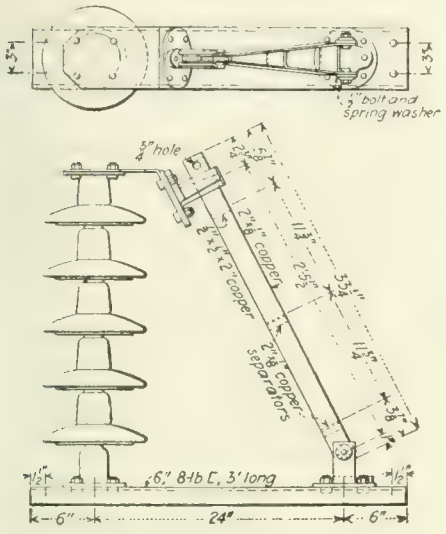
Exactly the same thing can happen in the case of natural lighting where there is sufficient light on one side and a considerably reduced amount on the other. I have observed these effects of lack of uniformity in illumination in myself and in others a good many times and am convinced it is a condition which should be guarded against more carefully than has usually been the case. To get thoroughly good lighting, especially for continued or critical work, the illumination should have the same effective value seen by either eye and should have equal freedom from specular reflection considering both. This condition implies both fair uniformity in lighting and symmetry of position in using the eyes. This condition is particularly worth attaining in schools and clerical offices where many people are engaged in somewhat steady visual work, generally without any proper inspection for the errors of refraction which lie at the root of eye strain.

LOUIS BELL,
Boston, Mass. Consulting Engineer.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Simplified Grounding Switch for Outdoor High-Voltage Lines



UNIT-TYPE GROUNDING SWITCH SIMPLIFIES CONSTRUCTION

FOR grounding 60,000-volt lines on outdoor racks the Southern California Edison Company has developed the simplified unit-type switch illustrated. By placing the switch at an angle its operation by means of a stick held by the operator standing on the ground below has been made easy. At the same time all necessary clearances have been cared for. The insulating unit consists of a five-section rigid pillar insulator which is attached to a 3-ft. piece of 6-in., 8-lb. channel iron. The ground wire is attached to the channel iron.

Southern California Edison Co. W. R. BATTEY,
Los Angeles, Cal. Chief Electrical Designer.

Companies Want Standardization of Instrument Transformers

STANDARDIZATION of a number of features of instrument transformers was advocated at the Miami convention of the Southeastern Section of the N. E. L. A. The discussion was the result of a questionnaire sent to member companies by the meter committee of the section. The committee's report contained answers of the companies as well as the committee's recommendations.

In this report standardization of the manner of bringing out leads of current transformers was strongly advised as regards both their polarity and their position. A unanimous opinion favored bringing out the leads at the sides of the transformer instead of the ends to give greater safety for handling the leads while the transformer is energized and to permit neater wiring. All companies were in favor of having the nameplate in front of the transformer so that it may be read when the transformer is in position. Nine companies preferred that the transformer feet should be fitted for mounting on pipe framework as well as on brackets or walls, while six were satisfied with wall mounting.

For potential transformers also it was urged that the polarity of leads be standardized. The polarity should be the same on corresponding primary and secondary leads. Moreover, it was pointed out that the use of paint for marking polarity should be discontinued, because leads are frequently repainted, thus covering all painted markings. Brass tags were suggested for use in place of paint. The committee urged that the leads of potential transformers be constructed so that oil will not siphon out of the cases of oil-insulated transformers. Several companies reported such trouble, which they overcame by cutting off an inch of insulation inside the case and soldering together the strands where this insulation was removed. The proper position for nameplates was unanimously declared to be on the side of the transformer opposite to the mounting. For 2,200-volt installations it was agreed that oil insulation was not desirable in potential transformers.

Although there was some diversity of opinion, the majority ruled that there should be no fuses on potential transformers in customers' substations, but that such transformers should have fuses in a station where a company operator is in attendance.

Alabama Power Company, S. A. FLETCHER,
Birmingham, Ala. Superintendent of Service.

Hauling Heavy Penstock Sections up Mountain Roads

ONE method of hauling heavy equipment to the site of the Kerckhoff project of the San Joaquin Light & Power Corporation, described in the ELECTRICAL WORLD for Feb. 26, page 471, is illustrated in the accompanying


THREE 5-TON TRUCKS AND TRAILERS TRANSPORTED THE PENSTOCK PARTS TO THE KERCKHOFF POWERHOUSE

photograph. This shows a 5-ton Mack truck and a two-wheel 5-ton dolly hauling a section of the penstock line. This pipe weighs about 7 tons, is 22 ft. long and 8 ft. in diameter. The haul was over mountain roads for

5 miles with many turns and a maximum grade of 12 per cent.

The total weight of penstock, including gates, was 1,500,000 lb., or 750 tons, made up by 138 pieces of pipe varying in weight from 4,000 lb. to 14,800 lb., three complete gates, and miscellaneous fittings, bolts, rivets, etc. All the penstock was hauled with three 5-ton Mack trucks, each equipped with a 5-ton two-wheel trailer. Both the trucks and trailers were equipped with specially designed oscillating bolsters to permit the long wheel base to be hauled over the short curves in the road. Each truck made three round trips daily, delivering the entire penstock in 118 trips, an average of 6.4 tons per load.

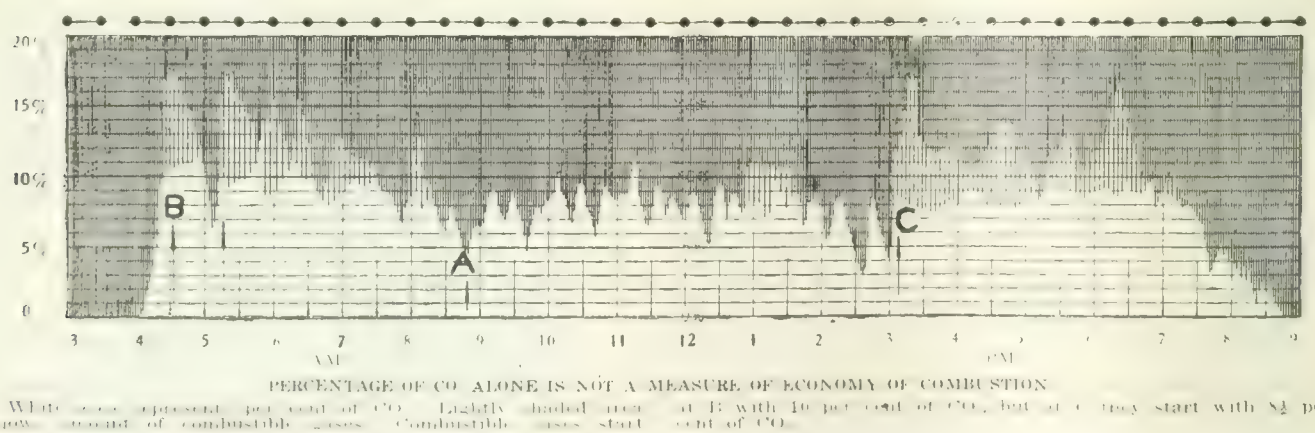
R. C. Starr,
Construction Engineer.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Analyzing Records of CO_2 and Combustible Gases

AN ANALYSIS of the accompanying chart shows that continuous records of combustible gases present in the flue should be kept as well as CO_2 records. In this chart the clear space from the bottom upward represents the percentage of CO_2. The lightly shaded area between the white space and the heavily shaded area represents the percentage of combustible gases. The chart was taken on a duplex gas-analyzing instrument.

A consultation of the chart shows that combustible gases started to form in one case when CO_2 is at 10 per cent and in another case when CO_2 reached 8½ per cent. In the first case, at the point *B*, to the left, combustible gases began to form when the percentage of CO_2 was 10. The amount of combustible gases increased rapidly as the percentage of CO_2 increased to 11, only to vanish again when the percentage of CO_2 was again reduced to 10. At point *C*, to the right, combustible gases began to form again, this time, however, when CO_2 was only 8½ per cent. This shows that between 4:30 in the morning and 3 o'clock in the afternoon changes took place in the furnace conditions such that while combustible gases began to form early in the morning when CO_2 was 10 per cent, they began to form in the afternoon when CO_2 was only 8½ per cent. Should the operator keep CO_2 at 10 per cent all day long, it is evident that serious losses might take place, as in this case between 3 and 4 o'clock in the afternoon, as indicated in the right-hand part of the diagram. That is what happens when the maximum allowable CO_2 is determined for an indefinite period by a snap CO test. Therefore it is clear that constant records such as those shown are valuable for continually securing the most effective combustion conditions.



PERCENTAGE OF CO ALONE IS NOT A MEASURE OF ECONOMY OF COMBUSTION

White [illegible] represent per cent of CO_2. Lightly shaded [illegible] at B with 10 per cent of CO_2, but at C they start with 8½ per cent of CO_2. shows record of combustible gases. Combustible gases start

A brief description of the operation of the instrument used, which is made by the Mono Corporation of America, may be of interest. The apparatus is driven by water pressure of about 10 lb. per square inch. Before entering the instrument the gas samples from the flue are pulled through a filtering system, which removes soot and dirt. They are then forced through the apparatus by a mercury piston. There are no mechanical valves. Samples of gas are forced alternately through two routes—one leading directly through a caustic potash tank where CO_2 is absorbed, and the other first through an electrically heated furnace wherein the combustion gases are oxidized to CO_2 and H_2O, and then through the caustic potash tank. Samples that are forced through the caustic potash tank only give the readings for CO_2. Those that are first forced through the electrically heated furnace and then through the caustic potash tank give readings of CO_2 plus combustible gases. The difference between any two successive readings is proportional to the amount of the combustible gases present at the time the analyses are made. These instruments are made to produce records covering a range of 20, 25 or 40 per cent. A range shifter can be provided to adjust the position of the range.

New York, N. Y. Field Editor Electrical World.

Distribution Losses Which May Be Eliminated

IN DISTRIBUTING electrical energy there are some losses, such as copper, transformer and conversion losses, that cannot be entirely eliminated; still, there are a great many other losses that may be overcome. It is possible to determine what losses may be reduced by a careful survey of the entire system, after which the problem may be considered as being divided into five parts, as follows: (1) To determine how much of the loss is necessary and how much is avoidable; (2) to locate and correct the cause of the avoidable losses and guard against their recurrence; (3) to furnish information whereby legitimate losses may be reduced by changes in operating practice and physical condition; (4) to furnish the rate department with information which will allow correct schedules to be applied and to see that billing departments receive necessary data for correct billing; (5) to furnish statistical information for use in constructing more equitable rates.

Although it is possible to reduce the amount of legitimate losses on a distribution system, there is a point beyond which it is unprofitable to go because the

small saving possible will be overbalanced by the expense. The losses that cannot be entirely eliminated but can be improved are as follows: Distribution copper losses, transformer core losses, conversion losses and meter shunt losses. Distribution copper losses can be reduced to a minimum by installing copper wire of sufficient size to carry the current transmitted. There is a point, however, in the size of copper where it is unprofitable to increase the size. Transformer copper losses are practically set, depending upon the load carried on each transformer. With a twenty-four-hour load curve on the operation of a transformer it is possible to estimate this loss. Transformer core losses can be improved considerably by installing a transformer of sufficient size to replace several smaller ones. The core loss per kva. decreases quite rapidly with the increased size of the transformer. It also depends upon the type of iron used in the core. The iron of today is better than that of some years ago (see table). Conversion losses where a light load is carried on a large unit may be reduced considerably by using a smaller unit. Meter shunt losses are constant and can be estimated if the sizes, types and makes of the meters are known.

A few of the avoidable losses that should be reduced are: Stolen energy, low voltage, removal of primary fuse of potential transformer by customer, overloaded instrument transformers, crossing of secondary wires, lack of control on flat-wire circuits, inaccurate meters, contact of primary wires with trees, and lack of proper maintenance.

As for the inaccuracy of watt-hour meters, it is generally agreed that the frequency of such tests will depend largely upon the revenue derived from the particular meter. In some states legislation is in effect

TRANSFORMER CORE LOSSES FOR DIFFERENT SIZES AND DATES OF MANUFACTURE

Kva. Rating	Loss in Watts – Made in 1894 to 1909 Iron	Made in 1894 to 1909 Copper	Made in 1909 to 1920 Iron	Made in 1909 to 1920 Copper
0.6	23	15		
1	30	28	20	25
1.5	35	35	25	35
2	43	43	29	44
2.5	50	46	32	53
3	53	55	34	63
4	61	77	37	70
5	67	90	42	82
7.5	98	125	58	110
10	115	156	69	140
15	155	220	95	190
20	190	275	120	225
25	210	350	130	310
30	230	400	150	365
37.5	305	420	175	405
40	325	480	190	415
50	375	640	230	510
75	415	850	500	825
100			530	1,050
150			725	2,000
200			950	2,350

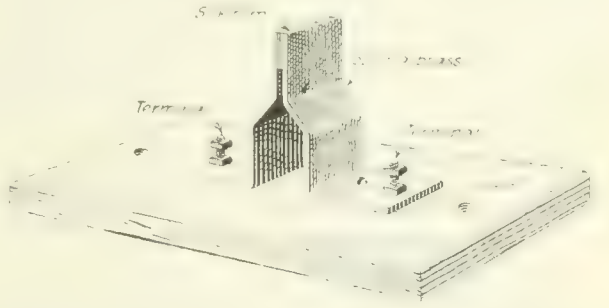
which specifically states the period of tests. In any event a test schedule should be developed taking into account the revenue earned and the revolutions of the meter, rather than merely the size of the meter. Direct-current meters usually require more frequent testing than alternating-current meters. For instance, with a certain type of meter one company tests every thirty-six months if the monthly revenue is not more than $5. The frequency is increased until for a revenue of $500 or more the period is only three months

THEO. H. RICE,
Operating Department.

Henry L. Doherty & Company,
New York, N. Y.

Silk-Film Device Prevents Damage to Opened Current Transformer

IN ORDER to prevent a dangerous rise in potential across the secondary terminals of a current transformer when the meter or relay circuit is accidentally opened, the writer has developed a protective device, as shown in the drawing, consisting of two brass spring contacts held apart by a silk film similar to those used in the sockets of series incandescent lamps. Each of



SILK FILM CONNECTED ACROSS SECONDARY OF CURRENT TRANSFORMERS WILL PREVENT HIGH VOLTAGES BEING INDUCED

these two contacts is connected to the terminals of the secondary of the current transformer as close to the transformer as possible. When an open circuit occurs the voltage punctures the silk film and no abnormal stress is put on the insulation of the transformer. Silk films one layer thick will puncture at a potential of about 200 volts.

It is well known that opening the secondary of a current transformer carrying load is likely to result in damaging the insulation and even in injury to an operator who may come in contact with the circuit. Short-circuiting the transformer by means of the contacts described, will prevent a dangerous potential from being induced and will not, of course, damage the transformer.

R. H. N. LOCKYER,
Engineer in Charge.

West Kootenay Power & Light Company,
Trail, B. C.

Value of Treating Cross-Arms Is Questioned

PRESERVATIVE treatment of cross-arms is a subject which at a recent meeting of the Empire State Gas and Electric Association brought forth a lively discussion as to the policies of the various companies in the use of painted, hot-dipped and untreated cross-arms. It was pointed out that painting is not entirely satisfactory because the pinholes cannot be adequately filled, and that moisture drawn in through the end fibers is held within the arm by the outer preservative treatment and rot results. Many companies are using untreated close-grained fir arms, which are said to have a life of fifteen years. Although it is claimed that a preservative will make even a good arm last longer, it is a question whether it is worth while to try to obtain a cross-arm that will have a longer life than the pole upon which it is mounted. Some companies that have used treated arms state that their linemen object to handling treated poles and that considerable trouble has been occasioned during the hot weather by dripping of the preservative.

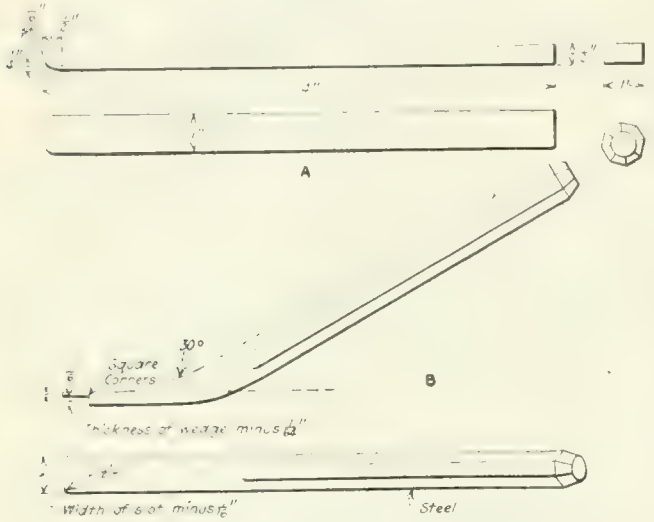
FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Tool for Driving Out Tight Wedges

IN ORDER to remove very tight wedges from a large generator it was necessary for a certain repair shop to construct a specially shaped tool which differs from those usually used for removing wedges. This tool,



TOOLS FOR DRIVING WEDGES OUT OF SLOTS

A—Special tool for breaking up wedges which cannot be driven out. B—Tool useful for driving wedges in or out of slots.

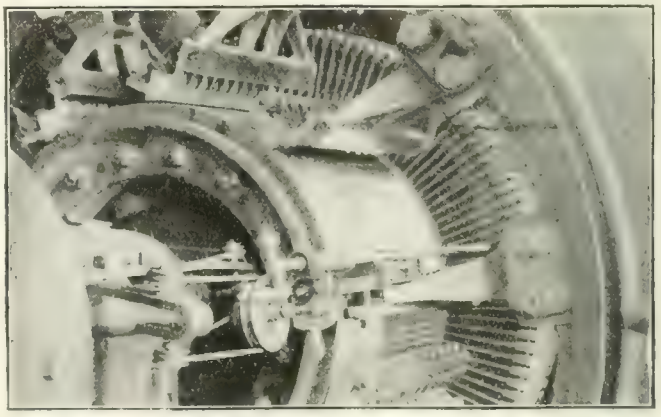
which is shown in drawing A, consists of a long tapered wedge with the front end bent over slightly and polished, and this end was used for prying the wedge out of the slot instead of driving it out lengthwise. The coils were in excellent condition and were to be saved and consequently it was necessary to be careful in removing the wedges. When an attempt was made to drive the wedges in the ordinary manner they refused to move. They were of composition material, nine wedges per slot, and the stator iron was 5 ft. 5 in. long with a bore of 24 in.—the small space to work in making the job still more difficult. All of the available wedge-driving tools were tried without success. It was noticed, however, that in using a chisel to make a hold for the wedge-driving tool shown at B, the wedge material pulled apart easily, flaking like mica. Accordingly a few wedges were removed by cutting one side near the iron with a diamond chisel, but this was very slow work. Therefore, it was decided to make another tool which would take advantage of the easy splitting quality of the wedge material. A piece of steel was purchased 1 in. wide (the slot being $1\frac{1}{4}$ in.), 14 in. long and $\frac{1}{2}$ in. thick. This was forged to the shape shown in Fig. A, making a long tapered wedge. The front end was bent over slightly as shown, and the tool was well polished on a buffing wheel for a distance of about 5 in. from this end. The tool was then driven in between the top of the coil and the bottom of the wedge with a rawhide mallet. This solved the problem satisfactorily, as the slot wedge was forced out of the groove by tearing the material apart and no damage was done to the coils or slots. The only precaution required was that in starting the tool it had to be tapped lightly while bearing down on the outer end. The wedges were removed by two men in four hours, which was a much quicker job than is usually done in driving them out, there being 324 wedges $7\frac{1}{4}$ in. long, $1\frac{7}{16}$ in. wide and $\frac{5}{32}$ in. thick.

It will be found that in most cases a tool shaped like the one shown in B is usually very effective in driving out wedges. This tool may also be put to very good use in driving wide wedges into the slots. A. C. ROE.

Detroit, Mich.

Tool Rest for Turning Commutators

FOR turning down commutators of 500-kw., 125-volt direct-current machines the mechanical department of a large electrolytic plant in Canada has made a very successful self-feeding tool holder. With this holder commutators 2 ft. 6 in. in diameter and 1 ft. 7 in. long are turned down in the average time of two hours. This machine consists practically of a modified compound slide rest. To apply the machine it is necessary only to move the brush boxes from one brush and clamp on the slide rest. The brush is driven through gears by means of a small pulley which has a worm gear upon its shaft. A round leather belt drives this small pulley. This belt itself is driven by the shaft of the machine which is being turned down, the belt passing over four idler pulleys before it gets to the small driving pulley. The



TOOL FOR TURNING DOWN COMMUTATOR DRIVEN FROM SHAFT OF MOTOR

pulley can be made to run free, or, in other words, stop the feed by means of a jam nut on the pulley end of the worm shaft. The feed may be reversed by means of a gear shift, so that when the cutter has gone across the face of the commutator it may be readjusted for a deeper cut and brought back across the commutator.

In turning a commutator a diamond-point tool should be used. This tool should be rounded sufficiently for

the cuts to overlap and not to cut a thread on the commutator surface. For the same reason it is necessary to use a very fine feed. Usually a surface speed of 500 ft. to 600 ft. per minute should not be exceeded. Some scheme must always be devised for taking up the end play of the shaft while the commutator is being turned. The machine has proved very satisfactory. Although sandpaper may be used with success for resurfacing a commutator which is dirty or one in which the mica is just beginning to get high, and although stoning will remove considerable high mica and even small flat spots, when the condition of the commutator is at all bad turning with a tool as described is the only satisfactory remedy.

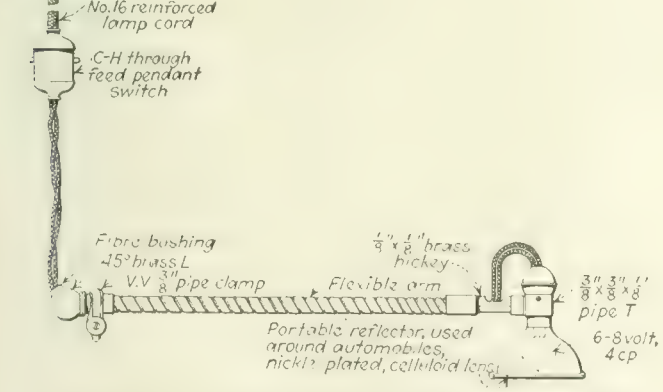
R. H. N. LOCKYER.

Trail, B. C., Canada.

Practical Bracket and Lamp for Punch Presses

MANY manufacturers who use presses know the need of a practical and efficient form of illumination. A lamp bracket for the individual illumination of each punch press which is not only economical to operate but also very effective is illustrated herewith. Those who operate open-back inclinable punch presses usually hang an electric light bulb behind the die in the open back; others hang ordinary drop lights over the operator, and some resort to general illumination. None of these methods is entirely satisfactory.

The bracket shown is clamped on either side of the punch press, and the light is focused on the die. A 4-cp., 6-volt double-contact automobile bulb is used, which is very rugged and gives a white light of ample intensity. The brackets have been assembled from standard parts, such as a flexible gooseneck, brass hickey, $\frac{1}{8}$-in. x $\frac{3}{8}$-in. x $\frac{3}{8}$-in. iron-pipe T and a small reflector made for use as a portable light around automobiles. The reflector is $2\frac{1}{2}$ in. in diameter and entirely shades the bulb, eliminating all glare from the operator. The actual cost of the entire assembly was less than $2.50, including labor and all parts. The current used is alternating at 6 volts,



AN ADJUSTABLE SHADED LIGHT FOR ILLUMINATING WORK ON A PUNCH PRESS

obtained from a 110-volt line through toy transformers which feed six or more lights.

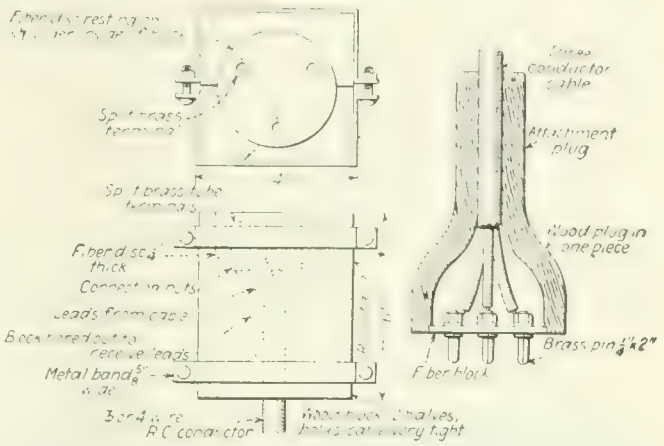
Several hundred of the brackets have been installed in the punch press rooms of a large corporation manufacturing adding machines, tin cans and other articles and have given excellent results.

American Can Company, Chicago, Ill.

JOHN A. TOLEIK, Electrical Engineer.

Rugged Attachment Plug for Portable Shop Machine

AN ATTACHMENT plug made by the writer for connecting an electrically driven sand cutter should be useful in many other shops where electrical machines are used which are wheeled around from one location to another. This plug is attached to an overhead beam, and in order that the cable shall not be in the way on the floor of the foundry the slack is wound on a reel mounted upon the cutter. The service is run to the center of the room along the beam in conduit. At the



THE RECEPTACLE IS HUNG ON OVERHEAD BEAM FOR FEEDING PORTABLE MACHINES

end of this conduit the copper wire is spliced to a heavy flexible cable, two-wire, three-wire or four-wire, depending upon the type of motor. This cable is hung down to a height which can be reached from a short stepladder, and a receptacle is attached to its lower end. The author has made a receptacle out of wood blocks with three brass tubes inserted in them for a three-phase line. Into this receptacle fits a wooden plug, into which in turn are fitted three brass pins. These brass pins fit in the brass tubes in the receptacle. To the plug is attached the cable which runs to the machine. About 4 ft. from the plug the cable is fastened in a split-wood clamp having an iron plate upon one of its faces which is drilled to take a hook. This hook is fastened to a chain which is passed over the beam and bolted together so that all strain is taken off of the plug and the cable is supported by the chain.

The cable used for such work should have stranded copper conductors covered with enough rubber to prevent short circuit, well reinforced with strong strain cords and with a closely woven outer braid. Although it is known that one conductor in such a cable is open, it is often very difficult to locate the exact position of the break. This may be accomplished by connecting a lamp across the switch at the machine end of the cable and twisting and bending the cable from one end to the other until the lamp lights on account of bringing the broken ends together.

In repairing such a cable where only one conductor is broken, it is best to try to discover this conductor and repair it without cutting the other conductors. This may be done by baring one broken end for six or seven inches and splicing on a piece of similar wire and then splicing it on the other end of the broken conductor. No solder should be used, as it stiffens the joints and causes them to break more readily. After splicing rubber and friction tapes are applied and the cable is built

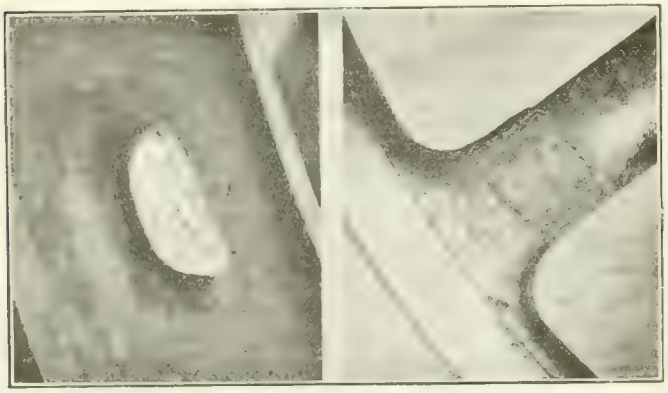
up to a uniform diameter. If more than one conductor is to be spliced, the joints should be staggered. When cutting into the braid with a knife, care should be taken not to make too deep a cut and thus spoil the insulation on the good conductors. H. S. RICH.

East Berlin, Conn.

Studding Cast-Iron Welds Relieves Contraction Strains

ADMITTING that steel can be welded to cast iron where the parts are free to align themselves, the use of studding is advantageous where the weld is in such a position that the parts are not free to align themselves with the contraction cooling strains that result. In such a case a steel weld made to cast iron without studs looks well until just about the time it is being admired during the cooling process, when it invariably cracks along the edge of the weld.

This is easily understood when it is considered that steel has approximately four times the strength of cast iron and that the contraction strains cause the weld to pull away from the cast iron just beyond the welded joint. This definite location of the break is because the cast iron right under the weld has become chilled cast iron, whether it was originally so or not, and a sharp



METHOD OF STUDDING A BROKEN FLYWHEEL SPOKE PREPARATORY TO WELDING

demarcation of structure together with a possible layer of weaker cast iron causes the break invariably to take place in this layer of cementite. If, however, steel studs are properly proportioned in the face of the cast iron to be welded or adjacent to the joint, so that the weld cannot pull away from the cast iron, the cooling strains result in stretching the steel weld while the welded joint to the cast iron and steel studs is maintained as it was made.

To insure the proportioning of the studs so that the weld will not pull away from the cast iron it must be remembered that, as already remarked, steel has four times the strength of cast iron, and therefore the problem is so to proportion the studs that the ratio of the cross-section of the steel to the cross-section of the remaining cast iron will be somewhat less than four to one at any section subjected to cooling strains at one time. This in general is a very simple and easily applied method and means large studs for large sections and smaller studs for smaller sections. It requires common sense in placing the studs, together with welding experience. The writer has seen this studding method abused by men who evidently did not understand why they were using it, and no doubt to such unsuccessful work done by amateurs is partly due the prevaling opinion that the studs function simply as tent stakes. That this is not true can also be seen from the fact that steam-tight joints on cast iron can be made by this method, showing that the weld to the cast iron has been maintained to its full efficiency by the use of the studs.

Another useful application of studding lies in the use of large studs as an anchor nucleus for breakage of castings such as gear teeth. One, two or three of these large anchor studs, together with some smaller studs appropriately distributed, will provide weld strength for the cast iron as well as the shear and thrust strains necessary, while the weld, built up to size and machined off, will furnish a perfect wearing or bearing surface. This method of studding is applicable to cast steel also where the original section has not been adequate to stand the strain.

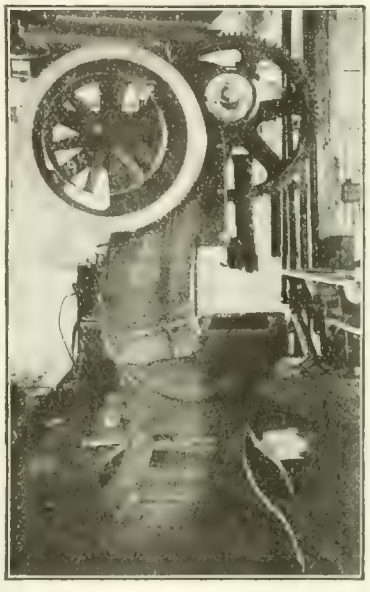
Details of the way in which this studding is accomplished not explained by the photographs are: First, "vee" out the crack on both sides of the break from the side which is accessible for welding, or half way from each side if both sides are accessible, saving enough of parts of the original break to keep the piece securely clamped in alignment. Before any of the welding is done the stud holes must be drilled and tapped with a bottoming tap and the studs screwed in tight, completely filling the hole for a distance of at least four times the diameter of the stud. A convenient way of doing this is to have a completely threaded rod screwed in tight with a Stilson wrench and to saw off $\frac{1}{4}$ in. to $\frac{3}{8}$ in. above the surface of the work, depending on the accessibility; that is, a narrow "V" should have the studs closer to the work than a more open one. The method of welding is as follows: Weld around the studs so that they become part of the cast iron, then weld between the studs crosswise or diagonally until the entire "veed-out" surface of the cast iron and the adjacent surface to form the under side of the pad are completely covered. They must at least be covered before proceeding with the main filling-in. Add metal one bead at a time so that no great section of the weld is cooled off in the molten state at any one time. The welding first of the stud to the cast iron makes the stud an integral part of the casting, and the welding from stud to stud diagonally or crosswise draws the casting together into its original contact, especially if a small amount of the original break is left intact at the bottom of the "V." This can be done in most instances unless one of the pieces is broken out and lost and must be replaced by casting or forging.

In this steel-studding process for cast iron, especially on cylinders and similar work, machining is usually required, and the hardened layer directly under the weld gives trouble unless grinding methods are used. There are other means of taking care of this hardened layer for machining on the surface, one of the newest of these being to finish the machined part with a nickel-copper electrode. This electrode has the property of so merging the cast iron that there is no hard layer of cementite formed. Such electrodes were developed by the automobile trade for repairing scored cylinders. An older method is to calk the bottom of the "V" with copper, which is machined off later. Probably the best method of all is to supply a bushing for the part to be finished. Many cylinders, especially with steam engines, are built with this bushing originally, and in welding the bushing is removed and perhaps slightly refitted after the welding job is completed.

The studding of cast iron is not necessary where electric welding is used simply as a means of filling in or building out, or where grinding is the only machining necessary. In handling such work clean out the spot to be welded by chipping or grinding so that all dirty, oily, sandy or porous metal is eliminated and a reasonably bright metal foundation is provided for the weld. Weld with either steel or cast-iron electrode according to whether a reasonably hard or a very hard surface is wanted after grinding. The steel gives a hard surface and the cast iron a very hard surface. Care must be taken to use the cast-iron electrode in such a way that the quick cooling does not cause gas bubbles in the weld, leaving holes after finishing. The steel causes no such trouble, and if one or two imperfections show a peening hammer will close them up.

Another case where studding is not required is in the electric welding of cast iron where tensile strength is required but no resistance to bursting pressure as in welding broken machine parts, small bedplates, etc. In general, where no undue strain will result and the part was originally broken by an accident which will hardly happen again in the same place, "vee" out wide enough to enable the electrode to be held at approximately right angles to either face of the "V." Weld the two faces of the "V" separately with steel, using great care to have the steel united to the face as the arc progresses and not to let any of it run down ahead of the puddle. Weld from the bottom up, and if any of the deposited metal does escape stop and chip it off. After the two faces are successfully covered it is extremely easy to make a good weld from the steel faces, using steel or cast iron in the "V."







EXAMPLES OF ELECTRIC WELDING WORK WHICH IS DONE WITHOUT PREHEATING

Studding is unnecessary where great tensile strength is not required and the parts are free to align themselves without setting up excessive contraction strains due to the cooling of the weld. In the welds shown, however, studding has been used.

Another method which has a basic theory similar to that underlying studding and is especially useful for sections that are too thin to stud applies to such work as automobile cylinders, jackets, crank cases, heating boilers and other cast-iron parts complicated in shape and where no deformation can be allowed. This procedure is to run beads at right angles to the crack about eight or ten times the thickness of the weld at the crack. These right-angle beads, laced back and forth at intervals of four to six times the thickness of the piece, hold the weld and adjoining cast iron from separating, so that the contraction takes place in the weld, where it does no harm. In this manner automobile water jackets, crank cases, furnaces, etc., have been welded. Automobile water jackets have been welded in emergencies without taking the water out of the engine.

Sometimes the weld will be stressed beyond its elastic limit and will crack, but no precautions need be taken in regard to rewelding, as this crack will then have steel to hold it. Naturally, the less the heat used the less will be the stress to be taken care of. To that end use the light-work taps on the welding machine to insure there being as little heat as possible and proceed a little at a time, allowing each bead to cool completely before beginning the next one. In the case of filling in the beads at right angles to the weld, the beads should be put down as nearly as possible at the same time in order to fill in the space between the intermediate beads which are crosswise of the crack. In pieces that have cracked and sprung apart and should be brought into alignment this method of crosswise beading, proceeding from the smallest end of the crack, will bring the original pieces into such intimate contact that the metal is very often watertight before the intermediate beading is started. In order to keep the heat as low as possible special electrodes with a melting rate higher than that of ordinary steel should be used. This will aid materially in keeping down the stresses. All of this welding with steel is done without preheating or annealing. Thus the necessary finish being ground to size, it is possible to make welds that would not be practical with methods using preheating.

C. J. HOLSLAG,
Chief Engineer.
Electric Arc Welding & Cutting Company,
Newark, N. J.

Synchronous Motors for Raising Power Factor of Industrial Plant

WHILE studying methods of raising power factor an investigation showed that there are many industrial plants where synchronous motors may be used in only one or two places and these motors must correct the power factor for the entire plant. Motors for such service should be designed in virtually the same way as synchronous condensers—that is, to operate at nearly zero per cent power factor—since the mechanical load in many cases may be quite small. For most of these applications either a direct-connected or a belted exciter should be used. The starting and control of these motors may now be made almost as simple as that of a squirrel-cage induction motor. In fact, there is quite

an interest shown at present in automatic starters for synchronous motors, and these will undoubtedly tend to increase the use of synchronous motors in plants where it had previously been thought that there was not sufficient skilled labor for their operation.

C. W. DRAKE,
General Engineer.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Calculating the Size of Lighting Units

CALCULATION of the proper size of lamps to use for lighting depends to a very large extent upon the good judgment of the illuminating engineer. A recent case that came to the writer's attention called for lighting a number of offices which consisted of remodeled rooms in an old dwelling house. It was not known either what the arrangement of desks or what the colors and finish of the paint of the walls and ceilings would be. The rooms were only 8 ft. 6 in. high, and consequently the lamps had to be rather close together and of small size. Accordingly they were placed at the corners of rectangles 8 ft. x 8 ft. 6 in. in size.

It was decided to have the intensity of illumination somewhat above the minimum fixed by the Pennsylvania code of lighting, which is 3 foot-candles. This code recommends that from 4 to 8 foot-candles be used and also requires that lamps shall be suitably shaded to minimize glare. In order to meet this last requirement it was thought that a fixture with a semi-inclosing opal bowl would be appropriate.

An important factor in illumination calculations is the coefficient of utilization. Values for this factor are determined by the proportions of the room dimensions, the colors or reflecting values of walls and ceiling and the type of lighting fixture. Tabulated data from researches to determine values for coefficients of utilization may be found in a paper on "Industrial Lighting" by Ward Harrison and H. H. Magdsick which is issued as a bulletin by the National Lamp Works of the General Electric Company. The correct application of these data to any particular case depends on the judgment of the illuminating engineer. In the case under notice it was judged that the conditions regarding walls and ceiling would be the average obtaining in an office, and therefore the coefficient of utilization was taken as 0.50.

Another factor which depends upon the good judgment of the designer and the conditions in the locality where the lighting fixtures are to be used is the depreciation factor. This value depends upon the amount and character of the dust suspended in the air, which will come in contact with the reflecting surfaces and transmitting glassware, and also upon the probable frequency of cleaning the fixtures. This office was in a rather dusty city, and the depreciation factor was taken as 1.25. Knowing these factors, the flux required was calculated from the following formula: $F = (E \times S \times D) \div (K \times N)$, in which:

E = foot-candles,
S = area illuminated (square feet),
N = number of lamps in area,
K = coefficient of utilization, and
D = depreciation factor.

Substituting the known values in the formula $F = (8 \times 612 \times 1.25) \div (0.50 \times 8) = 1{,}280$ lumens, which is the average flux per lamp required to give an illumination of 8 foot-candles. The output of a 100-watt, 110-volt "Mazda C" lamp is 1,260 lumens, which is very close to the desired value. Substituting this value of 1,260 lumens in this equation and solving for the illumination, the result is 7 foot-candles. Consequently these lamps were used mounted in "type MB Brascolites."

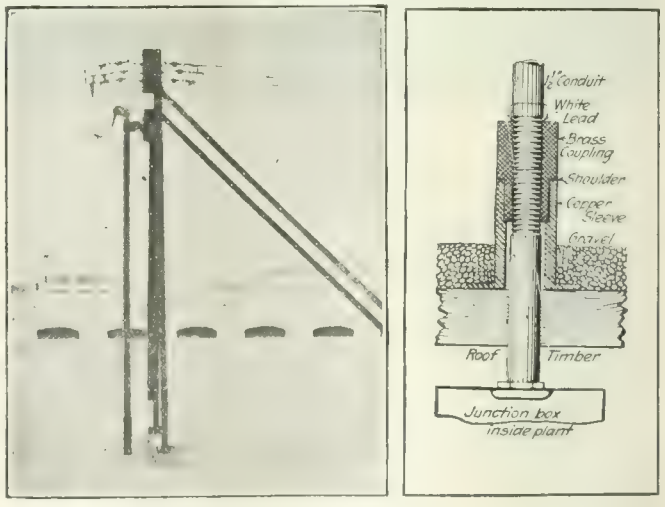
After two months' use without cleaning, the average useful illumination in the offices as obtained by photometric tests was found to be 4.5 foot-candles, the minimum 3 and the maximum 5.7 foot-candles. The difference between the calculated and actual results indicates that the values used for depreciation factor and coefficient of utilization were not correct. The coefficient of utilization should have been higher and the depreciation factor should have been lower.

D. W. BLAKESLEE,
Pittsburgh, Pa. Consulting Engineer.

Waterproof Anchorage for Roof Cables

TO SUPPORT a span of No. 0, 550-volt, three-phase circuit 125 ft. long on the roof of the Graton & Knight Manufacturing Company's plant at Worcester, Mass., the writer has developed the angle-iron structure shown in the accompanying photograph. A main frame of 2-in. x 2-in. x ¼-in. angles was provided, 36 in. wide and 10 ft. long. A 4-in x 6-in. cross-arm at the top carries six strain insulators as shown with the usual loops. Diagonal braces anchor the upright section and stiffen its construction. The leads to the interior of the factory are tapped off for each department through a 1½-in. pipe, with drip loop, and terminate in a junction box inside the building.

An interesting feature of this construction is the means used to make it waterproof. As shown in the accompanying sketch, the pipe carrying the conductors



ROOF SUPPORT FOR 550-VOLT, THREE-PHASE LINE AND WATERPROOF ENTRANCE FOR 1½-IN. CONDUIT

is screwed into a brass coupling, and the pipe section from below is similarly fastened with its end brought flush against the downward section of pipe. A shoulder was turned on the coupling at its lower end, and to this shoulder was soldered a copper sleeve which terminates in a flange carried down beneath the roof gravel and fastened to roof boarding. The entrance of the pipe to the coupling is white-leaded.

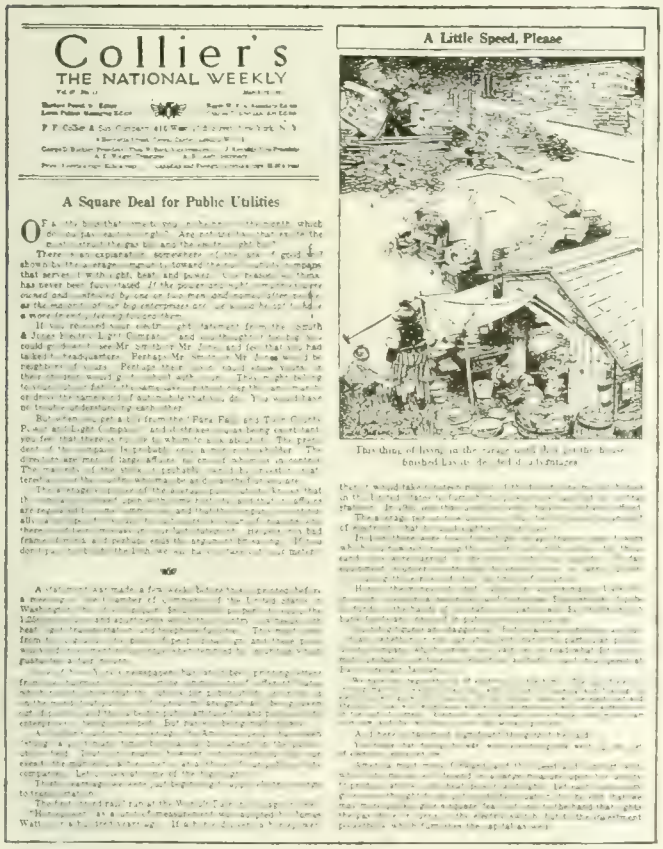
A. H. MAGNUSON,
Graton & Knight Mfg. Co. Electrical Engineer.
Worcester, Mass.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

"Collier's" Asks a Square Deal for Public Utilities

PLAINLY the utilities are to receive a fair hearing in the court of public opinion. Reproduced here is an editorial page from *Collier's* for March 12 in which the editor puts before his readers the difficulties which confront the executives of every public utility today and


Collier's
THE NATIONAL WEEKLY
A Square Deal for Public Utilities
A Little Speed, Please

AN EDITORIAL PAGE FROM "COLLIER'S"

from his unbiased viewpoint asks that a square deal be given to the public utilities. Without taking up the cause of the utilities as such it is pointed out that national expansion, increased housing facilities, industrial growth and general public convenience depend largely upon how well the public utilities are able to meet the additional requirements.

"America must move forward," concludes the editorial, "and the speed and comfort with which she moves will depend in a large measure upon her ability to produce, at low costs, heat, power and light. Let each community give some thought to its public utility situation, to the end that we may more quickly give a square deal, not only to the hand that lights the gas stove or turns on the electric switch but to the investment pocketbook which furnishes the capital as well."

Such a constructive attitude as is thus shown by *Collier's* is a long stride forward in the public relations problems of the utilities. It augurs well for a real appreciation of these problems by the public and it is also proof that the educational work which is carried on by the electrical industry has not fallen upon barren ground.

Boston Edison Company Establishes Suburban District Managerships

IN ORDER better to co-ordinate the relations between itself and the local publics in various parts of its territory of some 750 square miles, the Edison Electric Illuminating Company of Boston has recently established a number of suburban district managerships under the broad supervision of W. H. Atkins, general superintendent of the company, and under the immediate direction of J. M. Bassett, who has been made head of the department of suburban district managers. The district managers have been appointed to enable customers, municipal officials and persons concerned with or interested in the company's service to become acquainted and deal directly with a responsible official of the company who is in close touch with local conditions and empowered to represent the company and carry out its policies along broader lines than is feasible with minor-placed employees.

The duty of each district manager is to please all the customers in his district. The company desires each community served by it to feel that its interests are continually looked after by an alert and efficient official of the company and that their affairs are not left in the hands of minor agents. The district managers endeavor to make their presence felt, seeking ways to serve the customer, anticipating his wants and acting without display.

It is aimed to make the service so efficient that if any question should arise in the community adverse to the company the answer would be: "I have always found them ready, effective and willing. I see no reason to think that any other company or arrangement could do better."

It will be the duty of each district manager to impress upon the people of his district the high reputation of the company for business ability and fair dealing. Each district manager is provided with a headquarters which becomes the local Edison office in his territory. Often it is on the premises occupied by an Edison appliance department store. The solicitation of business and commercial activity as such are not scheduled duties of the district managers. The appointees to date are these: E. F. Booth, Waltham; F. E. Randall, Woburn; A. J. Ashe, Chelsea; F. L. O'Bryan, Framingham; J. H. Kent, Newton; J. W. Swain, Arlington; W. E. Holmes, Walpole; H. W. Jones, Somerville, and F. W. Shaw, who is still unassigned.





California's Fifth Electrical Home

FIVE electrical homes have been successfully conducted by the California Co-operative Campaign since last June, when the first one was opened in San Francisco. Reproduced here are views of an adobe electrical home which was open in Los Angeles from Jan. 20 to Feb. 13 and was visited by 75,000 people in that time. This "home electrical" differed from the previous ones in the other cities in that the house was built of adobe and it is the first time that this material has been used for the construction of a modern home.

Of the 75,000 people who visited the adobe electrical home during the three weeks it was open, 50,000 made a careful inspection of each room. The other visitors confined their attention to the first floor only, where the majority of the electrical conveniences were installed. On the last day that the house was open to the public 6,900 people inspected it.

The home electrical campaign is being conducted by the California Electrical Co-operative Campaign as a demonstration to a community how to build, wire and equip a house so as to obtain the maximum use of electricity in every room twenty-four hours a day.







Points to Consider in Adjusting for Customers' Power Factor

THE chief object of a power-factor rate clause is generally to better power-factor conditions, not to produce additional revenue. Its purpose should be to avoid discrimination and to increase net earnings by reducing operating costs. The power-factor problem still appears to be an engineering problem, and a great deal must be done by engineers, metermen and operators before power-factor correction can be embodied in a rate schedule in a clear, sound and workable manner.

Successful rate making embodies not only the factors of cost of service and the value of the service, but also considerations of public policy and other elements which are not subject to exact measurement and weight. To begin with, the unfortunate word "penalty" should not be used even among central-station men. Failure of a customer to meet a given requirement may call for a correction or adjustment, but never a penalty. Every effort should be made to work out the situation with each customer without any measures that may even seem harsh. If an adjustment against a customer is justified in the case of subnormal power factor, it would seem that the reverse condition would call for an adjustment in his favor.

Where is the level or the percentage of power factor which may be deemed satisfactory and require no adjustment? Is it 80 per cent or something higher or lower? Is it the same for all classes of consumers, large or small, or is it the same for every generating, transmitting and distributing system? Is the figure for a company distributing locally different from that for a company with extensive transmission systems feeding local systems from a number of generating stations? These questions merit careful consideration.

In applying a power-factor correction to a demand-rate schedule should the correction be made on the demand charge only or on the energy charge only, or should it be applied to both, and if so in what proportions?

This immediately raises a question as to the effect of power factor on the cost of service. Is its effect chiefly to current losses, and if both effects are noted, then in what class of costs is its effect the more important? Again, are these effects or cost of service the same in different generating and distributing systems?

Assuming that a power-factor correction is agreed upon and assuming that proper instruments are available for measuring the power factor, then a question arises as to the application of the correction. Shall it be the power factor determined at the time of the customer's peak load, the company's system peak or an average over the week or month? The last method is probably the fairest, all things considered.

Power-factor corrections are necessary, but it is a debatable point whether or not power-factor clauses should be embodied in the rate schedule. For instance, there is one company which has 150 customers with demands varying from 50 kw. to 10,000 kw. These customers pay an aggregate bill of about $3,500,000 per annum.

Most of the customers have been purchasing their power for a number of years, and with the exception of possibly twelve or fifteen the power factors of this group of customers are quite generally satisfactory. The company has been working steadily with these 150 customers to get power-factor conditions bettered, and the twelve or fifteen customers mentioned are those who cannot or will not do anything to better their power-factor conditions. Should the company insert in its rate schedule a clause aimed solely at these few customers and stir up the entire 150, or should the customers who will not or cannot meet reasonable power-factor requirements be made to go on some other rate schedule?

This entire problem should be carefully analyzed by each company, according to F. A. Newton of Hodenypl, Hardy & Company, Jackson, Mich., who presented these ideas on power-factor correction at the Cleveland meter conference of the Ohio Electric Light Association.

Smaller Volume of New Business Brings Increased Revenue per Kilowatt-Hour

NEW business obtained by the Metropolitan Edison Company, Reading, Pa., during 1920 is shown in comparison with that of the year previous in the following table:

	1919	1920
Number of old houses contracted for	1,319	2,449
Number of new houses contracted for	201	190
Number of commercial houses contracted with	335	539
Number of power customers contracted with	89	121
Total number of new customers	1,944	3,229
Additional light and heat, in kilowatts	3,912	2,184
Additional power, in horsepower	10,200	4,879

Analyzing the figures, which show increases in the number of new customers and contracts taken but decreases in the total connected load, the company states:

"While the volume of new business contracted for during 1920 has not been so great as in the year 1919, yet it is worthy of note that the number of old houses contracted for is nearly twice that of 1919 and the number of new houses is nearly the same. This will indicate a larger revenue per kilowatt-hour sold for the business done in the year 1920 than for the business done in the year 1919, as all residential lighting is sold on a straight 10-cent rate, whereas the average rate for commercial power is about 3 cents."

Tenney Companies Hold Sales Conference at Boston

ABOUT twenty-five representatives of the associated companies managed by Charles H. Tenney & Company, Boston, attended a sales conference in that city Feb. 24. Cyrus Barnes, general sales manager, presided.

Among the topics discussed were definite sales plans for 1921, importance of territorial analyses and education of plumbers and of electrical contractor-dealers in the handling of appliances. Representatives from the George M. Clark Company, Weir Stove Company, Hoover Suction Sweeper Company, Eureka Vacuum Cleaner Company, Westinghouse Electric & Manufacturing Company, Landers, Frary & Clark, Ruud Manufacturing Company and the Surface Combustion Company gave instructive addresses at the convention on methods of securing business. At the close of the meeting the announcement was made that Charles H. Tenney & Company, in appreciation of the sales effort for 1921, would donate a silver cup to the company showing the best sales results, a cash prize also to be presented to the sales force.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Five Thousand-Kw. Rotary Converter.—F. Hartig.—For the drive of their electric rolling mills the Peiner works have been using six motor-generators to convert 10,000-volt three-phase current into direct current. An order was placed in 1913 with the Siemens-Schuckert works to erect one, and later a second, large rotary of 5,000-kw. direct-current output, to supplant the motor-generators. A water-cooled 5,000-kva. transformer reduces the 10,000 volts to 384-volt, six-phase current, operating at full load and unity power factor with 98.35 per cent efficiency. The huge rotary has twenty-eight main poles, commutating poles, an auxiliary compounding and damping winding, six double-collector rings and a 185-kw. direct-current starting motor, clutch-coupled. The machine is designed for 215 r.p.m., and gives at full load 9,600 amp. at 520 volts, direct-current. Including the losses in the main transformer and the 265-kva. induction regulator, the rotary gives an over-all efficiency of 94 per cent, whereas the old motor-generators operated with only 81 per cent, resulting in an annual saving of about 5,000,000 kw.-hr.—*Elektrische Kraftbetriebe und Bahnen*, Jan. 10, 1921.

Temperature Rise in Headlight Generators.—Experimental data are offered to show that excessive armature heating in these units had been due to excessive brush pressure.—*Railway Electrical Engineer*, February, 1921.

Lamps and Lighting

Gas Lighting, Past, Present and Future.—Howard Lyon.—The writer deals with modern developments in incandescent gas lighting. He gives information concerning mantles, kinds of gas used and their value for illumination purposes.—*Transactions Illuminating Engineering Society*, Feb. 10, 1921.

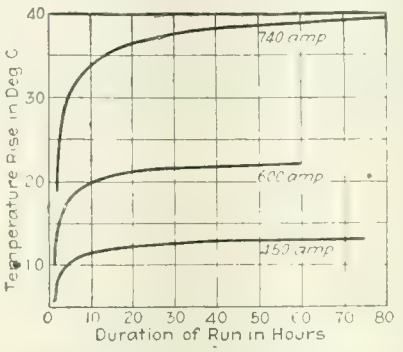
An Examination of the Munsell Color System. —Irwin G. Priest, K. S. Gibson and H. J. McNicholas. —Results of extensive measurements of spectral reflection of colored card standards submitted by the Munsell Color Company. The determination of total reflections for sunlight from these curves and the relation of these reflections to the Munsell scale were arrived at, and recommendations were made for the improvement of the system.—*Technologic Paper No. 167, U. S. Bureau of Standards.*

Generation, Transmission and Distribution

Suspension Type of Transmission-Line Insulators.—Alfred Still.—The writer considers the use of static shields and arcing horns in changing the potential gradient across the units of certain strings. He deals with the characteristics of thick porcelain units and also the link type of units in which there is no cement used.—*Electrical Review*, Jan. 22, 1921.

Information on Powdered Coal and Briquets.—R. Dawson Hall.—Extensive data are given on the results of boiler trials made at pulverized fuel plants at the Lykens colliery. Low carbon dioxide is said to be not inconsistent with efficiency. The Bethlehem Steel Company, the article reports, has for years used pulverized coal to advantage.—*Coal Age*, Jan. 6, 1921.

Research on the Heating of Buried Cables.—This report is divided into several sections. A short summary of the history of the investigation and a statement of the work still outstanding are first given. Section 1, by S. W. Melsom and Miss V. Cockburn, deals with the work done at the National Physical Laboratory on paper-insulated cables laid under various conditions. Section 2 consists of a report by E. Faussett on work at Newcastle-upon-Tyne on extra-high-pressure paper-insulated cables laid direct in the ground at different depths. Section 3, by Prof. E. W. Marchant summarizes tests at Liverpool University on vulcanizing bitumen cables laid solid in stoneware troughing. Considering paper-insulated cables, considerable data are offered, first for cases where the cable is laid in air. Curves show the temperature rise in the lead and in the core at different voltages and for various periods of run. The effect of color of paint on the cable suspended in air is also shown. The curves give the temperature rise in a cable 0.6 sq.in. (3.9 sq.cm.) in section laid solid in bitumen in stoneware troughs.—London *Electrician*, Dec. 24, 1920.



TEMPERATURE RISE OF CABLE LAID IN BITUMEN

Installations, Systems and Appliances

Electricity on Merchant Ships.—E. D. Dickinson.—In considering electric service on merchant ships continuity, or reliability, is probably the most important consideration, since interruption of service can be directly translated into dollars lost. Another factor is the operating cost in dollars per ton-mile of cargo transported. This cost has increased so radically in the last few years that efficiency of operation is more important now than in the past. Means of improving the efficiency of operation are discussed in detail.—*General Electric Review*, February, 1921.

Heating Rivets by Electricity.—J. R. Bower.—The heating of rivets electrically is, the author asserts, fast supplanting the older coal, coke, oil and gas methods. The energy required to heat 100 lb. of rivets regardless of size has been found to be from 10 kw.-hr. to 20 kw.-hr. With energy from 1 cent to 2 cents the maximum cost per 100 lb. of rivets would be less than 40 cents. Experience with the oil method shows that with

oil at its present price it would cost about $2 per 100 lb. to heat the rivets by this method. It is said that coke is even more expensive. Advantages aside from the cost economy are also shown for electrical systems.—*Journal Engineers' Club of Philadelphia*, January, 1921.

High-Speed Turbine Drive of Merchant Ships.—ESKIL BERG.—Three methods of applying the turbine to the drive for ships are considered: (1) The turbine directly connected to the propeller shaft. This method involves a serious sacrifice in the efficiency of both turbine and propeller on account of the low speed. (2) A gear train interposed between the turbine and the propeller. (3) The substitution of what might be called an electrical gear in place of the mechanical gears

For the Navy:	Hp., Each.	Total Hp
One collier	7,160	7,160
Four battleships	32,000	128,000
Two battleships	60,000	120,000
Four battle cruisers	180,000	720,000
Total		975,160

For the Merchant Marine	Hp., Each.	Total Hp.
Twelve freighters	3,000	36,000
Four coast guard cutters	2,600	10,400
One fruit steamer	3,000	3,000
One express passenger vessel	3,000	3,000
Total		52,400

of method 2. In this case the turbine is designed so as to secure the highest efficiency in the operation of an electric generator, and the driving motor, which is directly connected to the propeller, is in turn designed solely for that purpose. All reversing is done without reversing the turbine. The advantages of the electric system are discussed particularly, and the accompanying table is given to show the extent of electric drive furnished by the General Electric Company.—*General Electric Review*, February, 1921.

Electrophysics and Magnetism

Hysteresis Effects with Varying Superposed Magnetizing Forces.—W. FONDILLER and W. H. MARTIN.—An analysis of the causes of "flutter" in composited telephone lines is given by the author. To obtain a quantitative measure of the flutter tests were made to determine the effects of telegraph currents on the transmission of single-frequency currents in the telephone range. The conclusion was that the flutter is complementary to a suppression of the hysteresis normal for a magnetization by telegraph currents. An empirical formula is given which states the relation between flutter and telephone and telegraph currents.—*Journal A. I. E. E.*, February, 1921.

Some Applications of the Method of Images—I.—JAKOB KUNZ and P. L. BAYLEY.—In the first part of the paper the authors have obtained expressions for the potentials at any point between an infinitely long charged wire and two conducting infinite planes parallel to it for the surface density of the induced charge at any point on the planes and for the capacity per unit length of such a condenser. These expressions contain only circular and hyperbolic functions. The authors then take up the case of a charged wire inside an infinite rectangular tube and of two or four charged wires inside a rectangular tube.—*Physical Review*, February, 1921.

Determination of Heat Dissipation Coefficients of Iron and Copper.—K. LUBOWSKY.—The heat dissipation coefficients of iron and copper bodies, in air and in oil, stationary and in motion, influenced by different paints and insulating materials, are determined in watts per square centimeter for 1 deg. C. temperature rise. A standard-size plate or cylinder of copper and iron was used for all tests. The metallic body was uniformly heated by eddy currents caused by a 500-cycle alternating-current field, and the rate of cooling off was measured by means of copper-constantan thermocouples, soldered directly on the metal. A number of curves and tabulations, giving test data obtained, are given.—*Elektrotechnische Zeitschrift*, Jan. 27, 1921.

Electrochemistry and Batteries

Electro Industry of Sweden.—SIGURD HALDEN.—A census of the power resources of Sweden, data on its power stations and transmission lines, electric railways, electrochemical and electrometallurgical industry and a general description of the magnitude of the different branches of the electrical industry are given.—*Elektrotechnische Zeitschrift*, Jan. 6, 1921.

Electric Furnace Smelting of Montana Manganese Ores.—E. S. BARDWELL.—An account of the plant of the Anaconda Copper Company for reducing the Montana rhodochrosite manganese ores chiefly from the Butte district. Detailed description is given of the furnaces, the electrode holders and the operation of the furnaces. A test made on a half-and-half mixture of ores from the Philipsburg and Butte districts indicated the useful efficiency of the furnaces tested to be 71.7 per cent. Of the losses sustained 40 per cent was due to radiation and 60 per cent to the electrical losses in transformers, conductors, electrodes and contacts. The composition and properties of the slags are discussed; also volatilization losses and the possibility that some are due to formation of carbonyls of iron and manganese.—Paper presented before meeting of the American Electrochemical Society, Oct. 2, 1920.

Miscellaneous

"Electric Week" in Hanover.—The Verband Deutscher Elektrotechniker during the last week of September held a big electrotechnical convention in Hanover. All the more important German associations of electro-industrial engineers had been invited to attend. A number of important lectures were given, and at a special meeting with the V. D. E. a series of standardization rules for electrical machinery and appliances were officially adopted. Tentative drafts for the standardization rules have been published from time to time in the *Elektrotechnische Zeitschrift*, and reference has been made to some of them in these pages. An account of the proceedings of the meeting and also a list of the adopted standardization rules, including some minor changes, voted by the meeting, may be found in the *Elektrotechnische Zeitschrift*, Oct. 21, 1920.

Vibration.—JULIUS FRITH.—An analytical treatment, including vibrations occurring in crankshafts, flywheels and alternating-current generators. Vibration or hunting of alternators when connected in parallel slightly out of synchronism is also considered.—London *Engineering*, Nov. 12, 1920.

American Wood Preservation Methods.—BOYER.—A résumé of methods used in America for protecting wooden poles against decay through the application of disinfectants by means of a brush, by immersion of the poles and by injection. The author has recently returned from a trip to America and has made a special study of preservation proceses used in this country.—*Revue Générale de l'Electricité*, Nov. 13, 1920.

Scientific and Industrial Research

(Printed in the Third Issue of Each Month)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work

Conducted by Prof. Vladimir Karapetoff

Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ELECTROPLATING, CO-OPERATIVE RESEARCH IN.

The Bureau of Standards is at present engaged in co-operating with the Electroplaters' Society in discussing the possibilities for research in electroplating, especially that which may be carried out by co-operation with manufacturers and chemists during a period when there is relatively little industrial activity. It is hoped that through direct and personal association with the Electroplaters' Society the bureau may make its work more immediately useful and secure a more extended application of new methods in everyday electroplating practice, as well as become better acquainted with the problems and possibilities of the situation.

FURNACE, ELECTRIC, ROTATING TYPE.

The usual stationary furnace of the arc type is not quite satisfactory for melting alloys of copper, aluminum and volatile metals, because of the concentrated heat of the arc, which evaporates valuable constituents such as zinc, and because it is not possible to provide a thorough mixing of the charge, which is necessary for a uniform product. A rotary furnace has been developed and tested in which these drawbacks are largely eliminated. It consists of a lined steel drum or cylinder with its axis horizontal. A carbon electrode projects into this melting chamber from each end. The furnace rests on four rollers, two of which are driven by an electric motor through a worm gear. Thus the melting chamber and charge can be continuously rotated in either direction, insuring thorough mixing and avoiding concentration of heat in one part of the charge. The drum is provided with two copper rings which bear on contact shoes, and through these the current is carried to the electrodes. One of the electrodes may be provided with an electric motor for automatic control and temperature or current regulation. With heavy material the furnace is held stationary for a short time after turning on the power in order to prevent breakage of the electrodes.—*C. H. Booth, Chicago.* (N. B.—Several of these furnaces are in operation with apparently satisfactory results.)

FUSE, CARTRIDGE-TYPE, WITH CEMENT BLOCKS.

A renewable cartridge-type fuse has been designed and tested, in which the fusible wire passes through several cement cylinders with small spaces in between. These cement blocks take the place of the usual filling in an inclosed fuse. Tests have shown that with low-power short circuits the metal is vaporized only in the small exposed portions between the blocks, the protected portions being cooled by the cement. With a violent overload the entire wire is melted and absorbed by the porous cement, which, however, remains intact and protects the fuse container from carbonization and blisters. Since the wire melts in several places simultaneously, there is no persistent arcing. The number of melted places depends upon the voltage across the fuse, so that the fuse may be called "articulated" with respect to the voltage. The amount of fusible material and of air space in its vicinity has been reduced to a minimum and the container is made substantially airtight.—*H. E. Trent Lansdowne, Pa.*

FUSE, RENEWABLE, LINK-TYPE.

A fuse has been developed in which the fusible element is a renewable link. This link is inserted in the fuse tube, which is closed at both ends by screw caps. A slotted washer is provided at one end to hold the link in definite place, and there is a recess in the cap to allow the molten metal after the blowing of the fuse to collect without interfering with the removal of the cap and renewal of the link. The links are made narrow in cross-section at two points so that these points will melt first and minimize the explosive gases generated by the melting. —*Bussmann Manufacturing Company, St. Louis*

HYSTERESIS, VARIATION OF, WITH MAGNETIZING FORCE.

An investigation has been made to ascertain whether or not analytical expressions similar to the reluctivity relationship of Kennelly represent the variation of residual induction, B_r and coercive force, H_c, with the maximum magnetizing force, H_m. Hysteresis measurements were made on a large number of samples, using a wide range of materials and using magnetizing forces up to 2,500 gausses. The relationship $H_m / B_r = a + bH_m$ and $H_m / H_c = a + bH_m$ were found to hold within the limits of the probable experimental error.—*R. L. Sanford and W. L. Cheney, Bureau of Standards, Washington, D. C.*

LIGHT, DETERMINATION OF STANDARD WHITE.

Ordinary incandescent light sources give out reddish or yellowish light, and it is not possible to operate an artificial light source to "color-match" sunlight, on account of the very high temperature involved. A source of light at a higher temperature than that required to color-match sunlight would probably appear blue relative to the sun. The question arises at what temperature a source would appear neither blue nor yellow but white, and, in reference to this standard, whether the sun is blue, yellow or white? The first accurate experiments recently performed gave the following results: The theoretical temperature at which a source of light might evoke the hueless sensation of brilliance called white would be about 5,200 deg. (absolute) C. The light of the average noon sun at Washington, very closely approximates white. —*Bureau of Standards, Washington, D. C.*

MAGNETIC TESTING OF TWIST DRILLS.

A co-operative investigation is being carried out by the Bureau of Standards and the American Society for Testing Materials on the testing of twist drills by magnetic analysis. The steel has been carefully prepared and tested for homogeneity by magnetic methods. The drills are to be manufactured from this steel under carefully controlled conditions and tested magnetically and mechanically. An attempt will be made to correlate the mechanical performance of the drills with the results of the magnetic tests. The ultimate object is the development of apparatus which can be used in a commercial way for the non-destructive testing of twist drills. The apparatus for the tests is in progress of construction, and no data are yet available.—*Bureau of Standards, Washington, D. C.*

PHOTOMETER, MICROSCOPIC, FOR MEASURING PHOTOGRAHIC DENSITIES.

A new microphotometer has been developed for use in measuring photographic densities. It has been used for measurements of the wave lengths and densities of spectral lines, for the measurement of the energy distribution in a broad spectral line and the spectral sensitivity of photographic plates. Measurements of the photographic density, when the plate is illuminated in parallel lines, have been found to be much larger than in diffuse illumination, calling attention to the importance of specifying the character of illumination when measurements are to be made on the light transmission of diffusing media.—*W. J. Meggers and F. D. Foote, Bureau of Standards, Washington, D. C.* (N. B.—This will be of interest in the study of diffusing glassware.)

Suggestions for Research

COMPUTATIONS PERFORMED ELECTRICALLY.

Just as electrical phenomena can be represented by mathematical equations, many mathematical equations and relationships may be imitated by electrical phenomena. For example, a direct-current network of conductors with unknown currents is reduced to a system of simultaneous linear equations representing Kirchoff's laws. Conversely, for a given set of such equations an electrical network may be constructed in which the emfs. and the resistances will correspond to the known coefficients in the equations. The unknown quantities may be read directly on ammeters in the respective branches. Thus a complicated system of equations can be solved by simply setting an electrical device and reading the answers on indicating instruments. It is quite possible that more complicated computations could be similarly performed and even linear differential equations solved by means of transient electric phenomena recorded on oscillographs. The motto is "Let laws of nature do your work." Those interested in this problem will find some interesting information in an article by A. W. Wright on "Electrical Methods for Solving Equations," *Philosophical Magazine*, Vol. 18 (1909), page 291.—*Editorial Suggestion.*

INSULATING VARNISH AND COMPOUNDS.

The subject of insulating varnish and other similar materials is of prime importance to builders of electrical apparatus and one to which has been given a great deal of thought and study by electrical engineers and chemists, but as far as we know this information has not been very well checked for guidance in handling various insulation problems which come up. For instance, the vacuum process for impregnating windings and coils could well be considered as to its limitations, advantages and disadvantages for the various classes and sizes of apparatus, even as well as with regard to the kind of impregnating material which should be used and the properties of this material, both electrically and mechanically, its life, etc. Another well-known process for insulating motors, the dip-and-bake process, could be considered, first, as to best temperature for baking; second, as to the proper insulating material to be used under various conditions; third, as to the physical and chemical characteristics of varnish or impregnating material and its life under varying conditions.—*J. L. Hamilton, St. Louis, Mo.*

MAGNETIZATION CURE, DUE TO SUPERIMPOSED MMFS., FORM OF.

The determination of the actual form of the magnetization curve under the action of two magnetizations presents an interesting field for further investigation. The most direct mode of attack appears to be the use of the Braun tube to obtain the dynamic magnetization curve in a manner similar to that employed by Madelung. Such an investigation could give data on the total hysteresis with two or more magnetic forces acting simultaneously. With a number of superposed magnetic forces differing in their magnitudes and rates of change the problem is further enlarged to the determination of the interaction of any two of the forces in the presence of the others.—*W. Fondiller and W. H. Martin, Western Electric Company, and American Telephone & Telegraph Company, Research Laboratory, New York City.* (N. B.—This problem is of importance in connection with the so-called "flutter" in telephonic transmission. See a paper by the authors in the *A. I. E. E. Journal*, 1921, page 149.)

PRESSURE INDICATOR, FOR HIGH-SPEED GAS ENGINE.

An ordinary indicator used for drawing pressure-volume diagrams of medium-speed reciprocating engines is not suitable for high-speed gas engines on account of the unavoidable inertia of its parts. An indicator is desired operating on an electrical principle—for example, of the nature of a stretched-wire oscillograph or a cathode-ray oscillograph—by means of which instantaneous pressures in a cylinder could be recorded practically without any time lag. The problem is essentially that of devising an arrangement by means of which an electric current or voltage could be varied in proportion to instantaneous gas pressures in the engine cylinder.—*Central-Station Mechanical Engineer.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Secretary of War Again Heads Federal Power Commission

FOLLOWING the precedent established by President Wilson, the Secretary of War has been designated by President Harding as chairman of the Federal Power Commission. It will be remembered that Secretary of War Baker was chairman of the first Federal Power Commission.

According to the terms of the water-power act the commission is to be composed of the Secretaries of War, the Interior and Agriculture. The new commission therefore is made up of Secretary of War Weeks, Secretary of the Interior Fall and Secretary of Agriculture Wallace.

Owing to the pressure of other important matters, the first meeting of the new Federal Power Commission was not held March 14, as scheduled.

Western Companies Offer $9,000,000 in Bonds for New Financing

TWO new issues of bonds, one of $7,000,000 in 7 per cent unifying and refunding mortgage bonds of the San Joaquin Light & Power Corporation, the other of $2,000,000 by the California-Oregon Power Company of first and refunding mortgage twenty-year 7½ per cent series gold bonds, came on the market this week. The former issue includes $2,000,000 serial bonds, maturing in equal amounts annually for five years, the remaining $5,000,000 becoming due in 1951. The proceeds of the serial bonds are to be used to refund $2,000,000 of debentures, and the proceeds of the 1951 maturities are to be used to refund floating debts and to reimburse the treasury of the company for the construction of additional transmission and distribution lines. The serial bonds are being sold to yield from 7½ to 8 per cent, according to the maturity, and the bonds maturing in 1951 are being sold at 7.2 per cent. The California-Oregon Power issue, which is due in 1941, is being sold on a 7½ per cent basis.

Daylight Saving Situation Not Uniform in the East

DAYLIGHT saving will be adopted again this year by many sections in Eastern and New England states. Present indications are, however, that there is going to be considerable confusion. New York has passed a bill repealing state-wide daylight saving, but leaving it optional with the local community whether it shall run on daylight saving or standard time. New York City will go on a five-month daylight schedule on the last Sunday in April. A bill is pending in the New Jersey Legislature to make the daylight schedule effective from April to September inclusive. The Pennsylvania Legislature defeated a measure providing that clocks be turned forward an hour the second Sunday in April and back on the second Sunday in September. This means that Pennsylvania will have standard time, as was the case last year.

In New Hampshire the Governor gave his approval and formal effect to a bill making standard time obligatory in that state. A similar bill passed the Connecticut Legislature this week. Massachusetts and Rhode Island will both go on the daylight-saving schedule.

It seems doubtful, in view of the action already taken by some states, that there can be a uniform time adopted throughout the East, and under the present arrangements perplexing conditions seem likely to prevail in the states of that section.

Electrical Industry Benefits But Slightly from Acts of Last Congress

NO LEGISLATION of which the electrical industry was the chief beneficiary was enacted by the third session of the Sixty-sixth Congress, which adjourned *sine die* March 4. This excepts the regular appropriation bills, a number of which provide for research and other activities of electrical interest. The electrical industry is expected to benefit materially from the action of the session in rehabilitating the War Finance Corporation, as well as a dozen other industries.

The legislation in which the electrical industry was interested most failed. The bill authorizing the Federal Power Commission to hire its own personnel, which would have made it an active and really independent agency, as well as paving the way for appropriations commensurate with the importance of its work, did not become a law. Legislation looking to the continuance of development work on the power project at Muscle Shoals was defeated. Closely linked with this latter was the United States Fixed Nitrogen Corporation bill, which passed the Senate but was pigeonholed by the House committee on military affairs.

The electrical industry was much interested in the Patent Office bill. That measure, after having been agreed to in conference, failed when the Senate refused to approve the conference report because it contained a section authorizing the Federal Trade Commission to administer patents granted government employees. The bill provided for the reorganization of the Patent Office and granted material increases in salaries. The electrical industry was particularly interested in seeing that portion of the bill become a law, but many electrical interests were opposed to any special favors in the handling of government employee patents.

An amendment to the water-power act exempting from its provisions lands within the national parks was adopted, but an effort to make the amendment apply to areas which in the future might be added to the parks was unsuccessful.

Among the measures which failed were the so-called packer and Calder bills. This legislation proposed

regulation of the packing industry and the coal trade respectively. The course of these two measures was watched closely by business generally, since their enactment would have established precedents in the regulation of private enterprise.

William McClellan Receives Nomination for A. I. E. E. Presidency

THE board of directors of the American Institute of Electrical Engineers upon receipt on March 11 of the report of the committee of tellers on its canvass of the nomination ballots cast for candidates for the Institute offices selected its list of "directors' nominees" as follows:



WILIAM M'CLELLAN

For president—William McClellan, Philadelphia.

For vice-presidents—W. A. Hall, Boston; N. W. Storer, Pittsburgh; W. A. Del Mar, Yonkers, N. Y.; C. G. Adsit, Atlanta; J. C. Parker, Ann Arbor, Mich.; F. W. Springer, Minneapolis; H. W. Eales, St. Louis; Robert Sibley, San Francisco; O. B. Coldwell, Portland, Ore.; F. R. Ewart, Toronto.

For managers—A. G. Pierce, Pittsburgh; R. B. Williamson, Milwaukee; Harlan A. Pratt, New York.

For treasurer—George A. Hamilton, Elizabeth, N. J.

The ballots will be mailed to the membership prior to April 1.

Utility Securities Gaining in Investment Strength

THE assertion that public utility securities were at last coming into their own in the eyes of the conservative investor was made by Charles Monroe, vice-president of the People's Gas Light & Coke Company, Chicago, in a talk on "Utility Securities from the Owner's Standpoint," before the Electric Club of Chicago on March 8. Mr. Monroe made the point that the danger of political attack from which the utility had suffered formerly had been largely removed by reasonable commission regulation and the fact that ownership of utilities had become so widely distributed among men of small means, all of them voters anxious to protect their interests against demagogues. Utilities, he continued, after six years of strenuous fight against high prices of material, fuel and labor, had reached a point where costs would go down and profits would go up correspondingly.

New York Edison Company Announces Specialized Exhibit Plan

A POLICY of specialized exhibits has been inaugurated by the New York Edison Company. This company does no merchandising but maintains showrooms where the public can see various electrical devices. At its largest showroom, at Irving Place and Fifteenth Street, the company now is planning monthly special exhibits at which some one line will be emphasized each time.

This plan was tried out last month with an electric vehicle show. April 4 to 15 will be given over to the display of electrical refrigerating equipment. It will be followed by an exhibition of electric signs in May, and in June industrial heating apparatus will be shown. There will be no special displays during the summer, but in November there will be a display of lighting fixtures and methods and in December electrical household equipment will be featured.

All manufacturers are invited to exhibit without charge. No admission is charged to the public, and in promoting the electric vehicle show the New York Edison Company even paid for the advertising.

Electric Vehicle Show for New Jersey Public Service

ANNOUNCEMENT is made this week that the showrooms of the Public Service Electric Company, Newark, N. J., will be given over from April 9 to April 16 inclusive to an electric vehicle show. Like the show held by the New York Edison Company in February, the Newark show will be held without expense to exhibitors or charge to the public. The show will include all classes of electric vehicles and accessories.

Following is a list of the exhibitors:

Commercial trucks—Commercial Truck Company, Oneida Truck Company, Walker Vehicle Company, Ward Vehicle Company.

Passenger cars—Rauch & Lang.

Industrial trucks—Automatic Transportation Company, Baker R & L Company, Crescent Truck Company, Hoagland-Thayer Company, Industrial Truck Company, Karry Lode Industrial Truck Company, Lakewood Engineering Company, Mercury Manufacturing Company, Terminal Engineering Company.

Battery manufacturers—Edison Storage Battery Company, Electric Storage Battery Company, General Lead Battery Company, Philadelphia Storage Battery Company.

Charging apparatus and accessories—Auto Electric Devices Company, Cutler-Hammer Manufacturing Company, Westinghouse Electric & Manufacturing Company, L. Bamberger & Company.

Arizona Votes Funds to Aid Colorado River Commission

THE Arizona Legislature has voted $25,000 as its share of the fund for the Colorado River Commission which will investigate and control the development of the Colorado River for power and irrigation purposes. Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, as noted in the ELECTRICAL WORLD for Jan. 29, page 277, are to be represented on the commission.

It is thought that the commission will be of considerable influence in stimulating the development of power from this river, which will be of importance to the Southwest a few years from now. At the present rate of increase in power load in that territory most of the other easily available sites will have been developed and recourse must be had to the millions of horsepower available from the Colorado. The Southern California Edison Company has filed preliminary application with the Federal Water Power Commission for the development of the Colorado totaling more than 2,500,000 hp. The city of Los Angeles is also working on plans to develop power on this river. Action on the Edison company's permit has been suspended in order that a more general investigation of the river's possibilities may be made.

Much Optimism Expressed at Annual Meeting of Electrical Manufacturers

ATTENDANCE at the sixth annual meeting of the Associated Manufacturers of Electrical Supplies, held at the Hotel Biltmore in New York on Tuesday of this week, was the largest seen at any annual meeting of the association since its organization in 1915. In reviewing the status of the electrical manufacturing business for the fiscal year just closing President J. F. Kerlin pointed out that during that period conditions heretofore unknown to the industry had developed. The first six months had found every member of the association forcing the production of his plant to the utmost, while during the last half of the year in many cases the rush of orders was held up completely.



PRESIDENT J. F. KERLIN

"The pendulum of prosperity," said Mr. Kerlin, "apparently went too far, struck something and came back with a terrific rebound. It is still quivering and somewhat unsteady from the shock, but is now gathering momentum for another forward swing which is just as sure to come as day follows night. Contrary to the popular belief, there was no inflated bubble in our business. It was simply a legitimate expansion forced into high speed by the unprecedented and universal call for help upon man's most marvelous co-worker—electric power. This demand was temporarily met but not satisfied, and if the logic of events continues to repeat, we can look forward with the assurance that our present expanded capacity will be altogether inadequate."

Better Public Good Will

His opinion, Mr. Kerlin stated, was based entirely upon actual and available figures, and he called attention to the greatly increased demand for electric service brought about by the exigencies of war conditions and consequent reconstruction. People who had regarded electricity as a luxury now think of its practicability, safety and comfort, and they constitute a potential purchasing power difficult to estimate. Referring to the attitude of the public toward the utility companies, which has an important bearing upon the whole industry, he said:

"The people of this country are learning the facts about the electric public utilities, with the result that their attitude is constructive rather than destructive, and the government—federal, state and municipal—is extending to them the hand of needed encouragement."

Further grounds for optimism were found by Mr. Kerlin in the achievements of the manufacturers' association, which included the elimination of waste by standardizations, development of a cost system and simplification of many devices and their adaptation to common usage. Co-operation with other bodies has carried the matter of safety to a point consistent with regulation and public satisfaction. Through discussion the association has learned more about the raw materials used in its products, and a uniformly increased quality has resulted. Furthermore, the association has improved its merchandising methods, solved many traffic problems and increased the efficiency of its credit systems, all of which enter into the primary cost of the product.

Standardization and Cost Co-operation Desirable

Concluding his review of existing conditions and the work of the association, Mr. Kerlin said: "With these and many other advantages we approach the enforced, new order of business, with full confidence in our ability to render a valuable service that is bound to bring commensurate reward. Notwithstanding the accomplishments of the past, there is still much work to be done. A more universal standardization along lines now under way, and closer co-operation in the matter of costs, will be found desirable, if not necessary, in order that our members may keep fully abreast the rapid changes in economic conditions. The association should continue its intimate connection with the various associations and committees with which it is now affiliated with a view to concentration of effort or perhaps a consolidation of some organizations which will eliminate to some extent this apparent duplication."

That the association has changed but little since its organization was emphasized by Charles E. Dustin, general secretary, in his report for the past year. Mr. Dustin thought that this seemed the best indication that the lines upon which the association was formed were correct. Much has been accomplished by the association, he said, in compiling records of production and costs and submitting these to members in the form of comparisons. From these comparisons differences of as much as 25 per cent to 40 per cent were discovered, indicating the urgent need of uniform cost accounting.

H. R. Sargent in presenting his report of the activities of the association's representative to the National Fire Protection Association said that it had been proposed that the National Electrical Code be adopted by the American Engineering Standards Committee. However, as such adoption would allow of revision of the code only once every three years, it was not thought desirable at this time.

In connection with the revision of the code Mr. Sargent stated that a simplified code recently brought out by Portland, Ore., had many advantages over the present code in its clarity and ease of application. A committee will be appointed by the association with a view to modifying the code to correspond to that of Portland.

Tariff

In reporting the work of the tariff committee, William Burgess brought out the fact that few electrical manufacturers were aware of the protection they have been receiving, because the present tariff does not cover electrical apparatus by name. Electrical products have been classified under the metals schedule, which up to 1914 had a protection of 45 per cent. Passage of the Underwood bill at that time reduced this to 20 per cent. During and since the war imports were virtually nil, but renewed importation of foreign-made electrical apparatus may be expected at any time, and this, under the reduced tariff and depreciated values of foreign money, would seriously handicap American manufacturers.

At this time the ways and means committee in Washington is working on a revision of the tariff for better

protection of American manufacturers. With this end in view it is proposed to assess tariff payments on the value in the United States instead of the value in the country of origin. This would have the effect of placing on German-made goods a duty of about 25 per cent, instead of only 7 per cent if assessment were made on the basis of value in Germany in marks.

Upon completion of Mr. Burgess's report the following resolution was adopted and sent to President Harding and also Senator Penrose and Representative Fordney of the ways and means committee in Washington: "Resolved, that this meeting approves the proposition that tariff payments shall be assessed in United States values instead of the value in the country of origin."

Thomas M. De Bevoise, general counsel of the association, said that the Lockwood investigating committee of the New York Legislature had called for certain records and files of the association's transactions. This, however, in Mr. De Bevoise's opinion, was a mere matter of routine on the part of the Lockwood committee as the affairs of the association have been so conducted as to avoid any cause for suspicion on the part of such a committee.

Elections

To take the places of members of the board of governors whose terms had expired by limitation the following were proposed and elected: S. H. Blake, General Electric Company, Schenectady, N. Y.; A. H. Englund, Electric Service Supplies Company, Philadelphia; F. L. Bishop, Hartford Faience Company, Hartford, Conn.; A. F. Hills, Crouse-Hinds Company, Syracuse, N. Y.; Robert Kuhn, American Electrical Heater Company, Detroit.

The following officers also were elected for the ensuing year: President, Shiras Morris, Hart & Hegeman Manufacturing Company, Hartford, Conn.; vice-president, W. H. Thornley, Tubular Woven Fabric Company, Pawtucket, R. I.; treasurer, J. W. Pery, Johns-Manville Company, New York, and general secretary, Charles E. Dustin, New York.

By a rising vote of all members present suitable resolutions were adopted expressing sorrow at the death on Feb. 18 last of Edward B. Hatch of Hartford, Conn., a charter member of the organization and a member of the board of governors.

Atlantic Jobbers Get Together to Discuss Current Business Conditions

REGARDING the subject of prices and stocks as a good rallying point in any present-day discussion, the Atlantic Division of the Electrical Supply Jobbers' Association opened its session in the Hotel Commodore, New York City, on March 15, with the topic, "Necessity for Maintaining Stocks for Service Under All Conditions," led by W. I. Bickford, Iron City Electric Company, Pittsburgh. That stocks should be kept in a balanced condition under any conditions of business was the main thought expressed by Mr. Bickford, but both his remarks and those of other jobbers and of manufacturers who took up the discussion bore strongly on the question of price reductions and buying.

Charles L. Eidlitz, president of the R. B. Corey Company, New York City, gave some very entertaining and enlightening figures and ideas in presenting, with the use of charts, "How to Sell the Contractor." With figures on costs of electrical work on four large wiring jobs in New York City, he showed that almost the entire cost of electrical material entering into those jobs was covered in mechanical, current-transmitting and contact-making-and-breaking materials. Consequently most of the attention of jobbers' salesmen could profitably be concentrated on sales of these classes of material.

A report on systems employed in receiving, shipping and charging departments was presented by E. Donald Tolles, secretary of the division, showing the results of a detailed study of record keeping.

Part of the afternoon was given over to a message from the Society for Electrical Development, brought by W. L. Goodwin, assistant to the president. Mr. Goodwin appealed for greater support of the society by all branches of the industry. He showed representation of approximately 25 per cent of the jobbers, 10 per cent of the manufacturers and 20 per cent of the contractors. The central station was well represented.

At the executive session Fred E. Stow, secretary and general manager of the H. C. Roberts Electric Supply Company, Philadelphia, was elected chairman of the division to fill out the unexpired term of A. M. Little till July 1, 1921.

Recommends Private Development of New York Water Powers

GOVERNOR MILLER appeared last week before the Legislature of the State of New York with his long-expected water-power message, in which he recommends regulated private development of the state's water power resources rather than state and municipal development, as was proposed last year. Water-power development is urged because of the revenue to be derived from the resulting taxes and because of the benefits that will come from resulting cheaper power.

To insure development of the state's waters the Governor recommends the passage of a licensing act along the general lines of the federal water-power act. It is recommended that licenses be granted only for projects which provide for the maximum development of a given stream, watershed or territory.

The first step, as the Governor sees it, in the development of the water powers of the state is "the adoption of a policy which will make it practicable for private initiative to undertake the task under safeguards which will protect the public interest." It is recommended that power purposes be included as one of the uses to which state lands within forest preserves may be put.

The Governor in his message hinted at a state-wide transmission project, saying:

"Undoubtedly maximum use and economy of hydro-electric power will result only from some common method of transmission by which the widest distribution may be secured, and thus the variable factor both of use and development ameliorated as much as possible. Steam and hydro-electric power must supplement each other, and it is undoubtedly true that tremendous economies would result if all power could be converted into electrical energy and by a common transmission system made to serve all users within a given zone. If the potential energy of coal and water could be utilized in common by the most economical generation of each and a common distribution of both, true conservation of energy would result."

Metermen Plan "Get-Together" Meeting at N. E. L. A. Convention

PLANS are now under way and the details will be announced later for a metermen's "get-together" dinner at the N. E. L. A. convention in Chicago, May 31 to June 3. It is proposed to discuss at this time the report of the meter committee and to find out in what way this committee can better co-operate with the metermen.

Vermont Electrical Association to Meet March 24

THE Vermont Electrical Association will hold its annual meeting at the Hotel Vermont, Burlington, Vt., on March 24. A business meeting will be held at 3 p.m., with a banquet in the evening. On the same date and at the same place the accident prevention committee of the New England Division, N. E. L. A., will hold a meeting. A. B. Marsden, Rutland, Vt., is secretary of the Vermont association.

Security Sales, Fuel and Other Themes Interest Illinois Utility Men

THE change in the status of public utility securities wrought in the last eighteen months as a result of the shift from the great industrial profits due to war conditions to the losses of more recent months was the theme of John F. Gilchrist's address at Chicago this week before the joint session of the electric, gas and railway associations of Illinois. The vice-president of the Commonwealth Edison Company dwelt on the education of investors during the last few years to put their savings into sound securities and to buy on the partial-payment plan. Utility securities, founded on the rock of human needs, are second only to government securities, Mr. Gilchrist continued, and with the growing public confidence it is the easy and logical thing to utilize the personnel of the utility organization as a sales force to dispose of securities. The ease with which several stock issues have been recently disposed of in Illinois was cited, and the speaker explained the saving in brokerage fees of 15 or 20 per cent that this plan makes possible. The employees selling these issues have as a rule been paid a fee of 2 or 3 per cent.

The Illinois State Electric Association session on Tuesday afternoon listened to a discussion on central-station merchandise service and its possibilities by D. W. Snyder of Bloomington, in which Mr. Snyder outlined his company's policy of not doing house wiring where there are dealers able to do this work, of handling only meritorious appliances, of co-operation with local dealers and the conduct of its merchandising department in such a way as to increase electric energy sales, popularize the use of electricity and better the service of the community. J. G. Learned of the Public Service Company of Northern Illinois pointed out the opportunity of bettering public relations through proper merchandising and outlined a new plan of training saleswomen to call at homes and put appliances already in possession of the consumer in usable condition. No charge for repairs that can be made with a screwdriver is made, and the women give suggestions for the better use of appliances. Mr. Snyder, in discussion, said that in some small towns the net revenue from appliance sales was as much as 50 per cent of the net revenue from light and power, while it was approximately 10 per cent of that of the system as a whole.

J. H. Thomas of Peoria presented customer accounting from the standpoint of machine billing, and in the discussion that followed H. E. Addenbrooke of Chicago emphasized the importance of the one-line bill as an efficiency measure.

On Wednesday W. L. Abbott discussed "The Consumers' Stewardship of the Coal Deposits." After outlining the waste due to improper mining methods and the high costs due to the irregular nature of the business as now conducted, Mr. Abbott suggested that waste due to improper mining methods might be eliminated by giving a bounty on all coal mined clean—that is, with none left in the area mined.

Isolated Plant vs. Central Station

The Wednesday afternoon session was devoted to the discussion of isolated-plant as against central-station service under present conditions, the hazards of faulty switchboard construction and the testing of instrument transformers. John H. Mitchell of East St. Louis pointed out the inefficiency of the average isolated plant, asserting that there are many more turning out a kilowatt-hour on 8 lb. of coal than there are turning one out on 2 lb. and that the majority of isolated plants of less than 1,000 kw. rating are running in excess of 8 lb. That the industrial managers of the country are boosters for central-station service was maintained, but the service must be sold not merely for today but for years to come and to the real advantage of the purchaser. R. M. Bert of Rockford discussed the hazards of faulty switchboard construction, illustrating his remarks with some examples of severe troubles due to switches of inadequate rupturing capacity and pointing out the danger of attempting to fight fires on switchboards without shutting down the plant.

In discussing the work of the National Electric Light Association President Insull announced that a long stride toward co-operation with the American Telegraph & Telephone Company in solving the inductive-interference problem had been made.

The morning session on Wednesday concluded with the adoption of a joint resolution pledging the aid of the Illinois public utilities in the renewal of building construction by making all needed extensions.

Electrical Leaders Address New England Jobbers

CO-OPERATION between the various branches of the electrical industry was informally discussed before the New England Electrical Supply Jobbers' Club at Boston, March 14, by William Goodwin, assistant to the president of the Society for Electrical Development; C. L. Edgar, president of the Edison Electric Illuminating Company of Boston; Bowen Tufts, president New England Division N. E. L. A.; M. F. Falk, chairman Rhode Island Electrical League; William Gould, chairman New England Electrical Sales Associates, Boston; A. J. Hixon and George B. Quimby, Boston; C. B. Burleigh, General Electric Company, Boston; George H. Cox, manager Westinghouse Electric & Manufacturing Company, Boston; C. R. Hayes, engineering manager Charles H. Tenney & Company, Boston, and Frank S. Price, president Pettingell-Andrews Company, Boston. W. F. Abely, assistant manager Western Electric Company, Boston, presided.

Senate Confirms President's Nominations for District Commissioners

PRESIDENT HARDING has nominated and the Senate has confirmed Cuno Rudolph and Capt. James F. Oyster to be commissioners for the District of Columbia. Objection was voiced to each of the nominees on the ground that they were interested in public utilities. At a hearing before the District committee of the Senate it developed that neither of the nominees has any financial interest in Washington utilities. The inference was plain that those who appeared in opposition to the nominees fear that the new commissioners will be too friendly to the public utilities. That the opposition to the nominees made little impression was evident from the fact that the committee acted unanimously in recommending their confirmation.

Electric Service in Steel District to Be Topic of Joint Meeting

RECENT steps which have been taken by the Duquesne Light Company still further to assure the Pittsburgh steel district of adequate power and uninterrupted service will be the principal topic of discussion at the joint meeting of the American Institute of Electrical Engineers and the Association of Iron and Steel Electrical Engineers to be held in Pittsburgh on April 16. In the morning at 10 o'clock there will be an inspection trip to the new 300,000-kw. (ultimate capacity) Colfax station of the Duquesne company. Following luncheon at the station the visitors will return to the Chamber of Commerce, Pittsburgh, where the first technical session will be held. At this session, which will be under the auspices of the A. I. E. E. and will be presided over by President A. W. Berresford, a paper will be presented on "The Colfax Power Station of the Duquesne Light Company" by D. L. Galusha and C. W. E. Clarke of Dwight P. Robinson & Company, Inc.

At 6 p.m. an informal dinner will be served at the William Penn Hotel, followed by a technical session at 8 p.m. in the hotel. This session will be under the auspices of the A. I. & S. E. E. and will be presided over by President E. S. Jeffries. Two papers will be presented: "Problems of Conversion from 60 Cycles to 25 Cycles," by B. G. Lamme of the Westinghouse Electric & Manufacturing Company, and "Some Results in the Change from 60-Cycle to 25-Cycle Energy," by D. M. Petty, Bethlehem Steel Company.

Experiments Being Conducted to Popularize Radio Telephone

SOME interesting experiments having as their purpose the popularization of the wireless telephone are being conducted by the Westinghouse Electric & Manufacturing Company at East Pittsburgh, where it has installed a radio telephone station, from which a nightly program is given that can be heard within a radius of 1,800 miles. The evening concert consists of music such as phonograph selections, vaudeville from the Davis Theater and talented singers. On Sundays the entire church service of the Calvary Church is sent out broadcast and the church is thus virtually brought to the home. Radio amateurs with ordinary short-wave receiving sets can hear this station, and letters have been received from hundreds of operators as far distant as Warren, Ariz.; Denver, Col.; Ellendale, N. D.; Deland, Fla., and Montreal, Canada, saying that these concerts are enjoyed almost every night. One of the features of the nightly program is the answering of questions on wireless by means of the radio telephone. The latest news is sent out, and persons living in rural districts can thus receive news much sooner than would ordinarily be possible. When eminent men visit Pittsburgh their speeches are given to thousands by means of the radio telephone, instead of to only the few assembled in the banquet hall. Transmitters are concealed in flowers on the speakers' table and the words telephoned to East Pittsburgh, where they are broadcasted.

New Public Service Board for New Jersey Named

IN ACCORDANCE with the provisions of the new public utility bill of the State of New Jersey, recently passed over his veto, Governor Edwards has submitted to the State Senate the following names: Former Congressman Joseph A. Hammill, former Civil Service Commissioner Joseph S. Hoff, at present president of the National Bank of Princeton and the Princeton Savings Bank, and Harry Bachrach, former Mayor of Atlantic City and now president of the Marine Trust Company and director in several other mercantile institutions. The terms are for six, four and two years respectively.

The board of three members will succeed the old board of five members. Under the new law the power of removal is taken away from the Governor.

Massachusetts Utility Financing Explained at Boston Hearing

FREDERICK MANLEY IVES, general counsel for the Edison Electric Illuminating Company of Boston, appeared before Councilor Watson and others at the City Hall, Boston, on March 10, to explain pending legislation to enable Massachusetts electric utilities to capitalize premiums on stock issues. He pointed out that in the case of the Boston company its total capitalization, including premiums, now amounts to $40,447,000, the stock par value representing $22,528,000 and the premiums $17,919,000; an average of $179.54 has been paid in per share. Considerable popular misunderstanding exists, Mr. Ives said, regarding the intent of this legislation, which was recently outlined in the ELECTRICAL WORLD. Early stockholders, he maintained, deserve a higher yield on account of the greater risk that they took. The object is primarily to facilitate the raising of money for utility development, he pointed out, through the conversion of premiums into stock and the unification of shares at a reduced dividend rate. The speaker announced that the decreasing cost of coal will be reflected in bills rendered to consumers month by month as spring advances and showed that through easier financing the tendency is toward improved service and more favorable rates. The point was brought out that in 1919 the Edison company sought to have the price of street lighting arbitrated through joint petition with the Corporation Counsel of the City of Boston, but that no steps had been taken toward this readjustment of rates, necessitated by increased costs of service, for the reason that the city's representative preferred to negotiate for the new price and that up to date no agreement had been reached.

Waste Elimination Study Well Under Way

THE work of the committee on elimination of waste in industry is well under way, according to a statement this week by L. W. Wallace, secretary of the American Engineering Council of the Federated American Engineering Societies. Reports on the first investigation in each industry have been made. At a meeting of the planning board held on March 1 further reports were presented and plans made for continuing the investigations more intensively. In New York, New England and Pennsylvania the fuel investigation is virtually completed.

A small staff to plan and direct the work is to be maintained at headquarters. The field work is to be done by engineering firms carefully selected for their fitness so that the committee will obtain the benefit of the experience and knowledge of that firm that has had most intimate contact with a given industry. The firms are doing the work at actual cost to them. Ten industries because of their general importance and interest to the public have been selected for study. They are (1) bituminous coal, (2) building trade, (3) transportation, (4) men's ready-made clothing, (5) printing, (6) paper, (7) metal trades, (8) textiles, (9) shoes and (10) rubber.

From three to ten plants of each selected industry are being visited by an experienced engineer, who will get the information desired by the committee. A carefully prepared list of questions has been placed in the hands of each field worker. The information obtained by the field investigator is being supplemented by such authoritative data as may now exist in the form of reports made by reliable parties or agencies. Through this means information is to be obtained to enable the committee to formulate specific conclusions as to the major causes of industrial waste.

To accomplish the purposes of the committee it has been found necessary to make studies along the following lines:

First—Organization, which assigns responsibilities and relationships and concerns the discharge of such functions.

Second—Engineering, which comprises the design, construction and maintenance of plant, machinery and tools and the design of the product.

Third—Production control and cost control. Under this division fall all the factors relating directly to production and its proper direction and accounting.

Fourth—Physical factors. This division relates to the storage and inspection of raw and processed materials and to matters of internal transportation. It also includes consideration of the physical condition of the plant as regards lighting, heating, toilet facilities, etc.

The first and third sections, as well as a major part of the fourth, directly relate to the human element in industry. The committee is devoting the major portion of its effort to the factors that affect the human element. The important subdivisions of the major factors, organization, production and cost control, and the physical factors to which special attention is directed by the committee follow:

ORGANIZATION

(a) Nature of operation: (1) Contractual—This form presents many problems that affect personal relations; building operations are largely contractual; this form of relationship is quite common in the clothing industry. (2) Repetitive—A large portion of the industrial activity is repetitive; this phase of industry makes prominent the question of monotony and occupational diseases. (3) Continuous—Steel and chemical industries are typical representatives. In this form of operation the question of the number of shifts is considered important.

(b) Types: The type of organization is some index to the quality of the management and as such is an essential consideration—(1) functional, (2) line and staff, (3) staff, (4) mixed, (5) committee.

(c) Personal relations: (1) Employment policies. (2) Representation—to what extent each plan has been tried and with what results—(a) federal plan, (b) joint committee, (c) employees' co-operative associations. (3) Strikes and lockouts—the case for the duration of, the man, hours lost, and the total cost. (4) Restrictions by management and labor—an investigation of the means employed by management and by labor to restrict production; such practice produces an unstable condition and hence leads to uncertain labor conditions and disturbed relations. (5) Unemployment—(a) quantity of, (b) causes of, (c) remedy for. (6) Seasonal and intermittent employment—(a) quantity of, (b) causes for, (c) remedy of.

PRODUCTION CONTROL AND COST CONTROL

(a) Planning: All of these factors have a direct influence upon the productivity of the individual worker. If inadequately or ineffectively provided for, the worker loses time and compensation, and hence a high morale is not sustained.

(b) Establishing standards: This is very significant, as many labor disputes have arisen over the method and fairness used in establishing such standards. They have a direct bearing upon the earnings of the worker.

(c) Maintenance: If equipment is not properly maintained, the operator does not accomplish standard tasks, hence dissatisfaction results.

State Legislature Subpœnas Public Utility Heads

THE fight that has been going on in California for the past two months between the state government and the heads of the various corporations of the state over the proposed King bill, which proposes to increase the taxes of corporations, has taken on a different aspect. The bill was passed March 5, but an opportunity is to be given various corporation heads who have been making statements in the press to show how from $8,000,000 to $11,000,000 can be cut from the budget without impairing the efficiency of the government. Senator W. J. Carr, head of the budget investigating committee, has prepared a list of subpœnas for these corporation heads to make them appear before the budget investigating committee and show where this money can be saved. Among the men subpœnaed are Wiggington E. Creed, president Pacific Gas & Electric Company; Herbert W. Clark, counsel San Francisco-Oakland Terminal Railways; B. C. Carroll, general agent Pacific Telephone & Telegraph Company; Frank Karr, chief counsel Pacific Electric Railway Company; Champ E. Vante, vice-president Los Angeles Gas & Electric Corporation; W. R. Alberger, vice-president and general manager San Francisco-Oakland Terminal Railways; Mortimer Fleishhacker, president Anglo-California Trust Company; William Sproule, president Southern Pacific Company; R. H. Ballard, vice-president Southern California Edison Company; William Clayton, vice-president San Diego Electric Railway, and Max Thelen, attorney representing the corporations, who was formerly president of the California State Railroad Commission. The new law increases the tax rates of utilities about one-third.

Electrification Plans in Italy

A REPORT from Rome is to the effect that a special department has been established in the Ministry of Public Works for the purpose of studying thoroughly all possibilities for the utilization of water power in the country. Up to the present time only two-fifths of all available water power has been exploited for industrial purposes. The government has now appropriated 800,000,000 lire (about $160,000,000 at the old rate of exchange) in order to extend the electrification all over the country. It is said that by taking these steps about 2,000,000 tons of coal will be saved every year. Besides supplying energy to the Italian industries it is intended to begin as soon as possible the electrification of the railroads, attention being given in the first place to the lines from Rome to Turin and from Rome to Nettuno.

Society for Promotion of Engineering Education Forms N. E. Section

GARDNER C. ANTHONY, dean of the Tufts Engineering School, was elected chairman and H. S. Boardman, dean of the University of Maine Engineering School, was made secretary of a New England section of the Society for the Promotion of Engineering Education on March 12, at a meeting for organization held at the Worcester (Mass.) Polytechnic Institute. President Ira N. Hollis of the institute welcomed about fifty engineering educators to Worcester, and during the day addresses or discussions were contributed by Dean M. E. Cooley of the Engineering School, University of Michigan, and president of the society; Prof. Charles F. Scott of Yale University, Dean Anthony, Dean H. J. Hughes of the Harvard Engineering School, Prof. Dugald C. Jackson of the Massachusetts Institute of Technology, Principal A. L. Williston of the Wentworth Institute, Boston; Prof. W. S. Franklin, Massachusetts Institute of Technology; Profs. C. M Allen, A. L. Smith and W. W. Bird, Worcester Polytechnic Institute, and others. Preliminary plans were reviewed for the national convention of the society at New Haven, Conn., in June. Emphasis during the discussions was laid upon the importance of broad training for engineers, upon separating the school training of artisans and foremen from that given to candidates for professional engineering degrees, upon the need of less fragmentary textbooks and the importance of human interest to instructors.

Wireless Fog Signals to Protect Navigation

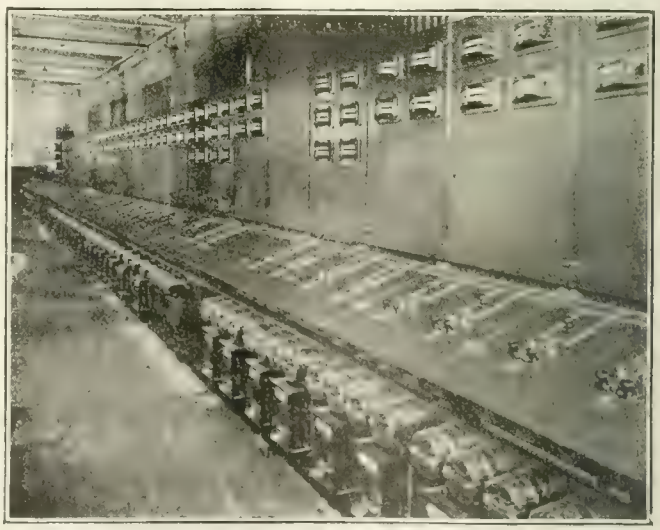
ANNOUNCEMENT was made this week by Secretary of Commerce Hoover that because of the important development of a radio compass by the Bureau of Standards three wireless fog signals would be immediately installed at the entrance to New York Harbor through the Lighthouse Service. Each of these three stations is equipped with an automatic radio set sending out signals continuously during fog or thick weather. They may be picked up on shipboard by means of the new radio compass which indicates the direction from which the radio signals are sent out, and by taking observations on the different stations the captain of a vessel may determine his exact position without being obliged to rely on the former unsatisfactory method of locating himself by the sound of whistles and foghorns. The Lighthouse Service plans to establish other stations as rapidly as necessary funds are provided.

These signals have been developed as the result of co-operative experiments by the Bureau of Standards and the Lighthouse Service, and more especially through the research work of the Bureau of Standards in improving the radio compass. The system differs from other systems in use for determining radio direction in that the navigator himself can determine radio bearings just as he uses his magnetic compass for bearings in clear weather and does not have to depend upon expert radio operators.

Would Legislate Against Compulsory Customer Financing in New York

AN AMENDMENT to the penal provisions of the public service law of New York State has been introduced into the Legislature which makes it a misdemeanor "for a public service corporation, its agents or employees, to solicit, exact or receive any subscription to its capital stock, or any purchase of its bonds, notes or other evidence of indebtedness, as a consideration or inducement for furnishing its service, or for constructing, extending or supplying structures, equipment, instrumentalities or other means for furnishing such service; and providing that such service shall not be withheld, diminished or delayed because of the failure or refusal of any person to subscribe to such stock or to purchase such bonds, notes or other evidence of indebtedness."

Switchboard of Record Size Shipped to South Africa



WHAT is said to be the largest switchboard ever built was recently shipped to Capetown, South Africa, by the General Electric Company to be installed in the new municipal Dock Road power house. It is designed for an ultimate capacity of 20,000 kva., the actual capacity at the present time being 11,500 kva. The board, which is of the bench type, is 101 ft. 6 in. long, 90 in. high over all and 6 ft. 5 in. from the back to the front of the sub-base sections. It has forty-seven sections, is entirely equipped with standard apparatus and also has some special features which are made necessary by the installation. To give an idea of the magnitude of the board there are 145 horizontal flush-type meters, 180 relays of various types, 161 current transformers, 126 indicating lamps, 27 potential transformers and 33 watt-hour meters.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Final Hearing on St. Lawrence Project. — Final arguments for or against the proposed St. Lawrence River navigation and power development are to be heard by the international joint commission in the Federal Building at Detroit on Wednesday, March 30.

Central Maine Power Company Enlargement Probable.—The Maine Public Utilities Commission has authorized the Central Maine Power Company to take over the property and franchises of eight smaller companies—the Hartland, Newport, Union, Waldoboro, Wiscassett, Penobscot Bay, Solon and Bath & Brunswick.

Hydro-Electricity on the Tippecanoe.—Work is expected to begin this spring on dams along the Tippecanoe River intended to promote the development of electricity for several of the larger towns in northern Indiana under the auspices of a three-million-dollar corporation to be known as the Tippecanoe Power Company. Seven units of 20,000 hp. each are planned.

New York Electric Rates Cut by Injunction.—The city of New York has obtained an injunction from the Supreme Court restraining the New York Edison Company and the United Electric Light & Power Company from continuing to charge consumers of electricity a rate higher than that fixed by the Public Service Commission in July, 1917. This official rate was fixed on a sliding scale, and the maximum charge was 7 cents per kilowatt-hour. The immediate result of the decision is to reduce the rate from 7.9 cents per kilowatt-hour to 7 cents. The matter will be settled upon trial.

Mexican Power Projects.—It is announced that plans have been adopted by the Dolores Mines Company, an American corporation, to construct a large electric power plant at Madera, in the Mexican State of Chihuahua, and to build an ore-reduction mill at Dolores, in the same state. In the Guanajuato district important improvements and additions are, it is reported, to be made to the hydro-electric plants and power-transmission system of the Guanajuato Light & Power Company, which supplies electrical energy to mines and industries in the states of Guanajuato and Jalisco. A scheme said to have the approval of the government engineers is reported from Santa Rosalia. According to the announcement, the water which passes through the turbines of the large hydro-electric plant at Boquillas, Chihuahua, is to be used for irrigating 200,000 acres of land in the valley of the Conchos River.

Measuring the Human Emotions by Electricity.—A novel field for electricity was described recently before the Royal Institution of Great Britain by Prof. A. D. Walker, who explained how the electrical art can be of assistance to psychologists in studies of a biological nature. The method is that of measuring by means of a Wheatstone bridge the changes in blood pressure which result from the response of the human brain to emotional indications. The subject for study is used as one arm of the Wheatstone bridge, through which a constant current is passed, any change in blood pressure being recorded on a galvanometer. According to the London *Electrician* Professor Walker said that he was not as yet prepared with any explanatory theory of the phenomena that take place. He suggested that the method might serve in the detection of malingering and the exposure of spiritualistic frauds.

Purdue Experiments with Electricity in Floriculture.—The agricultural experiment station at Purdue University has announced results from recent tests which may prove of great value to florists and flower raisers generally. The experiment consisted in using electric lamps during cloudy weather to prevent "bud drop," sweet-pea plants being selected as those on which to make the trial. It had been found, according to R. D. Brown, who had charge of the work, that the buds began to drop Jan. 24 during a period of dark weather and they continued to drop during the cloudy period until Feb. 8, when a 100-watt lamp was placed above the twelve plants used in the experiment. Twelve flowers were picked from these plants on Feb. 10. On Feb. 13 five out of the twelve buds had a full blossom, while none of the buds without the artificial light had developed any color. Further experiments are to be conducted.

Tidal Power Plant at East Saugus, Mass.—This undertaking, which is being promoted by the Universal Tide Power Company, as described on page 507 in the Feb. 26 issue of the ELECTRICAL WORLD, has not received the indorsement of the Providence Engineering Society, which investigated it with the idea of protecting local investors. After a thorough investigation the society concluded (1) that the project now under construction will not develop sufficient power to demonstrate the efficiency of the machinery, (2) that the claims with respect to contemplated plants cannot be met, (3) that the proposed method of converting water power into electrical power is very inefficient and not so practicable as with modern and efficient low-head waterwheels, (4) that the two-basin method of developing power has been tried out thoroughly by experienced engineers and has not yet proved a success, and (5) that the probability of the Universal Tide Power Company's ability to pay dividends on the investment is very remote, and therefore "we do not think it would be advisable for any one to invest his money in this firm."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

An Engineers' Club for London.—Strong support for a proposed Engineers' Club in London is being received, and a representative provisional committee has been appointed. L. B. Atkinson, president of the Institution of Electrical Engineers, and other well-known electrical men are members of this committee.

Atlanta Engineers Meet.—A "get-together" meeting of the various engineering societies of Atlanta, with the local members of the A. I. E. E. as guests, was held on Feb. 25. Following out the study of the Atlanta Section, A. I. E. E., on Superpower Zone work, Charles G. Adsit, consulting engineer of the Georgia Railway & Power Company, addressed the meeting on "Rainfall on the Southeastern and Western Slopes of the Appalachian Range," giving facts which materially aided the Superpower Zone committee in its work.

Section Meetings, A. I. E. E.—At a meeting of the Detroit-Ann Arbor Section, A. I. E. E., last night (March 18), B. G. Lamme told "The Story of the Induction Motor." The Kansas City Section will meet on March 25, when H. C. Blackwell, general manager Kansas City Light & Power Company, will describe that company's plant. The San Francisco Section also will meet on March 25, when J. E. Woodbridge, resident engineer for Ford, Bacon & Davis, will discuss "A Variable-Voltage Railway Converter Substation." On April 1 J. Muirhead will speak on "High-Voltage Transmission in British Columbia" before the Vancouver (B. C.) Section.

Coming Meetings of Electrical and Other Technical Societies

Association of Iron and Steel Electrical Engineers—Birmingham Section, March 19; Pittsburgh Section, March 19; Chicago Section, March 22; Philadelphia Section, April 4; Cleveland Section, April 11.

Wisconsin Electrical Association—Milwaukee, March 23 and 24. (For program see issue of Feb. 19, page 448.)

A. I. E. E. (New York Section) and A. S. M. E. (Metropolitan Section) — New York, March 25.

A. I. E. E., Section Meetings—Kansas City March 25; San Francisco, March 25; Vancouver, B. C., April 1.

A. I. E. E. and A. I. and S. E. E.—Joint session, Pittsburgh, April 16.

Missouri Association of Public Utilities—Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society—Washington, April 23.

United States Chamber of Commerce—Atlantic City, April 27-29.

American Society of Civil Engineers—Houston, Tex., April 27.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Service Standards and Original Cost.—The Kansas Natural Gas Company having appealed from an order of the Kansas Court of Industrial Relations which denied increased rates and insisted on enlarged requirements of service, the United States District Court declared that neither the rule that plant efficiency must precede an increase in rates nor the rule that deferred maintenance must not be reflected in the rates holds good in all cases. The court held that to take original cost less theoretical accrued depreciation as a controlling basis of valuation for rate making would in the case before it be virtual confiscation. Cost of reproduction new, the court said, should not be rejected but carefully considered, together with the other elements, in reaching judgment. "The elements of depreciation," it added, "should not be measured by a theoretical yardstick, but should be determined by a careful consideration of the actual facts touching the physical condition of each particular plant under consideration."

Injury to Consumer from Shock While Using Electric Light Creates Presumption of Company's Negligence.—Affirming a judgment against the defendant in Lynch vs. Meyersdale Electric Light, Heat & Power Company, where damages were sought because of the death of plaintiff's husband from electric shock while handling a bulb attached to a cord, the Supreme Court of Pennsylvania held that with proper precautions on the part of the electric company the presumption is that no such injury will occur, and that therefore its actual occurrence creates a presumption of negligence against the company. Where the court charged that if defects in apparatus owned by the deceased caused his death the verdict should be for the defendant, the jury must be presumed to have determined that there were no such defects. Experts were properly permitted to base opinions on the testimony of witnesses who described the facts, and evidence that other persons who used the company's service had received shocks about the same time as the deceased was properly admitted, even where the premises in which such persons were said to have received shocks were not connected to the same transformer as the house where the fatality occured. (112 At. 58.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Rules of Evidence in Commission Proceedings.—The public service company law of Pennsylvania did not contemplate that the strict rules of evidence should be applied to hearings before the Public Service Commission, and therefore, the Supreme Court of that state has held, in Schuylkill Railway Company vs. Pennsylvania Commission, the article in the law providing that the testimony taken should come up on appeal as a part of the record was no doubt intended to afford the courts an opportunity to see that there was some reasonable basis in the proofs for the decision of the commission, not that the courts might examine the testimony to see whether the strict rules had been complied with. (112 At. 5.)

Admissible Evidence in Suit for Damages Because of Fatal Accident.—Evidence as to the effects of electrical shock given by a witness who, though not a physician, had seen fatal electrical accidents, and evidence that another person than the deceased in the case on trial had subsequently to the death of the latter received a shock under similar circumstances, were both held admissible by the Supreme Court of California in Robinson vs. Western States Gas & Electric Company. In this suit damages were sought because of the death of a farmer while working with a windmill with the metal part of which, it was alleged, electric wires designed to convey power for its operation had, through the negligence of the company, come into contact. The company disputed the cause of death and offered evidence that the fatality was due to dilatation of the heart, but the court overruled this testimony as having been based on hearsay. (194 Pac. 39.)

Interpretation of Washington Commission Law as It Affects Change of Rate by Utility.—The Supreme Court of the State of Washington has, reversing the court below, found, in North Coast Power Company vs. Public Service Commission, that an electric company which, after the Public Service Commission law went into effect, entered into a contract with a municipality for furnishing energy at a stipulated price may increase its rates without an order of the commission where changed conditions render the contract rate unprofitable, notwithstanding a section of the law declaring that nothing in the act shall prevent any such public utility from continuing to furnish service under contracts in force at the effective date of the act, but that the commission shall have power to direct the termination of such contracts. This limitation, the court holds, applies only to contracts entered into before the act became effective. The Public Service Commission, which had found the new rates fair, was therefore ordered to set aside the order issued by it postponing their enforcement and to enter one dismissing the complaint of the city of Centralia, the municipality concerned. (194 Pac. 587.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Extensions of Service as Affected by Rate of Return.—The Public Service Commission of Missouri has refused approval to regulations of the Jefferson City Light, Heat & Power Company requiring persons desiring extension of service to advance the estimated cost of construction, the commission holding that such regulations are not justified where the utility company is receiving a fair return on its property.

Privileges to Directors Are Discriminatory.—Unless they are actively engaged in the operation of the plant the directors of a public utility should receive compensation only in the form of dividends, according to a decision of the Missouri Public Service Commission, and to give them a flat rate for the electricity consumed by them exactly equivalent to a sum allowed them as salary—that is, to supply them with free energy by way of salary—is discriminatory.

Financing Rural Extensions. — In passing upon the proposed rules of the Eastern Wisconsin Electric Company with respect to rural electric extensions, the Wisconsin Railroad Commission authorized the company, as an emergency provision, to require from an applicant for extension of service a deposit equal to the total estimated construction cost of the extension, with a refund to be made of one-half of all the monthly bills paid during a period of four years, any portion of the deposit remaining in the utility's hands at the end of the four-year period to be the property of the public utility.

Present Conditions Call for Circumspection in Granting Rate Increases.—Refusing to grant more than part of an increase in gas rates asked by the Freeport Gas Company, the Public Utilities Commission of Illinois said recently: "It is clear that the inevitable reaction from war prices is already well under way in this country, and the signs of financial depression now so prevalent about us cannot be ignored. While thus far lighting materials have been virtually unaffected by the tendency of lower prices, it must be evident to even casual investigators that industrial depression must effectively operate to reduce the prices of oil, coal and other materials essential to the production of gas, electricity and other utility services. It is now a matter of almost daily testimony before this commission that labor has increased in efficiency within the last few months."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Thomas Sproule has recently resigned as assistant engineer of transmission and distribution of the Philadelphia Electric Company to become associated with the Public Service Electric Company of New Jersey as assistant to W. K. Vanderpoel, general superintendent of distribution. Mr. Sproule has been a



THOMAS SPROULE

member of the engineering department of the Philadelphia Electric Company since the organization of that company and has been active not only in its engineering work but in many engineering associations and affiliated societies. He took an active part in the formation of the Philadelphia Electric Section of the National Electric Light Association and was elected its third president. In 1919 Mr. Sproule also served as president of the Pennsylvania Electric Association, having served before and since that time on its important committees. At the time of his resignation he was acting chairman of the technical section of that association. Mr. Sproule is a member of the overhead systems, inductive interference and underground systems committees of the National Electric Light Association and chairman of the safety rules committee. In 1914, while chairman of the overhead systems committee, he was largely responsible for the editing and publishing of the handbook on overhead-line construction, which is a very valuable compilation for distribution engineers. He has also served on many joint committees dealing with wire crossings, joint use of poles, safety code, etc. In addition, Mr. Sproule is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society, the National Electric Light Association, the American Electric Railway Association and the Engineers' Club of Philadelphia. Mr. Sproule was born in Philadelphia and received his early education there. He entered the electrical industry in 1895 with the Brush Electric Company, which was later merged with the Philadelphia Electric Company.

Arthur Prager, who was elected president of the New Mexico Electrical Association for the year 1921, has been engaged in the public utility business since 1907, having served most of that time with the Federal Light & Traction Company, which owns and operates public utilities in the West and Middle West. Mr. Prager was born in Trinidad, Col., in 1890. He was connected with the Trinidad Electric Transmission, Railway & Gas Company for a number of years and was transferred to the Deming (N. M.) Ice & Electric Company and then to Albuquerque, N. M., as auditor of the company for three years. From this post he was promoted to be assistant treasurer of the Springfield (Mo.) Gas & Electric Company and Springfield Traction Company and served in that capacity for a three-year period. He resigned to enter the United States Army, remaining until the close of the war. After his discharge from the army he was made manager of the Albuquerque (N. M.) Gas & Electric



ARTHUR PRAGER

Company. Mr. Prager has served as an officer of the New Mexico Electrical Association for the past two years and was elected president at the annual convention held in Albuquerque in February.

Benjamin F. Cleaves, chairman of the Maine Public Utilities Commission since its establishment in 1914, has tendered his resignation to take up the management of the Associated Industries of Maine, with headquarters at Augusta. Chairman Cleaves is a native of Waterboro, Me., and was graduated from the Biddeford High School in 1885. He read law in the offices of Hamilton & Haley, was admitted to the bar in 1892, and practiced law at Biddeford thenceforth, ultimately becoming a member of the firm of Cleaves, Waterhouse & Emery. With the establishment of the Maine commission he sought to create an understanding between the utilities, the public and the commission which was peculiarly adapted to the conditions



B. F. CLEAVES

prevalent in Maine and which has borne fruit in a regulation of marked breadth of view, straightforward action and a sane and sympathetic realization of the problems of public utility service and financing. The decisions of the Maine commission under Chairman Cleaves' guidance have been strikingly free from unnecessary complications of legal phraseology and very readable. The board's work has borne witness to a practical appreciation of public utility affairs not always encountered in regulative tribunals of comparatively short experience. The New England Geographic Division of the National Electric Light Association has twice been the beneficiary of Chairman Cleaves' ability to set forth the issues of the day in public relations, and at the Kineo convention last fall he made a strong plea for the extension of publicity work along the line of better educating the public at large in the problems of service, financing and general development confronting the industry, offering his earnest co-operation in this work. Last year he traveled about 25,000 miles in Maine, seeking to bring the interests of the public and the companies into intelligent accord and striving to give the scattered population of the state the benefit of the commission's understanding with minimum formality and expense.



C. W. M'KAY

Charles W. McKay, president and general manager of McKay & Sherman, a recently organized firm of valuation engineers in Chicago, was formerly connected with the engineering firm of McMeen & Miller and was chief appraisal engineer for L. V. Estes, Inc., of Chicago. Upon graduation from Cornell University in 1906 Mr. McKay entered the employ of the New York & New Jersey Telephone Company, serving an apprenticeship in the maintenance department. In 1909 he was promoted to the position of engineer for the North Brooklyn district, and in 1910, when the New York Telephone Company absorbed the Bell companies, serving the New York district, Mr. McKay was assigned to special work inspecting the newly acquired properties. During 1912 he was engineer of the Borough of Queens. From 1912 to 1913 he was associated with Henry Floy in the capacity of assistant engineer on several important appraisal cases. In the summer of 1913 he became engineer to the McCall & Clark Company, efficiency experts of New York City. He resigned this position to become associated with McMeen & Miller in Chicago on problems involving the appraisement of public utility properties. Later he was engaged in valuation work for the Central Union Telephone Company and continued in this capacity until his appointment with the Cooley & Marvin Company. In 1919 he was placed in charge of the appraisal division of L. V. Estes, Inc., of Chicago. Mr. McKay has written numerous articles on appraisal subjects for the technical press and is the author of "Valuing Industrial Properties" and "Telephone Rates and Values." The firm of McKay & Sherman will specialize in problems involving the valuation of electric utility and industrial properties. P. C. Sherman, who holds the position of vice-president, is a well-known industrial engineer, heretofore president of Sherman & Associates, Inc., New York City.

B. H. Gardner, sales manager Connecticut Light & Power Company, Waterbury, Conn., has resigned to become manager of the Lafayette district of the Northern Indiana Gas & Electric Company, Lafayette, Ind. Mr. Gardner was graduated from the electrical and mechanical engineering course at Clemson College, S. C., in 1903. After two and one-half years with the General Electric Company at Schenectady, N. Y., he spent six years with the Dayton (Ohio) Power & Light Company, most of his time being devoted to power engineering work. In early 1912 he was appointed power engineer of the United Electric Light & Water Company, a predecessor of the Connecticut Light & Power Company, and served in this capacity for two years, with headquarters at Waterbury. He was then transferred to Norwalk, Conn., as superintendent of the gas and electric property there and in 1917 was again transferred to New Britain as district superintendent. In the fall of 1919 he was appointed sales manager of the company, with offices at Waterbury.

A. M. Little, who for the past ten years has been president of the Mohawk Electrical Supply Company of Syracuse, N. Y., has recently resigned to take up other work. His future plans have not yet been announced.

E. S. Janison has been appointed acting general sales manager of the Goulds Manufacturing Company, Seneca Falls, N. Y., to succeed W. E. Dickey, who retired on Jan. 1. For the last five years Mr. Janison has been manager of the company's Philadelphia office.

Alfred J. Paine, who became treasurer of the McKenney & Waterbury Company, Inc., Boston, March 1, has been with the McKenney & Waterbury house for seventeen years in capacities ranging from salesman to general manager. He occupied the latter post until the purchase of the concern by himself and M. W. Vye. A native of Malden, Mass., Mr. Paine's entire business career has been spent in the fixture field, first with the house of R. Hollings, Boston, and then with the E. H. Tarbell Company, Boston, before joining the staff of McKenney & Waterbury.



A. J. PAINE



F. C. FOSTER

F. C. Foster, for four years sales manager of the Buckeye Electric Division, National Lamp Works, Cleveland, has just assumed the position of director of sales with the Laundryette Manufacturing Company, Cleveland.

Obituary

Francis Robbins Upton, former associate of Thomas A. Edison and first president of the Edison Pioneers, an organization of men who worked with Mr. Edison in the early days of the inventor's great successes, died on March 10 at his home in Orange, N. J., following a long illness. When Mr. Edison was notified of the death of his former aid he spoke feelingly of their long association. "Mr. Upton was one of my old pioneers," said Mr. Edison. "He was a loyal worker and as a mathematician assisted me in working out the complicated problems as to economy and adaptability of the devices necessary to make a complete system of electric light by incandescence. He was a very fine man. I am sorry to learn he has passed on." Mr. Upton was also associated with Mr. Edison in his ore milling and subsequently was interested in quarries and in selling materials for concrete construction. He was born in Peabody, Mass., July 26, 1852, and educated in Phillips Academy, Andover; Chauncey Hall, Boston; Bowdoin College, Princeton University and Berlin University. His New England progenitors were manufacturers, and he was keenly interested in manufacturing problems, which were part of his work with Edison. Mr. Upton is the last of the "Big Four" who were associated with Mr. Edison in his early activities. The three others were Charles A. Batchelor, the mechanical engineer; John Kreusi, the chief of production, and Edward H. Johnson, the business executor, while Mr. Upton was the physicist and mathematician. Mr. Edison was as comprehensive in selecting his helpers as he has been in every line of work.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Wants of 110,000,000 People Must in Time Be Met

IT IS an old saying that things look blackest just before the dawn. It is not improbable that some such situation now prevails. Outwardly things have looked pretty black for the past three weeks. Inauguration came and went and apparently brought no improvement. Wage cuts have been frequent. Reports on the financial and operating conditions of the railroads played havoc for a while on the stock exchanges. Other poor reports hammered down stock prices. Copper is selling now at its lowest price since 1914, but very little metal is changing hands. The iron and steel business is about at a standstill. On the face of it things look pretty black. Still, there are certain underlying conditions that are quite favorable.

Spring is here and will bring a certain amount of new building. In the metropolitan area of New York this will be stimulated by the city's action in withdrawing new dwelling houses from the tax list for ten years. Moreover, spring brings a certain amount of rehabilitation work from many sources. Besides, there are millions of dollars to be spent this year on municipal improvements. Word comes from the automobile centers of the Middle West this week that business is picking up. This affects a number of lines. Non-employment, while showing an increase in February, bids fair to show a decrease in March. The textile industry, one of the largest employers, is again taking on men. The same is true of a number of other fundamental commodity industries.

Finally, there are the wants of 110,000,000 people to be met. To feed and clothe these people means production and transportation. The public can't continue on a buying strike forever. It may be several months before buying reaches factory capacity, but in the meantime it looks as though a fair business could be expected.

Cross-Arm Prices Are Again Reduced

PRICE decreases on Rainier fir and longleaf-pine cross-arms varying from 9 to 15 per cent are announced by representative producers effective March 1. This is the second decrease within a month, the first amounting to 15 per cent and becoming effective on Feb. 1, as stated in the Feb. 5 issue of the ELECTRICAL WORLD. The supply of arms both with jobbers and at distributing yards is reported good, with stock shipments prevailing. Demand remains uneven in different sections of the country and among different producers. On the one hand buying is said to be slow with only a few straggling orders coming in. Some producers, however, state that sales have picked up recently with more inquiries and greater interest being shown in the market by consumers who are looking forward to their spring needs.

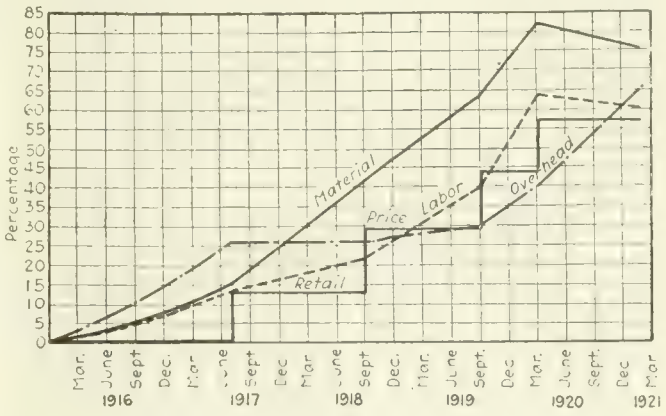
Representative prices now in effect on fir arms per 100 delivered are as follows: Electric light arms, 3¾ in. x 4¼ in. x 3 ft., two pins, less than 1,000 lineal feet, New York $56.99, Chicago $52.57, and 1,000 to 3,000 lineal feet, New York $50.66, Chicago $46.73; 3¾ in. x 4¼ in. x 6 feet, six pins, less than 1,000 lineal feet, New York $113.99, Chicago $105.13, and 1,000 to 3,000 lineal feet, New York $101.33, Chicago $93.45. N. E. L. A. arms, 3½ in. x 4½ in. x 5 ft. 7 in., four pins, less than 1,000 lineal feet lots, in New York cost $128.92, Chicago $118.90, and 1,000 to 3,000 lineal feet, New York $114.59, Chicago $105.69. New England arms, 3¼ in. x 4¼ in. x 5 ft. 6 in., four pins, lots of less than 1,000 lineal feet in New York cost $113.99, Chicago $105.13, and 1,000 to 3,000 lineal feet lots, New York $101.33, Chicago $93.45.

Increases in Vacuum-Cleaner Cost and Prices

IN THE general discussions going on at the present time concerning the possibilities of reductions in prices of various commodities and specialties, and in numerous requests made to manufacturers asking for a guarantee against price declines, F. J. Gottron, general manager of the P. A. Geier Company, Cleveland, Ohio, has gathered some data on retail selling price, cost of material, labor and overhead, as applied to one make of vacuum cleaner and set the cost down in curve form for comparative purposes.

Retail prices on July 1, 1917, went from $35 to $40; on Sept. 1, 1918, they went to $45. This was increased on Sept. 1, 1919, to $50 and on March 1, 1920, to $55.

While these increases were being made, it is interesting to note from the other curves, the increase in materials on March 1, 1920, above the 1916 level was approximately 84



COSTS AND PRICES IN LAST FOUR YEARS

per cent, the increase in labor about 63 per cent and the increase in overhead about 40 per cent.

Since March, 1920, there has been a slight decline in the cost of materials and a very slight reduction in the cost of labor, but reference to the overhead-cost curve will show that it has gone up very abruptly and has now reached the unprecedented height of 65 per cent above normal. This rapid increase in overhead is due, of course, to the drop in the volume of business and the resultant high cost per unit of advertising, selling and general overhead expense.

Fiber Conduit Stocks in Good Volume at Mills

UNLIKE usual buying conditions in the fiber-conduit field at this time of year, the present market is quite dull. Manufacturers at the same time have built up large stocks of this material to handle business which is expected to come in later in the spring and summer with request for quick delivery. No difficulty can be experienced now in shipping common sizes from stock. To continue this condition the mills as a whole are working virtually full time. To be sure, orders have been taken for good amounts

for spring delivery, and the early break up of winter is providing an added incentive to purchase at this time. Many power stations have plans ready for heavy extensions, but these are being held in abeyance till a later time. Certain parts of the Southwest, West and Central States have been in the market already, with some amounts coming from the East. Still, as a whole, business is dull, but with the general trend of municipalities to place their lines underground the future stands out very brightly.

In line with prices of other commodities, at least one mill has reduced its price in an amount ranging from 15 to 18 per cent. Up to date no other instances of a price drop have been found.

Balancing of Stocks Important Factor in Jobbing

THE function of a jobber as a carrier of stocks was well discussed in the open meeting this past Tuesday of the Atlantic Division, Electrical Supply Jobbers' Association, held in New York. W. I. Bickford, in speaking on the "Necessity for maintaining stocks for service under all conditions," said that although a year ago a jobber was more or less justified in being without stocks, at this time there was no excuse whatever. Manufacturers can make immediate shipments on virtually any kind of jobber material, and it is a shortsighted policy for any jobber to let his stocks run out on any item.

A balanced stock is the essential thing to work for, and because some items may be excessive is no reason for a jobber permitting other items to run low. One of the prime functions of a jobber is to provide stocks to meet prevailing demands, and no matter how bad business conditions are a lack of stock certainly can not be said to meet even the little demand which is existent. The good will of the customer is an important adjunct to future business.

During the discussion the attitude of certain manufacturers in attempting to force stocks on jobbers was criticised. It was shown that this was the case even where present stocks were already too heavy. Some manufacturers held the threat of withdrawal of their lines unless stocks of new lines were also laid in.

Secretary Hoover Outlines Aims in Commerce Department

THAT the Department of Commerce should in the widest sense be a department of service to the commerce and industry of the country is the attitude of Herbert Hoover, the new Secretary of that department, in a public statement made on March 11. He does not consider it a department for the regulation of trade and industry. In order to do service to the greatest advantage he wishes to establish a wider and better organized co-operation with the trade and commercial associations, and will in a short time present some plans to this end. He desires to see efforts to push this country's foreign commerce more closely related to its industries.

"In the long run," says Secretary Hoover, "we may as well realize that we must face a lower standard of living in Europe for many years ahead. The production cost of her people will in consequence be lower than even before the war. If we meet this competition and still maintain our high standards of living we shall have to work harder, we shall have to eliminate waste, we shall need still further to improve our processes, our labor relationship and business methods.

"There are some of these directions—possible improvements and elimination of our great waste in labor, in material, in power and a host of other directions—in which I believe this department can secure some results by co-operation with the different trades and industries.

It is generally known that the Secretary is a firm believer in standardization of products, materials, methods, etc., as an economic necessity. In discussing foreign trade Secretary Hoover outlined the tendency in European nations to mobilize definitely the export and in some cases the import trade for militant commercial invasion. In some instances this is being done under government direction and organization and often even with government finance; in others it is being carried out by government leadership and suggestion. These are some of the conditions which American manufacturers must meet.

Pole-Line Hardware Consumers Not Covering Spring Needs

A SURVEY of the pole-line hardware market reveals the fact that utilities are not anticipating their spring needs. Some business has been placed, but the market on the whole is quiet. Restricted buying power with both power companies and electric railways is largely blamed by manufacturers for the light demand. It is expected, however, that by the end of next month sales should have picked up considerably.

Producers are continuing production of hardware, though in some cases reserve supplies are not large. One company, in fact, reports being still as long as three to four weeks behind in its line hardware department. In general, however, stocks are more than ample for present needs, and on reasonable size orders consumers may count on stock to one-week shipments.

Prices have not changed since general reductions of from 5 to 7½ per cent were put into effect by leading manufacturers about the middle of February. This is the second general cut that has occurred, as decreases of from 5 to 15 per cent were made during December and early January. In some quarters the view is heard that present quotations have about reached bottom. Prices quoted by a representative producer f.o.b. Chicago are as follows: Carriage bolts, ⅜ in. x 4½ in., $2.31 per 100; crossarm braces, 1¼ in. x ¼ in. x 28 in., $14.42 per 100; lag screws, ½ in. x 4 in., $4.02 per 100; machine bolts, ⅝ in. x 12 in., $10.65 per 100. New York prices are about 20 per cent higher than the above to allow for freight and warehouse charges.

The Metal Market Situation

CONDITIONS in the copper market remain unchanged. It is strictly a buyers' market with no improvement in demand. Producers of finished brass and bronze goods have again cut prices, but there is not enough demand for those products to warrant much buying of copper. Foreign orders are slight too, and though production is being curtailed in an effort to prevent stocks of copper piling up, output is still greater than consumption, it seems.

Large producers hold aloof with nominal quotations of 12.75 to 13 cents for March delivery, but small interests are actively competing for business at prices of 12 to 12.25 cents for prompt shipment. Only small quantities are obtainable at these prices, however. Small lots can also be obtained at 12.25 cents delivered for April shipments and 12.50 cents for June. The outside market is inactive, with prices fractionally higher than the above.

The market for lead is quiet but steady. There is very little movement of zinc, the price of spot having receded in consumer demand.

NEW YORK METAL MARKET PRICE

	March 9, 1921	March 15, 1921
Copper	£ s d	£ s d
London, standard spot	65 10 0	67 0 0
	Cents per Pound	Cents per Pound
Prime Lake	12 50	12 25 12.50
Electrolytic	12 25	12 00 – 12.25
Casting	12 00	11 75
Wirebase	15 00	15 00
Lead, trust price	4 00	4 00
Antimony	5 20	5 50
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 30	5 27½
Tin	27 50	28 50
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 25 10 50	10 00 10 25
Brass, heavy	6 00 6 50	5 75 6 00
Brass, light	4 00 4 25	4 00 4 25
Lead, heavy	3 25 3 50	3 25 3 50
Zinc, old scrap	2 87½ 3 00	2 87½ 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE electrical industry is marking time and nothing more. In virtually every section of the country trade continues on the same fairly quiet level as heretofore. Until a return of general business, and more especially until improvement in the volume of building work is noted, this condition bids fair to continue. The electrical industry cannot lead the way; it must follow prosperity in other lines of business. Just now it is suffering from a wave of cautious retrenchment, of "holding back for the other fellow."

This is seen all the way up the line as not only the ultimate consumer and the retailer are buying cautiously but also jobbers as a rule are ordering only for current needs, and this phase is in turn passed on to the manufacturer. Stocks are being held low, but are more than ample for current needs in nearly every line.

NEW YORK

The trade as a whole is further postponing the date by which a return of good business is expected. During the early winter the President's inauguration was quite generally looked forward to as the turning point, but as yet there is little or no change in week-to-week conditions. Several jobbers now state that they do not look for a return of normal business before midsummer, but it appears that one man's guess is as good as another's.

The present market for electrical material is quiet on the whole. The one thing apparently needed above all others to act as a stimulus to buying is lacking as yet, and that is a large volume of building construction. Until normal construction work is again resumed demand for staple supply items will probably remain light as at present. Retailers are very cautious in their buying, partly because of money tightness and poor demand and in some instances because of expectations of somewhat lower prices in certain lines. Jobbers in turn are ordering very conservatively, not more than for current needs. Fan buying of jobbers from this section, it appears, will be light this season. Porcelain prices were revised by manufacturers the first week in March, the reduction on knobs, tubes and cleats amounting to about 17 per cent.

Fans.—Since price reductions of about 10 per cent were announced by manufacturers the latter part of February many jobbers have placed orders, but the buying in nearly all cases is on a very conservative basis. Stocks held over are large.

Sockets.—With pulls listing at 60 cents, keys 33 cents and keyless 30 cents, jobbers are giving a discount of from 15 to 18 per cent in standard-package quantities. Demand is slow.

Conduit.—Prices cover a wide range and buyers generally resort to shopping. On 2,500 ft. of ½-in. black as low as $67.50, with intermediate prices up to slightly over $79, was quoted this week, and for the same size in galvanized the price ranged from $72.60 to $84.50. The lower level seems more nearly representative of the market, however. Demand is slight and stocks fair.

Outlet Boxes.—In quantities of 100 the current discount quoted by jobbers holds about 29 to 30 per cent on black boxes and 21 to 25 per cent on galvanized. Stocks are more than ample for the light demand.

Flexible Armored Conductor.—No. 14, two-wire, double-strip, in 1,000-ft. lots, is worth from $63 to $65. Stocks are fairly low and demand small.

Non-Metallic Flexible Conduit.—Demand is light and stocks vary but are more than adequate. In quantities of 1,000 ft. the average discount quoted by jobbers on $\frac{3}{8}$-in. and ½-in. sizes ranges around 47 to 50 per cent, though 40 per cent is quoted by one representative house.

Flush Switches.—The call for this line is very light, and consequently jobbers are not carrying many in stock.

Rubber-Covered Wire.—Demand continues poor, but most jobbers have reduced stocks to fairly average levels. In 10,000-ft. lots No. 14 is quoted at from $7.50 to $8.50 per 1,000 ft. Prices are more or less readily shaded and buyers shop around a good deal.

Porcelain.—A revision of prices is announced by several manufacturers, effective in some cases March 3 and in others March 5. The reduction on knobs, tubes and cleats in a representative instance amounts to 16⅔ per cent. "Nail-it" knobs list for $70 per 1,000, 3-in. x $\frac{5}{16}$-in. tubes at $23 per 1,000, and two-wire unglazed cleats $52 per 1,000.

CHICAGO

Locally the retail trade reflects a feeling of gloom owing to the difficulty with which stocks are moved. Investigation in a score of stores fails to bear out the statement that the retailers are refusing to bear their portion of the burden of stock carrying, leaving it all to the jobber and manufacturer. All sorts of stock conditions are found. The great majority of dealers, however, are found to have adequate stocks and to be reordering as heavily as prudence will permit.

General business conditions are improving, very slowly but steadily. Every day sees the inception of a number of apartment or residence projects, and more actual construction of this sort is under way now than there has been for five years. Contractors have notified the Building Trades Council that at the expiration of existing agreements on May 1 there will be a reduction in skilled labor from $1.25 to $1 per hour or no agreement will be signed, which means open shop.

Bare Copper Wire.—Sales, lively on low prices a short time ago, are now quieter owing to uncertainty of the price future. Quotations are unsatisfactory but quantity transactions at around 15 cents are admitted as possible. It is probable that 15¾ cents and 16¼ cents is a proper reflection of the present market on No. 8 in 1,000-lb. lots.

Insulated Wire.—Base on triple-braid weatherproof has been reduced to 18 cents, which makes the quotation on No. 6 triple-braid 19 cents per pound in 1,000-lb. lots. This price is subject to variation, depending on the needs of buyer and seller. Owing to the apparent possibility of even lower prices, buying has fallen off in the last week. No. 14 rubber-covered is quoted at $7.75 and $7.85 per 1,000 ft.

Poles.—Business is seasonably quiet, and it is a question as to whether it is going to improve very much with the advent of the construction season. Buyers believe that lowered labor cost should bring lower prices, while all producing interests maintain that they are as low as they are going to be.

Heating Appliances.—Great quiet is reported by dealers, jobbers and makers. No recent price changes are noted. A small amount of routine buying is being done by the public, but not enough to cause any strength in the trade.

Hollow Ware.—The buying public is freely expressing its opinion that prices are too high and sales by retailers are at a minimum. The employment situation, which is acute, undoubtedly is curtailing business in this class of material.

Washing Machines.—A canvass of the retail situation develops the fact that more washing machines are being sold than all other varieties of appliances put together. Installment payments are a great factor in this. Less price cutting is reported, and almost no complaint is made by the public in regard to price.

BOSTON

Increased activity in electrical supplies for automobiles and easier prices on porcelain products, weatherproof and bare copper wire and rigid conduit were features of the Boston market at the beginning of this week. Inquiries show a healthier tone as regards motors, and efforts to start building construction held up by strikes marked the week just closed. The indications are that conditions will improve considerably in the building trade through at least partial resumption of work upon the employers' terms in the near future. Jobbers' stocks are not being increased much and are equal to most demands. Collections are poor. Except in insulators deliveries appear to be thoroughly satisfactory. In industrial circles the weeding out of inefficient employees continues to liquidate the labor situation.

Wire.—Rubber-covered wire holds firm around $8 per 1,000 ft. in 5,000-ft. lots, weatherproof base is off to 17 cents, and bare base has slumped to 16 cents, with good stocks and light demand.

Rigid Conduit.—Boston jobbers are quoting pipe in all sizes, black and galvanized, on a two-column price classification. On 5,000-lb. lots and less the former 5,000-lb. rate applies, and above 5,000 lb. the old carload rate is quoted. This results in reductions estimated between 10 and 20 per cent and is expected to stimulate some business.

Motors.—Inquiries are increasing somewhat, and a revival of proposition work is yielding encouragement to a rather drab market. Competition is very keen for business, and large stocks are in hand. Prices are steady, considering the pressure upon agencies for more stocks.

Non-Metallic Flexible Conduit.—In 5,000-ft. lots the $\frac{3}{32}$-in. size is selling at $22 per 1,000 ft. and the $\frac{5}{16}$-in. size at $24. A dull market is evident, with heavy stocks.

Ranges.—Manufacturing for factory stock continues in anticipation of active spring business. Prices are steady.

Radiators.—Sales are moderate with excellent factory deliveries and good prospects for active demand with the closing of the furnace-heating season. Steady prices prevail.

Starting and Lighting Sets.—Trade is brisk, with good stocks and firm prices. Many cars are being put into service on account of the mild weather and unusually good road conditions prevailing.

Porcelain Insulating Material.—Readjusted price schedules yielding reductions of about 10 per cent are now in effect. The demand is light. "Nail-it" knobs are steady at $27 per 1,000 in barrel lots. On Monday 3-in. tubes were selling at $9.50 per 1,000 in barrel lots, with plenty in hand.

Appliances.—Reduced prices on the less modern designs are bearing fruit in sustained buying, notably in flatirons, table lamps and light heating equipment.

Flexible Armored Conductor.—No. 14 double-strip brought $60 in 2,500-lb. lots Monday. Larger quantities showed some weakness in prices.

ATLANTA

The strike of employees of the Atlanta, Birmingham & Atlantic Railway has prevented either freight or passenger trains from being operated over that road for two weeks. Approximately forty towns in southern Georgia and southern Alabama are thus deprived of all railway communication, with a consequent demoralization of business in that section. Unless train service is resumed very soon heavy losses in the produce and fruit lines will result, it is said, as this road serves one of the largest producing sections in the district.

The voters of Atlanta passed favorably on the issue of $3,850,000 in bonds covering the improvements to waterworks and sewerage system and the construction of schools and a viaduct. This will, of course, serve to sustain local building activities throughout the year, especially as a number of large school buildings are contemplated. Jobbers report that their business is still quiet. Most of the orders received are small in size and are coming from the medium-size contracting firms, while inquiries of industrial plants have fallen off in the past two weeks. Just now municipalities and public utilities are the heavy buyers.

Cross-Arms.—These are moving better than for the last six months, the principal demand being for the standard arm. Stocks are good and shipments satisfactory.

Rigid Conduit.—A price reduction of approximately 5 per cent is to be noted. This line continues to move fairly well; galvanized stocks are reported rather low, but black pipe is on hand in sufficient quantities for all purposes, except in one or two of the more popular sizes.

Safety Switches.—A wider application of the underwriters' ruling is keeping up the demand, and jobbers report sales as very satisfactory. No reductions in price are yet noted, though the trade feels that they are in order. Stocks are in fair condition with shipments three to five weeks.

Insulators.—There is little or no demand for the 2,300-volt porcelain type, but the glass insulators are moving steadily. Stocks of the glass type are in excellent shape, but the porcelain are low. Prices, glass, $9 per 100; porcelain, $20 per 100.

Pole-Line Hardware.—A price reduction of 15 per cent was announced last week, affecting all classes of hardware. As with insulators and cross-arms, there is a heavy demand, particularly for braces and through-bolts. Stocks are reported in fair condition.

Wire.—Little change in price is noted, weatherproof being on a 17-cent base and rubber-covered on a 16-cent base. The former is sluggish, but popular sizes of rubber-covered are in fair demand.

Flexible Armored Conductor.—The heavy price reduction seems to have brought flexible conductor back to an active market, and jobbers report the receipt of good orders. Local stocks are in good condition, and No. 14, two-wire, is offered at $55 per 1,000 ft.

Farm-Lighting Outfits.—Little or no activity is reported in this line, and the trade seems disposed to feel that there will be no movement of note until well toward the end of the summer or early fall. The rural population has no funds at the present time to purchase these plants.

ST. LOUIS

Business conditions not only with the electrical interests but also with industrials generally are making very gradual improvement. Business in this territory has been and is greatly hampered by the marked stagnation in the South, due almost entirely to the inability of the cotton growers to move their product at warrantable prices. The territory comprising states to the east, west and north of St. Louis is developing a healthy tendency toward normal demands. The agriculturists in this territory are able to move their farm products at more favorable prices than those in the South and trade is benefited accordingly. Power sales show a reduction over last year but have been virtually steady for the last few months. Several replacements of large isolated plants are reported.

No price changes worthy of note have occurred in the last week. Stocks generally are normal for the condition of business prevailing. Immediate shipment can be made on almost all items except insulators, for which sixty-day deliveries are still being quoted. Jobbers are becoming gradually more optimistic, but it is the general opinion that there can be no material change for the better in the electrical jobbing line for perhaps six months. Collections are still on a sixty-day basis and are giving no great concern.

No settlement has been reached between the building trades and the contractors on the matter of wage scales, and it is felt that there will be no marked increase in building until wages can be reduced.

Wire.—No. 6 rubber-covered is moving quite slowly because of the lack of industrial activity. The demand for No. 14 shows slight improvement. Prices are unchanged, No. 14 selling at $8.10 per 1,000 ft. in 5,000-ft. lots. Stocks are in excellent condition.

Lamp Cord.—This is one of the few items where it can

be said that normal demand obtains. Stock of jobbers is in good condition, as a rule monthly purchases being made to keep the stocks in line. No. 18 twisted silk sells at $23 to $24 per 1,000 ft. and No. 18 twisted cotton at $15.25.

Conduit.—A fair demand is reported for ½-in. black, but the demand for ¾-in. and larger is quite dull. Prices were reduced recently, ½-in. being quoted from $65 to $70 and the ¾-in., as a rule, from $95 to $98.

Flatirons.—Jobbers' stocks are reported to be about normal, but the stocks of some dealers for a while were heavy. Some price reductions were made by the dealers which to some extent stimulated the demand, until then rather dull.

Fans.—Considerable uncertainty is expressed as to the demand this summer for fans. Good-sized stocks are on hand from last summer, and it seems to be the tendency to await buying until the character of the summer is determined.

Lamps.—A good business in this line for this time of year is being experienced. Stocks are in good shape.

Knobs and Tubes.—The market in these items is competitive owing to heavy stocks in the hands of some jobbers, though other jobbers contend their stocks are in good shape. The demand is generally slow. "Nail-it" knobs are quoted at $23.80 per 1,000, and 3½-in. tubes at $9.20.

SAN FRANCISCO

At no time this year has there been serious delay in shipments of electrical material from the factories to the Coast, although these shipments have decreased in volume because of the completion of many outstanding orders, the decrease of building and the retrenchment policies of customers.

Boxes and Covers.—There has been a slight decrease in the selling prices of boxes and covers to electrical dealers, this decrease figuring about 5 per cent and resulting in standard-package selling at prices of approximately $23.60 per 100 on standard galvanized boxes for rigid conduit and $13.30 per 100 on the most popular covers. Stocks are good, but orders are rather spasmodic.

Motors.—The various Eastern factories have gradually cleaned up their back orders and are making quick deliveries. The sharp change in the character of these deliveries has resulted in several instances in piled-up jobbers' stocks, but in the majority of cases vigilant following has maintained the stocks in a proportionate manner. The volume of business continues very good, for although farmers have had a disappointing return for the last season on their crops, it is highly important for them to continue the future safety of those crops by the installation of efficient irrigation systems. New distributing lines have increased this business in the San Joaquin Valley, but the strike on the lines of the Great Western Power Company has resulted in a curtailment of business, in the Sacramento District especially.

Sewing Machines.—Lately the trend in sales in some sections has been toward a console type of machine, supplied complete with stand, at prices ranging from $110 to $150, which is about double the average prices on the portable machines. However, the portable machine is still the big seller. Sewing-machine motors have sharply dropped from $22.50 list to $18.50 list. This change was rather unexpected, and it is reported that several jobbers found themselves with rather heavy stocks at the old prices.

SEATTLE—PORTLAND

There seems to be considerable optimism apparent in the Northwest, particularly in the Puget Sound district, but manufacturing, constructional and sales activities up to date do not warrant this feeling. True, the lumber mills and logging camps are reopening slowly, construction work is picking up gradually, especially along residence building lines, and certain lines of electrical material and appliances have started moving, but the combined scale of these activities is light. The employment situation is easing gradually with resumption of lumbering and logging operations and with the call from truck gardens, fruit ranches and wheat farms for labor becoming stronger. Wage cuts are being made over the entire Northwest, particularly in lumbering and logging lines, and further decreases in an effort to reduce manufacturing costs are contemplated. No further reductions in wages of building mechanics and laborers are anticipated.

Manufacturers in the Northwest, particularly in the Portland field, report business continuing quiet. Portland jobbers, as well as those in Seattle, say that business is keeping up in fair shape, although it still consists of short orders for the most part. Quotations on pole-line material continue active and another slight price drop was noted in the past week. There is very little contracting business at present. Dealers in good locations, especially in Portland, are having a fair amount of business, some reporting a slight increase over the past few weeks. There is considerable activity in residence building, and prospects for pole-line construction and erection of large buildings of various kinds have not been so good for years. However, to offset this in Portland the unions have refused to accept the wage reduction proposed by building contractors, and contractors have announced that on the expiration of the present agreement on May 1 they will refuse to continue paying present wage scales.

Knobs, Tubes and Cleats.—Generally speaking, these stocks are in good supply, demand is increasing slightly and replacements are easy to obtain.

Ironing Machines.—Considerable interest has been noted, but prices are hindering a movement of any size. Stocks are ample.

Vacuum Cleaners.—Dealers report increased interest, and the more optimistic are of the opinion that this spring's sales will be comparable with or even better than last year. Uncertainty and lack of employment are holding back sales of these and other domestic appliances.

Hollow Ware.—Both retailers and dealers have large stocks on hand; movement is light.

SALT LAKE CITY—DENVER

The outstanding feature of present conditions in electrical merchandising is the determined effort of jobbers and dealers to revive the old-time demand for their wares. The consuming public continues to sit tight in the hope of lower prices. Only the extremely useful and practical kinds of electrical items seem to tempt investment. With the approach of housecleaning time renewed interest is shown in cleaning devices and the business in vacuum cleaners promises to be very satisfactory. Washer campaigns are also going over with fair success. One energetic dealer has gone the limit of advertising "a washer in your home for 25 cents down."

Non-employment is still a factor to be reckoned with. It reflects itself in a reduced demand for many electrical necessities. Dealers who cater to the laboring class feel the pinch especially. Deliveries have not been better in months. Collections show little change, with possibly a slight tendency toward improvement.

Fans.—Jobbers are laboring diligently with their dealers to get them to stock early, and their efforts are not without results. It is believed, however, that little dealer interest will be shown before May. The consumer demands begin early in June. There is no dearth of stocks.

Lamps.—The active lamp season is somewhat on the wane. Empty sockets are pretty well filled and the lengthening days lessen interest in lighting. Stocks are both varied and plentiful.

Ranges.—The retail price remains at a point that makes buying almost prohibitive. Jobbers and dealers would welcome any change that would stimulate consumer interest. Power companies, however, are looking forward to an active summer and are stocking jobbers accordingly.

Panels and Switchboards.—With the slow resumption of building, orders for jobs are coming in. The trade has been virtually nil during the winter months. All kinds of construction materials are on hand in plentiful amounts.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Engineers Establish Department for Apparatus Repair

George F. Motter's Sons, York, Pa., steam and electrical engineers, has established a department for repairs to electric motors, generators, etc., including rewinding of armatures, rotors, rebuilding commutators, making new coils, etc. The construction department of the company follows industrial-plant wiring exclusively in the installation of power equipment and lamps.

Charles Cory Adds Industrial Equipment Department

Charles Cory & Son, Inc., 183-187 Varick Street, New York City, organized on Feb. 1 an industrial equipment department which will handle all the work of the firm in connection with power plants, mines, hydraulic stations and industrial plants. The Cory corporation, as one of the oldest manufacturers of marine electrical and mechanical signaling and communicating systems, fire-alarm systems and lighting equipment, through the aid of its industrial department intends to provide the same service in the commercial field as it now gives in the marine field. The new department is in the hands of L. E. Oneal.

Watts Company Moves Into Larger Quarters

The Watts Company, Philadelphia, has moved its offices from the Pennsylvania Building to 1723 Ludlow Street, where it has taken the entire building. This change was made necessary owing to the increase in business. The company is sales engineer for the Wilmot Engineering Company, manufacturer of the Keystone rivetless chain and bucket elevators and conveyors; the General Manufacturing & Conveyor Company, St. Louis, manufacturer of portable and belt conveyor, and the Allan Manufacturing & Welding Corporation, Buffalo, manufacturer of polyphase arc welding apparatus.

Contract Form Sought by Purchasing Agents' Association

The National Association of Purchasing Agents, 19 Park Place, New York City, in its efforts to make contracts safe and to find a solution of the cancelation evil, is co-operating with various trade, manufacturing and professional associations in the United States and Canada in an attempt to arrive at a co-operative contract form which it will be possible to standardize, according to Harry Botsford, assistant to the president. It is hoped that such a contract form, when universally accepted and established, will result in a crystallization of business opinion toward livng up to contractual obligations.

The plan is that each of the national commodity committees shall work out a contract form meeting with its specific needs. After these forms have been presented to the particular trade, manufacturing and professional organizations interested for suggestions and revisions, various commodity contracts are to be turned over to the Standardization committee for drawing up a basic standard form of contract which, it is hoped, will meet the need of every industry. In seeking a contract form that will be fair to and satisfy not only the buyer but also the seller the association is asking for wide co-operation.

Manufacturer Accumulates Large Stock of Line Hardware

The American Jobbers' Supply Company, Woolworth Building, New York City, reports that it is carrying one of the largest stocks of pole-line hardware at its Chicago factory in the history of the company. Immediate shipments of standard material are made on orders of any size. The company has accumulated this large surplus supply on the expectation of a good demand developing in the near future, and, in fact, sales in the East have increased to such an extent recently that business in that territory, it is stated, compares favorably with the best previous year. In the West and Middle West, however, demand is reported to be small. Central stations are said to account for the greater part of current buying.

Illumination Exhibits Appeal to Plant Executives

An analysis of the figures on attendance at the industrial lighting exhibit that is being shown throughout the country under the auspices of the Edison Lamp Works of the General Electric Company shows that since about the first of March of the 4,000 persons who were present in the twenty-five cities visited about 75 per cent were executives of industrial plants, including presidents, vice-presidents, secretaries, treasurers, purchasing agents and general superintendents.

Ten per cent were foremen, electricians and superintendents and 10 per cent, exclusive of the executives mentioned, were representatives of civic organizations. The remaining 5 per cent comprised architects, engineers, teachers, students, etc. Of course, contractors, dealers, central station men and jobbers' salesmen were in the number.

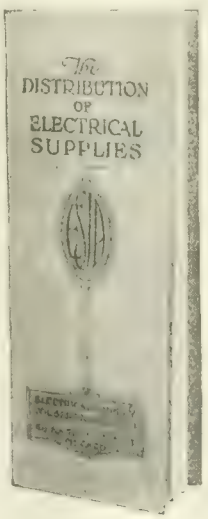
The point is that the exhibit apparently is reaching the principle industries in each city and fulfilling the educational plan laid out to stimulate better illumination as a means to fewer accidents, increased production and better quality of workmanship.

Advance Electric Completes Six New Agencies

Arrangements have been completed by the Advance Electric Company, St. Louis, Mo., for direct sales agencies for its motors, generators and motor applications with the Blake Electric Company, 1 Rowe's Wharf, Boston; D. J. Vogt, 10718 Amor Avenue, Cleveland; W. C. Fletcher, 2439 College Avenue, Indianapolis; R. R. Caskey, Conway Building, Chicago; W. P. Johnson, 8 North Sixth Street, Minneapolis, and W. I. Cheyney, 922-924 Sansom Street, Philadelphia. Contracts are also pending for New York, Cincinnati and other points.

The Jobber as a Link in the Distribution Chain

In the booklet "The Distribution of Electrical Supplies," part of the campaign of publicity launched by the Electrical Supply Jobbers' Association, 411 South Clinton Street, Chicago, the principal point which appears to be made is that the supply jobber is an indispensable link in the chain of economical distribution of electrical supplies. It is shown that he is headquarters in the service of supplies and that in good times or bad times he has been a stabilizer for the manufacturer and for the user of electrical equipment. In proportion with the extent of participation in the policy of distributing electrical goods through the electrical supply jobber and buying electrical goods from the electrical supply jobber will the efficiency and economy of distribution and purchase improve.



Amateur Radio Convention Just Closed in New York

Branching out into the field of general publicity, the Second District Amateur Radio Convention-Exhibition was held from March 16 to March 19 at the Pennsylvania Hotel in New York City. Realizing the growing interest in radio telephony as well as in radio telegraphy, the Second District Executive Radio Council has taken this opportunity of bringing the amateur public into the closest touch possible with the new developments in apparatus and in electrical wireless communication.

The amateur class has developed rap-

idly from the boy stage, with a good deal of homemade apparatus, to the business-man stage and a higher class of apparatus. Much of the interest in these directions has been in the satisfaction of a hobby and of a pastime which gave unlimited outlet to scientific investigations and thought. From this the field has broadened so that wireless is being used in increasing degree for market and crop reports, news reports and for transmitting operas, concerts, lectures, sermons, addresses, etc. It is in this way that the public is coming more closely in contact with the wireless field and is eager to keep up with the developments shown at the convention and exhibition.

Liberty Machine Organizes

The Liberty Machine Company, Wauwatosa, Wis., has recently been organized to take over the electrical fixture fittings business of the Liberty Foundry of Wauwatosa, owned by William J. Grede. The new company has added to its line of fixture fittings a new porch bracket and contemplates the addition of several other articles in the near future. The Liberty Foundry will continue to manufacture light gray-iron castings, specializing on work for the electrical trade.

Cabell & Irby Change from Retail to Wholesale

The Cabell-Irby Company, Jackson, Miss., recently organized with a capital stock of $100,000, will conduct a wholesale business in electrical supplies in Mississippi and the northern part of Louisiana. Stuart C. Irby and T. B. Cabell, the promoters of this enterprise, conducted a retail and construction business for nearly two years under the name Stuart C. Irby & Company. Mr. Cabell is president, Mr. Irby vice-president and R. O. Jones, Jr., secretary and treasurer.

Screw Thread Commission Makes Progress Report

A progress report of the National Screw Thread Commission has been summarized by H. W. Bearce, chairman. The commission, which was appointed in accordance with the act approved July 18, 1918 (H. R. 10,852), has had the full co-operation of engineering societies, standardization committees, engineers and manufacturers throughout the country, and it has been the desire of the committee to embody in its progress report the best of present-day American screw-thread practice.

As an outline of the work accomplished, fundamental definitions of screw-thread elements, etc., have been agreed upon; a standard form of thread has been adopted, the so-called U. S. or Sellers form; an adequate system of screw threads, consisting of a coarse-thread series and a fine-thread series has been adopted; four kinds of fit have been established, loose, medium, close and wrench fits, and an adequate system of gaging for inspecting has been worked out in detail. In addition, careful consideration was given to the question of tolerances.

The Bureau of Standards and also the superintendent of documents, Government Printing Office, receive applications for this progress report, now ready for distribution.

Florida Court Upholds Legality of Credit Association

An announcement from the National Electrical Credit Association reports a deliverance of the Supreme Court of Florida on the legality of a merchants' mutual credit protective association service. On the basis that the matter of extending credit is a large part of modern business, the decision reasons that merchants have a right to organize for their own protection and agree to report to each other the name of a person to whom credit has been extended and who has failed to pay his account and to agree that they will not extend credit.

The court cited from a decision rendered in the West a clause to the effect that "It is lawful and not libelous for one party to the agreement to report to the others the names of such of his customers as have become delinquent."

The Standard Electric Stove Company, Toledo, Ohio, has made Leon E. Moon, Inc., 1133 Broadway, New York City, its sales representative in New York, effective the latter part of February.

The Hopewell Insulation & Manufacturing Company, Hopewell, Va., announces that it is now represented in Chicago by the Midstates Engineering Company, Westminster Building, which company takes in the district of Ohio, Indiana, Illinois, Michigan, Missouri and Wisconsin.

The Under-Feed Stoker Company of America, Book Building, Detroit, has placed its Western selling agency with the Merkle Machinery Company, of Kansas City. This selling agency has branches in Omaha, Neb., and Tulsa, Okla., selling, designing and installing machinery for power and pumping plants. The Salt Lake City agency has been placed with N. L. Alison, 616 Newhouse Building. The company also will be represented in the Southern territory through Smith & Whitney, Southwestern Life Building, Dallas, Tex.

The Western Agencies Company, 285 Minna Street, San Francisco, has been appointed Pacific representative for the Bleadon-Dun Company, manufacturer in Chicago of electro-medical apparatus. This company's apparatus will be carried in stock at the Los Angeles, San Francisco and Seattle offices of the Western Agencies Company, which will sell to jobbers and assist both wholesalers and retailers in disposing of their stocks.

The North Coast Electric Company and the Northwest Utilitor Company, wholesale dealers in electrical machinery and supplies, are to house their Spokane branches in remodeled quarters at W. 330-36 Sprague Avenue. Main offices of the company are in Seattle. The Spokane branch will maintain a stock of more than $50,000 worth of machinery. Albert Reeves will be the Spokane manager of the North Coast Electric Company.

The Steelduct Company, manufacturer of rigid conduit, Youngstown, Ohio, has appointed two new sales agents. The Wood & Lane Company, St. Louis, will cover the states of Missouri, Kansas, Arkansas, Oklahoma and Tennessee, while the McNair Electric Sales Company, Detroit, will cover Michigan.

The Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, announces the removal of its Pittsburgh office from 1208 Farmers' Bank Building to 718 Bessemer Building, Sixth Street and Duquesne Way.

The American Atmos Corporation, Pittsburgh, manufacturer of the Atmos and Dreager oxygen resuscitation and breathing apparatus, announces the appointment of George Oliver Smith as vice-president and chief engineer.

The Play-O-Lite Company, formerly of Buffalo, has moved to Worcester, Mass., and will establish a plant in the near future at 215 Front Street to manufacture electric lamps. The company has incorporated under the laws of Massachusetts with a capital stock of $15,000. Allen Frazer, sales manager of the Wickwire-Spencer Steel Corporation, is president.

The Dudley Electric & Machine Company, East Fayette Street, Uniontown, Pa., lost a portion of its plant by fire on Feb. 22. The damage is estimated at $50,000.

The Keystone Hair Insulator Company, 1243 Spring Garden Avenue, Pittsburgh, manufacturer of electrical equipment, is reported to be receiving bids for the erection of a three-story building, 70 ft. x 100 ft., in the vicinity of its present plant.

The Eureka Sales Company, Indianapolis, Ind., dealer in electrical labor-saving devices, etc., has moved into its new three-story and basement building at 34 South Meriden Street. The company will consolidate its wholesale and retail departments with its warehouse.

The Sterling Storage Battery Company, Schenectady, N. Y., has filed notice of reorganization with an active capital of $55,000 and $50,000 in preferred stock. The company manufactures electrical equipment.

The Pruitt-Deming Manufacturing Company, Edinburgh, Ind., recently organized, has completed plans to establish a new plant for the manufacture of storage-battery equipment.

The General Electric Company, Schenectady, N. Y., has completed plans for the construction of its proposed new plant at New Albany, Ind., for the manufacture of electric lamps, to cost about $1,000,000. It will be operated in the name of the National Lamps Works division of the company and will give employment to about 600 operatives.

Foreign Trade Notes

PROPOSED HYDRO-ELECTRIC DEVELOPMENTS IN NETHERLANDS EAST INDIES.—There are indications, according to the London *Engineer*, that great changes will be made in the methods of supplying electricity for light and power in the Netherlands East Indies. Investigations are now under way to determine the possibility of utilizing the water power of the various rivers with a view to equipping for electrical operation the railway systems which are in operation as well as those projected. Housing and building schemes in every portion of the large towns and seaports in Java and Sumatra call for large supplies of electrical apparatus of various types.

ELECTRIFICATION OF FINNISH RAILWAYS PROPOSED.—The Director-General of the Finnish Railways, according to *Electrical Industries*, has announced that steps have been taken to equip the Finnish state railways for electrical operation and that plans and estimates for the work will be prepared during the year.

ELECTRICITY FOR WAIROA, NEW ZEALAND.—The ratepayers of the Wairoa electric power district, according to the *New Zealand Gazette*, have approved the proposal of the Wairoa Electric Power Board to borrow the sum of £100,000 for the following purposes: (1) Erecting main electric transmission and feeder lines between Waikaremoana and the borough of Wairoa, including substations and equipments, to cost £35,000; (2) erecting subsidiary transmission lines, feeders and substations from the main transmission line to outlying districts in Wairoa County, £60,000; (3) purchase of electric motors, equipment, etc., £5,000.

MEXICAN ELECTRIC SYSTEM TAKEN OVER BY CANADIAN COMPANY.—A report from Consul Stewart to the Bureau of Foreign and Domestic Commerce states that the Parral Electric & Telephone Company, an American firm, which operated the electric and telephone systems in Parral, Chihuahua, Mexico, has been acquired by the Compañia Agricola y de Fuerza Electrica del Rio Conchos, S. A., a Canadian company. For a number of years the latter company furnished energy to the Parral company, but now it proposes to distribute electricity direct to the consumer. It took over the system on Jan. 1 and will install a practically new system.

ADDITIONAL CAPITAL FOR ELECTRIC COMPANIES IN GERMANY.—Forty-four electric companies in Germany raised 739,000,000 marks in additional capital stock, while eight new companies issued shares amounting to 28,000,000 marks. The German General Electric Company is asking the public for 300,000,000 marks, bringing its capital to 850,000,000 marks, larger than that of any other company. Krupps' 250,000,000 issue was greatly oversubscribed. The total new capital subscribed last year, 8,202,000 marks, compares with total value of all existing shares in 1913 of 15,500,000,000 marks.

ELECTRIC LIGHT AND POWER PLANT IN PARAGUAY.—A bill has been presented to the Paraguayan Congress authorizing the municipality of Encarnacion to call for bids for electric light and power plants.

ELECTRICALLY LIGHTED TRAINS IN SIBERIA.—The Chinese Eastern Railway is planning to run electrically lighted trains between Harbin and Vladivostok. When improvements are completed on this line the service between Harbin and Manchuli will be improved. The belief is expressed that conditions in Siberia are more stabilized and that the resumption of trade relations will come soon.

ELECTRICAL NEEDS IN SPAIN.—According to a publication of the Guaranty Trust Company of New York, Spain is well provided with foreign goods, particularly of American and German origin, and general buying has decreased. Prospects for future sales depend more than ever upon the quality and prices of articles offered. There is a demand, however, for electrotechnical goods, motors and turbines.

NEW ELECTRIC PLANT FOR KARACHI, INDIA.—The Karachi Electric Supply Corporation, Ltd., Consul Richardson reports, is to build a new and larger central generating plant, instead of an extension as originally planned. The proposed station will be equipped with steam-driven turbo-alternators of 1,000 kw. each. The company plans to supply electricity throughout the whole municipal area of Karachi and [illegible] within a radius of 20 miles from Karachi.

ELECTRICAL INVESTMENTS IN JAPAN IN 1920.—Investment in new companies in Japan during 1920 totaled 130,000,000 yen in electrical enterprises, 59,600,000 yen in manufactories, 27,700,000 yen in railways and electric traction roads, 25,000,000 yen in banks and 5,200,000 yen in mining, according to the Guaranty Trust Company of New York. The value of the yen a year ago was 17.1 cents and par is 49.8 cents; present value, 48.4 cents.

New Apparatus and Publications

LIGHTING GLASSWARE.—The Jefferson Glass Company, Follansbee, W. Va., has issued photograph No. 35, showing approximately 300 pieces of glassware taken from its catalog. Photo No. 36, showing still more, is in process of issuance.

FIXTURE CHAIN.—The National Chain Company, College Point, L. I., has issued a folder on its lighting fixture chains.

LUBRICATION.—"Lubrication of Steam Turbines," Part 1, is the subject of the February issue of *Lubrication*, published by the Texas Company, 17 Battery Place, New York City.

CONSTRUCTION.—"Achievement" is the caption of a folder being distributed by the J. G. White Engineering Corporation, 43 Exchange Place, New York City, giving information on power developments, etc.

PAPER-MILL DRIVE.—A new type of sectionalized motor drive for paper machines has recently been developed by the General Electric Company.

MOTOR CONNECTOR.—The Bryant Electric Company, Bridgeport, Conn., has brought out a midget motor connector for use on motor-driven socket devices.

CONTROL.—The General Electric Company has developed new types of semi-magnetic and full magnetic control for alternating-current elevator motors.

INDUSTRIAL TRUCKS.—The Baker R & L Company, Cleveland, has developed a duplex compensating suspension for its industrial trucks and tractors.

AMMETER.—The Western Electro-Mechanical Company, Oakland, Cal., has put out its Knopp multi-range alternating-current ammeter for capacity up to 200 amp.

SWITCHES.—In bulletin No. 16-22, Harvey Hubbell, Inc., Bridgeport, Conn., describes the line of toggle flush switches equipped with adjustable aligning lugs and plates.

REDUCING WASHER.—The Safety Electric Products Company, Inc., Los Angeles, has a new reducing washer for conduit and box work.

KNOCKOUT SEAL.—A new knockout seal has been developed by the Safety Electric Products Company, Inc., Los Angeles.

LIGHTING FIXTURE PARTS.—The Crescent Brass Products Company, 8410 Lake Avenue, Cleveland, is distributing a catalog covering its lighting fixture parts.

FEED-WATER FILTER.—The Griscom-Russell Company, 90 West Street, New York City, has issued bulletin No. 615, describing the G-R multiscreen filter, a redesign of the Reilly water filter and grease extractor.

INDUCTION MOTORS AND FREQUENCY CHANGERS.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 41,521A, describing its high-speed motors and frequency changers.

MAGNETIC PULLEYS.—The Dings Magnetic Separator Company, Milwaukee, is distributing a leaflet describing its magnetic pulley for removing iron and steel from coal.

PUMPING EQUIPMENT.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued a catalog describing the Goulds "Autowater" system, electrically-driven pumps, etc. The company is also circulating a small booklet giving instructions for the installation, operation and care of Goulds "Hi-Speed" pumps.

WASHING MACHINES.—The White Lily Manufacturing Company, Davenport, Iowa, has issued a catalog describing "The White Line" washing machines.

ELECTRICAL EQUIPMENT FOR BRIDGES.—Bulletin No. 48,034, issued by the General Electric Company, covers its electrical equipment for movable highway and railway bridges.

CONNECTOR PLUG.—The Ideal Electric Manufacturing Company, 42 Walnut Street, Newark, N. J., is distributing a four-page leaflet describing its "Attachall" plug for irons, toasters, stoves, percolators, etc.

INDICATORS AND GAGES.—The Bacharach Industrial Instrument Company, Homewood Station, Pittsburgh, is distributing pamphlet M, covering its engine indicators (Maihak type). Bulletin G describes its "Easy Read" manometers and gages.

PORTABLE INSTRUMENTS.—The Westinghouse Electric and Manufacturing Company is distributing leaflet No. A3501, describing its type PX portable instruments for general testing purposes.

DESIGNS FOR BOILER PLANT.—E. W. Clark & Company Management Corporation, Huntington Bank Building, Columbus, Ohio, is distributing booklet A, showing designs of unit boiler plants.

SAFETY, SANITATION AND WELFARE.—The United States Steel Corporation, Bureau of Safety, Sanitation and Welfare, 71 Broadway, New York City, has issued bulletin No. 8 on this work.

New Companies

THE AGLOW SALES COMPANY, 671 Third Avenue, New York City, has been organized by Harry and Frank Aglow, the founders of the Artfibre Products Company, which later changed its name to the Fibreduro Corporation. Temporary quarters have been established at the above address by the new company, and it will cover the field in fiber compositions, metal lighting fixtures, art and leaded glass and silk shades.

THE PAOLI WATER & LIGHT COMPANY, Paoli, Ind., has been incorporated with a capital stock of $75,000. The directors are Raymond Stout, C. C. Johnson and R. M. Cass.

THE C. D. ELECTRIC COMPANY, Philadelphia, has been incorporated with a capital stock of $5,000 by F. W. Woodcock, C. A. McClure and others.

THE TINKER BROTHERS ELECTRIC COMPANY, Painesville, Ohio, has been incorporated by C. H. and M. L. Tinker and A. J. Few. The company is capitalized at $25,000.

THE ROCKFORD POWER MACHINERY COMPANY, Rockford, Ill., has been incorporated by Ray Brown, Charles B. Joyce and Perry C. Brown, 706 Seventh Street, with a capital stock of $35,000. The company proposes to manufacture electric winding machinery.

THE PROGRESSIVE ELECTRIC & ENGINEERING COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $100,000 by H. and E. J. Flesher, M. L. Dilley, E. Horvath and H. Bolotin.

THE NOCATEE ICE & POWER COMPANY, Nocatee, Fla., has been incorporated with a capital stock of $5,000 by F. R. McConnell, C. F. Walker and H. T. Davis.

THE WHEATON LIGHT, ICE & COLD STORAGE COMPANY, Wheaton, Mo., has been incorporated with a capital stock of $40,000. W. A. Davidson is interested in the company.

THE CONNELLY SPRINGS LIGHT & POWER COMPANY, Connelly Springs, N. C., has been incorporated with a capital stock of $25,000 by R. R. Ennis, W. J. Davis and A. C. Page.

THE GLOBE CODE-STANDARD ELECTRIC COMPANY, Hamilton, Ont., has been incorporated by George W. Harper, Roy W. Baxter, Frederick J. Christmas and others. The company is capitalized at $40,000 and proposes to manufacture electric switches, etc.

THE INTERCOURSE (PA.) ELECTRIC COMPANY has been incorporated with a capital stock of $65,000 and has acquired the property and holdings of the Intercourse Electric Light, Heat & Power Company, the Paradise Electrical Company, the Salisbury Electrical Company and the East Lampeter Electrical Company. Enos L. Zimmerman is general manager.

THE UNITED ELECTRIC SERVICE COMPANY, Springfield, Mass., has been incorporated by Edward A. Higney, Palmer, Mass.; John G. Waddell and Charles J. Weston, Springfield. The company is capitalized at $100,000 and proposes to manufacture electrical appliances and equipment.

THE ELECTRIC CHEMICAL LABORATORIES, 527 Gaither Building, Baltimore, Md., has been incorporated with a capital stock of $10,000 by William Hardy, Herman M. North and Samuel H. Reed.

THE REFRACTORY PRODUCTS COMPANY, Fredericksburg, Va., has been incorporated with a capital stock of $300,000 to manufacture insulating material. The officers are: W. S. Quigley, president; L. E. Turk, treasurer, both of New York City and T. M. Cavin, secretary.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 22, 1921)

1,369,353. METHOD OF MAKING GRID PLATES; Paul B. Rabe, Chicago, Ill. App. filed April 30, 1919. Apertures and paste-receiving devices are formed by a single punching.

1,369,360. METHOD OF WELDING ELECTRICALLY SHEET-ZINC LAP SEAMS; Edmund Schroder, Berlin, Germany. App. filed Jan. 13, 1917. Resistance welding process.

1,369,403. TESTING APPARATUS; Charles S. Demarest and Hugh F. Shoffstall, Brooklyn, N. Y. App. filed March 19, 1919. For telephone, light and power circuits.

1,369,407. RHEOSTAT; Frederick Diehl, Elizabeth, N. J. App. filed Oct. 2, 1917. Variable, wire-wound.

1,369,408. COMMUTATOR AND COMMUTATOR BAR; Frederick Diehl, Elizabeth, N. J. App. filed April 30, 1918. Iron and copper segment.

1,369,457. ELECTRO-IONIC SYSTEM OF CONTROL AND REGULATION; Frederich W. Meyer, Milwaukee, Wis. App. filed March 22, 1919. Effects of cascade arrangement obtained by a single valve.

1,369,475. IMMERSIBLE HEATING UNIT; Louis J. Schneider, Milwaukee, Wis. App. filed May 11, 1920. Circuit automatically completed when device is immersed.

1,369,516. MAGNETIC SEPARATOR; John P. Bethke, Milwaukee, Wis. App. filed Nov. 5, 1917. Magnetic pulley.

1,369,564. FLASHLIGHT; Frank W. Slady, Bridgeport, Conn. App. filed June 11, 1919. Improved switch.

1,369,578. ELECTRIC FURNACE; Max R. Trembour, Troy, N. Y. App. filed Oct. 1, 1919. Conducting hearth.

1,369,589. ELBOW FITTING FOR ELECTRIC INSTALLATIONS; Wheeler H. Vibber, New London, Conn. App. filed Dec. 2, 1919. For pipe conduit.

1,369,594. IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Robert A. Williams, Llanwnda, near Carnarvon, Wales. App. filed Sept. 9, 1920. No rotating coils.

1,369,601. HIGH-FREQUENCY ALTERNATOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 4, 1918. Improved rotor.

1,369,630. SANITARY MOUTHPIECE COVER; Harry V. Dempster, Minneapolis, Minn. App. filed March 15, 1920. For telephone.

1,369,635. ELECTRICAL CONNECTOR; Harry A. Douglas, Bronson, Mich. App. filed Feb. 19, 1919. For connecting incandescent electric lamps.

1,369,644. SAFETY LAMP; Frank T. Forster, Pittsfield, Mass. App. filed June 7, 1917. For use in mines and explosive factories.

1,369,645. FACILE ASSEMBLY FOR LAMP SOCKETS; Edgar H. Freeman, Trenton, N. J. App. filed Oct. 21, 1916.

1,369,680. BANK CONTACT; Frank A. Lundquist, Chicago, Ill. App. filed July 19, 1918. Automatic telephone exchanges.

1,369,702. ELECTRIC HEATING SYSTEM; Jose A. Oca-Balda, New York, N. Y. App. filed April 12, 1920. Radiator.

1,369,714. ELECTRIC FIXATION OF GASES; George T. Southgate, East Orange, N. J. App. filed April 11, 1918. Fixation of atmospheric nitrogen.

1,369,715. TIRE-WRAPPING MACHINE; Claus Spreckles, San Diego, Cal. App. filed Feb. 28, 1918. For wrapping pneumatic tires.

(Issued March 1, 1921)

1,369,765. POLE AND METHOD OF CONSTRUCTING SAME; Robert L. Alexander, West Allis, Wis. App. filed Aug. 28, 1918. For large alternating-current generators.

1,369,781. SIGNALING SYSTEM; Theodore W. Case, Scipio, N. Y. App. filed Feb. 20, 1918. For detecting visible and invisible light rays.

1,369,796. TROLLEY POLE; Charles S. Essex, Pomeroy, Ohio. App. filed May 2, 1917. For train locomotives.

1,369,805. SECRET-COMMUNICATION SYSTEM; Baxter P. Hamilton, Brooklyn, N. Y. App. filed Dec. 27, 1919. For insuring secrecy.

1,369,813. PRIMARY CELL; Park B. Hyde, East Orange, N. J. App. filed March 18, 1919. Caustic alkali as electrolyte.

1,369,863. GOVERNOR; William M. White, Milwaukee, Wis. App. filed Sept. 15, 1917. Speed governor for generators.

1,369,892. LIGHTING APPARATUS; Ellsworth A. Hawthorne, Bridgeport, Conn. App. filed April 6, 1918. Portable dry-battery lamp.

1,369,900. ELECTRIC LIQUID HEATER; Barnett W. Macy, Jacksonville, Fla. App. filed Jan. 5, 1920. Coil heats pipe.

1,369,931. STORAGE BATTERY; Harry McCreary, Youngstown, Ohio. App. filed May 10, 1920. Used in automobiles.

1,369,935. HOT-AIR SYRINGE; Oscar H. Pieper and Alphonse F. Pieper, Rochester, N. Y. App. filed Aug. 13, 1917. Employed by dentists.

1,369,938. VANITY CASE; Bertha M. Schwab, Good Ground, N. Y. App. filed Dec. 6, 1919. Provision for illumination of mirror.

1,369,984. METAL VAPOR RECTIFIER; Bela B. Schafer, Baden, Switzerland. App. filed July 14, 1920. Means for increasing suction.

1,370,004. CIRCUIT-INTERRUPTING SYSTEM; Lewis W. Chubb, Pittsburgh, Pa. App. filed July 28, 1917. For rectifying.

1,370,005. STARTING MECHANISM FOR GAS ENGINES; Frank Conrad, Pittsburgh, Pa. App. filed July 19, 1913.

1,370,011. STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed Aug. 23, 1919. Plate support.

1,370,012. VENT COVER FOR STORAGE BATTERIES; Bruce Ford, Philadelphia, Pa. App. filed Sept. 18, 1919. Used on submarines.

1,370,013. STORAGE-BATTERY PLATE; Bruce Ford, Philadelphia, Pa. App. filed Jan. 23, 1920. For starting automobile engines.

1,370,014. STORAGE-BATTERY PLATE OR ELECTRODE; Charles D. Galloway, Philadelphia, Pa. App. filed Sept. 4, 1918. Material inclosed in perforated insulating tubes.

1,370,016. ELECTRIC SYSTEM FOR ELECTRIC FURNACES; Henry A. Greaves and Harry Etchells, Sheffield, England. App. filed Sept. 12, 1918. Three-phase conducting hearth.

1,370,018. TROLLEY SHOE; Oliver P. Hipple, Wilkins Township, Allegheny County, Pa. App. filed March 14, 1917. Current-collecting devices.

1,370,019. MOTER-CONTROL SYSTEM; Henry D. James, Edgewood Park, Pa. App. filed Jan. 29, 1917. For starting.

1,370,033. APPROACH FOR TROLLEY FROGS; Frederick H. Miller, Wilkinsburg, Pa. App. filed April 9, 1919. Renewable approach members.

1,370,034. MOTOR-CONTROL SYSTEM; Leonard Miller, Whitefield, England. App. filed May 6, 1919. Automatic contactor type.

1,370,051. STARTING MECHANISM FOR AUTOMOBILES; Otto S. Schairer, Oakmont, Pa. App. filed Aug. 22, 1913. Different relative speeds operating as a motor and as a generator.

1,370,052. DRY CELL; Arlie W. Schorger, Madison, Wis. App. filed Nov. 19, 1918. Elimination of gauze bag.

1,370,054. DRY CELL AND METHOD OF MANUFACTURING THE SAME; Walter Z. Schulte, Madison, Wis. App. filed May 15, 1920. Bag type.

1,370,055. DRY CELL AND METHOD OF MANUFACTURING THE SAME; Walter B. Schulte, Madison, Wis. App. filed May 15, 1920. To eliminate air bubbles.

1,370,056. TWO-SOLUTION METHOD OF PASTING; Walter B. Schulte, Madison, Wis. App. filed June 10, 1920. Dry cells.

1,370,058. SECONDARY-BATTERY PLATE OR ELECTRODE; Edward W. Smith, Philadelphia, Pa. App. filed Sept. 4, 1918. Conducting rods embedded in active material.

1,370,059. CALLING DEVICE; Ernest R. Smith, San Francisco, Cal. App. filed July 30, 1920. For calling guests at a hotel, etc.

1,370,064. STORAGE-BATTERY SEPARATOR; Godfrey Steerup, Chicago, Ill. App. filed June 7, 1919. Method of treating wood.

1,370,077. DISTRIBUTER UNIT FOR IGNITION SYSTEMS; Ralph H. Whisler, Detroit, Mich. App. filed May 31, 1919. High-tension, high-frequency ignition.

1,370,090. METHOD OF AND MEANS FOR MELTING BRASS AND SIMILAR SCRAP; Walter R. Clark, Bridgeport, Conn. App. filed Aug. 2, 1918. Induction furnace.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BRATTLEBORO, VT.—The F. R. Patch Manufacturing Company plans to build a power plant and a dam, 125 ft. long and 40 ft. high, on East Creek, one mile north of Brattleboro.

ROYALSTON, MASS.—The installation of an electric plant in Royalston is under consideration. The plans include a transmission line estimated at a cost of between $10,000 and $12,000.

HARTFORD, CONN.—The Board of Health and the Board of Charities have had plans prepared for the construction of a power house and laundry on Vine Street to cost about $77,000. K. G. Lincoln is chairman of the joint committee.

Middle Atlantic States

BROOKLYN, N. Y.—The Brooklyn Edison Company, 360 Pearl Street, has had plans prepared for the construction of a two-story substation, 30 ft. x 100 ft., on Sumpter Street near Stone Street, to cost about $60,000. The company also contemplates the construction of a new coal hoisting and handling plant at Sixty-sixth Street to cost about $125,000.

BROOKLYN, N. Y.—Considerable electrical machinery, refrigerating and ice-manufacturing equipment will be installed in the plant to be built on Tilden Avenue by Rubel Brothers, Glenmore Avenue and Junius Street, at a cost of about $500,000.

CADYVILLE, N. Y.—Bids will soon be asked by the International Paper Company, 30 Church Street, New York City, for the construction of a hydro-electric plant on Saranac Road, Cadyville, to cost about $250,000. A. H. White, 30 Church Street, New York City, is architect and engineer.

CORNING, N. Y.—The Corning Glass Works contemplate the construction of a new power plant to cost about $250,000, including equipment. The Dwight P. Robinson Company, 125 East Forty-sixth Street, New York City, is engineer.

MASPETH, N. Y.—The United States Industrial Alcohol Company, 27 William Street New York City, will install considerable electrical machinery in its plant to be built at Grand Avenue and Harrison Street, Maspeth, to cost about $500,000.

NEW YORK, N. Y.—The Sinram Brothers, 910 East Fifth Street, plan to install electrically operated machinery for conveying, hoisting, etc., in the coal pocket to be constructed on waterfront property on the East River near Thirty-seventh Street.

ROCHESTER, N. Y.—Bids, it is reported, are being asked by Sibley, Lindsay & Curr, East Main Street and Clinton Avenue, for the construction of an addition to the power plant used in connection with their department store.

ROSSIE, N. Y.—The Rossie Electric & Manufacturing Corporation has applied to the Public Service Commission for permission to construct new electric light and power plants at Hammond and Rossie, St. Lawrence County.

ST. GEORGE, S. I., N. Y.—The construction of a municipal power station to supply energy for the ferry terminal and shops, the East Shore piers and municipal trolley lines, has been proposed by Commissioner Whalen of the Department of Plants and Structures. The plans would include the construction and equipment of a 9,000-kw. power plant to cost $1,917,900; substation at Stapleton docks, $57,750; transmission lines to Stapleton and Concord, $9,500; transformer and changes at St. George, $3,000; construction and equipment of additional coal bunker, $30,000; etc.

LINCOLN PARK, N. J.—The establishment of a lighting district in Lincoln Park is contemplated. Pequannock Township Board is in charge of the proposed work.

BAKERSTOWN, PA.—Plans have been completed by the Pittsburgh Cut Flower Company, 116 Seventh Avenue, Pittsburgh, for the construction of a power house at its local plant.

BETHLEHEM, PA.—The Bethlehem Hotel Corporation contemplates the installa-

tion of considerable electrical equipment in the proposed ten-story hotel estimated to cost more than $4,000,000.

GLEN ROCK, PA.—The erection of an addition to the power house of the Enterprise Furniture Company is under consideration.

PHILADELPHIA, PA.—Plans have been completed by the American Ice Company for the construction of an addition to its power house at Walnut Lane and Belfield Street. Improvements to the present structure will also be made.

SCRANTON, PA.—The electric power plant of the Coalbrook colliery of the Hudson Coal Company, north of this city, it is reported, has been damaged by fire, causing a loss of about $30,000.

BALTIMORE, MD.—The Washington, Baltimore & Annapolis Electric Railroad Company, 108 North Liberty Street, has been granted permission by the Public Service Commission to issue $1,400,000 in notes, part of the proceeds to be used for extensions, improvements, operations, etc.

BALTIMORE, MD.—The Western Maryland Dairy, Inc., Linden Avenue and Dolphin Street, will install considerable electrical and mechanical equipment in the proposed milk pasteurizing and distributing plant to be constructed at an estimated cost of $1,000,000. I. D. Baxter is chairman.

RIVERDALE, MD.—The Council has appointed a committee to prepare plans and specifications for a municipal lighting plant and distributing system.

CHARLESTON, W. VA.—The Virginian Power Company contemplates the installation of a fourth electrical unit, consisting of a 25,000-kva. turbo-generator at its Cabin Creek station. The cost is estimated at $1,000,000.

HUNTINGTON, W. VA.—The Parsons Company, 118½ Tenth Street, it is reported, will receive bids in May for the installation of electrical equipment and mining machinery at its properties in the vicinity of Peach Creek. A. F. Parsons is president and manager.

LEWISBURG, W. VA.—The construction of a power plant at the Lewisburg Seminary for Girls is under consideration. Dr. J. I. Anderson is president; S. S. Johnson People's Bank Building, Lynchburg, is architect.

NORFOLK, VA.—The installation of an ornamental lighting system on Main Street is contemplated. The cost is estimated at $12,000.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until March 25, Charleston, Schedule 7687—miscellaneous quantity of switchboard panels; Philadelphia, Pa., Schedule 7694—miscellaneous quantity of electric cable. Until March 29, Puget Sound, Wash., Schedule 7666—miscellaneous quantity of electric wire and cable; Eastern and Western Yards, Schedule 7664—miscellaneous quantity of electric wire and cable. Until April 1, Mare Island, Cal., Schedule 7686—miscellaneous quantity of magnet wire. Until April 8, Mare Island, Cal., Schedule 7676—nine electric motors. Applications for proposal blanks should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until March 25, circular PR 5929-1aCP, for radio receivers and transmitters in lots of 100, 200, 250 and 300. Further information may be obtained on application to above office.

North Central States

BENTON HARBOR, MICH.—A new curb-lighting system in Benton Harbor is under consideration.

DETROIT, MICH.—The Semet-Solvay Company has had plans prepared for the construction of a new power house.

UNION CITY, MICH.—The proposal to issue $80,000 in bonds for the development of a water-power system west of Union City will be submitted to the voters at an early date.

CINCINNATI, OHIO.—The Stellar Refinery Company, Wooster, has plans under way for the construction of an oil refinery, power house and pumping plant near Cincinnati, to cost about $300,000, including equipment. E. M. Quincy is vice-president.

COLUMBIA, KY.—The plant of the Columbia Light Company has been purchased by S. E. Shiveley, J. S. Knifely and others for $22,000. The new owners, it is understood, plan to make improvements and extensions to the plant.

PEORIA, ILL.—The installation of an ornamental street-lighting system throughout the city is under consideration.

JEFFERSON, WIS.—The question of issuing $22,000 in bonds for improvements to the light and water system is under consideration.

WHITEHALL, WIS.—Plans have been prepared for a power house and other improvements for the county asylum to cost about $12,000. P. K. Risberg is county auditor.

DULUTH, MINN.—The Northern States Electric Construction Company contemplates the installation of a light and power system and the erection of transmission lines. For further information address R. H. Hilgedick, 117 East Second Street.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company, 15 South Fifth Street, plans to install a new 30,000-kw. steam electric generating unit at its Riverside station. The company also contemplates the erection of a 100,000-volt tie line between St. Paul and Minneapolis for increased service.

BARNES CITY, IOWA.—The Williams Electric Company, recently incorporated with a capital of $20,000, plans to furnish electric light and power service in the city. Fred Williams is president.

BOONE, IOWA.—The Iowa Railway & Light Company contemplates improvements to its local properties during the year to cost about $64,030. F. W. Linsbaugh is manager.



WATER INTAKES AT HELL GATE STATION

Seawall and circulating water intakes for 280,000-kw. Hell Gate station of The United Electric Light & Power Company now being constructed in New York City. The station was designed by Thomas E. Murray, Inc., and will cost approximately $25,000,000.

FULTON, MO.—The construction of a power house at the State Hospital is contemplated. M. O. Biggs is superintendent.

WHEATON, MO.—The Wheaton Light Ice & Cold Storage Company, recently organized, has plans under way for the construction of an electric power plant to cost about $50,000. H. C. Hindman is manager.

NOONAN, N. D.—Plans are under consideration to erect an electric power plant at the mines near here to supply electricity in Noonan, Crosby and Ambrose.

CANASTOTA, S. D.—At an election to be held soon the proposal to issue bonds to establish an electric light plant will be submitted to the voters.

FAIRBURY, NEB.—New equipment including a 550-kw. generator and Corliss engine, is being installed at the municipal electric plant. The erection of a 23-mile transmission line to connect at several small towns is also planned.

JUNCTION CITY, KAN.—The United Light & Power Company, Abilene, has completed plans for the extension of its lines into the oil district and the towns of Florence and Peabody.

TOPEKA, KAN.—The State Senate has passed a bill providing for an appropriation of $50,000 for the construction of a new power house at Western University in Quindare.

Southern States

BLACK CREEK, N. C.—A proposal to issue $10,000 in bonds for the installation of an electric light system will be submitted to the voters. W. T. Privett is town clerk.

ELM CITY, N. C.—Arrangements are being made for an issue of electric light bonds to the amount of $25,000. C. Winstead is town clerk.

NEWBERRY, S. C.—Bids, it is reported, will soon be asked for extension to the electric light system and other municipal improvements. Sanders & Sweeny, Anderson, are engineers.

NOCATEE, FLA.—The Nocatee Ice & Power Company, recently organized, contemplates the operation of a local light and power system. F. R. McConnell is interested in the company.

OCALA, FLA.—The Ocklawaha Reclamation Farms have applied to the Federal Power Commission for permission to develop power for public utility purposes at the government lock and dam in the Ocklawaha River, Marion County.

SOUTH JACKSONVILLE, FLA.—The City Council has approved an issue of $190,000 in bonds, part of which will be used for extensions to the electric light and power system.

CLEARWATER, ALA.—The installation of an electric lighting plant in Clearwater is contemplated.

WINONA, MISS.—Arrangements have been made by city officials for an issue of $60,000 in bonds for the purchase of the plant of the Winona Light, Ice, Water & Sewage Company. The plant will be known as the Winona Public Utility Plant and will be entirely remodeled. Lighting and water service will be extended to cover the whole town. John T. Sharp, Jr., Canton, is manager and H. E. Johnson is local superintendent.

COTTER, ARK.—The Dixie Power Company, 1100 Title Guaranty Building, St. Louis, Mo., has been granted permission by the Federal Power Commission to construct a hydro-electric plant and a high-head dam on the White River. The plans include the development of 100,000 primary horsepower for distribution in Arkansas, Missouri and Oklahoma. W. V. Powell is president; Col. H. A. Allen, 23 Metropolitan Block, Chicago, Ill., is consulting engineer.

ALEXANDRIA, LA.—The Louisiana Gas Distributing Corporation, recently organized with a capital of $10,000,000, it is reported, plans to investigate the possibility of distributing electric power and natural gas in Louisiana. William Polk and others are directors of the company.

FREDERICKSBURG, TEX.—The electric light and power plant of Ernest Wilke & Company, it is reported, has been damaged by fire causing a loss of about $35,000. The plant, it is understood, will be rebuilt.

Pacific and Mountain States

KELSO, WASH.—The Long-Bell Lumber Company plans to build an electrically operated lumber mill.

SPOKANE, WASH.—The Amalgamated Gold Mines Company, Blewett, plans to build a hydro-electric plant to cost about $50,000. C. R. Hesseltine is president.

LOS ANGELES, CAL.—The Federal Power Commission has approved the application of the Southern California Edison Company for a 200,000-hp. hydro-electric development of the San Joaquin River. This is part of the $100,000,000 project contemplated by the company.

WESTWOOD, CAL.—The Mount Shasta Power Corporation, a subsidiary of the Pacific Gas & Electric Company of San Francisco plans to build two power houses on the Rising River and Hat Creek watersheds for the Red River Lumber Company. Application is now before the State Railroad Commission for approval of the construction of the power plant and the leasing of certain lands needed by the Mount Shasta Power Corporation in its hydro-electric program on the Pit River.

OGDEN, UTAH.—At an election to be held March 26 the proposal to issue $2,025,000 in bonds for an electric lighting system will be submitted to the voters.

Miscellaneous

FORD ISLAND, H. T.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 11, specification 4401, for electric supply and distribution system at Ford Island.

Electrical World

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Pulling Together for the Common Good

ELECTRICAL manufacturers are among the most enterprising and wide awake in the country. Nor is their product one whit less admirable than they. Not only does it suffice, but in addition it possesses those intangible qualities which make for superiority. We say this not in the spirit of braggadocio but as a matter of pride, for it is gratifying to witness not only the continued excellence of the product but the kindly feeling of comradeship which pervades the industry and is becoming more and more conspicuous every day. This naturally has led to more sympathetic appreciation of the functions of each branch of the industry and to more genuine and closer co-operation. Do the contractors need help, it is forthcoming. Is the development of the electric light and power industry stopped temporarily for want of funds, immediately there is a prompt and hearty response in the shape of a good-will campaign. This is not charity, but good business, as a moment's reflection will show. "Is it good for the industry?" is the only question asked, and the response is as liberal as the object is worthy. We understand that the National Electric Light Association has in contemplation larger and more intensive work of a nature that will merit the support of the entire industry. To carry on this work the dues have been increased (they always were too low), and excellent results are already being shown. Much of this work redounds to the credit of the manufacturer, and we are sure that when this is appreciated the manufacturers will insist on carrying some of the burden.

Passing of Absentee Landlordism of the Old-Time Sort

IN TOO many cases the local manager of a comparatively small electric utility controlled by a remote holding company has been a figurehead. Of course, this is not a universal rule, but there are sufficient instances to indicate a grave weakness in the system as it was originally inaugurated. Holding companies have played a strong and prominent part in the history of American utilities. They have taken over tottering companies and by overhauling their properties and steering them over rough spots in the road have improved the standards of electric service. It is subsequent reluctance to remove the steadying hand before guidance becomes restraint which has sometimes raised local objection. When customers of a utility managed by a distant organization acquire the idea that the local agents with whom they deal have no power or authority an evil influence spreads that is difficult to remove. From such small beginnings municipal ownership agitations spring and public good will and general confidence in the electrical industry receive a setback. In the smaller communities where the electrical idea is just beginning to prevail no efforts should be spared to bind the public to the local company with bands of service, community interest and man-to-man dealing. Publicity tending to establish the local manager as having full authority and responsibility in the operation of his company's affairs and encouragement to him to conduct security-selling campaigns in his community are the constructive steps that are essential to the building up of local confidence in the electric service of a company which must be operated as a part of an associated group of public utility properties.

What Water Power Means to a Nation

IT IS not always possible to place one's finger on tangible evidence of what water power means to a community, state or nation. However, in the case of Canada, especially the Provinces of Ontario and Quebec, the task is easy and the exhibit instantly convincing. Those provinces represent the industrial hub of the Dominion, and hydro-electric power is the great impelling force. Serving the Province of Ontario is the immense network of the Hydro-Electric Power Commission. Remarkable as has been the growth of that governmental enterprise, the demands for power still exceed the visible supply. In Quebec the increase in the use of hydro-electric energy has been just as phenomenal as in Ontario. The Shawinigan Water & Power Company, to mention just one of the companies serving that province, has grown from 20,000 hp. in 1905 to 220,000 hp. in 1920 and cannot be said to have reached maturity yet. Both Ontario and Quebec realize what they owe to hydro-electric development and look to their water powers as assets with which to attract industries and build up industrial and community life of great importance. Indeed, the "Hydro" and Shawinigan systems are among the most complete and extensive groups of hydro-electric developments in the world. Blessed with enormous water-power resources, Canada has used them to her profit and happiness from coast to coast. Her greatest industries, morever, could not live without them.

The Influence of the Radio Telephone

WHEN it is recalled that the first successful transmission of speech over the telephone between two distant points just forty-five years ago on the tenth of this month is well within the memory of men not yet old and that its great inventor is still in robust health at seventy-three, the development of the art through its various stages to the present-day transmission of speech without wires reveals the dramatic side in the advance

of scientific achievement. Just forty-five years ago the social and business affairs of communities a thousand miles apart were separated relatively as far as the hemispheres are today, when the sending and receiving of messages through the air have ceased to call for passing comment. What the future holds for the radio telephone is beyond the vision of the dreamer, but certain it is that the popularizing of its use among the youth of this country will widen the knowledge of electric circuits and the functions of the elements which are involved in the sending and receiving of radio messages, a combination of electrical and magnetic forces not long ago considered only within the comprehension of the learned scientist. The entrance of the radio outfit into the home of the American youth is not only one of the greatest agencies working toward a universal knowledge of electricity but also a factor in the advancement of civilization. Those who are now promoting a popular knowledge of radio by developing inexpensive outfits and sending news broadcast to the thousands of amateur users are rendering the world a great service, a service which will bring the science of electricity into the home and into general education just as the phonograph and the player piano and the printing press have stimulated a wider love for musical art and for the romance, poetry and history of good literature. To make this service far reaching the commercial distribution of the equipment must be worked out. This is a new problem, with possibilities of profitable interest to the electrical jobber and contractor-dealer.

Economy of Transmission System Dependent on Cost of Energy

FUNDAMENTALLY it is necessary to know the cost of energy as accurately as possible when considering from the economical viewpoint any problem of transmission. This truth, which is emphasized in the current issue by P. O. Reyneau and H. P. Seelye, is evident if it is remembered that the most economical condition is obtained by studying the relations between the annual cost of the investment and the annual cost of the energy lost. The difficulty of ascertaining energy cost accurately is clearly recognized, as an analysis of the whole system is necessary and as an apportionment of the demand and output cost must be made for each kind of load. Furthermore, in order to make calculations for an economical line it is requisite that the cost of energy at some particular point of a system be known. This cost should represent, for the particular nature of the load under consideration, all the costs back to the coal pile, both as to investment and as to losses.

Experience has shown that many who have undertaken to solve distribution problems with a view of obtaining maximum economy have gone as far in their work as attempting to determine the cost of energy to be used. At that point the difficulties encountered have seemed insurmountable and the problem was solved by rule-of-thumb method. The article in this issue affords means of getting acquainted with the various factors affecting the cost of energy. Without minimizing the difficulty of obtaining the exact values for it, it provides a viewpoint by which even the roughest kind of a guess can be improved. There is no question that it is essential for those concerned in distribution engineering work to be familiar enough with the fundamentals involved in obtaining values for the cost of energy to be able to use to the best advantage the data available. The success of their designs will depend in no small measure on the ability to analyze their system conditions in order to provide a satisfactory figure for the cost of energy.

Electrical Fire Risks and Their Real Proportions

IN THIS issue details of a thorough study of alleged electrical fire risks made by Reginald Trautschold of the Society for Electrical Development are presented which are of particular interest because of the fact that the statistical records of the National Board of Fire Underwriters have placed electricity in the first rank as a source of fire hazard. The implication of such a statement is very serious, indicating that the electrical risk is really one which is of the gravest character from the standpoint of the fire underwriter. It is therefore only proper that those who are most closely connected with the development of lighting and power for general service should investigate the alleged facts to see in how far they are strictly representative of the true situation. The Fire Underwriters charge electricity with about 6 per cent of the fires in the country. To anticipate a little, the investigation carried on by the Society for Electrical Development shows a shade above 2½ per cent of the fires to be electrical in their origin. The difference means in the aggregate many thousands of fires and is too considerable to let go without comment.

In dealing with this matter, however, we do not agree with Mr. Trautschold's suggestion that the records of the Board of Fire Underwriters must be biased to a greater or less extent, and we cannot conceive that the Underwriters should have any interest in showing that the percentage of fires caused by electricity is greater or less than that chargeable to rats and matches. What we do suspect rather strongly is that the steadily growing presence of electrical wiring as a possible source of danger tends to deflect attention from other sources from which somewhat less is feared and of which much less is known. When a fire occurs in a building wired or unwired and the loss is total or nearly so there is as a rule no means of ascertaining the exact way in which the fire started, and the cause should be reported as unknown unless it can be actually determined. We are much inclined to the opinion that a considerable number of the fires charged to electricity really belong in the category of the unknown and that not a few of them may well be properly chargeable to causes less familiar but more instrumental than electricity. For instance, the half has not been told of the ignition of dust and other inflammable matter of relatively low temperatures. Nor has there been anything like a thorough investigation of the conditions under which there may be spontaneous ignition of uncared-for waste saturated with oils and grease.

In the early days of electric service it was a pretty safe bet that any fire in a wired building would be reported as due to crossed wires, and this tendency has not wholly disappeared. It is for this reason that the investigation of the Society for Electrical Development was necessary. Its data seem to show that electric service has had to take the brunt of criticism which it does not fully deserve. Especially interesting are the analyses which Mr. Trautschold gives of the conditions found in some particular cities where a study

of the actual facts brought the figures in the report down to a modest fraction of the size which they had originally assumed.

In particular, the society has done good work in segregating electrical fires which represent a public risk from those which do not. A transformer burning out on a pole is a loss to the operating company, but does not represent a contingent risk to the users of electricity. The same is true of an automobile catching fire from a short circuit in its wiring system. Such fires, although they may be electrical in their origin, are outside the range of public electrical risks. When cases of this kind are eliminated and fires of dubious origin removed from the electrical category the situation takes on a very different aspect, especially in view of the fact that in some towns and cities where the use of electricity is particularly extensive—in fact, almost universal—the fires of electrical origin are almost negligible in number.

Of even greater importance than the establishment of the actual number of fires of electrical origin is their correlation as regards their several causes. The Underwriters will do the public great service if they will indicate in their count of alleged electrical fires in what way they actually originated. We are convinced that a thorough investigation of this feature of the case would result in the removal of no small number of the fires from the electrical list. If an inspector who asserts that in his opinion electricity was the real cause of a fire were required to specify where and how electricity started the flames, he would often find himself looking for another cause. Whenever the ascription could be made with reasonable probability, on the other hand, he would place at the disposal of the Underwriters and the public valuable data for improvements in electrical practice and service to the public.

A Plant Which Has Distinctive Features

THE Queenston-Chippawa development of the Hydro-Electric Commission of Ontario, which is described on page 697 of this issue by E. T. J. Brandon, is distinctive in having on order the most highly rated water-wheel generators of all the stations in the world, the units being designed for developing 50,000 hydraulic horsepower and 45,000 kva. It will also rank at the head of the list of plants actively under way for ultimate plant rating, since the station and waterways are planned for ten generating units, or a total rating of 450,000 kva. Although the working head (305 ft.) is not comparable with some now utilized in mountainous parts of the United States, it is notable because it represents virtually the full difference of level at Niagara between Lakes Erie and Ontario.

Operation on the unit basis—that is, each generator feeding through its own transformer and transmission line—is not original with this plant, but it is to be commended on its adoption of this practice as a means of avoiding one problem common to the operation of superpower plants. The units may be operated independently or in unison with other units without forcing a conscious realization of the colossal ratings and sizes involved.

Another very commendable feature of the installation is the provision of a control pedestal adjacent to each generator from which the unit may be governed if necessary. At the same time the unit is in direct connection with the control room from which the operation of the station is normally directed. This bringing of the last and final element of control close to the generator, where whatever happens the operator can intervene, is a factor of no little importance in bringing about increased security of operation.

Commission Regulation Creates Responsibilities

THAT commission regulation of public utilities establishes certain responsibilities on the part of the public which do not exist toward unregulated business seems to be largely overlooked by both utility commissions and utility men because of their neglect to keep in mind the axiom that authority can no more be assumed or delegated without the corresponding responsibility than responsibility can exist without the existence of the necessary authority to control the means by which the required results are sought. Unregulated business stands or falls on its ability to meet competition with good management and efficiency. It is free to take the course that judgment dictates, and the results are swift and certain. Under rapidly changing conditions policies may be readily changed to meet unlooked-for emergencies. During prosperous times large profits can be taken and reserves built up to meet times of storm and stress.

Regulated business as handled under the present policies of public utility commissions is restricted as to what it may do. Earnings are decidedly limited, and the building up of such reserves as unregulated business is accustomed to regard as conservative is impossible. The whole tendency is to restrict maximum profits to values that represent the average or less than the average profits of unregulated business over long periods of time in which both good profits and heavy losses may be expected. The result of the restriction of profits under complete regulation is the elimination of adequate reserves to care for losses when they come. The hope of better profits is the incentive for the exercise of efficiency and the highest type of endeavor. If the hope is removed by regulation, it is certain that human beings are not likely to develop their best efforts in the building up of business.

When the public through its commissions takes the responsibility of guiding an industry because for one reason or another that industry cannot be left in a competitive field, it at once assumes the responsibility for providing that careful and efficient management shall receive enough reward to induce capital to seek investment in such business. Management of superior order needs to receive a surplus over this. The public must be responsible for providing an incentive to the exercise of initiative equal to that in any other field. A commission can have no right to say that a certain maximum of profits shall not be exceeded without assuming the responsibility of providing for the limitation of losses except such as may be due to mismanagement and inefficiency. In other words, the old maxim that it is a poor rule that will not work both ways applies to public utilities. Speculative enterprises balance the chance of great gain against the chance of heavy loss. The investor in a utility cannot win large profits; he should be protected against undeserved loss. Otherwise these companies, supplying absolutely essential service to the populations around them, are compelled to operate under an unfair handicap.



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Bancroft Gherardi

A national figure in the wire and wireless operations of the Bell Telephone system whose recognition has been earned by a practical knowledge of the engineering involved

THE development of the engineering side of the telephone industry has come not from the outside but from men who have given their entire professional life to the perfection of the service. Among these men is Bancroft Gherardi, now vice-president and chief engineer of the American Telephone & Telegraph Company. Throughout his career with the telephone organization Mr. Gherardi has been closely associated with Col. J. J. Carty, under whose supervision the telephone art came to its present high standard. In 1895 Mr. Gherardi entered the office of Colonel Carty, then engineer of the Metropolitan Telephone & Telegraph Company. The first work to which he was assigned was that of testing cables, a job at that time considered to be a matter of dull and profitless routine and one to be shunned if possible. Mr. Gherardi took over this work and made out of it a real occupation, developing the knowledge, application and use of telephone cables. He is now one of the leading authorities on this subject.

When in 1900 the traffic department of the New York Telephone Company was created he was transferred to that work and in the following year became chief engineer of the New York & New Jersey Telephone Company. Upon the consolidation of these two companies in 1906 he became assistant chief engineer of the new company. In 1907, when the late Theodore N. Vail became president of the American Telephone & Telegraph Company, Mr. Gherardi was brought over to the parent company as engineer of equipment and building, and in 1909 he was made engineer of plant, in charge of plant development and standardization for the Bell system. In 1919 he was made chief engineer after having acted in that capacity for more than a year. The following spring he was elected vice-president. Among the noteworthy accomplishments that have come under his supervision are the subway and cable construction from Boston to Washington, the completion of the open-wire loaded circuit from New York to Denver, and the transcontinental line and the wireless development of the American Telephone & Telegraph Company. During the war he performed important confidential work for the government.

Mr. Gherardi, who was born in San Francisco in 1873, is the son of Rear Admiral Gherardi, U. S. N., who as lieutenant on the old Niagara in 1857 was in charge of the boat which landed the American end of the first Atlantic cable. Bancroft Gherardi was graduated from Brooklyn Polytechnic Institute in 1891 and from Cornell in 1893. He has been a vice-president of the American Institute of Electrical Engineers and served on the board of managers for a number of terms. Foresight and executive ability have characterized his work. He has had what few men possess, sense to recognize an opportunity for development where others have seen nothing.

Electric Fires Only 2.57 per Cent of All

Careful Study of Reports from 345 Cities During 1919 Shows that the Percentage of Total Fires Formerly Attributed to Electricity Is Incorrect—Many Fires Are Erroneously Classed as Electrical

By REGINALD TRAUTSCHOLD
Society for Electrical Development, Inc.

A GRAVE misconception concerning the number of fires attributable to electricity has been caused in the past five years by the widespread publicity given to the statistical compilations of fire losses by the National Board of Fire Underwriters. Electricity has been advertised, quite erroneously, as the most general cause of fires, the inference being that it is the chief fire hazard—the reason for the abnormally high annual fire loss in the United States—outranking even carelessness in smoking and in the use of matches, which is given as the second hazard in importance, chargeable with a very considerably smaller loss than that due to fires of electrical origin.

The fallacy of placing any such interpretation on the records of the Fire Underwriters is made apparent by the exhaustive investigation which has been carried on by the Society for Electrical Development to ascertain the facts concerning fires which occurred in the year 1919 in communities supplied with electric service. Reports from 345 cities show that 138,553 fires occurred in 1919, of which those apparently of electrical origin numbered 3,568, establishing a mean fire ratio for fires of electrical origin of 2.57 per cent. This percentage differs sufficiently from the inferred electric fire ratio of the Fire Underwriters' reports—about 6 per cent—and from the even larger ratios frequently advanced to demonstrate forcibly the danger of accepting records compiled for special interests as in any way indicative of conditions in a matter of such local and national interest. True findings can be arrived at only by an approach from the viewpoint of community interest and welfare such as that made by the Society for Electrical Development.

Some Isolated Fires Should Be Eliminated

So widely do the results of the two studies differ that the premises upon which they were respectively made are obviously at variance. The compilation of the National Board of Fire Underwriters consists primarily of records of adjustments made on some 3,500,000 claims for damages occasioned by fires, to which is added an arbitrary 25 per cent to cover unrecorded fires. It is essentially a record of private interests and consequently must be biased to a greater or less extent. The investigation by the society, on the other hand, has been based upon investigated reports submitted by fire chiefs, department, municipal and state officials, central-station records and statements from special commissions in a very large proportion of the country supplied with electric service in 1919. These reports were received from 345 towns and cities of 5,000 or more population—an aggregate of 28,495,851 people—and were investigated as carefully as possible to discover the full number of fires attributable to electricity and to eliminate from the records such fires as could be proved to be wrongly classified as of electrical origin and those which are known to have been confined to street cars, automobiles, poles, transformers, generators and motors and which did not therefore in any way affect property of private ownership. These latter classes of fires could not be segregated in all instances so that even the investigated reports of the society admittedly list very many fires due to such causes, and the findings consequently err to some extent in unduly elevating the relative hazard of electricity as a cause of fires in residences and commercial buildings.

Favorable as the fire ratio for electricity as found by the society investigation is, it is at once apparent that simply dividing the number of fires of electrical origin by the total number of fires gives only a mean value to this important ratio which may or may not be truly typical. An analytical study of all reports submitted must obviously be made before a fire ratio can be found which will really serve as a dependable indication of the proportion of fires actually due to electrical origin—the obvious basis upon which to rank fire hazards.

A convenient basis for such a study is to classify the towns and cities in population groups, as has been done in Table I, and find the mean electrical fire ratio for each group. An examination of these individual fire ratios, given in the last column of the table, brings out the fact that in all instances they do not differ

TABLE I—FIRE STATISTICS FOR 1919

Population Group, in Thousands	Number of Cities	Population		Number of Fires			Fires of Electric Origin		Ratio of Electric Fires to All Fires, per Cent
		Aggregate	Average per City	Aggregate	Average per City	Per Thousand People	Aggregate	Average per City	
5-10	90	683,600	7,595	4,031	44 8	5 9	120	1 3	2.98
10-15	61	782,451	12,827	4,729	77 5	6.1	119	1.95	2.52
15-25	46	878,137	19,090	5,397	117 3	6.1	134	2.9	2.48
25-40	44	1,423,226	32,369	8,443	191 9	5 9	212	4.8	2.51
40-55	25	1,169,673	46,787	8,231	329 2	7 0	172	6 9	2 09
55-75	19	1,231,729	64,828	7,989	420 5	6.5	226	11.9	2.83
75-100	13	1,180,680	90,822	6,148	462 9	5 2	189	14.5	3.05
100-150	19	2,302,622	121,190	14,424	759 2	6.3	309	16.3	2.14
150-250	13	2,563,468	191,189	15,581	1,198.5	6 1	541	41.6	3.48
250-500	5	1,761,234	352,247	10,985	2,197 0	6 8	255	51.0	2.33
500-1,000	7	4,425,588	632,227	20,490	2,927 1	4 6	500	71.4	2 44
Over 1,000	3	10,093,443	3,364,461	32,105	10,701.7	3 2	792	264 0	2 47
	345	28,495,851		138,553			3,568		2.57

greatly from the mean fire ratio of 2.57 for the whole territory under consideration and that the size of the community has not much bearing on the relative prevalence of fires. If there is any indication, it is that fires are not proportionally quite so numerous in the larger cities, where it is reasonable to assume that the use of electricity is more general than in many of the smaller communities. The number of fires per thousand people in the various population groups appears to confirm the indication of a slight reduction in the number of fires in thickly populated districts, but the difference is so slight that it would seem quite justifiable to disregard the size of the city as a factor in the prevalence of fires. There are many other factors of greater potency, such as the construction of the buildings, the prevalence of buildings of an inflammable character, the fire risk involved in the purpose for which the buildings are employed, the care exercised by the inhabitants to guard against fires, and all the other conditions which govern the rate charged for fire insurance. These risks are well known, and it is not proposed to make an attempt to value or even segregate all the fire hazards. Rather, it is intended to place logical and dependable ratings upon the rational use of electricity in residences and commercial buildings as a fire hazard to the community.

An examination of the individual fire reports in each population group brings out the fact that the electric fire ratios even for cities in the same population group vary between quite wide limits, showing that the plan of establishing electrical fire ratios by simply dividing group or grand totals of fires due to electric origin by corresponding group or grand totals of all fires cannot portray the true condition of affairs or establish any reliable information concerning the prevalence of electrical fires. That is, the relative rank of electricity as a fire hazard is not demonstrated by such means.

Study of Individual Cities of Greatest Value

As so many factors affect the prevalence of both the total number of fires and the number of fires of electrical origin which may occur in a given community, the scheme of ascertaining the electric fire ratio cannot with safety be extended beyond its calculation for individual cities. For individual cities the electric fire ratio so computed is accurate enough for the particular city for a given period and does portray the condition there existing at the time, eliminating the errors incident to dealing with averages when the factors vary widely.

By arranging the electric fire ratios for the individual cities in each population group in order of their magnitude, as has been done on the accompanying series of charts (Figs. 1 to 12), a graphic picture of conditions as they were for the period under consideration is obtained with due regard to all pertinent influences or conditions. These group charts show conclusively the inaccuracy of group electric fire ratios. For example, take the first chart, showing the prevalence of fires of electric origin in the ninety towns in the population group 5,000 to 10,000.

Large Variations in Ratios Will Be Noted for Individual Cases

The electric fire ratio for the above group is slightly less than 3 per cent, but the chart shows that in about 62 per cent of the towns the electric fire ratio was actually less, that there were as many towns having an electric fire ratio of 1.5 per cent or less as there were towns with an electric fire ratio in excess of 1.5 per cent, and that in about 45 per cent of the towns there were no fires of electrical origin. The charts for other population groups show quite similar variations from the group electric fire ratio.

The smooth broken line curves on the various group charts depict what may be termed the prevalence of fires of electrical origin for the various population groups. Sometimes the curves lie above and at other times below the charted records of the electric fire ratios for the individual towns or cities, but with the possible exception of the relatively few communities where the electric fire ratios are abnormally high, the difference between readings taken on the smooth curves and those of the recorded ratios is not great. For high electric fire ratios the recorded values from the reports submitted have in nearly all cases which it was possible to investigate proved unduly high, the reports listing numbers of fires which were subsequently shown not to be of electrical origin or which did not occur in residences or commercial buildings. The broken line curves, consequently, may be accepted as quite accurately portraying the prevalence of fires of electrical origin for the various population groups. They certainly give far more dependable values for the electric fire ratios than do grand or even group averages.

It will be noted that the smooth broken line curves for the various population groups, the co-ordinate dimensions of which are to similar scale, are all very similar, indicating that a similar graph of mean curvature will closely approximate each one of these group curves and depict with considerable accuracy the prevalence of fires of electrical origin for all towns and cities—large or small. Such a master curve depicting the prevalence of fires of electric origin is shown in Fig. 13. The data for plotting this curve were obtained from average corresponding readings on the

TABLE II—ELECTRIC FIRE RATIOS FROM POPULATION GROUP CURVES

Population Group, in Thousands	0 100	10 90	20 80	30 70	40 60	50 50	60 40	70 30	80 20	90 10	100 0
5-10	13.5	9.6	7.65	4.4	2.8	1.6	0.7	0.2	0.0	0.0	0.0
10-15	9.2	7.0	5.3	4.0	2.85	1.8	1.1	0.5	0.3	0.0	0.0
15-25	9.5	7.0	5.0	3.3	2.4	1.85	1.35	1.0	0.6	0.2	0.0
25-40	7.3	5.3	4.0	3.0	2.4	2.0	1.4	1.0	0.5	0.3	0.0
40-55	7.0	5.0	3.6	2.5	2.0	1.65	1.35	1.0	0.9	0.65	0.5
55-75	7.35	5.65	4.5	3.8	3.1	2.65	2.05	1.65	1.1	0.9	0.75
75-100	8.8	7.1	5.7	4.6	3.5	2.8	2.1	1.65	1.2	1.0	0.9
100-150	7.7	5.7	4.0	2.7	2.0	1.6	1.2	1.0	0.65	0.45	0.4
150-250	7.5	6.1	5.0	4.0	3.35	2.65	1.9	1.35	1.2	1.0	0.9
250-500	6.6	5.0	3.7	2.7	2.1	1.9	1.5	1.3	1.0	0.9	0.7
500-1,000	7.0	5.7	4.4	3.4	2.75	2.0	1.6	1.25	1.0	0.8	0.75
Over 1,000	5.8	5.0	4.25	3.35	2.7	2.0	1.35	0.9	0.65	0.6	0.55
Mean values	8.0	6.2	4.7	3.5	2.7	2.0	1.6	1.1	0.8	0.6	0.5

broken line curves of the population group charts (see Table II).

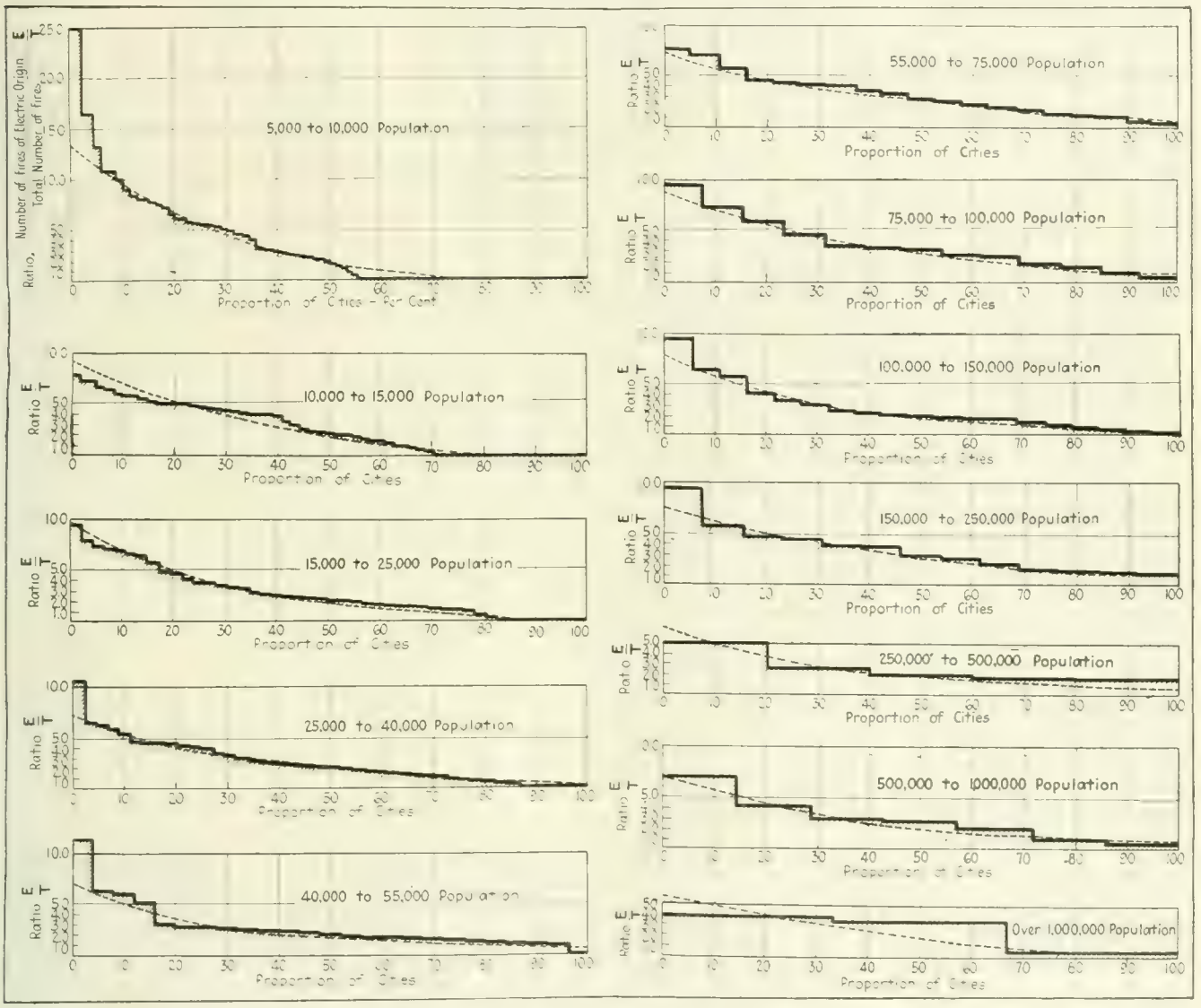
Table III lists readings taken from the master chart and shows that the mean electric fire ratio for cities and towns of all sizes—a fair rating of the seriousness of electricity as a fire hazard—is about 2 per cent; *i.e.*, there are as many towns and cities utilizing electricity for light, heat and power for domestic and industrial purposes in which the ratio between the number of fires of electrical origin and the total number of fires is less than 2 per cent as there are towns and cities in which the ratio is higher than this mean value.

Taking the mean electric fire ratio implied by the records of the National Board of Fire Underwriters, 6 per cent, the chart of prevalence of fires of electrical origin shows that in communities enjoying electric service there are about nine times as many towns and cities in which the electric fire ratios fell below this ratio as there are towns and cities in which the ratio was exceeded. Or, in the same limited portion of the country, that provided with electric service, there are about three and a third times as many towns and cities with electric fire ratios under 1 per cent as there are with records of 6 per cent or more. These comparisons consider only the sections of the country enjoying electric service, so if the large sections not provided with electric service are taken into account, the ratios for the entire country are very substantially reduced—cut in half, at least.

This refutation of the inferences which are quite naturally drawn from the compilations of the Fire Underwriters does not in any way imply that the carefully kept insurance records are inaccurate. In fact, if the arbitrary 25 per cent addition made to cover unrecorded burnings is disregarded, the records of that body are probably more accurate than the records of the society, despite the pains taken to investigate and substantiate the reports submitted by the various communities.

The apparent discrepancy is due entirely to the differences in method of approach and in objective of the two investigations.

In the interests of the public, however, a few facts concerning inaccuracies found in some of the reports submitted to the society should be mentioned and the



FIGS. 1 TO 12—DATA ON PREVALENCE OF FIRES OF ELECTRICAL ORIGIN WITHIN ANY GIVEN POPULATION GROUP

Fig. 1, for instance, shows that in about 40 per cent of cities having from 5,000 to 10,000 inhabitants the number of fires of electrical origin is less than 2.5 per cent of total fires. Other cities show a somewhat similar ratio.

expressed views of some fire chiefs and other officials should have publicity.

The city of Chicago reported through its acting fire marshal that in 1919 there were 14,407 fires, 562 of which were of electrical origin. This would give an electric fire ratio of 3.9 per cent, which in view of the fact that Chicago had in service at that time 10,309,517 incandescent lamps, more than half a million horsepower from electric motors and more than a million electrical appliances, including flatirons and other household devices—indicating a general use of electricity which is probably exceeded in no other large city—might not be considered excessive. However, a careful investigation of all fire records made jointly by the engineers

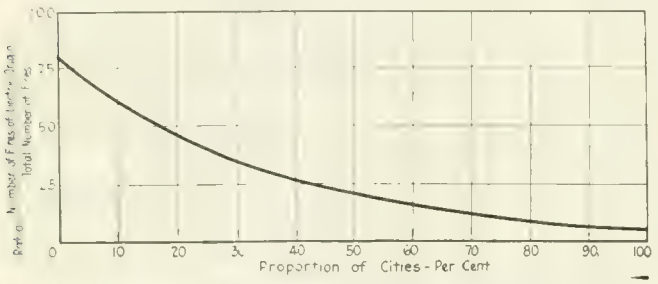


FIG. 13—MASTER CURVE FOR ALL CITIES SHOWS THAT 62 PER CENT HAVE FIRE RATIOS BELOW 2.57 AND ABOUT 90 PER CENT BELOW 6

of the Commonwealth Edison Company and the city department of gas and electricity established the fact that the total number of fires known to have been of electrical origin was only 116. Even this relatively small number proved an over-estimate upon further investigation, as sixteen of the so-called fires turned out to be simply cases of motors or generators being burned out without other damage and six were due to short circuits occurring in automobiles on account of chafed wires. From the viewpoint of electricity as a fire hazard affecting property—residences and commercial buildings—these twenty-two fires are not pertinent. Thus the total number of fires in Chicago in 1919 attributable to the use of electricity was not more than ninety-four—probably less—giving the city an electric fire ratio of 0.65 per cent.

A very similar condition was found in the report for fires in Boston. Out of 4,318 fires in 1919, the number first claimed to be of electrical origin was 152. Investigation brought the number down first to sixty-four and subsequently to thirty-eight, giving Boston an electric fire rate of 0.88 per cent. Columbus, Ohio, first reported thirty-two fires in residences and commercial buildings due to electric causes. The number was subsequently found to be seven. Such experience in investigating reports presumably authentic was not at all uncommon.

Fires Not Accurately Reported

Some time ago in the Pittsburgh district a large and destructive fire occurred at the plant of the Superior Steel Company which was at first thought to be of electrical origin. Later investigations established the fact that the fire actually started some distance from any motors or service lines and originated from an open oil torch carried by the watchman on his inspection trips during the night. Numerous other instances of mistaken attribution of fires to electricity can be cited, and if all erroneous charges of this character could be established, it is very probable that the electric fire ratios in almost every community would be materially reduced.

In a small city in Michigan—Marquette—there was one fire of electrical origin in 1919 out of a total of 111. Owing to the low rate for energy in this community, it is said that every house in the city and the surrounding country is wired for service and that lamps, candles and lanterns are almost non-existent. The one electric fire was due to the wind loosening a sheet of corrugated iron on the local power house, which slid down the roof and came in contact with a trolley wire. This case is of interest in that the use of electricity by the population was universal—the point of absolute saturation had been reached—yet fires of electrical origin were virtually unknown, a direct refutation of the claim frequently made that the great number of fires in the United States is largely due to the extensive and growing use of electricity.

Electricity a Minor Fire Hazard

The investigation of the Society for Electrical Development brought out much more information showing that electricity is in reality a minor fire hazard. The material in this article has been presented not so much with this object as to indicate the care exercised by the society in its investigation and the reliability of its findings. No mention of the monetary loss occasioned by fires of electrical origin—the basis of the compilation made by the Fire Underwriters—has been included, for the reason that there is no justified reason to believe that a conflagration caused by a fire of a certain origin is likely to be more costly than one caused by a fire of another origin. A large proportion of electric fires, if not the majority, are caused by the careless disregard of quite obviously necessary precautions, such as leaving an electric flatiron with the current turned on upon an inflammable ironing board. This carelessness may result in a disastrous fire, but in the greater number of cases the reports of fire departments show that the damage resulting is really small—the loss being termed "negligible," or only a few dollars in amount.

TABLE III—ELECTRIC FIRE RATIO

Ratio of Electric Fires to All Fires, Per Cent	Percentage of Cities with Larger Ratios	Smaller Ratios
6 2	10	90
4 7	20	80
3 5	30	70
2 7	40	60
2 0	50	50
1 6	60	40
1 1	70	30
0 8	80	20
0 6	90	10

Unquestionably the use of electricity where the circuits are subjected to excessive demands, where the wiring has been improperly done or where appliances are defective or improperly constructed constitutes a fire hazard. Ignorance and carelessness on the part of consumers also create a hazard. This is appreciated by the whole electrical industry—in value of product and capital invested now by far the greatest industry in the United States—and efforts without any abatement are being made to reduce these hazards to a minimum. For this reason the inferences which have been drawn quite erroneously from such reports as those of the National Board of Fire Underwriters are not fair either to the electrical industry or to the public, to whom an exposition of the facts concerning fires of electrical origin is due.

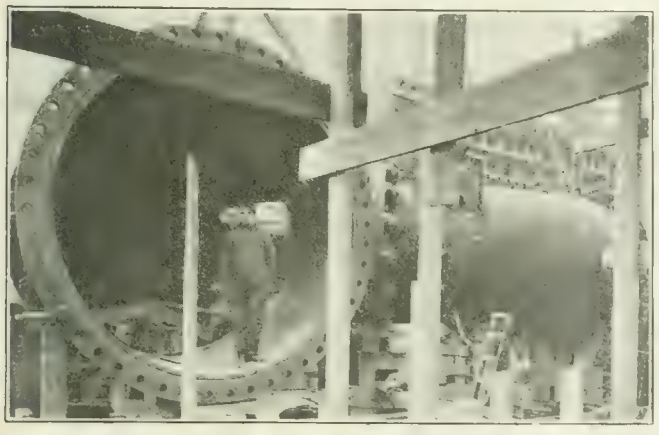
50,000-Hp. Wheels for 500,000-Hp. Plant

Five 45,000-Kva. Generators Already on Order for the Queenston-Chippawa Project in Ontario—Unit System Followed for Electrical Layout —Generators Set Below Floor Level—Control Pedestals at Generators

By E. T. J. BRANDON
Electrical Engineer Hydro-Electric Power Commission of Ontario

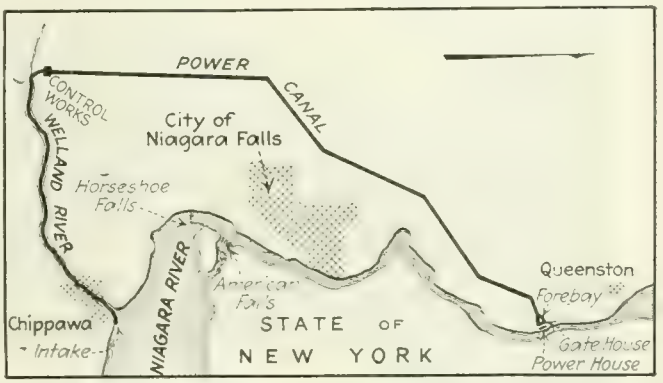
AN ULTIMATE development of 500,000 hp., produced by nine 45,000-kva. generators, is contemplated for the Queenston-Chippawa project, which has been under construction for about three years by the Hydro-Electric Power Commission of Ontario. This project, which is the biggest under way at the present time, when completed will utilize nearly the full drop between Lakes Erie and Ontario near Niagara Falls. Construction is now under way on half of the ultimate plant. The generators and the turbines, of which five have already been ordered, will be larger than any in use at the present time. The 50,000-hp. turbines will operate at a head of 305 ft. (93 m.).

The five contracts which have been placed are for 45,000-kva., 12,000-volt, three-phase, 25-cycle, 187½-r.p.m. vertical generators. Three of the machines are being manufactured by the Canadian Westinghouse Company and two by the Canadian General Electric Company. One of these is now ready for shipment. Direct-connected exciters and thrust bearings are mounted directly above the generators. The air system is completely inclosed so that the cooling medium can be taken from and discharged to the outside air without mixing with the air inside the station. It is an interesting fact that the weight of air passing through one of these generators every three hours will equal the total weight of the generator itself. At full load, about 100,000 cu.ft. (2,800 cu.m.) of air per minute will be required. In the present installation there will be fifteen 15,000-kva., 25-cycle, single-phase transformers. These are connected in delta on the 12,000-volt side and in star on the high-tension (63,500-volt) side. Taps on this side allow the voltage to be changed from 110,000 to 132,000.



LOOKING INTO THE SUPPLY END OF 50,000-HP. TURBINE SCROLL CASE

Provision is made for operating on the unit system. That is, one generator, one transformer and one transmission line will be considered as a unit and each will be able to carry the same load. In case of emergency a unit may be operated at full load of one generator without utilizing either the high-tension or the low-tension buses. The units may also be operated in parallel on either the high-voltage or the low-voltage bus. For this purpose current-limiting reactors are placed between generators on the 12,000-volt bus. These reactors may be shunted out by means of oil switches in case it is desired to feed directly from one generator to the transformer of another generator. There is an emergency bus on the high side and provision has been made for an emergency bus on the low side if it becomes desirable in the future. Any one of the generators may be connected to the main bus or straight through to its transformer bank. Likewise the transformer bank may be connected to the main bus or straight through to the generator. The same arrangement holds on the high-tension side of the transformer bank, it being possible to tie the outgoing lines straight into the bank, to the main bus or to an emergency bus. Similarly the high-tension side of the transformers can be connected straight through to the line, the main bus or the emergency bus.



THIS CANAL WILL ALLOW UTILIZATION OF VIRTUALLY THE TOTAL DROP BETWEEN LAKES ERIE AND ONTARIO

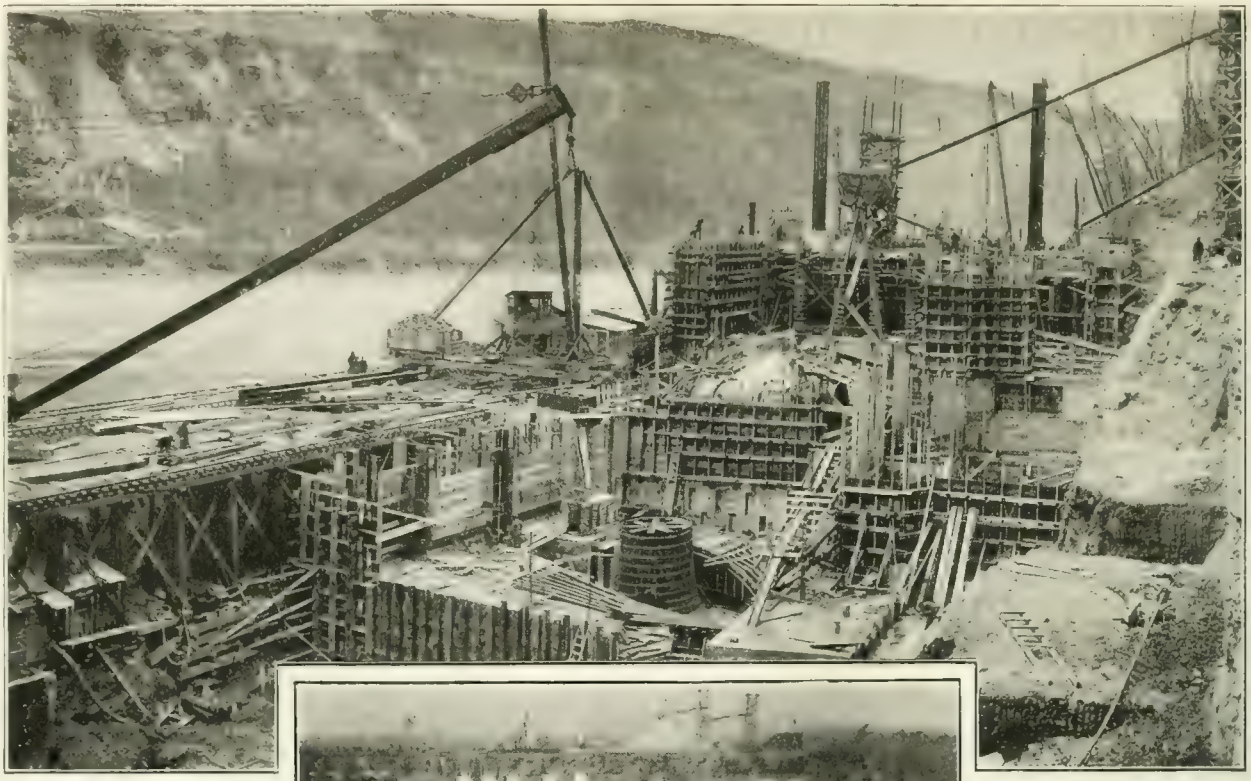
All electrical equipment contracted for to date, except some minor accessories, is estimated to cost about $4,000,000 and will be made in Canada.

FLOOR IS LEVEL WITH TOP OF THE GENERATORS

The entire equipment belonging to one unit, consisting of a generator, high-voltage and low-voltage switching apparatus and transformers, occupies a 50-ft. (15-m.) length of the station. The five units at present on order will require 250 ft. (76 m.) of the station, and 100 ft. (30 m.) more will be used for erection space and surplus equipment, making the building for the present 350 ft. (106 m.) long. The ultimate length will be about 650 ft. (200 m.).

The main generator room will be about 60 ft. wide

500,000-Hp. Development at Queenston, Ont.

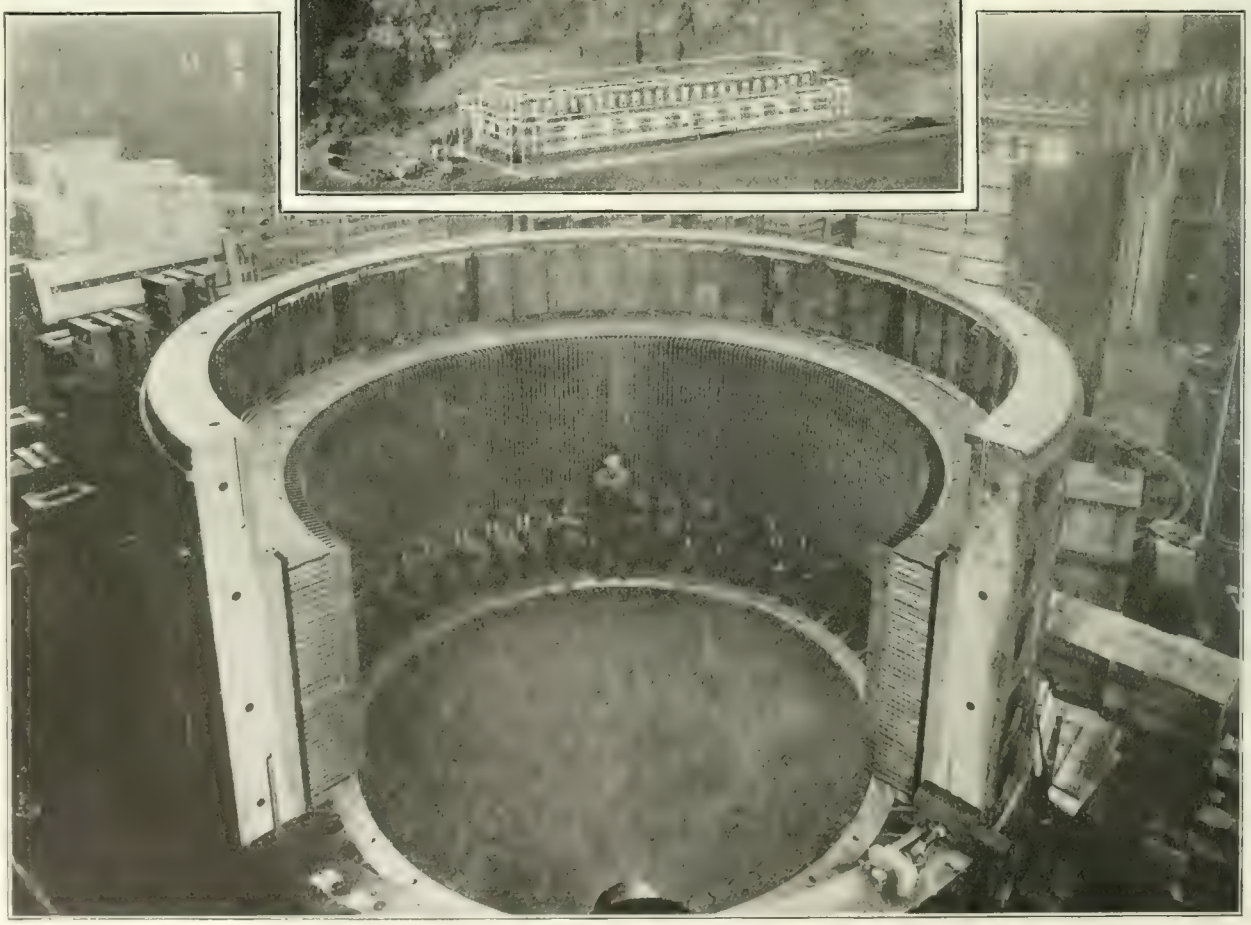


Top—Foundations under construction for three 50,000-hp. waterwheels.



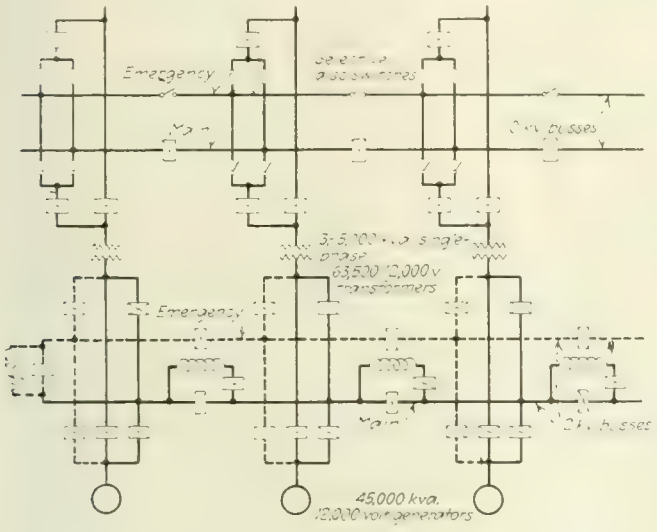
Center—Power-house site as seen from American side of Niagara River, showing openings at top of cliff for penstocks.

Bottom—Interior of one of the 45,000-kva. generators.



by 60 ft. high (18 m. x 18 m.). An interesting feature of the construction is that the floor of this room is level with the top of the generator frames. The space between this floor and the floor at the bottom of the generator is used for cooling-air ducts, power leads and piping. The space devoted to transformers and low-voltage and high-voltage switching apparatus is approximately 90 ft. wide and 100 ft. (27 m. x 30 m.) high.

The generator leads run beneath the generator-room floor to oil switches in an adjacent room on the same



ONE GENERATOR, ONE TRASFORMER AND ONE LINE FORM A UNIT IN THIS SYSTEM OF LAYOUT

The 12,000-volt emergency bus will not be installed unless future operating experience proves that it is necessary.

level. The low-voltage gallery for main and emergency buses is just above this room and the gallery for the low-voltage transformer switches is just above the bus gallery. Leads from this switch gallery pass into the transformer room, the floor of which is level with the generator floor. All high-tension oil switches are on a floor above the transformer room. On the top floor just above this are the main 110-kv. bus, lightning arresters and line disconnecting switches. The emergency high-tension bus is in a room below the oil switches and furthest from the generator room. The control room is above the generator room and overlooks the river.

RECORD HYDRAULIC INSTALLATION

Interest attaches to the hydraulic part of the installation on account of its record size and of certain details. Among the important features which diverge from standard practice are the large single-leaf control gates near the beginning of the canal, the 50,000-hp. turbines —which are the largest ever built—the location of the power house, the record size of the Larner-Johnson valves and the special details of ice skimmers and track racks. This plant takes water from the Niagara River about 1½ miles (2.4 km.) above the falls and delivers it, through a canalized river and a dug canal, a total distance of 13½ miles (21.7 km.), to the power house, which is under a bluff on the lower Niagara River 5 miles (8 km.) below the falls. The upper 4½ miles (7.2 km.) of the canal is in the Welland River, the flow of which is reversed for that distance, the canal section, cut partly through rock and partly through earth, being 8½ miles (13.6 km.) long. A single motor-operated vertical-lift roller gate for the purpose of controlling or entirely shutting off the flow will be installed at the upper end of the canal near Montrose, where the earth section of the canal merges into the rock section. The combination of span and head make this gate the largest ever built, and particular attention has been paid to the roller design in order to insure bearing loads well within safe limits. The clear width is 48 ft. (14.4 m.), and the height of the gate is 42½ ft. (12.7 m.). It has been decided to omit permanent gates in the screen house and the penstocks as it is thought that Johnson valves alone will be sufficient. To take care of any failure in the valves, removable gates made up in sections will be provided, which can be lowered into any penstock entrance by an electric traveling crane.

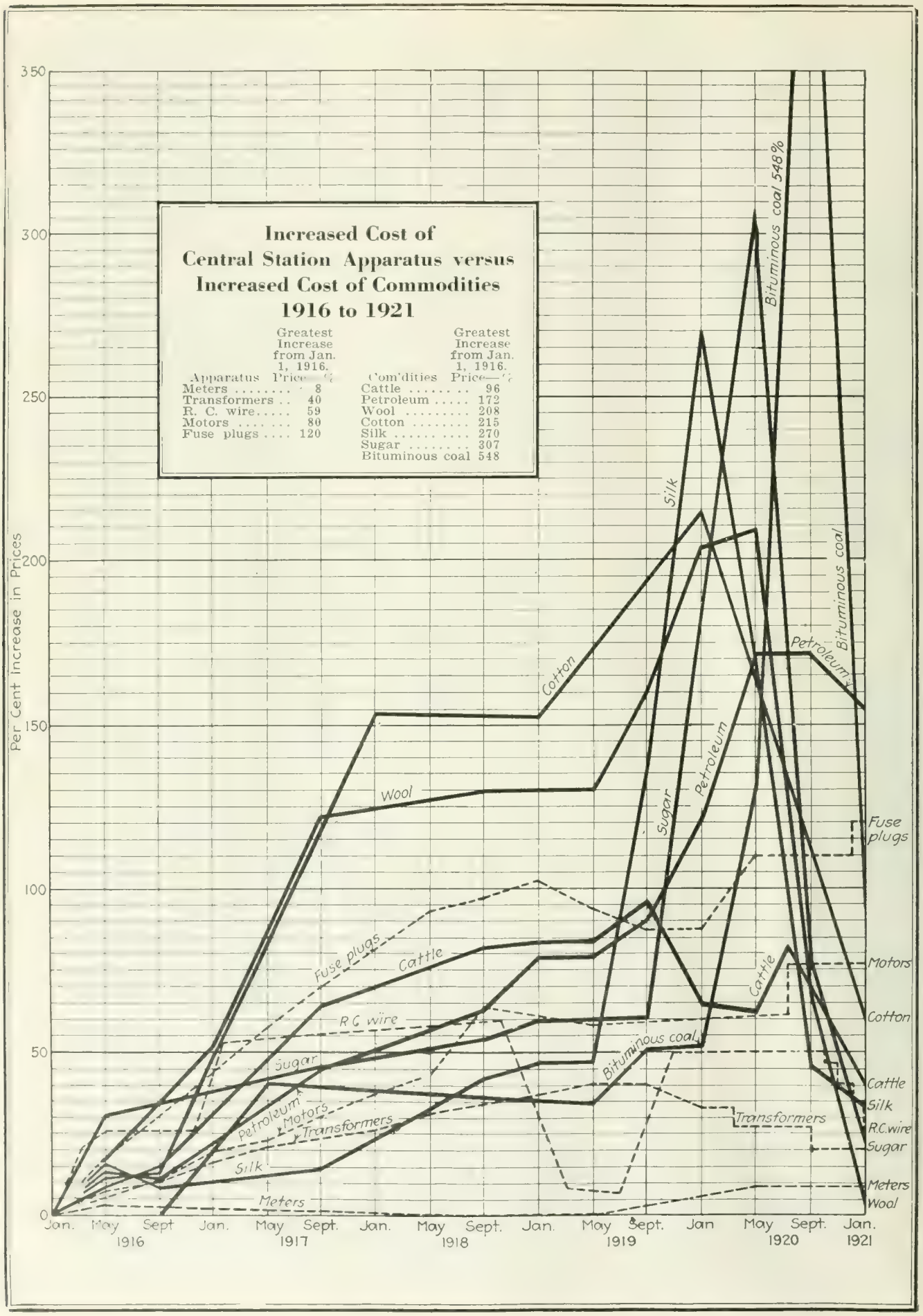
An elaborate ice skimmer has been made and will be installed later if necessary. This consists of a reinforced-concrete horizontally pivoted leaf which can be raised or lowered to skim floating ice off the surface into a discharge channel, at the same time allowing clear water to pass underneath the leaf.

RUNNER REMOVED WITHOUT DISTURBING GENERATOR

The turbines are of the vertical, spiral-case, single-runner type and will operate at a speed of 187½ r.p.m., which means a specific speed of 36. The maximum guaranteed efficiency is 90 per cent, although in view of recent practice it is expected that this efficiency will be exceeded. The inlet diameter of the scroll case is 20 ft. (6 m.), and the diameter of the runner is 10 ft. 5 in. (3.1 m.) at the inlet. An open space has been left in the power-house foundation below the runner in order that it may be taken out from below by removing a section of the draft tube, thus obviating the necessity of dismantling the generator when a renewal of the runner is to be made. The runners and spiral casings are cast steel, and a test pressure of 260 lb. per square inch (18 kg. per sq.cm.) is required on the latter.

The centrifugal-head relay valve controlled by each governor will be installed on the generator floor, while the main automatic valve control will be placed directly under the governor stand at the level of the turbine-regulating cylinder. This arrangement has the advantage of requiring short piping between the main valve and the regulating cylinders and gives freer access for repairs and maintenance. The pressure fluid will be water, probably treated with bichromate of potassium to prevent rusting and at the same time give a lubricating quality to the water.

Adjacent to each generator a control pedestal will be set up, and on this the various indicating instruments will be mounted. The control room will be so connected with the local control and indicators that the operator on the generating floor can handle the machine while in touch with the chief operator. Telegraph communication similar to a ship telegraph and a loud-talking telephone communicating with the control room are the principal means of transmitting signals. In addition to this a lamp mounted at the top of a column over the control pedestal will enable the chief operator to call the floor operator to any unit as required. The air-brake and Johnson-valve control will also be mounted on the pedestal. The location of this pedestal adjacent to the governor places the control of all the important operations of the unit within easy reach of the operator, while he is at the same time in communication with the control room.


Increased Cost of
Central Station Apparatus versus
Increased Cost of Commodities
1916 to 1921
Greatest Increase from Jan. 1, 1916.
Apparatus Price—%
Meters 8
Transformers .. 40
R. C. wire..... 59
Motors 80
Fuse plugs 120
Com'dities Price—%
Cattle 96
Petroleum 172
Wool 208
Cotton 215
Silk 270
Sugar 307
Bituminous coal 548
Per Cent Increase in Prices
350
300
250
200
150
100
50
0
Jan. May Sept Jan. May Sept. Jan. May Sept. Jan. May Sept. Jan May Sept. Jan.
1916 1917 1918 1919 1920 1921
Bituminous coal 548%
Silk
Bituminous coal
Petroleum
Cotton
Wool
Sugar
Petroleum
Fuse plugs
Cattle
R.C. wire
Sugar
Petroleum
Motors
Transformers
Silk
Meters
Fuse plugs
Cattle
Motors
Cotton
Cattle
Silk
R.C.wire
Sugar
Meters
Wool
Bituminous coal
Transformers

Basic Schedule of House Wiring Costs

Principles that Have Been Used in Pricing More than $500,000 of Wiring Annually Explained by N. E. L. A. Sub-Committee, Consisting of A. L. Nelson, Chicago; C. Renshaw, Pittsburgh, and R. H. Tillman, Baltimore

FORTUNATELY all house wiring is so much alike that except in unusual cases it is entirely practicable to base prices on a pre-arranged schedule instead of estimating each job separately, and this plan is commonly used. Most of the schedules which have been devised for this purpose, however, have been so general and have omitted so many essential details that they have not been satisfactory. It is possible, however, to devise schedules which make due allowances for type of building being wired and which are yet so simple that they can be readily used. One such schedule has been devised by the Commonwealth Edison Company of Chicago and used by it and local contractors for several years. This schedule has been found not merely to give correct prices on the basis of averages, but to yield uniform profits for the individual jobs, and thus to conform to sound business principles. It has been used in the pricing of house wiring totaling more than $500,000 per year, and it has given complete satisfaction.

The first and most important principle on which this schedule is based is that in making up the price for wiring buildings the service entrance (including the first meter loop and the first circuit) should be covered by a separate item instead of being averaged with the outlets. Additional circuits, when required, should be covered in the same way. In the case of apartment buildings also additional meter connections, after the first, should likewise be listed independently. Second, the effect of the size and type of building on the various items of cost should be recognized, as well as that of the number of stories.

The third principle upon which the schedule is based is that certain types of outlets are inherently more costly than others.

In addition to the above the prices have also been carefully arranged to care for other variations in procedure, which have been found by experience to affect the cost. It will be noticed, for instance, that for service entrances the price is less for a one-story building with a flat roof than for a similar building with a peak roof, or for building of more stories. This is due to a local requirement in Chicago that the service entrance in conduit must extend to the level of the second-story ceiling, or on buildings which are of less than two stories to the highest point on the building.

In apartment buildings an additional charge is made on circuits where switches have been omitted. The work is made more difficult by the omission.

Outlets in public halls in apartments cost more than other outlets, because usually they are supplied from a separate meter, and the average length of conductors for such outlets is greater than in the living rooms.

HOUSEWIRING SCHEDULE.

Table 1. Prices of Service Entrances and Circuits for Residences.

Type of Building.	Service with meter, first Circuit (1 to 16 lights)	Second Circuit (17 to 32 lights)	Each additional Circuit (33 to 48 lights etc.)
One story building with flat roof.	$13.20	$6.90	$3.85
All other residences.	14.35	6.90	3.85

Table 2. Outlet Prices for Residences.

Schedule No.	Stories	Type of Building. Description	Min. no. of Outlets (Including Switches)	Ceiling Outlet	Wall Outlet	Baseboard Outlet	Push Switch and Plug Outlet	S.P. Switch Outlet	3 Way Switch Outlet.
1	1	Open attic, no basement, or unfinished basement.	6	$3.95	$4.45	$5.45	$5.75	$4.60	$5.15
2	1	Open attic, finished rooms in basement.	6	4.30	4.90	5.45	5.75	4.60	5.15
3	1	Flat roof, with or without basement.	6	4.30	4.90	5.45	5.75	4.60	5.15
4	1½	With or without basement.	6	4.30	4.90	5.45	5.75	4.60	5.15
5	2	Peak roof, open basement	7	4.30	5.30	5.45	5.75	5.15	5.50
6	2	Peak roof, no basement, or finished rooms in basement	7	4.60	5.60	5.75	6.00	5.15	5.50
7	2	Flat roof, open basement.	7	4.90	5.85	5.75	5.75	5.15	5.50
8	2	Flat roof, no basement, or finished rooms in basement	7	5.15	6.15	6.00	6.60	5.15	5.50
9	2½	With open basement	7	4.60	5.60	5.75	6.00	5.15	5.50
10	2½	With no basement, or finished rooms in basement.	7	5.00	6.00	6.15	6.45	5.15	5.50
11	3	Ordinary Residence.	8	6.00	7.60	7.45	6.60	6.30	6.25
12	4	Ordinary Residence.	10	6.30	7.90	7.45	6.60	6.30	6.25

HOUSEWIRING SCHEDULE.

Table 3 Prices of Service Entrances and Circuits for Apt. Bldgs.*

Type of Building	Service with meter, first circuit	Each additional circuit (not exceeding 48 lights) on same meter	Each additional meter with first circuit on any main wiring meter
One story, flat roof	$13.20	$4.10	$6.90	$3.85
One story, peak roof, or 1½ story	14.35	4.10	6.90	3.85
Two story	17.25	4.10	6.90	3.85
Two and one half story	17.25	4.20	6.90	3.95
Three story	19.55	4.20	6.90	3.95
Four story	19.55	4.30	6.90	4.10

* The prices listed for service entrances are for single buildings, or for double buildings, not exceeding one and one half stories. For double buildings of 2 stories or more the prices for service entrances are 50% more than those given in the table.

* For each circuit having no switch the price in the table will be increased by $2.00 for two story buildings, $2.25 for 2½ or 3 story buildings and $2.50 for 4 story buildings.

** There is usually required one meter for each apartment in the building and one meter for public hallways etc.

Table 4. Outlet Prices for Apartment Buildings.*

Schedule No.	Stories	Type of Building Description	Min. Outlets per Circuit	Ceiling Outlets	Wall Outlets	Baseboard Outlets	Push Sw. and Plug Outlets
13	1	Open Attic, no basement or unfinished basement	6	$3.95	$4.45	$5.45	$5.75
14	1	Open Attic, finished rooms in basement	6	4.30	4.90	5.45	5.75
15	1	Flat roof, no basement or unfinished basement.	6	4.30	4.90	5.45	5.75
16	1	Flat roof, finished rooms in basement	6	4.60	5.20	5.75	6.00
17	1½	With open basement	6	4.30	4.90	5.45	5.75
18	1½	With finished rooms in basement	6	4.60	5.20	5.75	6.00
19	2	Peak roof, open basement	6	4.30	5.10	5.45	5.75
20	2	Peak roof, no basement, or finished basement	6	4.60	5.40	5.75	6.00
21	2	Flat roof, open basement.	6	4.60	5.40	5.75	6.00
22	2	Flat roof, no basement or finished basement	6	4.90	5.65	6.00	6.30
23	2½	With open basement	7	4.60	5.60	5.75	6.00
24	2½	With finished rooms in basement	7	5.00	5.80	6.15	6.45
25	3	Peak roof, open basement	7	4.90	5.65	6.00	6.30
26	3	Flat roof, open basement	7	5.00	5.80	6.00	6.30
27	3	Peak roof, no basement or finished basement	7	5.15	5.95	6.30	6.60
28	3	Flat roof, no basement or finished basement.	7	5.30	6.05	6.30	6.60
29	4	With open basement	7	5.30	6.05	6.30	6.60
30	4	With finished rooms in basement	7	5.55	6.35	6.60	6.90

* Single pole Switch Outlets $.60 each in buildings of 2 Stories or less and $.15 each in buildings of 2½ to 4 Stories

* Three way Switch Outlets $.15 each in all buildings of 1 to 4 Stories

* Outlets of any kind in public halls, $.50 each in all buildings of 1 to 4 Stories

* Where there is alternating switching in public hallways (i.e. where lights are controlled by two or more switches) add $.50 for each building

SERVICE AND OUTLET PRICES FOR DIFFERENT TYPES OF RESIDENCES AND APARTMENT BUILDINGS

Apartments over stores are more difficult to wire, because of the lack of partitions in the stores.

For the same general reasons it is more expensive to wire a store than to wire an apartment even when open conduit is used for a portion of the work. Obviously, the additional cost is less when there is an open basement under the store to facilitate the work than when there is none.

TABLE 5—OUTLET PRICES FOR WIRING ONE OR MORE APARTMENTS BUT NOT THE COMPLETE BUILDING

Schedule Number	
31	For wiring first apartment in three or four-story building, charge two-story schedule plus 50 cents per outlet.
32	For wiring second apartment in three or four-story building, charge three-story schedule plus 50 cents per outlet.
33	For wiring third apartment in four-story building, charge four-story schedule plus 50 cents per outlet.
34	For wiring top apartment in three-story building, charge three-story schedule plus 35 cents per outlet.
35	For wiring top apartment in four-story building, charge four-story schedule plus 35 cents per outlet.

Where wire guards are desired in any of the above cases, add 30 cents each. Duplex receptacles, add $1 each.

The price for wiring any residence or apartment building is made up of a charge for service entrance, meter connections, and circuits, together with a charge for each outlet. These prices vary with the size and construction of the building as well as with the type of outlets, as indicated in the following tables. Under certain circumstances there are various other items to be charged for, as likewise indicated.

The prices cover wiring ready for the attachment of fixtures, but they do not include any fixtures or other devices. These items should be covered by a separate contract. In certain cases, however, single sockets at each outlet, either hung by drop cords or mounted on the wall, are considered sufficient, and these may be included in the wiring contract at the prices given in Table 6.

Where additional outlets are specified after the work of wiring has been started, the price for these outlets will be 10 per cent greater than the prices given in the tables. Where the number of outlets originally specified is reduced after the work is in progress the credit allowed is 10 per cent less than the prices given in the table.

Residences.—The charges for service, meter connections and circuits are given in Table 1. To these must be added the proper charges for outlets in accordance with Table 2.

Apartment Buildings.—The charges for service, meter connections and circuits are given in Table 3 and the notes below it. To these must be added the charges for outlets in accordance with Table 4. The prices given in Table 4 are based on wiring the entire building at one time. If this is not done the prices given in this table must be increased in accordance with Table 5.

Stores.—Where apartment buildings include stores an additional charge of $5 per circuit will be made for wiring the apartments over the stores. In wiring stores the following charges should be added to the regular schedule prices:

One and one-half story building	$11.50
Two to four-story building, open basement	12.65
Two to four-story building, finished rooms or no basement	16.10

These prices cover wiring the store by using exposed conduit along the corner of the ceiling and concealed armored cable from this conduit to the various outlets. If it is desired to have all the wiring concealed the price for meter connection (not including service), circuits and outlets for the store will be 25 per cent greater than corresponding figures in Tables 3 and 4.

Garages.—For wiring individual garages and connecting them to the circuits and meters of residences or apartments the price is made up of a charge for extending the circuit, a minimum price for wiring (which includes certain outlets) and a charge per outlet fo additional outlets. The minimum charge for wiring is $28.75, and this covers one drop cord, one wall receptacle and one switch, together with a 15-ft. extension cord. For additional outlets the charge is $3 each.

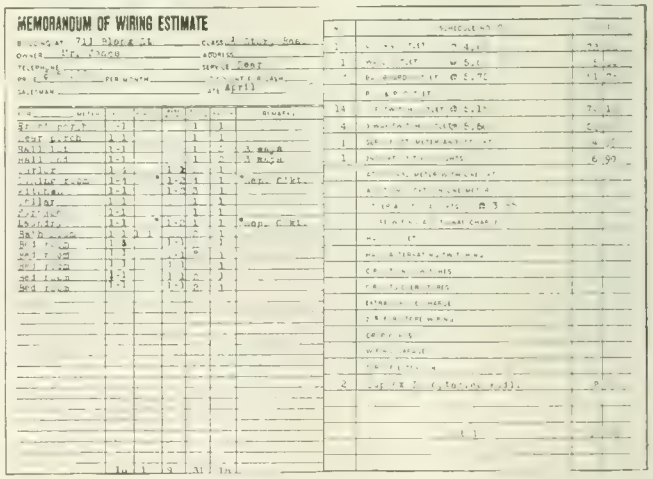
TABLE 6—PRICES FOR WALL AND DROP CORD SOCKETS WHERE THESE ARE USED INSTEAD OF FIXTURES

	Wall Socket	Drop Cord with Steel Box Cover	Drop Cord with Brace Canopy	Drop Cord on Gas Outlets
With key socket, each....	$0.80	1 05	$1 40	$1 50
With chain pull socket, ea.	1.05	1 25	1 60	1 75

Where wire guards are desired in any of the above cases, add 30 cents each. Duplex receptacles, add $1 each.

Service Extension.—Where service must be carried along outside wall of a building the charge is 35 cents per conduit foot. Overhead lawn service between buildings, first 20 ft. $5.15 and 9 cents per foot additional work. The capacity covered by these prices is 100 lights or less.

As a means of illustrating the working of the schedule it has been applied to a two and a half story residence. The costs have been worked out in detail on the estimate sheet, and it will be seen that while all of the various items are taken fully into account the pricing of the job with the aid of the schedule is very simple and gives a total figure of $256.


MEMORANDUM OF WIRING ESTIMATE

SAMPLE ESTIMATE USING SCHEDULE

These prices were used in Chicago prior to May, 1920. They cover the use of rigid conduit for all wiring in basements and the use of armored cable for all other wiring. For service entrances the prices cover No. 14 wires in ½-in. conduit, where the current is 15 amperes or less, and larger sizes of wire and conduit where necessary to comply with National Electrical Code requirements.

Where the current for a two-wire service would be more than 24 amperes a three-wire service is used.

The prices were based on a wage of $1 per hour for wiremen and on the prices for material which were in effect at that time. Owing to an advance in wages the actual prices used have since been increased.

Cost of Energy Fundamental in Design of Distribution Systems*

Necessity of Distinguishing Between Value for Rate-Making Purposes and That for Economic Studies—General Methods for Obtaining Total Charge per Kilowatt-Hour at Any Point on a System—Conditions Governing Variations in Unit Cost

By P. O. REYNEAU† and H. P. SEELYE‡
Detroit Edison Company

SINCE any economic study of transmission or distribution is, fundamentally, a consideration of the cost of energy or energy losses as compared with other costs—in general fixed charges increase as energy loss decreases—it is of the utmost importance that the cost of energy be accurately determined. The value assigned to the unit cost of energy may be the deciding factor in a problem. This value, moreover, may vary considerably according to the assumptions, methods and precision employed in its calculation. It is evident that the cost per kilowatt-hour of the energy used by a 5-hp. motor running one hour per day 25 miles north of the generating station may be quite different from the unit cost for residence lighting load 5 miles west of the station, and both of these may be far from the average unit cost over the whole system. The question of the determination of energy cost offers an extensive field for study and one that, generally speaking, has been only touched upon. No detailed treatment of the subject can be given here, but some of the fundamental principles involved will be presented with a few methods of attacking the general problem and suggestions as to conditions governing variations in the general cost as applied to particular uses.

In studying energy cost the fundamental difference between the cost of energy for rate-making purposes and the cost of energy for economic studies must be recognized. In determining the cost of energy for the purpose of adopting a rate scale it may be sufficient to consider the system as a whole and determine the average cost per unit for each of a few general classes of load which have markedly different characteristics. The chief point to be kept in mind is the amount which the customer pays, and that this, on an average, should at least equal the expense of the company plus a reasonable profit. Usually about the same rate must be applied to similar customers within a reasonable area unless there is a marked difference in the individual cost of serving each. There are also other factors than actual production and distribution cost which must be considered in rate making, such as public opinion, regulations and franchise agreements, previous practice, competition, etc. On the other hand, in making an economic study we are interested in the actual amount which the energy delivered to the point under consideration is costing the company, and hence in how much money, if any, can be saved by reducing energy losses. If energy costs more per unit 5 miles from the station than it does 1 mile from the station, for example, the amount saved will be correspondingly more important. For this purpose, then, it would seem desirable to investigate the cost of energy as fully as is warranted by the amount and accuracy of the information available on costs of construction and operation and on loads carried.

Even with fairly complete data at hand it is a difficult matter to determine definite figures for energy costs. The cost is affected by many quantities of a variable nature, and these limit the extent to which it is practicable to carry the study. At any given point the cost of energy is largely dependent on the fixed charges and operating expenses of the central station and of the distribution system between the station and that point. It is also affected by the size and characteristics of the load at the point in question in relation to all the other loads on the system. Hence, strictly speaking, energy cost may be conceived as having a different value at every point on the system and for every different load at any given point. Loads of the same type may show a different unit cost according to their size, and the unit cost may vary at different times during the day or even for different parts of the same load. The length to which the determination of cost of energy might be carried is almost infinite. In practice it will depend not only on the accuracy of the data available but also on how this cost is to be used.

CLASSIFICATION OF COSTS OF A CENTRAL-STATION SYSTEM

The various items entering into the total annual cost of a central station may be classified as follows:

1. Costs dependent on the number of customers.
2. Costs dependent on the peak load carried or the demand.
3. Costs dependent on the total output in kilowatt-hours during the year.

This method of classification, which was suggested by Dr. John Hopkinson in England in 1892 and was later enlarged upon by H. L. Doherty and other writers, is quite generally accepted as sufficient for ordinary purposes. It must not be assumed that all expenses come strictly under one of these three classifications. There are a great number of other minor divisions which might be made. For example, there are certain operating expenses at the station which are dependent on the efficiency and size of the machines and the relation of the load at any time to the capacity of the generators in use and to the method of operating the station and the system. It does not appear practicable, however, to attempt to include all such classifications. The above three are the ones of most importance, and

*Third installment of a series on "Economics of Electrical Distribution"; see also ELECTRICAL WORLD, Jan. 8 and Jan. 15, 1920.
†Distribution engineer.
‡Distribution department.

other costs can be included in one of them without great error.

Consumer's Cost.—The first division, consumer's cost, usually need not be considered in determining energy cost for economic study, as it is independent of the amount of load carried. This cost occurs beyond the limits of the lines and need be added only when determining the charge to the customer. Care must be taken, however, that charges actually belonging to this classification are not included under either of the other heads. Here rightfully belong the greater part of charges for general office expense, sales expense, metering, billing, collection, etc., part cost of service wires and a percentage of various other charges according to local conditions.

Demand Cost and Output Cost.—The two other cost divisions, demand cost and output cost, must include all charges which are dependent on the load carried. The demand cost is that part of the total cost which is caused by the fact that the system is built and operated to care for a certain maximum load. If this peak load is 100,000 kw. the station must have a capacity of at least 100,000 kw., with a reasonable amount of reserve, regardless of the fact that that capacity may be reached for only a short time each day. The output cost or kilowatt-hour cost, on the other hand, is that part of the total cost which is occasioned by the total output in kilowatt-hours regardless of the *rate* of that output.

Some items of the total annual cost clearly belong only to demand cost, while others which might seem to depend only on output have some percentage of demand cost included. In the first group come interest, taxes, insurance, depreciation, etc., on the generating station building; interest, taxes, etc., on boilers, turbines, generators and other equipment, and a large part of their depreciation and maintenance. Fixed charges on lines and substation equipment are also here included. Under the second group come part of the cost of coal, oil and other expendable materials, part of the labor of operating, also part of the energy losses on lines and transformers due to the fact that they are kept energized at all times. The apportioning of such costs is a matter for considerable study. The method of operation may affect the amount chargeable to demand in certain cases. Large machines are less efficient at small loads. Hence if large units are employed and are run far below their most economical load for the greater part of the day the extra expense due to decreased efficiency may be charged to demand. In a large, efficiently operated station this condition would not arise to any great extent, but it suggests some of the items which must be considered. In fact, there must be included in demand cost all charges directly or indirectly occasioned by the total capacity of the system. The remaining annual costs, aside from the consumer cost before mentioned, may be considered as dependent on the output. These comprise the kilowatt-hour cost.

Methods of Making Classification

The actual division of the total annual cost on any part of the system into three classifications will depend largely on local conditions. The relative percentages will probably be different for each company. Several general methods of attacking the problem are in use. In the generating plant, for example, an empirical analysis can be made of each item of cost, such as charges on building, on steam equipment, on electrical equipment, fuel, labor, etc. The proportion belonging to each classification may be estimated from known conditions, keeping in mind the general definitions of demand cost, kilowatt-hour cost and consumer cost. One method of separating demand and kilowatt-hour charges on fuel, lubricants and such items is by comparing costs under a period of light load and under one of heavy load—a month at different seasons of the year for example.

If C_d = demand cost per unit demand,
C_f = kilowatt-hour cost,
D = station demand,
F_1 = kilowatt-hours at low period,
F_2 = kilowatt-hours at high period,
C_1 = total cost at low period,
C_2 = total cost at high period,
$C_1 = C_dD + C_fF_1$,
$C_2 = C_dD + C_fF_2$,
$C_f = (C_2 - C_1) \div F_2 - F_1$,
$C_d = (C_1 - C_fF_1) \div D$.

This should give satisfactory results if there is enough difference between the loads at the two periods to give a good comparison of cost.

Another somewhat similar method* that may be applied to items such as total station or system costs, which involve all three classifications, considers the total cost over three given periods—three years, for example, or three different months. Using similar symbols to the above:

C_c = customer's cost,
N = number of customers,
$C_1 = C_dD_1 + C_fF_1 + C_cN_1$,
$C_2 = C_dD_2 + C_fF_2 + C_cN_2$,
$C_3 = C_dD_3 + C_fF_3 + C_cN_3$.

If these are solved simultaneously the values of C_d, C_f and C_c can be determined.

An example of a typical division of costs between demand and kilowatt-hours of some of the items for the generating station is as follows:

	Demand Per Cent	Kw.-Hr. Per Cent
Superintendence	100	
Wages	90	10
Fuel	25	75
Lubricants	25	75
Station supplies, etc.	100	

These general methods may be adapted to other parts of the system, transmission lines, substations, etc., as well as to the generating plant. In analyzing the cost of a hydro-electric plant the available supply of water is an important factor in the consideration. It is evident that the kilowatt-hour cost will depend considerably on whether the supply is unlimited or whether storage is resorted to for regulating the flow.

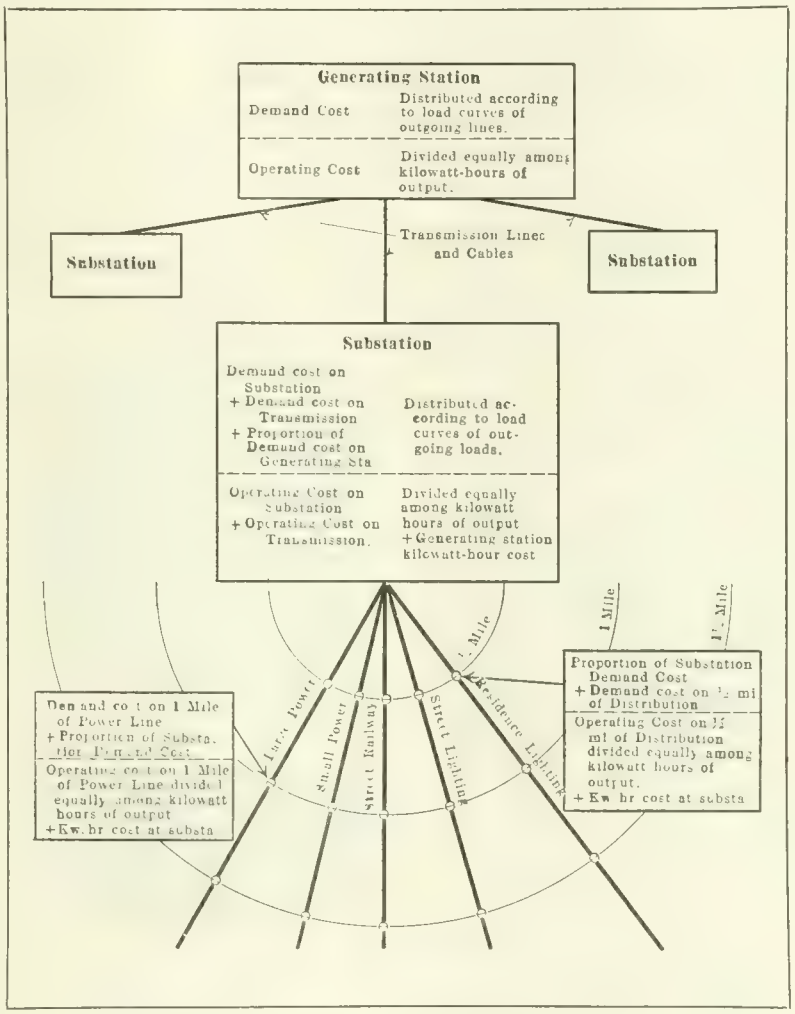
It appears, then, that the first step in the study of energy cost is the determination as accurately as possible of the total annual costs on each subdivision of the system and the proportion of these costs in each case belonging to demand and to output. Naturally the more detailed the accounting record on various parts of the system the easier the determination of these costs will be. If an entirely new system is being considered the various quantities can only be estimated from data of other similar systems and present prices on construction materials, equipment, etc. For the purpose under consideration, if the study of energy

*This method is more fully explained in "Central-Station Rates in Theory and Practice," by H. E. Eisenmenger, *Electrical Review*, Vol. 75, Aug. 23, 1919, page 305.

cost is to be carried to any degree of exactness, it is probably better to prepare separate figures on each of the three classifications of costs as related to different parts of the system, generating station, various substations, underground cable lines, overhead power lines, feeders, etc. Just how much of such detail is necessary will be determined by the method which is to be used in apportioning the costs among the various classes of loads and localities.

Apportioning of Demand and Output Costs to Various Types of Loads

When the proportions of the total cost chargeable to demand and to output have been determined there arises the problem of finding what part of that demand cost or of that kilowatt-hour cost belongs to any particular load or type of load. The kilowatt-hour cost may be simply disposed of for the present by considering that the kilowatt-hour charge at any point in the system is equal to the sum of the kilowatt-hour costs incurred on all parts of the system from that point back to the generating station. Considerable study may be involved in determining the kilowatt-hour costs on such parts as transmission lines or power lines, since a great part of the cost depends on the energy losses, and the cost of these losses in turn includes the demand and kilowatt-hour charges up to that point. The theory is not complex, however. Modification of this method for special purposes will be explained later. The apportioning of the demand cost presents a more difficult question.



GENERAL METHOD OF STUDYING ENERGY COST AT VARIOUS POINTS ON A SYSTEM

If all loads had similar characteristics—*i.e.*, similar load curves, with the peak coming at the same time—it is evident that the demand charge for each would be simply proportional to its peak load. This assumption is sometimes used in figuring energy cost, but is obviously not correct except in cases where all loads are similar or nearly so, such as for a plant serving residence lighting only. On this assumption the demand charge per kilowatt may be reduced to a figure per kilowatt-hour inversely proportional to the load factor, and this added to the kilowatt-hour charge determines the total cost of energy. Where both lighting and commercial power or other loads are carried, however, it is evident that the demand responsibility of each cannot be accurately obtained in this way as the peaks come at different times and the loads show different characteristics throughout the day. For example, the power peak might come at the same time as the station peak, perhaps at 2 p.m., whereas the lighting peak comes at 8 p.m., the lighting load at 2 p.m. being only 30 per cent of its peak.

Again, the assumption might be made that the demand charge of any load is proportional to its demand at time of station peak. This might sound reasonable inasmuch as the demand cost of the station is figured on the basis of its peak load. The demand responsibility for any customer is sometimes computed on this basis by multiplying his total connected load by his demand factor to get his individual demand, dividing this in turn by the diversity factor on the line for his proportion of the line demand, this by the diversity factor of the substation, and so on back to the generating station, thus determining that customer's proportion of the station peak. Of course a careful determination of diversity and demand factors is necessary for this. Here again the variable characteristics of the different loads make this assumption erroneous except in special cases. Take for a simple example a small station of 1,000 kw. serving two customers A and B. A takes 1,000 kw. for six hours each day. B takes 600 kw. for the remaining eighteen hours but does not overlap A. On the assumption of demand proportional to individual peak load A's cost would be ten-sixteenths and B's six-sixteenths of the total demand cost. On the assumption of demand proportional to load at time of station peak A's proportion would be the whole station demand and B's nothing.

If the station may be considered as consisting of two parts, one of 600 kw. capacity and one of 400 kw., it will be seen the 600-kw. may operate six hours for A and eighteen for B, while the 400 operates six hours for A. Thus A's cost would be:

$$\frac{400}{1{,}000} + \frac{6}{24} \times \frac{600}{1{,}000} = \frac{2}{5} + \frac{3}{20} = \frac{11}{20}$$

of the total, while B's would be

$$18 \div 24 \times (600 \div 1{,}000) \text{ or } \frac{9}{20} \text{ of the total.}$$

This theory can also be extended to cover any number of loads with variously shaped curves. It may be stated in general that the cost of each unit (kw.) of the total demand should be divided in accordance with the length of time or number of hours it is in use to obtain an accurate apportioning of demand cost. A full explanation of this theory, with examples of its application, may be found in "Central-Station Rates in Theory and Practice," by H. E. Eisenmenger, *Electrical Review*, Vol. 75, Aug. 2 and 9, 1919. Ordinarily sufficient data in regard to the various load curves may not be available or the degree of accuracy desired in the result will not warrant an extensive analysis on this basis. There is no doubt that theoretically it will give a more acurate distribution of the demand cost for most purposes than either of the other methods mentioned, and the principles involved may often be used to advantage even in a more approximate determination. For some special uses, as will be explained later, the second method given above is preferable.

General Method for Determining Demand Cost at Any Point

In order to determine the demand cost at any point on the system other than the generating station the following general steps should be followed:

1. Apportion the generating station demand cost among the various substations by one of the above methods, in accordance with their loads.

2. For any substation add to its portion of the generating station cost the demand costs on its transmission cables and on the substation itself.

3. The total demand cost for the station can now be distributed among the various lines feeding out from it, and by repeating the same method the cost at any point or for any customer may be determined. If more general figures only are desired the total demand cost for the station may be divided among various classes of load, such as lighting, commercial power, street lighting, street railway, etc. By assuming average figures on line costs the cost at any distance from the station for each class of load can be determined. The analysis may be extended in a similar manner to cover suburban transmission lines, substations and distribution, even where several substations intervene.

Any such analysis should give a fairly accurate demand charge at any point. It requires, however, quite a large quantity of accurate data for its accomplishment. Detailed annual costs on each subdivision of the system must be known. Moreover, the load curves throughout the year for each load considered, such as substations, power lines, etc., must be studied to obtain one or more characteristic curves for each as a basis of analysis. Where a load shows an appreciable seasonable variation several curves may be necessary, as for high load, low load and average load. In many cases it will be found practicable to determine a general characteristic curve for each type of load, such as residence lighting, street lighting, street railway, large power, small power, etc., and refer all loads of that type to it, assuming that the curve will be always proportional to the peak load. The collection, classification and proper selection of data will be found to be a large part of the whole problem of determination of energy cost and requires the application of a high degree of engineering knowledge and judgment.

All the formulas which will be developed later include the cost of energy as one total charge per kilowatt-hour. The computations might be made with the demand charge and the kilowatt-hour charge as two separate quantities, but it is found more convenient to use a single charge per kilowatt-hour. If the above analysis is carried out in detail the demand charge for energy will be determined as a different amount for each type of load and for any distance from each substation. The kilowatt-hour charge will be the same for all loads in any one locality. Since the average load factor for any type of load considered may be determined the demand charge can be reduced thereby to a charge per kilowatt-hour, since kw.-hr. = kw. $\times$ load factor $\times$ 24 $\times$ 365 per year. This added to the output or kilowatt-hour charge will give the total charge per kilowatt-hour for that class of load at that point.

Easily Inspected Auto-Starter

AN AUTO-TRANSFORMER starter which is easily opened for inspection is being manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee. No wood or casting is used in the construction. The case is strongly reinforced with angle iron and has a hinged cover which can be lifted to expose the transformers and relay. The special construction of the transformer core allows either coil to be easily and quickly replaced. Each coil is provided with three accessible taps which give 50, 65 and 80 per cent of full-line voltage. The oil-immersed commutating mechanism is placed at the bottom of the case below the transformers and may be exposed for inspection by removal of the oil pan, a simple one-man job. An ample head of oil is maintained above the contacts and a double horizontal break is provided in each line. Breaking the circuit horizontally confines the arcs between the copper contacts and prevents burning of other parts.



THIS AUTO-STARTER CONTAINS NO WOODEN OR CAST PARTS

The low-voltage mechanism is mounted inside the case on the right-hand side. A duplex overload relay with a true inverse-time-limit movement is mounted inside the case on the transformer assembly in such a position that adjustments for time and current values can be readily made. This duplex relay is equivalent to two overload relays, each in series with one or two phases. Rigid copper leads are used throughout, with the exception of four flexible stationary leads to the transformer taps and low-voltage coil.

These starters are made in various sizes for the operation of two-phase or three-phase induction motors rated between 5 hp. and 100 hp. on standard commercial voltages between 110 and 2,200 and at frequencies of 60, 50, 40, 33 and 25 cycles per second.

Temperature Rise with Short-Time Loads

From Usual Shop Test Data It Is Possible to Predict Temperature Rise for Electrical Machinery on Fairly Well Defined Load Cycle

BY R. E. HELLMUND
Engineer Westinghouse Electric & Manufacturing Company

IN MANY applications of electric motors, such as crane, hoisting or railway motors, it often occurs that after the motor has assumed a certain temperature rise the load changes for a definite period and it is desirable to predetermine the temperature rise at the end of such period. While any calculation of temperature rises is, by necessity, rather inexact, it is believed that the method shown in this article will lead to better results than were obtained by the estimates usually made in the past.

A few simple formulas are first discussed to establish the relation between temperature rise for short-time loads and the characteristics of the motor as given in the usual shop tests. Having determined two constants, depending upon the ventilation and total mass characteristics of the motor, the temperature rise for any short-time load which may occur in actual operation may be determined from a simple equation. A practical example is worked out for a series motor, and by following this method it should be easy to calculate the temperature rises for other cases.

Discussion of Equations for Temperature Rise

The amount of heat generated in a motor is proportional to the total losses (L) in the motor. Such heat is either absorbed by the masses of the motor or taken away by the surface ventilation and radiation.

If L_a gives the losses which are absorbed by the masses of the motor, the temperature rise (dT) in a very short time (dt) is:

$$dT/dt = L_a/M, \tag{1}$$

where M is a constant, which is larger the larger the masses of the motor and their heat-absorbing capacity.

The losses (L_v), which can be taken care of by surface ventilation depend upon the amount and type of ventilation and difference of temperature (T) between the motor parts and the surrounding air—that is, the existing temperature rise. With forced ventilation, the amount of ventilation remains constant for all conditions, but even for natural ventilation it can in most cases be assumed as virtually constant for the period of special load under consideration.

We may, therefore, set approximately

$$L_v = KT, \tag{2}$$

where T is the existing temperature rise and K is a constant given by the type and amount of ventilation.

It is evident now that the losses L_a, which have to be absorbed by the masses at any time, must be the difference between the total losses L and the losses L_v, taken care of by the ventilation. Thus we have

$$L_a = L - L_v = L - KT. \tag{3}$$

By introducing this into equation (1) and solving the linear differential equation we get:

$$T = e^{-Kt/M}\left[\left(\frac{LM}{MK}\right)e^{Kt/M} + C\right]. \tag{4}$$

The integration constant C can be determined by substituting the initial temperature T_o at the time $t = 0$ in equation (4), giving

$$C = T_o - L/K. \tag{5}$$

By introducing this into (4) we get:

$$T = L\,K + \left(T_o - \frac{L}{K}\right)e^{-Kt/M}. \tag{6}$$

We have, therefore, a formula for determining the temperature T at any time during the period of special load, giving the average losses L.

It remains now to determine the values L, K and M from data usually available in practice.

The losses L can be taken from a curve showing the total losses in the motor against output torque or horsepower. If such a curve is not available, it can be easily derived from the efficiency curve.

The ventilation K has to be derived from an available continuous-load run for which the maximum temperature rise T_o and the total losses are known. With motors having forced ventilation the usual continuous rating test can be used for this purpose. For motors with natural ventilation the test should be made corresponding to the average speed prevailing during the period of special load under consideration. Usually it will be best to take available continuous load tests for several speeds and plot a curve for the values of K against speed, as found from

$$K = L_c/T_c, \tag{7}$$

where L_c = losses for the continuous test,
T_c = maximum temperature rise for the continuous test.

The mass constant M has to be determined from an available short-time test. Usually the hour rating test can be used for this purpose, although a shorter test will give more correct results, especially with smaller motors.

If the maximum temperature at the end of such a short-time test, lasting t_s minutes, is T_s, and K_s is the value of K corresponding to the speed used for the short-time test, we know from formula (6) that

$$T = \frac{L_s}{K_s} + \left(T_o - \frac{L}{K}\right)e^{-Kt/M}, \tag{8}$$

where L_s = losses during the short-time test. Usually such tests are started with cold motor, so that $T_o = 0$, giving:

$$M = K_s t_s \frac{\log e}{\log\left(T_s \frac{K_s}{L_s} - 1\right)} \tag{9}$$

In view of the inexactness of temperature tests, it is desirable to have a number of different tests for determining the constants K and M and use an average of the values thus found.

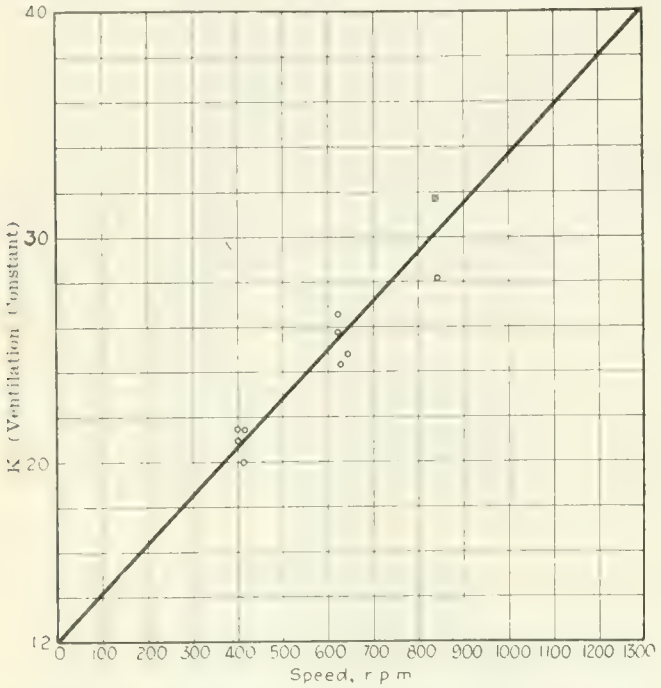
In certain cases where the temperature rise of a motor part exceeds that of other parts considerably, it may be advisable to carry through the calculation for such part individually by figuring the losses and temperature rises of such part.

Applying the Method to a Specific Case

Table I shows the tested speeds, voltages and currents for some continuous-load runs of a self-ventilating motor. Columns 4 and 5 give the calculated I^2R and the tested core losses, while column 6 shows the total electrical losses (L_c), being the sum of the values from columns 4 and 5. Column 7 shows the highest temperature rises as determined by thermometer readings. The last column gives the values of the ventilation con-

stant K, as indicated by equation (5). These values are plotted against the speed in r.p.m.

Table II gives the tested speeds, voltages and amperes for a number of the regular one-hour runs. Column 8 contains the values of K_s, as found from the figure for the speed given in column 1. Column 9 contains the values $Q = T_s\ (K_s/L_s)$ needed for the use of formula (9). Column 10 shows $(Q - 1)$, and



VENTILATION CONSTANT, K, VARIES DIRECTLY WITH SPEED

column 11 the values for log $(Q - 1)$. Column 12 shows the values $K_s t_s$, while column 13 gives the values for M, the mass constant, as found from formula 9. The average of these values is $M = 3{,}730$. The calculations will be safer if a smaller value of, say, $K = 3{,}500$ is assumed.

Let us assume now a crane service in which the motor runs all day with a load giving a temperature rise of 45 deg. C. up to the beginning of an overload period. The latter may be assumed to require a trailer load for forty-five minutes. The average motor losses during this time may be 5,000 watts with an average speed of 500 r.p.m. We find from the curve the value $K = 22.8$ for 500 r.p.m. We further know $L = 5{,}000$; $T_o = 45$; $M = 3{,}500$; $t = 45$. We find thus, from formula 6:

$$T = \frac{5{,}000}{22.8} + \left(45 - \frac{5{,}000}{22.8}\right) e^{-\frac{(22.8)\ 45}{3{,}500}}$$

The value

$$e^{-\frac{(22.8)\ 45}{3{,}500}} = e^{-0.293}$$

is found quickly from one of the curves giving e^n for a wide range of values of n which may be prepared for this purpose. For $n = 0.293$ it is found to be 1.341, so that

$$e^{(-0.293)} = 1\ 1.341 = 0.745$$

We have thus

$$T = 219.5 + (45 - 219.5)\ 0.745$$
$$T = 219.5 - 130 = 89.5 \text{ deg.}$$

Let us assume now that the motor runs subsequently for two hours with losses of 1,000 watts at an average speed of 600 r.p.m. We find $K = 25$ for 600 r.p.m. from

TABLE I—CONTINUOUS RUNS FOR DETERMINATION OF CONSTANT K

1	2	3	4	5	6	7	8
Speed, R.P.M.	Volts	Amp.	I^2R Losses	Core Losses	Total Electrical Losses, Ic	Maximum Rise, Tc	$\frac{L}{T_c} = K$
628	450	53.1	1,320	500	1,820	68.5	26 6
629	450	53	1,315	500	1,815	70.5	25.7
842	600	55.5	1,445	900	2,345	83.5	28.1
413	300	54.8	1,410	275	1,685	84.5	20 0
400	300	55	1,420	275	1,695	79.0	21 5
420	300	51	1,220	260	1,480	69.0	21.5
648	450	52	1,265	510	1,770	71.5	24.8
637	450	50.7	1,205	490	1,695	72.5	23.4
402	300	55	1,420	275	1,695	76.5	20.8
841	600	55	1,420	900	2,320	76.0	31.8

the curve. We further have $L = 1{,}000$; $T_o = 89.5$; $M = 3{,}500$; $t = 120$. By introducing this into formula (6) we get:

$$T = \frac{1{,}000}{25} + \left(89.5 - \frac{1{,}000}{25}\right) e^{-\frac{(25)\ 120}{3{,}500}},$$

or

$$T = 40 + 49.5\ e^{-0.857} = 40 + 49.5 \times 1/2.36,$$
$$T = 40 + 21 = 61 \text{ deg.}$$

Since the curve for the ventilation constant K is a straight line, it is correct to take K simply according to the average speed. In most cases the curve for K is

TABLE II—ONE-HOUR RUNS FOR DETERMINATION OF CONSTANT M

1	2	3	4	5	6	7	8	9	10	11	12	13
Speed	Volts	Amp.	I^2R	Core Losses	Total Electrical Losses L_s	Maximum Rise, T_s	K_s	$Q = T_s\ (K_s/L_s)$	$Q - 1$	Log $(Q - 1)$	$K_s t_s$	M
676	601	100	4,680	1,070	5,750	73.5	26.6	.340	—.660	+.180	1,595	3,840
655	600	99.5	4,630	1,020	5,650	79	25.6	.358	—.642	+.192	1,540	3,480
649	597.5	100	4,680	1,000	5,680	79	25.4	.354	—.646	+.190	1,465	3,360
677	602	99.3	4,620	1,070	5,690	71.5	26.6	334	—.666	+.176	1,595	3,920
672	601	100	4,660	1 070	5,730	75.5	26.5	.350	—.650	+.177	1,590	3,900
545	501	100	4,680	750	5,430	72	23.8	.316	—.684	+.165	1,430	3,770
522	499	100	4,650	700	5,350	78 5	23 3	.342	—.658	+.182	1,400	3,340
553	500	99	4,590	770	5,360	64.5	24.0	289	—.711	+.148	1,440	4,220
Average												3,730
Assume												3,500

so nearly a straight line that it is perfectly safe to simply use K for the average speed.

If the curve departs materially from the straight line, more exact results can be obtained by plotting a typical speed cycle for the period under consideration and also working out a corresponding cycle of the values for K, by finding a value of K for each speed point. The average of these K values can then be used for the above calculations. In Tables III and IV this has been done for the two cases figured above, using the curve. Since the latter is a straight line, the averages of K are the same as the values taken directly from the curve

TABLE III.

Speeds	K
100	14 1
300	18 5
500	22 8
650	26 0
770	28.6
850	30.4
900	31.5
960	32.8
910	31.7
840	30.2
760	28.4
500	22 8
0	12.0
0	12.0
0	12.0
0	12.0
Averages, 500	22.8

TABLE IV.

Speeds	K
150	15.2
450	21.7
750	28.2
930	32.1
1,040	34.5
1,120	36.2
1,090	35.6
1,020	34.1
930	32 1
860	30.6
780	28.8
500	22.8
0	12.0
0	12.0
0	12.0
0	12 0
Averages, 600	25.0

for the average r.p.m., bearing out the correctness of the previous statement. This agreement would, however, not exist for any other shape of curve, although the difference will usually be small in practice, making a detail calculation unnecessary.

NOTE.—Since the curve for K usually approximates a straight line, it may be conveniently expressed in an equation, $K = aR_m + b$, making the plotting of a curve unnecessary. If two values for K, as, for instance, $K_1 = 20.7$ and $K_2 = 30.3$, are known from tests for two speeds, $R_{m_1} = 400$ and $R_{m_2} = 850$, we find a value

$$a = \frac{K_2 - K_1}{R_2 - R_1} = \frac{30.4 - 20.7}{850 - 400} = \frac{9.7}{450} = 0.0216$$

and a value

$$b = K_1 - aR_1 = 20.7 - 0.0216 \times 400 = 12,$$

and thus have an equation for

$$K = aR_m + b = 0.0216\ R_m + 12,$$

giving the value K for any speed R_m.

Twelve Months' Experience with the British Electricity Supply Act

ALTHOUGH twelve months have elapsed since the electricity supply act of 1919 came into effect in Great Britain, the actual work that has so far been done, says the London *Engineer* in its review of electrical progress in 1920, is mainly of an administrative nature. The work of bringing those in control of existing systems and companies together is beset with difficulties. At present a "joint authority" within any of the newly created electricity districts must be representative of authorized undertakings in that district, either with or without the addition of representatives of the council of any county situate entirely or partly within the district. It is maintained that if it were possible for the joint authority to be simply a board of control, at least in the first instance, the whole situation would be modified. An existing electricity supply undertaking or group of undertakings might be willing to extend on a big scale if allowed to do so, irrespective of any agreements for subsequent control or purchase by a joint authority.

A tendency in this direction has been exemplified in several large cities. Rotherham, for instance, has erected a station which can be developed into a superpower station rated at 145,000 kw.; Manchester has obtained power to build a new supply station to have an ultimate rating of 150,000 kw., and Nottingham has sought the right to erect a station with a potential output of 240,000 kw. Application has also been made by the County of London Electric Supply Company for permission to build a station capable of extension to meet the growing demands of the metropolitan district.

In Scotland the corporation of Greenock has been informed that it will receive power to build a station ten times as large as that now in use at a possible expenditure of £2,000,000. Electrification of the railway between Greenock and Glasgow may form part of this project. An actually completed enterprise is the first section of a great new power house opened by the corporation of Glasgow at Dalmarnock, on the River Clyde. This section provides space for turbo-generators with a maximum daily output of 450,000 kw.-hr. A large station is also being erected by the Edinburgh corporation at Portobello. It is designed for the production of 100,000 kw., and the installation will begin with three 10,000-kw. turbo-generators.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Fire Losses and Electricity

To the Editor of the ELECTRICAL WORLD:

SIR: A Chicago correspondent has called my attention to the editorial in your issue of Feb. 12 upon discrepancies in statements regarding fire-loss statistics which you attribute to me and other officers of the National Board of Fire Underwriters. In this editorial you credit me with having publicly said that "of the $300,000,000 annual fire loss in the United States $70,000,000 is directly due to improperly constructed chimneys."

You discuss this at some length, draw some conclusions stated as facts, and conclude with the following sarcastic comment:

"Quite seriously, statements such as the one we quoted in a previous issue and the one we now quote leave us with grave doubts as to whether the underwriters themselves know, or anybody else really knows, very much about the cause of fire losses, concerning which they are willing to talk so glibly. The facts may be before them, but there should be a greater degree of agreement in drawing the conclusions than is indicated in the statements we have in hand."

You do not give the source from which you obtained the statement you attribute to me, but it is evident the figures were jumbled in some way. I quote from my manuscript what I did say in the opening paragraph of my remarks before the National Brick Manufacturers' Association upon the point to which your editorial refers:

"Among the known and strictly preventable causes of fires defective chimneys and flues stand third on the list as productive of the greatest fire loss, with a record of $70,800,000 for the last five years, or an average of $14,000,000 per year."

You will note that the average fire loss due to the cause named is about 4½ per cent of the estimated total annual fire loss of $300,000,000 and not "dangerously near a quarter of the whole" as you state. It is, therefore, evident that your reference to an inconsistency in my statement is not justified.

I do not wish for a moment to infer that our statistics are entirely correct or that all statements which may be made by officers of this organization in regard to them are always based upon strictly logical conclusions. However, I do assert without fear of successful contradiction that the fire-loss statistics as compiled by the actuarial bureau of the National Board of Fire Underwriters are the most complete and reliable figures upon the subject which can be found in this or any other country; also that the general trend of facts as expressed by these figures cannot be annulled by mere denial simply because they are unpleasant.

We are all liable to errors in dealing with statistics, particularly when speaking. Under the circumstances

it would have been an easy and courteous thing for you to have ascertained whether the speaker had been correctly quoted before you proceeded to question publicly the accuracy of his statement and the reliability of his information.

The National Board of Fire Underwriters enjoys an enviable reputation as an organization of high ideals and sound principles, and the writer feels that he personally has established a fairly well-known reputation for being conservative and reasonably reliable in his statements.

Under the circumstances I trust you will see the justice of publishing an explanation in your next issue correcting the erroneous statement attributed to me and the misleading conclusions which you draw therefrom and giving it the same prominence that you gave the editorial above mentioned. IRA H. WOOLSON,

New York, N. Y. Consulting Engineer.

[We are glad to acquit our correspondent, on the strength of his manuscript, of having made an apparently exaggerated statement. Our information was simply that which was sent all over the country in press dispatches and which has remained uncorrected, so far as we are aware, by Mr. Woolson up to the present time. In default of any attempt to correct published statements even though they be grossly inaccurate, the public, including this journal, is entirely justified in the belief that the statements as quoted were made. We have no objection to unpleasant facts which rest on something more than assertion, and it is our earnest desire to find out how far the alleged statistics regarding electric fires are fact and how far they are merely the attribution of fires of uncertain origin to an agency conveniently at hand, much as the doctor of a generation ago was wont to classify unknown distempers as malaria.—EDITOR.]

Temperature Limits of Large Alternators

To the Editor of the ELECTRICAL WORLD:

SIR: An endeavor is being made by British manufacturers of large turbo-alternators to increase the temperature rise now generally adopted for these machines. The following advantages are claimed for this increase: (a) In the case of machines running at the same speed those with high temperature rating are cheaper; (b) higher efficiencies are obtainable; (c) larger units can be built, or (d) higher speeds can be adopted for machines of certain size; (e) a smaller amount of space is required.

The limit in temperature rise generally adopted is 40 deg. C., independent of the type of machine under construction and of the class of insulation employed. Experiments have been made, however, upon mica, now used for insulating large turbo-alternators. These experiments have demonstrated the fact that mica retains its mechanical and electrical properties at temperatures up to 200 deg. C., and it is suggested that the limit of the ultimate temperature should be raised to 160 deg. C. instead of the usual value of 125 deg. C.

The effect of going to these higher limits, from the manufacturing point of view, as regards foreign competition is important. The ordinary practice for determining the temperature of large turbo-alternators is by thermometers placed outside of the machines at the most accessible parts, but it has been recognized for some years now that these do not indicate the true temperature and that in fact the machines are working at an appreciably higher temperature than provided for in the specification.

On these grounds, therefore, manufacturers urge users to agree to higher temperature limits, with an improvement in the method of determining the actual temperatures. In this connection it is suggested that thermocouples should be embedded in the insulation, though such devices of this kind as are at present available do not seem to inspire with much confidence either the manufacturers of turbo-alternators or the large users of them. MARK MEREDITH.

Liverpool, England.

Experiences in Working on Live Lines

To the Editor of the ELECTRICAL WORLD:

SIR: The writer has noted with much interest the comments by L. J. Moore, electrical engineer with the San Joaquin Light & Power Corporation, Fresno, Cal., regarding live-line maintenance in the issue of the ELECTRICAL WORLD for March 12. Mr. Moore's opinion is somewhat characteristic of the views of other engineers who have not had extensive experience with live-line work.

As you know, the writer's methods have been used by the line crews of the Georgia Railway & Power Company for the last six years in working on live lines from 11,000 volts up to and including 120,000 volts. Our experience has shown that there is no reason why we should not continue to use our live-line methods on even higher voltages. During the time the method has been in use we have gone through a period of twelve months a number of times without even a minor accident to a live-line worker.

A strange thing in this connection is that the only engineers with whom we can enter into a discussion as to the merits of live-line work are those who have never used it. Those who are most enthusiastic about it are the men themselves on the line. Most of our linemen would now object to a job on 2,300 volts, especially if they could get one on a 120,000-volt line, because they believe the high-voltage work to be the safer of the two.

The many companies that have adopted our live-line methods and are going through the same experience as ours would, I think verify all that I said on this matter. The total number of companies doing live-line work is in the neighborhood of 100. A few of them are the Georgia Railway & Power Company, Columbus Power Company, Tennessee Power Company, New England Power Company, Central Illinois Public Service Company, Great Northern Power Company, Florida Power Company, Chile Exploration Company, Cerro de Pasco Corporation, Kentucky Utilities Company, Virginia Power Company, Calumet Electric Company, Wisconsin Power, Light & Heat Company, Florida Ice & Power Company, Union Electric Light & Power Company, Ohio Utilities Company, Oklahoma Gas & Electric Company, Wisconsin-Minnesota Light & Power Company, and the city of Kansas City, Mo.

The most difficult thing in connection with live-line work is to convince those who have never seen the men actually at work that it is simple and elementary. This is so truly the case that their doubts, which were the same as our own before we attempted this work, are now amusing to us. T. F. JOHNSON, JR.,

Transmission Engineer.

Georgia Railway & Power Company,

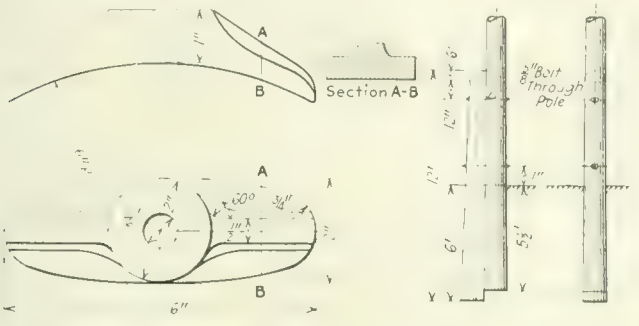
Atlanta, Ga.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Cheap and Effective Pole Stubbing

POLES can be stubbed quickly and cheaply by employing curved washers and bolts, as shown in the illustration. The washer is a special form devised for use by the Denver Gas & Electric Company to eliminate the labor of wrapping with galvanized wire and the danger of splitting pole or stub encountered when the



CURVED WASHER FOR STUBBING POLES AND ITS APPLICATION ON 11,000-VOLT LINE

ordinary bridge or square washer is used without wrapping. The pole is shaved sufficiently to give the washers full bearing. This method has been used on the heaviest Denver leads for a number of years with no signs of weakness and no indication of pole or stub splitting.

R. A. HAMMOCK,
Superintendent of Distribution.
Denver (Col.) Gas & Electric Company.

Air Bound in Penstock Reduced Output of Generating Station

A LARGE body of air entrapped in a long penstock recently caused the output of the Mill Creek No. 1 generating station of the Southern California Edison Company to decrease without warning and for no apparent cause. The station operates under a 500-ft. head and is rated at 750 kw. An investigation at the forebay disclosed the fact there was sufficient water to maintain the normal output of the station; in fact, there was water going over the spillway and there was enough water being taken through the station to carry full load. It was found that there were no plugged nozzles, but the water pressure gage at the waterwheels indicated a pressure below normal and the station operators were at a loss to account for the decreased output.

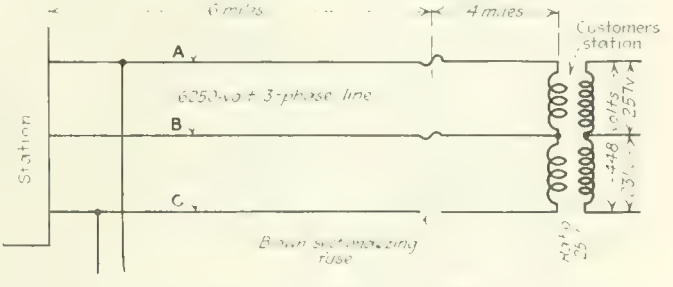
The superintendent was called to the station and after checking up the investigations made by the station operators came to the conclusion that the penstock was air-bound. To correct this condition and release the air trapped in the penstock, the nozzles at the waterwheels were gradually closed, and soon great quantities of air violently erupted from the penstock where it connected with the forebay. After a short while this eruption of air ceased, and upon opening the nozzles it was found that the generators picked up and carried full loads.

The explanation of the difficulty is that at one point in the penstock, which is 10,570 ft. long, there is a slight change of grade. Air taken in with the water was carried down to this point and formed a bubble upon which there were balanced forces acting, the pressure tending to force it upward against the velocity head of the water, which tended to force it downward. When the velocity of the water was decreased the equilibrium was destroyed and the air bubble rose to the surface of the water at the forebay. J. W. ANDREE,
Assistant Superintendent of Generation.
Southern California Edison Company,
Los Angeles, Cal.

Unbalanced Voltage Caused by Blown Fuse and Charging Current

A PECULIAR case of unbalanced voltage on the end of a 10-mile transmission line recently came to the writer's attention. This line was built under rush orders, and two power transformers were connected in open delta at the extreme end of the line for the purpose of supplying a three-phase customer. Sectionalizing fuses were installed at a point 4 miles from the transformers.

When power was put on the line the normal voltage on the secondary side of the transformer should have been 250 on all phases. However, the actual voltage was respectively 257, 231, 448 on the three phases. It was assumed at first that the 231 volts was the unbalance due to a single-phase line from the same supply bank of transformers, which line was feeding another load. As the 448 volts was approximately normal voltage, multi-



PECULIAR UNBALANCED VOLTAGE WAS CAUSED AT THE END OF LINE BY BLOWING OF SECTIONALIZING FUSE

plied by $\sqrt{3}$, it was assumed that one transformer secondary was reversed. Reversing this transformer, however, gave about 127 volts across the phase *AC*, which indicated that there was some other difficulty. It was soon discovered that a sectionalizing fuse had blown and that the measurements had been taken

on voltage due to the capacity of the 4 miles of open conductor. This voltage happened to be just the proper amount to mislead.

It must be remembered that these tests were made on open circuit and at no load. They would not be duplicated under load conditions. When the fuse was replaced the voltage at the end of the line was somewhat higher than that at the station owing to the line capacity.

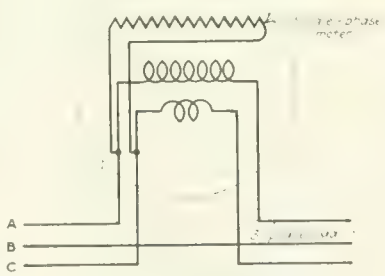
B. R. PAYNE,
Meter Superintendent.
Depew & Lancaster Light, Power & Conduit Company,
Lancaster, N. Y.

Use of Single-Phase Meters on Three-Phase Power Service

OWING to the recent shortage of meters some companies metered three-phase loads on single-phase meters. On an unbalanced load there was a large chance of incorrect registration. How various conditions of balance or unbalance affect a single-phase, 220-volt, three-wire meter connected in a three-phase, 110-volt circuit (according to the sketch) is shown in the following examples:

Neglecting the error due to underexcitation of the potential field (220-volt potential coil operating on 110 volts), the following cases for non-inductive load are found: Case 1—Balanced three-phase, 110-volt load. The actual watts are $I \times 110 \times \sqrt{3}$, while the measured watts are $I \times 110$. The registration is $1/\sqrt{3} \times 100 =$ 57 per cent. Case 2—All load on *AC*. The actual watts are $I \times 100$, the measured watts $I \times 110$, and the registration 100 per cent. Case 3—All load on *AB*. The actual watts are $I \times 110$, the measured watts $I \times 110 \times \cos 60$ deg., and the registration 25 per cent. Case 4—All load on *CB*. The registration is the same as case 3. Power factor other than unity will not affect case 1 or case 2, but will affect cases 3 and 4.

During the shortage of meters numerous expedients were tried. Many companies were obliged to connect customers without meters, necessitating estimates of energy used based on similar installations as metered, use after it became possible to obtain a meter, or on a flat charge of some sort. The flat rate has been found in general to be unsatisfactory in several ways, not the least among which is the wasteful use of energy. On the other hand, a flat rate devised to take into account the uneconomical use of energy by such customers has caused them to feel they have been charged unjustly for the inability of the manufacturers of meters to meet the demand.



SINGLE-PHASE METER ON THREE-PHASE LINE

Power meters have been very hard to get, and the bounds of proper sizes for various installations have been overstepped many times during the past year in the effort to maintain all on metered contracts. It became possible to obtain single-phase, 220-volt, three-wire meters at a time when the supply of three-phase, three-wire meters in smaller sizes was exhausted. As an expedient it was suggested that as most three-phase motor loads were approximately balanced a single-phase meter of the proper voltage might be used, applying a correction constant, until such time as the proper three-phase meters were available. The correction constant for a single-phase meter of the same voltage as the three-phase circuit in which it is connected would be $\sqrt{3}$ regardless of power factor, assuming balanced load. By allowing for this correction factor in designing the register manufacturers put out a "balanced three-phase meter," which is nothing more than an ordinary single-phase meter calibrated to allow for the correction factor to balanced three-phase. With such a register the registration in the cases given would be multiplied by $\sqrt{3}$, making case No. 1 read 100 per cent correct.

S. C. HENTON,
Superintendent of Meters.
Northern Ohio Light & Traction Company,
Akron, Ohio.

Cast-Iron Headers Unsatisfactory When Forcing Boilers

CAST-IRON headers began to develop leaks when boilers were forced and superheaters were installed in the plant of the Cortland County Traction Company, Cortland, N. Y. Cast-iron headers, flanges and other fittings had been originally installed. These proved entirely satisfactory until the load increased to such an extent that forcing the boilers and the use of superheaters became necessary. Under these conditions leaks rapidly developed, and it has become necessary to replace the cast iron with steel.

This experience was related by F. A. Dresser, chief engineer of the company, at a meeting of the Empire State Gas and Electric Association.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Both CO_2 and Combustible Gases in Flue Should Be Watched

ONLY by watching both CO_2 and combustible gases can an operator know how to regulate his boiler to get the highest efficiency. Experiments by the Bureau of Mines have shown that with one fuel, when the fuel bed is over 4 in. thick and free from air holes, a furnace without secondary air acts very much like a gas producer. In a fuel bed 12 in. thick, where no secondary air was supplied, virtually all the oxygen was consumed 4½ in. from the bottom of the fire. At this point CO_2 reached 14 per cent and combustible gases registered 10 per cent. About 26 per cent of the gases leaving the top of the fire were combustible gases, while the percentage of CO_2 was reduced to 7. Le Chatelier states that CO_2 generally reaches a maximum at a height in the fuel bed ten times the diameter of the coal pieces. From this point on reduction of CO_2 takes place.

The combustion of coal in an ordinary boiler furnace thus takes place in two stages. In the first stage, the fuel bed acts as a gas producer, forming CO and other combustible gases in large volumes. In the second stage these combustible gases are mixed with the secondary air,* the carbon in the CO and other combustible gases is oxidized to CO_2, and the hydrogen combines with oxygen to form water vapor.

*The primary air supply is that which flows through the combustible material in the fire bed. The secondary air supply is that which is admitted to the combustion chamber above the fire through holes in the fire bed, the fire doors, leaks in the boiler settings, etc. It supplies the free oxygen necessary to oxidize the combustible gases generated in the fire bed.

Contrary to the generally prevailing impression, the volume of the secondary air required to burn coal in a furnace is greater than the volume of the primary air. If the coal were all carbon, the volume of the secondary air required under ideal conditions would be the same as the volume of the primary air. In the first stage of combustion the reaction would be $2C + O_2 = 2CO$. In the second stage it would be $2CO + O_2 = 2CO_2$. In other words, the volume of air required to convert the carbon into CO in the primary stage is the same as the volume of air required to burn the CO into CO_2 in the secondary stage. However, there are other gases than CO which come off in the first stage of burning coal. To burn these additional gases secondary air is required. Inefficient mixing of the combustible gases in the combustion chamber with the secondary air supply gives rise to still further demands for excess secondary air that complete combustion may take place. How much secondary air is required depends on the furnace design, kind of stoker, method of firing, kind of fuel, etc.

Holes, ashes, clinkers or dirt in the fire, thickness of the fuel bed, draft, length of time of opening of fire doors and regulation of dampers—all cause wide and irregular fluctuations in the amount of secondary air admitted.

The best method of firing a particular furnace and regulating the air draft and dampers can only be determined by trial, watching the results recorded from the analysis and recording of both CO_2 and combustible gases. Only through such a procedure can the fireman learn by experience what must be done and what must be avoided to give the maximum percentage of CO_2 at all times without the loss of combustible gases up the flue. With a record of CO_2 only, he can tell little about the results of his efforts toward attaining higher combustion efficiency.

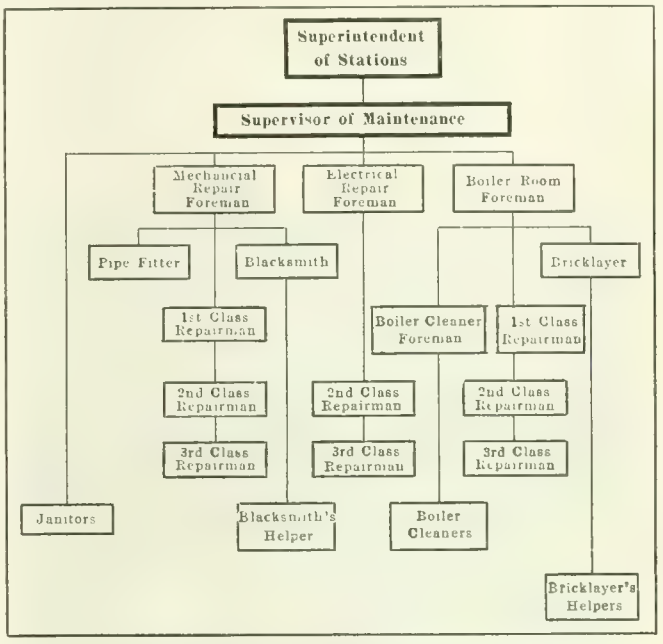
OLOF RODHE,
Mono Corporation of America, Chief Engineer.
New York City.

Maintenance Organization for a 35,000-Kva. Plant

THE size of the maintenance organization that will be justified in any plant and the method of organizing the department must, of course, depend upon the existing conditions in the station. The accompanying chart shows the organization of this department in one station of approximately 35,000 kva. installed rating, where the total number of station employees averages around 100. The three classes of repairmen are arranged at graduated rates of pay so as to afford definite steps for promotion. It should also be pointed out that this department is entirely separate from the operating department, the one having nothing to do with operation and the other no responsibility for maintenance or repairs, although the departments co-operate.

The work of the maintenance department may be divided into two general classes—(1) inspection or tests, and (2) repair. The inspections likewise may be divided into (a) periodic examinations carried out during operation or at least without taking the equipment out of service, and (b) thorough and less frequent inspections involving more or less complete dismantling and making it necessary to take the equipment out of service. Schedules should be arranged for both classes of inspections in order that none shall be overlooked. The arrangement of these schedules will depend, of course, upon the plant-operating conditions.

In considering the probable or actual maintenance costs on any particular piece or any class of plant equipment there is often a tendency to overlook the interrelation of the upkeep on different classes of equipment, and this oversight may easily lead to a "penny-wise, pound-foolish" policy concerning inspections and upkeep. For example, in a boiler plant using feed water requiring treatment the expense of inspecting and maintaining the treating plant may appear excessive and



REPAIRMEN IN THIS MAINTENANCE ORGANIZATION ARE PROMOTED IN DEFINITE STEPS

lead to neglect of this equipment. If so the result will be not only a lowering of plant efficiency because of decreased heat absorption by the boilers, but also an increase in boiler maintenance and possibly serious operating troubles. Likewise, the failure to inspect and check the apparatus for measuring temperatures in alternators or transformers may lead not only to the operation of such equipment at lowered efficiencies but also, if continued, to serious damage and excessive maintenance expense.

S. B. FLAGG,
Electric Bond & Share Company, Engineer.
New York City.

Arresters Needed on Low-Tension Bus of Power Customers

THAT the 2,300-volt side of high-tension customers' power transformers should be provided with some form of lightning protection was an opinion expressed by the meter committee at the recent meeting of the Southeastern Section of the N. E. L. A. Such installations, it was thought, are more subject to lighting than 2,300-volt retail systems. Although most of the companies reported no experience, both the multi-gap and the compression type were used satisfactorily by different companies.

For lightning protection on 2,300-volt retail system twelve companies found compression-type arresters satisfactory and four companies employ multi-gap arresters with satisfaction.

S. A. FLETCHER,
Alabama Power Company, Superintendent of Service.
Birmingham, Ala.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Improving Drafting Room Illumination

BY SUBSTITUTING 200-watt lamps and steel-enameled bowl-type reflectors for a former installation of drop lights carried in tin shades, the illumination of the drafting room of the Eastern Bridge &



INDIRECTLY LIGHTED DRAFTING ROOM HAS ILLUMINATION OF 8.5 FT. CANDLES WITH 200-WATT LAMPS

Structural Company, Worcester, Mass., has been greatly improved. The new installation is shadowless. The reflectors are suspended 7½ ft. above the working plane, the units being spaced 10 ft. apart. In the entire room twenty outlets are provided for an illuminated area of about 1,872 sq.ft. The walls and ceiling are painted mill-white, and on the working plane an illumination of 8.5 ft.-candles has been measured. The accompanying photograph was taken with a Goertz lens on a 6½-in. x 8½-in. "Orthonon" commercial film, exposed five minutes with a No. 32 stop, between 5 and 6 p.m., on Nov. 12 last. E. D. LEARNED.

Worcester (Mass.) Electric Light Company.

Proper Sizes of Electric Soldering Tool Necessary for Good Work

IN THE use of electric soldering tools there is much chance for disappointing results unless the proper tools are selected for the different jobs. For instance, a heavy tool should be selected for big work, but this same tool should not be employed for continuous use on small work, as the tool would become overheated, which would cause rapid deterioration of the soldering point in addition to the necessity for constant cleaning and retinning. In other words, an iron which is too large for the work must not be employed, particularly if the tool is used intermittently with long intervals of idleness, the tool being connected to the circuit continuously.

There are available resistance stands which automatically cut additional resistance into the circuit when the tool is laid on the stand, thereby reducing the current passing through the iron and preventing overheating. These are very satisfactory when they can be employed. However, if for some reason conditions do not permit their use, and if the work is always similar, satisfactory results can be obtained on small work, such as soldering splices in small-gage wire, by using an overvoltaged tool—that is, a tool wound for 150 volts on a 110-volt circuit. With this method the tool is just hot enough to flow the solder freely and not too hot to deteriorate the tip. J. H. MAYFORTH,

Maintenance Superintendent.

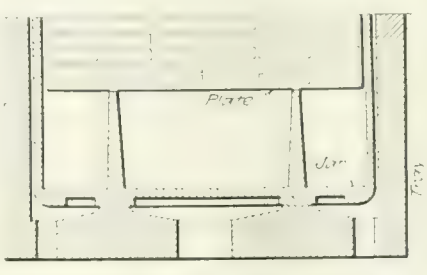
Eisemann Magneto Corporation,
Brooklyn, N. Y.

Breaking Battery Jars Avoided by Use of Special Tray

TO PREVENT the breakage of storage-battery jars on the electrical vehicles of the fire department of Paterson, N. J., a special form of inclosing tray has been built. This has reduced the number of broken jars from more than forty to an average of about two per month.

After experimenting with several different materials for the jars with no improvement an investigation of each broken jar and its tray was made. It was found that the majority of the breaks were in the sides of the jars above the plate-supporting bridges. In looking for the cause of the trouble it was found that in some cases the bottom of the jar was not square with the sides, and in other cases the sides and bottom of the tray had warped, preventing the jar from resting squarely on its bottom. This resulted in breaking the jars.

To obviate the breakage the trays were then made with two ribs formed on the bottom. These ribs correspond in position to the supporting bridges of the jar. With this construction, even if the jar or the tray is not absolutely true to shape, virtually all the weight is supported by the ribs and the thin shell of the jar is not excessively strained. Another feature of the tray, which is patented, is that spilled electrolyte may run out of it through openings in the bottom. The ribs in the tray are not quite so wide as the ribs on the bottom of a jar. Thus if any acid spills or leaks out it will run down the inclined bottom of the tray and through the openings.



LONGITUDINAL RIBS ALONG BOTTOM OF TRAY SUPPORT BATTERY PLATES

Commercial Truck Company, MARTIN MELIA,
Philadelphia, Pa. Engineering Department.

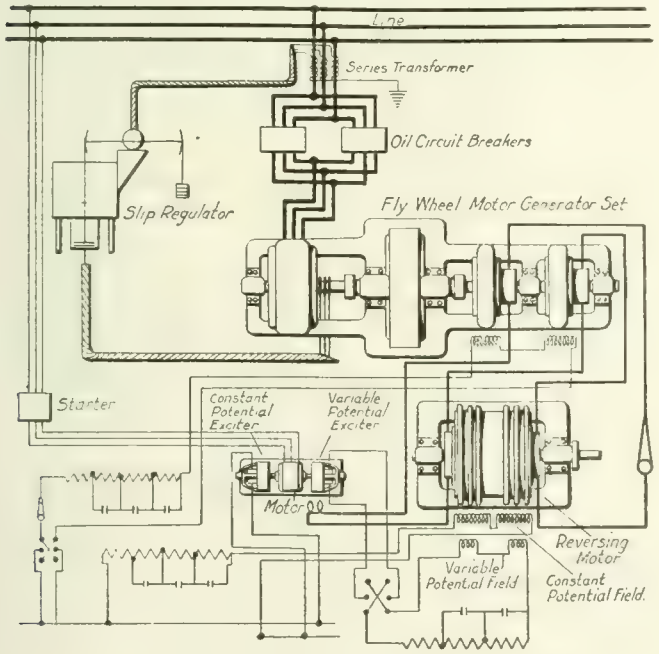
Electric Drive Replaces Steam on Large Blooming Mill

BECAUSE of the breakdown of the engine driving a 44-in. (101-cm.) blooming mill at the Steelton plant of the Bethlehem Steel Company, the drive had to be changed to electric power. Just twenty-four days after the work was started steel was being rolled with the new drive. Considering the tremendous task of tearing down the large reversing steam engine, blasting out its foundations, building the forms for the motor foundations and installing the complete electrical apparatus in working order, the speed made is remarkable.

Inasmuch as the blooming mill is the only one in the plant, it was important that the change-over to electric drive be made in the shortest time possible. In addition, it was also important that no time should be lost in making adjustments or in tuning up the new equipment. To accomplish this it was necessary to have everything well organized and planned in detail. The forms for the reversing-motor foundation were built up complete in two pieces as a templet before the engine was removed, and after the old foundation was blasted out these templets were set in position, the foundation bolts were placed and the concrete was immediately poured. This materially shortened the time required to make the change.

The motor rolled 609 tons of steel the first day, 796 tons the second and 1,006 tons the third. The mill is now operating single-turn and is in no way curtailing the output in spite of the fact that, owing to shortage of power under present conditions, it is necessary to operate the equipment with a power demand not exceeding 2,500 kw.

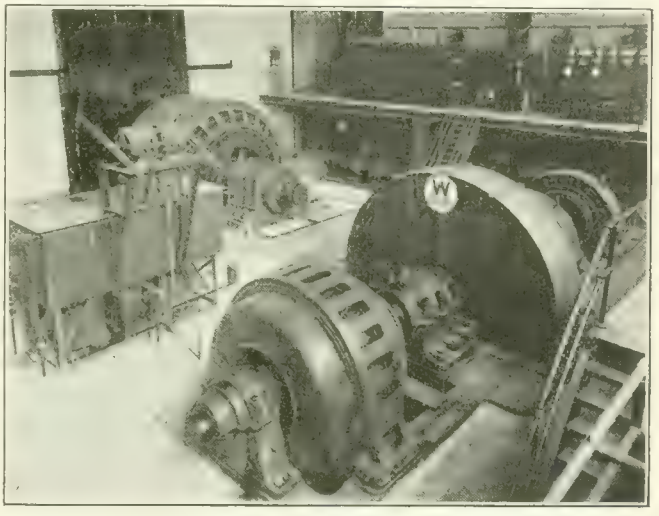
The electric drive consists of a double-unit reversing direct-current motor, the necessary flywheel motor-generator set for driving it, and a small exciter set,



SCHEMATIC DIAGRAM OF CONNECTIONS FOR DOUBLE-UNIT REVERSING MILL EQUIPMENT

together with a blower outfit and the necessary switching equipment. All the machines except the blower outfit are mounted on the first floor of the motor-room substation. The blower outfit is mounted in the basement and the switching equipment is mounted on a balcony. Lightning arresters are installed on the second balcony.

The double-unit reversing motor, as shown in the illustration, is a 600-volt, adjustable-speed, direct-current machine of the compound-wound compensated type, having a speed range from zero to 120 r.p.m. in both directions. It is capable of developing 1,900,000 ft.-lb. (262,200 kg.-m.) torque momentarily and is directly connected to the mill. Each armature of this motor is mounted on the forged-steel shaft, which is supported by two pedestal bearings arranged for water cooling and gravity oil lubrication. The bearings and frame of the motor are supported by a heavy cast-iron bedplate, which is well anchored to the concrete foundation by long foundation bolts. The motor is semi-inclosed and is arranged for forced ventilation. The blower



COMPLETE BLOOMING MILL DRIVE INSTALLED IN TWENTY-FOUR DAYS

equipment, installed in the basement, is interlocked so as to prevent operation of the reversing motor in case the blower is not delivering the proper amount of air to the motor.

The motor is a compound-wound machine, the compounding being obtained indirectly by means of a small series exciter and a separate winding on the main poles of the reversing motor. Owing to the extremely high-peak currents encountered in the main circuit, it would be extremely difficult to reverse the ordinary type of series field, which would be necessary to keep the proper shunt and series-field relation. Therefore the series exciter and the separate field are used, the series-exciter field being connected in series with the main motor armature circuit, and the armature of the series exciter being connected across the separate winding of the main reversing motor.

Switches for reversing this field are operated from the master switch, which also operates the reversing switches in the field of the generator. By this means the compounding effect is obtained without the necessity of reversing the heavy armature current. This compounding of the reversing motor allows it to increase its torque on the overloads and thereby meet better the severe shocks that are encountered.

The reversing motor receives its energy from two 600-volt, 367-r.p.m., separately excited shunt-wound, direct-current generators of the compensated type, which are designed to withstand the same peak loads as the reversing motor. These generators are driven

by a 3,200-hp. alternating-current motor of the wound-rotor type, which is designed to operate on a three-phase, 6,600-volt, 25-cycle circuit. A 100,000-lb. (45,000-kg.) flywheel is mounted on the same bedplate between the motor and generators.

A liquid slip regulator limits the peaks and equalizes the input to the flywheel. When the load on the alternating current motor reaches a predetermined value, the regulator introduces resistance in the secondary of the induction motor which causes the flywheel set to slow down, allowing the flywheel to give up a portion of its stored energy. When the peak load goes off, the regulator cuts out the resistance in the secondary circuit of the induction motor and brings the flywheel set back to approximately full speed. The regulator is so arranged that the alternating-current motor cannot be started until the maximum resistance is inserted in the secondary by means of the slip regulator being wide open.

The control of the main motor and generator is obtained by adjustment of the fields, the generator fields being reversed to obtain reverse direction of rotation of the main motor. The excitation of the motor shunt field remains in the same direction at all times. The speed of the reversing motor is proportional to the generator voltage up to normal voltage, and beyond that point the increase in speed of the reversing motor is obtained by weakening its main shunt field. The compound field described previously is adjusted to correspond with the speed of the reversing motor. The master switch is mounted in the mill for controlling the contactors which adjust the various field circuits of the motor and generators. The position of the master switch determines the speed of the reversing motor and its direction of rotation. This system of control makes the operation of the equipment extremely simple and very easy to operate, while at the same time obtaining a very rapid and effective means of control. The schematic diagram shows the connections.

The reversing motor and direct-current generators are separately excited, receiving their excitation from a small induction-motor-driven exciter set. The main direct-curent circuit breaker between the reversing motor and its generators is so interlocked that it cannot be closed unless the exciter set is operating properly.

The oil switch and synchronizing apparatus for synchronizing these two stations is installed on the gallery. A double feeder system is brought to the gallery from one of the power plants, and usually these two feeders are used in parallel for supplying the induction motor of the flywheel motor-generator set.

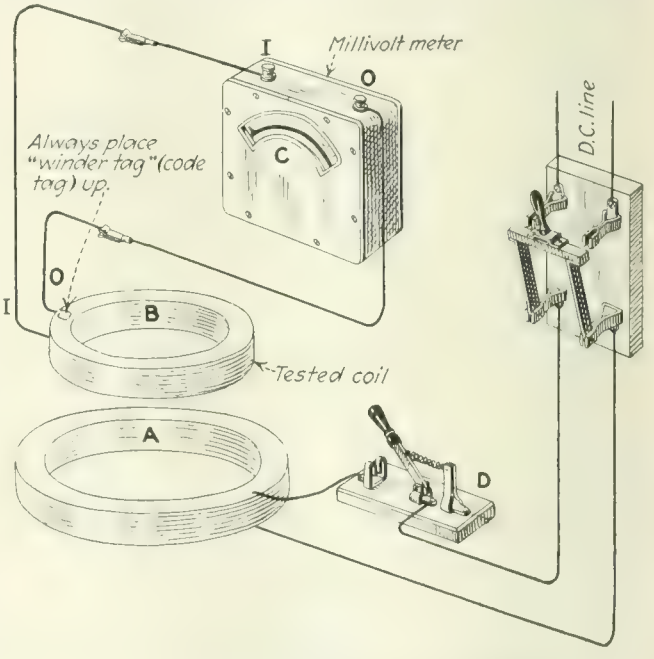
A small transformer, 6,600 volts to 440 volts with a 220-volt starting tap, is used for supplying the power to the exciter set, blower and pump motors. As an emergency feature, the Bethlehem Steel Company has brought the 440-volt alternating-current mill circuit into the motor-room substation. This circuit will be used for driving the exciter set, blower and fan motors in case any trouble develops on the small transformer.

As a convenient and effective means of keeping some of the mill dust and dirt out of the motor-room substation, an additional duplicate blower equipment was installed in the basement and is arranged in conjunction with the other blower equipment, so that either one can be used to ventilate the room while the blower is ventilating the reversing motor.

Westinghouse Electric & Mfg. Co., Pittsburgh, Pa. B. M. JONES, General Engineer.

Kick Method of Testing Coils for Polarity

WHEN a standard method is used in a repair shop for winding field coils and placing them in machines it is desirable to check the polarity of all coils before they are placed. This is necessary especially where such polarity cannot be determined by an inspection of the windings, as is the case when leads are brought out so that it is not possible to see which is the inside and which is the outside lead and what was the direction of winding. In the check used by the writer shown in the sketch the coil *A* is permanently connected to a direct-current system, so that direct current can be set up in it and broken at will by use of the switch *D*. Coil *B*, which is to be tested, is placed over this coil and the current set up by closing the switch *D*. When the switch *D* is opened quickly the meter *C* will give a decided kick, the direction of which will determine the polarity of the coil *B*. Markings on the leads *O* and *I* can be checked at once to see whether



KICK ON METER WHEN SWITCH OPENS DETERMINES POLARITY OF COIL *B*

they correspond with the polarity as determined by the test.

Coil *A* is made by winding 3,000 turns of No. 26 double-cotton-covered wire on a 4-in. x 6-in. form in a groove 1½ in. to 2 in. wide. The coil may be left on the forms if desired while using for tests. F. W. GAY.

Newark, N. J.

Correct Motor Sizes Help to Prevent Low Power Factor

THE fact that overmotoring is a wide cause of low power factor should not be overlooked amid the prevalent talk of synchronous motors for correcting this evil. Much can be done by carefully testing the motors in a plant and seeing that each motor is of the correct size for its particular work. In many instances power factor has been raised from 5 to 10 per cent by this method, and in exceptional cases as much as 20 per cent.

Such testing may allow a large motor on a certain drive to be replaced by a smaller motor now on some other drive. This motor in turn may be replaced by a

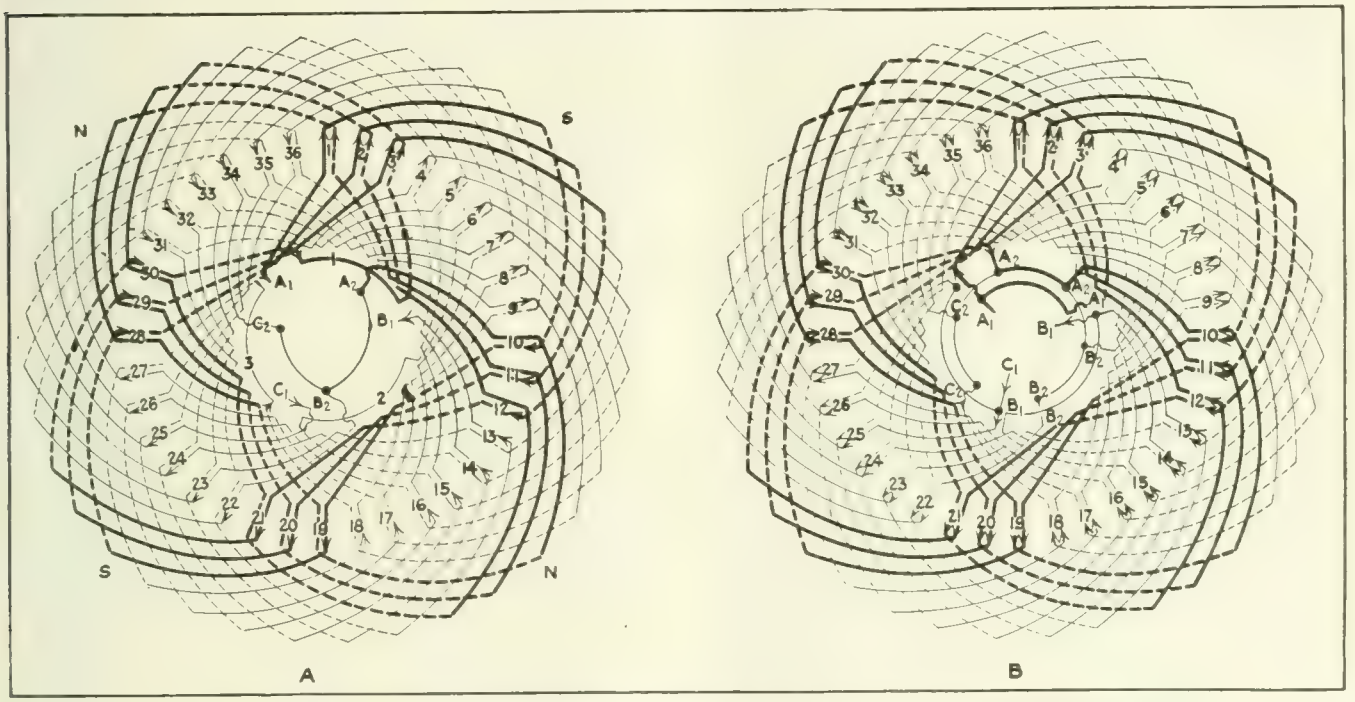
smaller size, and so on. This will result in motors released for extensions or for space equipment. The lower power factor will be accompanied by lower losses in generating and distributing equipment, which will assure higher and steadier plant voltage and consequently better torque in the motors. Another advantage is that it will avoid penalization for low power factor where such penalization is included in the central-station company's rate schedule.

Halving Voltage on a Wave-Wound Induction Motor

A MACHINERY dealer recently asked a Detroit repair shop to change a 440-volt wave-wound induction motor to operate at 220 volts. The motor was investigated, and it was found that it could be reconnected for this voltage in the manner outlined in the following paragraphs.

The machine was a 440-volt, 200-hp. squirrel-cage induction motor with eight poles, 875 slots and coils, with one turn per coil of $\frac{1}{8}$-in. and $\frac{1}{2}$-in. copper strap, connected in a series-star, wave winding. The dealer wanted a 220-volt motor with the other characteristics the same as the original motor, and wanted it in a hurry. The accompanying drawings show the principle of the change. It is a well-known fact that a wave winding has two paths or circuits and that in an induction motor the winding is in two sections, these two sections being joined by what is called a reversing jumper. Drawing *A* shows a thirty-six-slot, four-pole, series-star wave winding, thirty-six slots being used instead of 875 because it makes the drawing simpler and easy to understand. The pitch is 1-10. There are twelve coils per phase or three per phase per pole. The heavy lines represent the *A* phase, which starts at the top of slot No. 1 and goes through six coils, 1-10, 10-19, 19-28, 28-2, 2-11, 11-20, 20-29, 29-3, 3-12, 12-21, 21-30, to the bottom of slot 30. This is one-half of the *A* phase, the second being started in the bottom of slot No. 3. The reversing jumper No. 1 connects the bottom of slot No. 30 to the bottom of slot No. 3. From slot No. 3 the winding goes through six more coils, 3-30-21-12-2-29-20-11-1-28-19-A_2, but in the opposite direction to the first six, *i.e.*, from slot No. 1 the direction is clockwise until jumper No. 1 is encountered, which brings the winding to slot No. 3 and following the winding further, the procedure is in a counterclockwise direction through the same number of coils as before.

It is obvious, therefore, that if jumper No. 1 were cut in half, the *A* phase would be open, but if the bottom of slot No. 3 and the top of slot No. 1 were connected together and to the line lead A_1, and at the same time the bottom of slot No. 30 and top of slot No. 10 were connected to the star ring, this would be putting the two sections of the winding in parallel. Then if the *B* and *C* phases were connected in a similar manner a two-parallel star winding would be the result. Accordingly it was decided to reconnect the motor on this principle.



(A) 440-VOLT WAVE-WOUND THREE-PHASE INDUCTION MOTOR RECONNECTED FOR 220 VOLTS (B)

A—Four-pole series-star wave winding of thirty-six coils; pitch is 1-10. Leads are A_1, B_1 and C_1. Star point is A_2, B_2 and C_2. 1, 2 and 3 are the reversing jumpers. B—Four-pole, two-parallel-star wave winding reconnected from A. The reversing jumpers were opened and one end was attached to the leads of the same phase and the other end to the star connection. Leads connected to A_1-A_1, B_1-B_1 and C_1-C_1. Star ring was connected to A_2-A_2, B_2-B_2 and C_2-C_2.

Drawing *B* shows the two-parallel star connections. The A-phase paths are: A_1—1-10-19-28-2-11-20-29-3-12-21-30-A_2 (or star) and, A_1—3-30-21-12-2-29-20-11-1-28-19-10-A_2 (or star). Both of these paths start at A_1 and end on A_2, the star point. The connections for the other phases are similar.

All the leads, the jumpers and the star ring for the 440-volt connection were removed and new leads and a new star ring of twice the cross-section were put on. These consisted of two pieces of $\frac{1}{8}$-in. x $\frac{1}{2}$-in. copper strap in parallel, bent on edge. When a trial was made after the change, the motor operated satisfactorily in every respect on 220 volts.

A. C. ROE.

Detroit, Mich.

Continental Practice in Electric Drive for Textile Mills

INDIVIDUAL electric drive is chosen for the majority of operations in the textile mills of continental Europe. Openers and scutchers, drawing frames, flyer frames, spinning mules and spinning and winding machines are quite generally individually driven. Commonly revolving flat cards are group-driven.

According to W. Dundas Fox, in the London *Electrician* for Feb. 4, owing to the high speed of openers and scutchers individual drive is usually adopted, a three-phase, 50-cycle squirrel-cage motor being in many cases direct coupled to the machine, but frequently belt drive is chosen, as this arrangement does not limit the speed beaters and at the same time constitutes a considerably better protection to the motors and the machine against shock caused by momentary overloads. This belt-driven arrangement, in comparison with the direct-coupling arrangement, also offers the advantage of the better utilization of floor space.

Speaking generally, revolving flat cards are handled on the group-drive system, the motor being directly coupled to a high-speed transmission shaft. There are, however, occasional instances where individual cards are erected or the limited floor space produces difficulties in mounting the shafting, etc., and in such cases individual drive forms a convenient alternative which is often employed.

Individual drive is considered ideal for drawing frames and is generally recommended. Ordinarily the motor is mounted on the floor within the machine itself and is coupled to the latter by means of gears. The control switch for starting and stopping the motor is connected mechanically with the self-acting stop arrangement on the machine in such a manner as to stop the driving motor automatically in case the yarn should break.

Flyer frames are usually individually driven, and as it is important that they should start smoothly, special care has been taken in designing a motor without external control resistances to meet this requirement. The motors are specially constructed squirrel-cage motors which will come up to normal full-load speed in five to seven seconds. As a rule the motor is simply coupled to the frame by means of tooth gearing, and the operating switch on the motor is connected with the operating handle of the flyer frame.

It has been found impossible to guard against the possibility of very heavy speed variations when handling the drive of spinning mules on the group system, owing to the frequent synchronism of the maximum or minimum power required by the several mules. Individual drive is usually recommended. Each mule works separately, and the speed is found to be quite constant. The result is a considerable increase in production and a better quality of material.

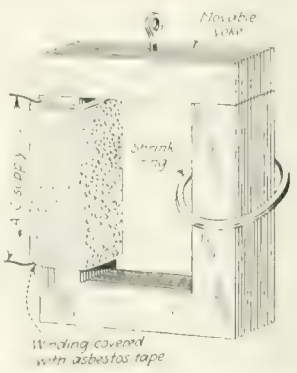
The even power consumption obtained by the regular spinning and winding process, the simple construction of the machines and the high speed of the driving shaft make the ring spinning machine highly suitable for individual drive. In order to produce a uniform tension of the thread, it is vital to obtain periodical variations in the speed, progressing with the diameter of the thread wound on the spindle. The speed should be variable, 10 per cent above and 10 per cent below average, or 20 per cent total. The highest possible speed is dependent upon the quality and count of the yarn required, and this makes it necessary that the motors utilized for the individual drive of ring spinning machines should possess both heavy starting torque and also the following special characteristics: (1) The possibility of a periodical variation of the speed in order to obtain a uniform tension of the thread throughout the process; (2) ability to run at a variable speed according to the class of material in progress of manufacture.

There are three types of motors which nearly provide these requirements—(1) the asynchronous alternating-current motor with resistance regulator, (2) the three-phase alternating-current motor with a pole-changing device, and (3) commutator motors. Another plan employs squirrel-cage motors connected to mains in which the frequency may be varied. This is accomplished by means of a motor-generator set, the generator of which operates at a different frequency from the motor frequency. The set may be comparatively small as it works during a limited fraction of the spinning period. It is said that the over-all efficiency of this system is as high as 89 per cent. Moreover, the installation cost is less than that for pole-changing motors.

Little or no improvement has been made during the last few years in the electric drive of looms, but it is interesting to note that after numerous trials and experiments some companies have discarded the individual gear drive, excepting in special circumstances, and as a general rule the well-known type of totally inclosed loom motor, with belt drive and spring belt tightener, is installed.

Effective Method of Expanding Metal Rings

FOR heating shrink rings to expand them before replacing them on a commutator the writer induces an electrical current in them by means of a reactance coil. By this method the heat is distributed evenly over the rings and the temperature to which the ring is raised may be accurately controlled. Although this method has since been used for many similar purposes it was first used while repairing a large high-speed direct-current machine. This machine has a long commutator in the center of which is a steel ring to keep the commutator bars in their place at the high speed. This ring had been taken off for repairs, and when it was replaced the scheme described was employed for expanding it. The reactance coil from an old rotary converter was obtained. This had a U-shaped core as is shown in the drawing. There was a winding on each leg of the core, and one of these windings was removed. A yoke was made to fit over the open end of the core so that it could be readily removed. The shrink ring was slipped over the leg, and by regulating the current in the winding any temperature desired could be obtained in the ring with the corresponding expansion due to temperature rise.



SHRINK RING IS EXPANDED BY HEATING DUE TO THE INDUCED CURRENTS

Trail, B. C., Canada. R. H. N. Lockyer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Church Funds Invested in Utility Preferred Stock

GOOD examples of how favorably the securities of an electric light and power company are esteemed by the local public as a result of the customer-ownership movement frequently come to light. One of the best illustrations of this is given in a letter from Robert Montgomery, manager of the investment department of the Louisville (Ky.) Gas & Electric Company. In this case a small church invested its surplus funds in the preferred stock of the Louisville company, the church treasurer being convinced of the absolute safety of the investment and wanting the money to earn the maximum interest. In relating the transaction Mr. Montgomery said:

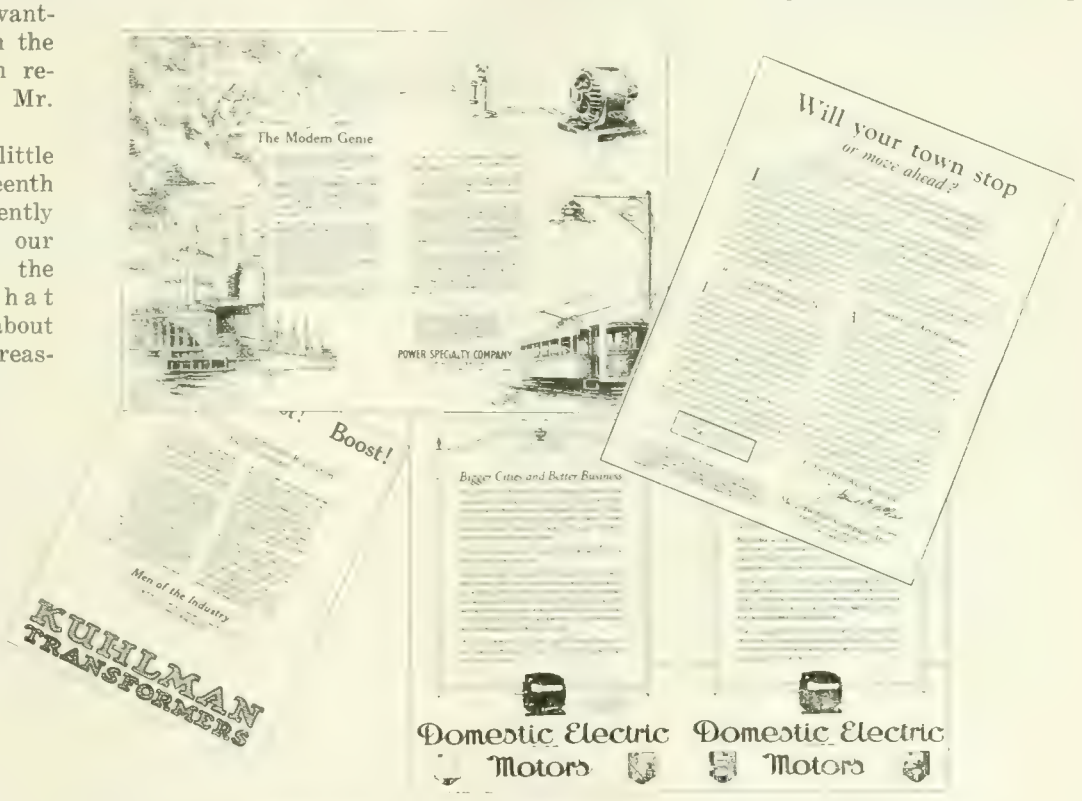
"The treasurer of a little church on South Eighteenth Street called on me recently to buy six shares of our preferred stock for the church, explaining that there was a surplus of about $600 in the church treasury and that this fund would gradually be added to until the church, in the course of eight or ten years, accumulated enough money to erect a new building. In the meantime he wished the money to earn the maximum interest consistent with safety. I told him it was rather irregular and unusual for a custodian of church funds to invest the money in any sort of stock, but he said his minister and the deacons, as well as himself, all owned some of our preferred stock, and he was thoroughly convinced it was a good investment; moreover, he said, the church would not lose as he would take full responsibility and personally buy the stock at par should the church at any time wish to realize the cash.

"The more I urged him to place the $600 in the bank at 3 or 4 per cent, the more insistent he became in his demand for the stock. Finally he said: 'If you and the company are as conscientious as that in handling the business of your customers, you deserve the support of our church and its congregation, and from now on we are with you, "sink or swim."' Thus the little church is now a shareholder of our company."

Such confidence in utility securities is an encouraging indication of the increasingly favorable attitude of the public.

Contractors Backing Up N. E. L. A. Good-Will Advertising Campaign

REPORTS this week from N. E. L. A. headquarters regarding the national good-will advertising campaign for electric light and power companies are very encouraging. The co-operation that is being obtained from the manufacturers and the other branches of the industry is helping to put the campaign over in a big way. A large number of advertisements have appeared and an even greater number are scheduled.



GOOD-WILL ADVERTISEMENTS TO APPEAR IN NATIONAL MAGAZINES AND TECHNICAL PAPERS

The April, May and June schedules are now being made up by Director of Publicity Oxley, who expects to be able to announce them the first of the month.

The lists of co-operating manufacturers continues to grow. This week word was received from the Pittsburgh Transformer Company and the Walker & Pratt Manufacturing Company stating their desire to participate. An interesting and gratifying development of the campaign is the way in which the contractor-dealers

are helping. Numerous requests have been received at N. E. L. A. headquarters for enlarged copies of the association's *Saturday Evening Post* advertising to hang up in store windows. Letters from the contractor-dealers tell of their sympathetic point of view and their desire to "do their bit" to help the campaign.

There are shown here reproductions of some of the recent co-operative advertisements—one the McGraw-Hill copy to appear in *Collier's* April 9 and the others being scheduled to appear soon in the technical papers.

Team Play on Central Maine System Yields More than 98 per Cent Collections

MERCHANDISING collections on the system of the Central Maine Power Company totaled 98.16 per cent and collections for gas and electric service 98.65 per cent during the year 1920 as a result of close co-ordination of the work of district superintendents and their subordinates with the records and receipts of the main office at Augusta. By regular comparisons of the charges, collections and percentages represented by the latter the district superintendents are kept informed of their standing, and much interest has been aroused by this competition to make the best possible showing in each district. A daily record of collections is maintained at the home office for each important division of the system, and in case the results tend to show a decided falling off as the middle of the month comes, telephone inquiries are made by the assistant treasurer's office to re-establish the rate of intake.

Considerable latitude is allowed local superintendents in making collections. The system is composed of a number of formerly independent companies whose collection requirements vary somewhat. In six of the twelve districts a discount of 5 per cent is granted for payment of an electric service bill within ten to fifteen days of presentation, and for cash payments a discount is made as a rule on the larger appliance prices, an allowance of $5 being made on vacuum cleaners and $10 on washing machines. In nearly all cases customers are billed monthly by mail from local offices, the bill covering amounts due for service and on electrical merchandise, properly segregated. Three follow-up notices are employed in case of payments delayed more than ten days beyond the usual thirty-day limit. These notices are spaced ten days apart, and the first and second respectively call attention to the bill and request payment. After the third or final notice the company reserves the right to discontinue service, but this is seldom necessary. Virtually no collectors are employed by the company. It is believed that the good-will resulting from a customer ownership in the system exceeding $3,000,000 is a potent factor in the punctuality of payments.

CENTRAL MAINE POWER COMPANY COLLECTIONS—1920*

	Charges	Collections	Per Cent	Balance Outstanding
Gas and electric	$1,327,192	$1,309,397	98.65	$17,795
Merchandise	686,911	674,267	98.16	12,647
Total	$2,014,103	$1,983,664	98.48	$30,439

* Not including companies acquired during 1920.

During December, 1920, five bulletins showing the comparative standing of the various collection centers and merchandising store centers of the company were sent to local superintendents by the main office, with comments on the progress of the various districts in the collection of outstanding accounts and changes in position of the competing centers. In some cases the collection of old accounts exceeded the outstanding charges, yielding more than 100 per cent collections.

TYPICAL BULLETIN USED TO STIMULATE COLLECTIONS

Interest in collections continues unabated. Bucksport, not content with an even 100 per cent, went clean over the top with a record of 1.258 in merchandise collections. Assistant Treasurer Jennings hasn't told us just how this is done, but if some can collect in advance it seems fair enough to put them at the top. Brunswick, in the same division, struck a high average of 0.985, with Bath closely tagging with 0.961. In the gas and electric accounts Winthrop, bound not to be pushed out of first place, pushed up her average to 0.962, but is pursued by Gardiner, which is only three points behind. Brunswick shows up well in this section also, with a percentage of 0.957. Augusta has picked up considerably and now has a percentage of 0.792.

	Per Cent Gas and Electric Collections		Per Cent Merchandise Collections
Winthrop	0.962	Bucksport	1.258
Gardiner	0.957	Brunswick	0.985
Brunswick	0.938	Bath	0.961
Foxcroft	0.866	Belfast	0.914
Lewiston	0.855	Pittsfield	0.904
Waldoboro	0.833	Oxford	0.831
Union	0.794	Gardiner	0.769
Augusta	0.792	Waterville	0.726
Bucksport	0.775	Rockland	0.721
Belfast	0.773	Kennebec G. & F.	0.654
Dexter	0.766	Augusta	0.624
Oxford	0.756	Foxcroft	0.608
Wiscasset	0.749	Lewiston	0.596
Rockland	0.70	Skowhegan	0.486
Hartland	0.699	Dexter	0.388
Bath	0.671		
Waterville	0.634		
Pittsfield	0.613		
Skowhegan	0.604		
Kennebec G. & F.	0.585		
Lisbon Falls	0.288		
Newport	0.237		
Readfield	0.000		

The friendly rivalry stimulated by these bulletins has borne good fruit. This year it is planned to send out these bulletins twice a month.

How Customer Ownership Influences Public Good Will

FURTHER evidence of the changing attitude of the public toward the utility companies is shown in an editorial, "Popular Interest in Utilities," which appeared in the Chicago *Tribune* for March 9. The editorial points to the increased number of public utility stockholders and the consequent removal of the utility companies from the machinations of "practical politicians." It is an interesting estimate of the value of customer-ownership as a means of placing the utilities' problems fairly before the public. The editorial says:

It is announced that the number of public utility stockholders has increased in this state until 400,000 citizens now have money in gas, telephone, electric power and electric railway investments. Nearly all of them are voters, and the number is virtually half the number of votes in Chicago.

The utilities are beginning to rest upon the general citizenship, and the wider the base spread for them the greater will be the intelligence of politics in dealing with them. That is the object of the utility companies in trying to make the stock attractive to the citizen with $100 or $500 to invest. It takes the air pockets out of politics, which hesitates to deal destructively with values in which the average citizen is interested. The old combination was one of politics and utilities. The new combination is one of utilities and the people.

When politics and utilities are combined it may be a bad thing for the ratepayer. When politics rides utilities as a campaign horse it may be a bad thing for the ratepayer. There is not likely to be the required amount of honesty and fair dealing in either arrangement. If the utilities represent community interests as investments, they will come more nearly representing community interests in service.

Relation of Securities to Value of Property

HOW closely the bonds, preferred and common stock of an electric light and power utility represent the value of the property covered has for long been a subject of discussion in establishing valuations and arriving at equitable rate schedules. An interesting analysis of this relation has been made by W. S. Barstow, president of W. S. Barstow & Company, in a recent news letter issued by that company and distributed among its stockholders. The transition of the electric utility from a dubious enterprise to a public necessity, he points out, was so rapid as to result in much misunderstanding on the part of the public. Explaining these questions, Mr. Barstow says:

"A question seems to have arisen of late as to the relation between the securities and value of property of a public-service enterprise. Many think the relation is more or less immaterial as far as common stocks are concerned, but admit the close relation when preferred stocks or bonds are mentioned. Bankers distributing securities to bondholders or lenders are as a rule vitally interested in the possibilities of common-stock financing as affecting the security and value of bonds, but often are unconcerned as to the importance of the common stock being properly represented in the value of the property. One of the requirements as to borrowing money is that the principal of the loan should be less than the bare physical property, and therefore it is assumed that a return on the bare physical property would meet the requirements of the bondholder without any recognized return on the common stock. But if the stocks are not represented in the value of the property and do not receive their proper recognition in the way of return, what becomes of the stabilization fund of earnings required by the bondholder and which is the return on these stocks?

VALUE OF PROPERTY

"What constitutes 'value of property' has never reached a definite basis, as in the majority of cases 'ability to earn,' which is the foundation of the enterprise, has never been fully recognized. The value of physical property is only one element in the value of property which produces the result of service and return.

"In the very early days of the power, lighting and transportation business, from 1885 to 1890, the industry was regarded as a purely speculative enterprise. In the first part of this period electric power was unknown and all service was confined to lighting. At such a time no one would invest but some would speculate. As a means of securing capital and developing an uncommercialized science it was necessary to offer large inducements to those who in more or less of a scientific way were attracted to the enterprise. As the enterprise grew it attracted more and more the attention of those outside of the scientific field, and as it was soon possible to secure capital without the help of the promoter.

"About 1895 the discovery of multiphase operation opened up an almost unlimited field and distances grew and services expanded rapidly. The operation of lighting, power and transportation companies then began to attract the attention of exploiters, who, discounting the future, added to the financial structure securities representing neither cash nor services of any kind and therefore represented in no way in the value of property. Thus the developments during those days are no doubt responsible for much of the misunderstanding of today between the public and the enterprise.

"In order to check the exploiting of this important industry which was supplying a public necessity, public service commissions were established and laws were enacted giving to commissions the power to prevent the issuing of securities which did not add to the value of the property and to regulate rates for service so that the investor would not receive an exorbitant return. It was never intended that such regulation should be carried to a point where the legitimate investor might be driven from the enterprise and the public be deprived of efficient service by being unable to secure extensions to keep pace with the growth of the community.

FEW INSTANCES OF OVERCAPITALIZATION

"Although there was at this time a great cry of overcapitalization, it was found that a large part of the amount of 'water' had already been made up by the investor adding to the value of the property by allowing the return to which he was entitled to remain in the property over a long period of years.

"When regulating bodies carefully investigated the situation, in each case they found that the difference between the value of property and securities was not as much as originally supposed, and that securities not properly represented by the value of the property had many times been passed down through innocent investors who were not parties to any of the original 'watered' transactions. With these facts in mind the early commissions ruled that inasmuch as the investor had not for many years received a fair return on his investment and had done his share to build up the value of the property and improve the conditions of the past, any difference which now remained between securities and value of property should be amortized over a period of years through earnings.

"The present method of rate making is not conducive to efficient management and in a majority of cases proves to be more or less guesswork, as no one can determine in advance the results which rates will actually produce under conditions which vary from time to time and over which there is absolutely no control. If rates are such that a company can earn and pay to the investor in cash more than is considered a fair market rate of return, and an effort is made by a change of rate to reduce this amount, experiences of the past have shown that the actual result may bring the return far below the fair market rate. If a second attempt is made to bring the results back to the fair market return unforeseen conditions may affect the result so that it either goes further below or again above the fair rate of return. This method of price fixing, although made by the best experts, has placed the investor in an uncertain position as to what return he is assured of in case he invests in the enterprise.

"One way to produce the result sought for would be to have any cash distributable in excess of a proper market return on the investment divided between the investor and the public, not through advanced reduced rates, the effect of which can only be estimated and which are so controlled by unknown future conditions as to make this method almost guesswork, but by an actual credit on the bills or fares after actual results of return are secured. If such a plan as this were established the position of public utility stocks would be assured and additional money could be readily secured at fair rates to provide for extensions to take care of the needs of the public."

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

High-Power Mercury-Arc Rectifiers.—GIROZ.—After some remarks on the theory of mercury-arc rectifiers, including a brief discussion of the action of choke coils and multiphase input transformers, the author proceeds to describe some recent developments in high-power rectifiers. Six-phase rectifiers, fed from three-phase-six-phase transformers, now are commercially built by the Brown-Boveri Company, in sizes giving 250 amp. to 1,000 amp. direct-current output. The vacuum vessel in such a powerful rectifier is made of steel and cooled by flowing water. The joints are of a special design and are kept air-tight by a thin film of liquid mercury. By careful design it has been possible to make the joints so reliable that the rectifier may be sent by rail over a great distance without suffering any air leakage. The mercury-arc rectifier, however, is an essentially static device, the author says, adding that its proper place is not on the locomotives but in the substations of an electric railroad. The internal pressure of these rectifiers normally is about 0.01 mm.Hg. The bigger units always are provided with pumping outfits of their own. It is important, in view of the danger of back-firing, always to keep the pressure down below 0.1 mm.Hg., and the evacuating pumps therefore should be kept running continuously when the load is very high. It has even been proposed to employ automatic maximum-current relays for starting the pumps automatically when the load passes a certain value. The rectifiers normally have six large main anodes, of hard, polished metal, two excitation anodes and one auxiliary anode for starting the arc. The two excitation anodes are fed from an extra single-phase winding on the input transformer and serve to maintain the arc even if the load on the main anodes happens to drop to zero. The efficiency of a high-power rectifier varies from 91 per cent at 200 volts on the direct-current side to 98 per cent at 700 volts. Owing to the tendency of the arc to develop harmonics, the input power factor is about 0.90 if the transformer primary is star-connected. The author presents diagrams showing how the input power factor may be raised to about 0.97 by using a delta-connected transformer primary. Several special arrangements are described in the article, such as automatic rectifier installations, battery-charging sets, etc. The use of two series-connected rectifiers for three-wire distribution is mentioned, but the author recommends the use of a single rectifier for supplying the full voltage, a small set of two equalizing dynamos being used as a voltage divider.—*Revue Générale de l'Electricité,* Nov. 20, 1920.

Lamps and Lighting

Progress in Lighting.—W. E. BUSH.—The author deals particularly with the necessity of considering illumination and light flux, rather than candlepower only. He suggests the following values of illumination (in foot-candles) as good practice in various interiors: General office lighting, 5; drawing office, 8; machine shop, 5; school class rooms, 4; weaving shed, 4; general store illumination, 5; operating tables, 30. It was also shown that the cost of lighting is very small compared with labor cost, and any possible advantage in increased production should be gained by proper lighting.—*Illuminating Engineer,* London, October-December, 1920.

Generation, Transmission and Distribution

Principles of Car Lighting by Electricity.—CHARLES W. T. STUART.—One number of a series of articles on car lighting in which the author deals with lighting circuits, distribution panels, fixtures, lamps, fans and switches.—*Railway Electrical Engineer,* February, 1921.

Problems of Electrical Transmission of Power.—J. BIERMANNS.—The author describes how it is possible to determine experimentally the short-circuit forces liable to occur at any point of a large network by means of a miniature model of the transmission lines, made to scale, in which there has been introduced between the different feeding points equivalent amounts of resistance, reactance and capacity and where a certain (low) voltage has been impressed upon the lines. All values being proportional to actual conditions, a short circuit may be made at any part of the miniature network, and the reading of an ammeter multiplied by the scale reduction factor will give the actual current to be expected. The model described shows the proposed electrification of the German Republic.—*Elektrotechnische Zeitschrift,* Jan. 27, 1921.

Basilit: A Preservative for Wooden Poles.—NOWOTNY.—Comparative tests have been made of the durability of wooden telegraph poles impregnated with copper sulphate and similar poles impregnated with basilit, a composition invented by Malenkovic and consisting of 88.89 parts (by weight) of sodium fluoride and 11.11 parts of dinitrophenolaniline. The poles were treated under pressure with a 2.4 per cent solution of basilit in water till the wood had absorbed about 3 kg. basilit per cubic meter (0.2 lb. per cubic foot). A statistical survey covering the performance of 4,000 poles during the years 1913-17 indicated a spoilage percentage of zero in the first year, 0.09 in the second and 0.12 in the third and fourth years, giving a total loss of 0.33 per cent for the four years. Similar poles impregnated with copper sulphate according to the Boucherie method and used under similar conditions during the same years showed a spoilage of respectively 0.11, 0.75, 3.26 and 6.23 per cent, or a total of 10.35 per cent poles lost in the four first years, which is thirty-one times as much as the corresponding figure for the basilit-impregnated poles.—*Telegraphen und Fernsprechtechnik,* No. 7, 1920. (See also *Elektrotechnik und Maschinenbau,* Nov. 21, 1920.

The Dual-Drive Units.—IVAN STEWART FORDE.—The writer shows the application of dual drive—that is a drive in which a motor is connected to one end and a

turbine to the other end of power-plant auxiliaries such as exciters or pumping units. The operation is such that in case of failure of one drive the other immediately takes the load. The steam end may be used according to the heat balance in the station.—*Electric Journal,* February, 1921.

Ultimate Boiler Capacity Limited by Fuel Conditions.—JOSEPH HARRINGTON.—The size and characteristics of fuel are shown to influence the rates of ignition and combustion in furnaces. The importance of air supply is pointed out, and the fusing temperature of ash is shown to limit possible rates of combustion on grates and in fuel beds.—*Electrical Review,* Jan. 22, 1921.

Traction

Operating a Modern Freight House Efficiently.—W. E. PHELPS.—A description of the Cleveland freight house of the New York Central Railroad showing the adaptability of electric trucks and tractors in handling a great volume of freight.—*Railway Electrical Engineer,* February, 1921.

Substantial Energy Saving on Philadelphia Rapid Transit.—Certain of the cars on this system are equipped with meters which are used both to promote economical operation and for timing inspections. Instructors explain to the men methods to be used in order to reduce the amount of energy consumed. Records are posted in trainmen's quarters and result in great rivalry; consequently records are kept low.—*Electric Railway Journal,* Feb. 19, 1921.

Installations, Systems and Appliances

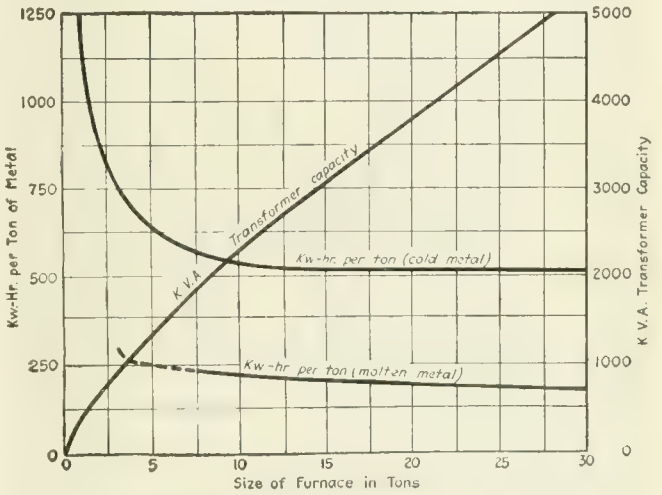
High-Voltage Fuse.—P. CHARPENTIER.—It is generally assumed that the break of a high-voltage and high-intensity current under oil requires a large and very strongly built container of oil. High-voltage fuses are therefore cumbersome and not popular. A new type of fuse is described, which gives satisfactory results apparently for voltages up to 45,000 and operating currents as high as 100 amp. The fuse wire itself is placed above the oil level and is incased in a metallic container. After melting, the lower contact is drawn into the oil by the combined action of gravity and an accelerating spring, quickly extinguishing the arc.—*Revue Générale de l'Electricité,* Jan. 1, 1921.

Safety Arrangement for Planers.—H. BECKER.—Special attention is paid to double planers, that is, planers with two beds, rectangularly arranged, so as to be able to finish two edges of large square steel plates at one time. It is essential to provide means to prevent collision of the two traveling tool heads at the corner. This is achieved by dog-operated limiting switches. Seven different methods of electric drive are considered and detailed switching diagrams are given.—*Zeitschrift des Vereines Deutscher Ingenieure,* Dec. 4, 1920.

Fuses.—H. W. KEFFORD.—The author reviews the present status of the fuse in electrical layouts and gives some indications of the lines along which fuse design should be developed. Fuses for generator, feeder and consumers' service protection are discussed. The article says that the essential requirements of fuses are: (1) Capability to open the circuit cleanly and reliably under any conditions of overload or short-circuit which may arise; (2) appropriate sluggishness to meet and follow the overload capacities of the apparatus or material protected; (3) safety for handling; (4) quickness of replacement; (5) safe-running temperatures, and (6) reasonable energy consumption. How modern fuses meet these requirements is discussed in detail.—*English Electric Journal,* January, 1921.

Application of Electric Power to the Rubber Industry.—A report issued by the sub-committee of the industrial and domestic power committee on the rubber industry for the A. I. E. E. An analysis of the various power applications is first made, and general principles are laid down for the proper selection of motor drive and heating equipment.—*Journal A. I. E. E.,* January, 1921.

Electric Smelting Furnaces.—F. ROWLINSON.—The development of several types of furnaces for steel smelting is first discussed, and the author then gives some of the characteristics of transformers required for furnace work. The discussion also covers electrodes and some effects of abnormal and normal operations on the



TYPICAL ELECTRIC FURNACE PERFORMANCE FOR THE SMELTING OF STEEL

wave form of voltage and furnace performances, an example of which is given in the illustration shown.—*Beama* (British Electrical and Allied Manufacturers' Association), London, January, 1921.

Electrophysics and Magnetism

Absolute Significance of Maxwell's Equations.—F. D. MURNAGHAN.—This subject is considered under three divisions—elementary proof of a generalized Stokes theorem for hyperspace, a statement of Maxwell's equations as integrals over hypersurfaces, and the other the electromagnetic potential.—*Physical Review,* February, 1921.

The Luminosity of Mercury Vapor Distilled from the Arc in Vacuo.—NORMAN H. RICKER.—The effect of an electric field on the spectrum was studied. It was found that charged grids decreased the luminosity without changing the color, but when, under certain conditions, the luminosity was increased there was a change in the relative intensity of the lines. The velocity of the vapor was measured by a stroboscopic method. The luminosity was decreased intermittently at a known frequency, and the resulting "puffs" as they moved along the tube were observed stroboscopically. From this velocity and the rate of distillation the density of the vapor was computed. Decay of luminosity along the tube was observed. Theoretical discussion of these results leads to the conclusion that recombination of the positive and negative ions produced by the discharge is the most probable cause of the afterglow.—*Physical Review,* February, 1921.

An Electromechanical Device for Rapid Schedule Harmonic Analysis of Complex Waves.—FREDERICK S. DELLENBAUGH, JR.—The writer calls attention to the great ease with which electric circuits may be combined by multiple switches and the accuracy with which electric measurements may be made, and shows the application of such combinations in the rapid analysis of irregular electrical waves. He deals with methods of applying such circuits to the problem of wave analysis and makes detailed comparison between this and other methods.—*Journal A. I. E. E.*, February, 1921.

Electrochemistry and Batteries

Electrolytic Zinc Plant of the Anaconda Copper Mining Company at Great Falls, Mont.—An investigation of the possibility of extracting zinc from the complex ores of Butte, which contain so much iron and lead that the concentrate analyzed only 33 to 35 per cent zinc, is described. After a careful preliminary study it was decided that the electrolysis of sulphate solutions was the most promising method of zinc recovery. An electrolyte is required free from all metals more electronegative than zinc, such as copper, cadmium, lead, arsenic or antimony. Arsenic and antimony are said to be particularly injurious, causing very small yield per horsepower when present in amounts so small as almost to defy detection. It is not found difficult to maintain an extremely high degree of purity in the zinc solution going to the cells if the iron content is thoroughly oxidized before precipitation by means of limestone or excess calcine and if sufficient zinc dust is added to satisfy the copper, cadmium and whatever small amount of lead might be present. It may be necessary to add a ferric salt to low-iron solutions to insure the complete precipitation of all arsenic as ferric arsenate. An aluminum plate makes the most successful cathode and a lead plate the most suitable anode. In practice the most satisfactory current density is from 2 amp. to 2.3 amp. per square foot (22 amp. to 25 amp. per sq.m.). Evolution of gas at the anode is then sufficient to provide the necessary agitation.—*Chemical and Metallurgical Engineering*, Feb. 9, 1921.

Units, Measurements and Instruments

Abnormal Behavior of a Weston Standard Cell—M. G. MELLON.—Occasionally there is encountered a Weston standard cell which has not maintained the desired constancy, or which does not show the expected change of electromotive force with corresponding change of temperature; that is, it exhibits hysteresis. The author states conclusions by Wolff: (1) That Weston cells can be set up which exhibit extremely little hysteresis in the range 0 deg. to 40 deg. C.; (2) that some of the cells showed marked and persistent hysteresis, particularly at lower temperatures; (3) that similar behavior was found for cells having abnormal values at room temperature. His own work indicates (1) the necessity of keeping in mind the fact that all Weston cells do not remain constant over an indefinite time, (2) the advisability of standardizing carefully any Weston cell before employing it for accurate measurements, and (3) the probability of obtaining uncertain results using any cell showing such a marked hysteresis, unless its temperature is maintained rigidly constant, as in a carefully regulated thermostat.—*Chemical and Metallurgical Engineering*, Jan. 26, 1921.

The Limitations of the Stop Watch as a Precision Instrument.—A. L. ELLIS.—After reviewing some of the errors occurring in stop watches, the author concludes that this watch is not sufficiently robust for application to engineering measurements, and suggests that manufacturers should make a special effort to produce a stop watch suitable for this class of service.—*Journal A. I. E. E.*, February, 1921.

Telegraphy, Telephony and Signals

High-Power Radio Station Deutsch-Altenburg.—J. MAYER and DR. L. HOGELSBERGER.—Detailed descriptive article of the newly erected (1915-1920) commercial radio station, the largest of its kind in German-Austria. Two towers of structural steel, 150 m. in height and weighing 48 tons, suspend the antenna and end at the bottom in a semi-spherical insulating abutment. The "T" antenna consists of ten bronze wires 500 m. long and 5 mm. thick. The station is connected to a transcontinental 16,000-volt, 40-cycle, three-phase line by means of a 150-kva. transformer rated at 16,000-380/220 volts. A 50-kw. high-frequency generator of 10,000 cycles at 3,000 r.p.m., a 5-kw. quench-spark sender and the necessary receiving instruments are installed for wave lengths up to 17,000 m. The entire installation was made by the Telefunken company. The multiplying of the basic frequency of 10,000 cycles is achieved in stationary transformers, operating on the Jolly-Arco principle. According to three wave lengths of 7,500, 5,000 and 3,750, frequencies of 40,000, 60,000 and 80,000 cycles are available. For the 5-kw. quenched-spark-gap sender a three-phase-single-phase motor-generator furnishes 220 volts at 500 cycles, which is being stepped up to 9,000 volts, the usual oscillatory circuit of condensers and quench gaps being used. Efficiency measurements gave these results:

$$\text{Longest wave} = \frac{\text{antenna output } (55.1)}{\text{generator output } (67.5)} = 81 \text{ per cent.}$$

$$\text{Shortest wave} = \frac{33.1}{67.5} = 49 \text{ per cent.}$$

The station is located 30 km. from Vienna.—*Elektrotechnik und Maschinenbau*, Jan. 2, 1921.

Some Phases of Railroad Telegraph and Telephone Engineering.—STANLEY RHOADS.—It is said that telephones are used almost exclusively for train dispatching. Automatic telephones are being used. Extensive local and long-distance lines and switchboards are required. A telegraph system reaches all stations. The problems include electric protection, inductive interference, electrolysis, transmission and traffic—necessitating continual experiment and investigation. How some of these problems are handled on the New York Central Railroad system is discussed in detail.—*Journal A. I. E. E.*, March, 1921.

Miscellaneous

Figuring Evaporation from Temperature Records.—C. E. GRUNSKY.—The author offers the theory that evaporation, taken in its yearly average, is directly proportionate to temperature, and presents an empirical formula corrected for altitude which may be used in calculating anticipated evaporation for any given reservoir site. The formula is $E = E' + 0.0000033 \sqrt{t}\, A$, where E is the mean monthly rate of evaporation in feet per twenty-four hours, E' is the mean monthly rate of evaporation at sea level, t is the mean monthly temperature, and A is the elevation in feet above sea level. It is reported that one of the Western power companies recently estimated a loss of approximately one-third of its stored water from evaporation.—*Journal of Electricity*, Jan. 1, 1921.

Books of Technical and Industrial Interest

THE THERMIONIC VACUUM TUBE. By H. J. Van der Bijl. New York: McGraw-Hill Book Company, Inc. 391 pages, 232 illustrations.

Nearly all the books which have been published on the thermionic vacuum tube are either highly scientific physical treatises or highly practical descriptions of this remarkable device. This book is essentially an applied-science treatise, midway between the two classes. It is written for engineers from an engineering viewpoint. There is hardly any subject so engrossing and important to electrical engineers at the present day as the vacuum tube. It can be employed as a converter from direct to alternating currents, as a receiver, an amplifier, a rectifier from alternating to direct currents, as a regulator and as a measuring device. In view of these numerous applications, an engineering treatise on the device becomes of great value at this time. The author has not only given much study to vacuum tubes but has also been engaged professionally for many months on the development and investigation of these devices, so he writes with authority. The book is divided into ten chapters, on the following subjects: Properties of electrons, ionization, dislodgment of electrons from solid substances, physics of the thermionic valve, influence of gas on the discharge, rectification of currents, the thermionic amplifier, the vacuum tube as an oscillation generator, modulation and detection of currents, miscellaneous applications. The volume will recommend itself as a textbook to engineering students and as a reference book to electrical engineers.

AUTOMOTIVE IGNITION SYSTEMS. By Earl L. Consoliver and Grove I. Mitchell. New York: McGraw-Hill Book Company, Inc., 270 pages, 345 illustrations.

Considering the millions of automobiles in every-day service throughout the United States which operate by internal-combustion engines and employ electric ignition, it is remarkable how little literature has been obtainable on the subject of electric ignition for the benefit of the hundreds of thousand of automobilists. This book is well directed toward filling that need. It gives clear and well-illustrated descriptions of the elementary principles of electric ignition and of a number of well-known ignition systems. The book is intended for the average automobilist and not for the specialist, although many specialists are likely to be interested in it. All who use internal-combustion engines, whether in automobiles, power boats, trucks, tractors or airplanes, are likely to find the information presented very serviceable. The book is divided into ten chapters on the following topics: Principles of electricity and magnetism, ignition batteries, the jump-spark ignition system, modern battery ignition systems, battery ignition systems for multiple-cylinder engines, the low-tension magnets, armature types of modern high-tension magnetos, inductor types of modern high-tension magnetos, care and repair of ignition apparatus, and ignition troubles and remedies. The text is clear and copiously illustrated. A good index ends the book. The directions for testing and adjusting ignition appliances will be found very serviceable.

COURANTS TÉLÉPHONIQUES, ET DE LA RADIOTÉLÉGRAPHIE. By J. B. Pomey, chief telegraph engineer for the French government. Paris: Gauthier-Villars et Cie. 510 pages, paper, 8vo.

The author of this book is to be commended for dealing with principles rather than apparatus, for there is a scarcity of such books in the field of communication. The first half of the book is devoted to a mathematical treatment of electricity and magnetism, a discussion of the theories of Maxwell and Lorenz, some transient problems, and about 100 pages on long-distance telephone circuits, in which the author outlines a method for making loading calculations and develops the equation of the propagation of current along a conductor of finite length. It is not likely that the vector calculus method outlined in Chapter I and used freely in Chapters II, III and IV will appeal to the practicing engineer. However, this method, on account of its brevity and definiteness, is a favorite with many mathematical physicists, and since the physicists and the engineers are working together on many problems of common interest, it is unfortunate that the method of vector calculus is not more generally understood. The author, no doubt appreciating this fact, decided on this method with the hope that other engineers would follow his example and that in time vector calculus would become the common language of these two groups of workers. The second half of the book takes up some mechanical problems in connection with aërial wires and the supporting towers; electrical oscillations in, and constants of, antennas by analogy, using La Grange's equations; resonance in the primary circuit of transmitter; damped and undamped oscillations; logarithmic decrement, using Bjerkne's method; coupled circuits and the calculations and measurements of inductance and capacity. It appears that almost too much space is devoted to analogies. The same amount of energy applied directly to the study of the electrical phenomena would have been more profitable. The reader should be grateful for the opportunity to profit by the wide experience of the author and to get his point of view.

Books Received

ELECTRIC WELDING. By Ethan Viall. New York: McGraw-Hill Book Company. 418 pages, 329 illustrations.

ELEMENTARY MACHINE SHOP PRACTICE. By James A. Pratt. New York: D. Van Nostrand Company. 320 pages, 201 illustrations.

MODERN HIGH-SPEED INFLUENCE MACHINES. By V. E. Johnson. London, England: E. & F. N. Spon, Ltd. 278 pages, 93 illustrations.

STORAGE-BATTERY MANUAL. By Lucius C. Dunn. Annapolis, Md.: United States Naval Institute. 392 pages, 146 illustrations.

STRAIGHT BUSINESS IN SOUTH AMERICA. By James H. Collins. New York: D. Appleton & Company. 305 pages.

"MECHANICAL WORLD" YEAR BOOK, 1921. Manchester, England: Emmott & Company, Ltd. 319 pages, illustrated.

THE ELEMENTS OF ELECTROTECHNICS. By A. P. Young. London, England: Sir Isaac Pitman & Sons, Ltd. 348 pages, 179 illustrations.

FINANCIAL ENGINEERING. By O. B. Goldman. New York: John Wiley & Sons, Inc. 272 pages, illustrated.

HILFSBUCH FÜR DIE ELEKTROTECHNIK. By Dr. Karl Shecker. Berlin, Germany: Julius Springer. 662 pages, 553 illustrations.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Precedents May Be Established in Study of Deschutes River Conflict

A JOINT investigation is to be made of the Deschutes River in Oregon by the Federal Power Commission, the Reclamation Service and the Geological Survey. On that river there is a conflict between irrigation and power projects. It is proposed to work out a plan which will permit of the best combined use of the waters of this river.

The investigation is regarded as being particularly important since it will establish precedents which will probably be followed on the Colorado, the Klamath, the Flathead and other rivers where similar conflicts exist

The Federal Power Commission will be represented in the investigation of Lieut.-Col. J. B. Cavanaugh, Corps of Engineers, U. S. A. The Geological Survey will be represented by F. F. Henshaw, while the Reclamation Service will be represented by either F. W. Hanna or D. C. Henny or both.

Water-Power Depreciation Regulation Is for State Commission Decision

THE regulations recently promulgated by the Federal Power Commission formed the subject of a hearing in Washington on March 25. The discussion was confined largely to regulation No. 16, which deals with depreciation reserves. The portion of the regulation about which most contention arises reads as follows:

> The licensee shall within six months after the date of going into service of any project prepare and submit to the commission a statement showing in detail the plan upon which it is proposed to charge depreciation, including the cost of the project, the property and the cost thereof on which it is proposed to charge depreciation, and the property and the cost thereof which the licensee considers is not subject to depreciation and upon which no depreciation charges are proposed. Such statements shall further show as to each class of property or structure unit or item, when separately estimated, on which it is proposed to charge depreciation, other than deferred maintenance, its cost, its service life (estimated if not known), the estimated value of salvage (if any) recoverable at the time of retirement, and the rate necessary to be applied to the cost of each such class of property, or structure, unit or item, to produce a reserve equal to the difference between such cost and the value of salvage (if any) recoverable at the time of retirement. A schedule shall also be submitted showing a list of property, if any, and the cost thereof on which it is proposed to charge depreciation representing deferred maintenance, the annual amount of such depreciation, the basis for determining such amount and such other details as may be appropriate. Such classification of property and such rates and amounts of depreciation thereon so proposed shall be used by the licensee as a basis for charging depreciation unless and until the commission, after investigation and hearing, shall by order require changes in such classification and in such rates and amounts of depreciation.

Brief hearings on the regulations were held prior to their promulgation, but owing to the necessity of having the regulations in force, so as not to delay the issuance of licenses and permits, it was decided to promulgate them with the understanding that they could be amended later. The feeling of the commission seems to be that the regulations should be allowed to go to the public utilities commissions of the various states for study and suggestion. During this time opportunity would be given every one interested to study them and submit suggestions. With all the suggested amendments before it, the commission, it feels, then could undertake more intelligently the changes that might be found desirable.

Washington Officials Upbraid Large Consumers for Not Storing Coal

FAILURE on the part of the public utilities and other consumers of coal who have definite knowledge of their needs to buy and store coal at the present time is causing apprehension to officials in Washington. The Interstate Commerce Commission, it is understood, has under consideration the issuance of a warning reiterating its position that no small part of the responsibility for a general shortage of coal rests with those who fail to make contracts when the cars are available and the mines are able to fill the order.

Dr. George Otis Smith, the director of the United States Geological Survey, makes the following statement:

"The consuming public must feel its part of the responsibility in the problem of an adequate coal supply. Today there is a supply of both coal and cars available, but the consumer seems to prefer to take his chances when the demand will be great. He hopes for lower prices and thus delays the contracts. This procedure is not helping to put coal production and distribution on a twelve-month basis. A seasonal demand is injurious to the coal operator, to the coal miner and to the railroads, while in the end the buyer of coal has to pay more than he would have paid had he co-operated in helping to stabilize coal production and movement."

Should Be Water-Power Board Devoting Entire Time to Work, Says Weeks

IN VIEW of the vast amount of work confronting the Federal Power Commission, the Secretary of War is of the opinion that it would be better to have a commission which could devote all of its time to the work. Secretary Weeks stated to an ELECTRICAL WORLD representative this week that he had not considered delegating his place on the power commission to a subordinate, but that he believes it will be necessary for him to delegate some of his work so as to give the remainder the personal attention it deserves. Whether the power commission work or some other duty will be shifted to other shoulders has not been determined. Secretary Weeks stated that he will not make up his

mind until he has participated in a few of the power commission's meetings so as to determine the exact character of the task.

To have a commission which would devote all of its time to water-power matters would require legislation. It also probably would require legislation for the Secretary of War to delegate the power to act to any of his subordinates. It would be possible, it is believed, for him to designate some officer of his department to sit in his stead at meetings of the power commission so long as the Secretary himself assumed final responsibility.

Federal Power Commission Printed Regulations Now Ready

THE rules and regulations of the Federal Power Commission for hydro-electric development under the federal water-power act have been printed and are now ready for distribution. The pamphlet contains in addition to the rules and regulations a set of the necessary forms for application and a copy of the water-power act under which the commission functions.

Commonwealth Edison to Stage Electric Vehicle Show in Convention Week

PLANS for an electric vehicle show to be held during the N. E. L. A. convention at Chicago, May 31 to June 3, have been announced by the Commonwealth Edison Company. The show will be given under the auspices of the company in its building at Clark and Adams Streets, and several thousand square feet of space in its electric shop will be given over to the exhibits, which will include passenger cars, trucks, industrial tractors and accessories such as charging equipment and batteries. The large lighting-fixture room will be used for showing motion pictures of various installations of trucks and their different uses. The show will be in charge of L. T. Carpenter, superintendent of the commercial vehicle service department of the company. An exhibit of electrical appliances will be given at the same time, but owing to the limited space available only those manufacturers whose products are carried by the company will be invited to exhibit.

Safety Is First Day's Topic of Wisconsin Electrical Association Meeting

THE main causes of accidents in the electrical industry formed the topic of C. B. Scott of the National Electric Light Association's safety committee when he spoke before the Wisconsin Electrical Association at Milwaukee on Wednesday last. Mr. Scott listed these causes as carelessness, the hazard of the electric current, lack of proper supervision, the warm-weather period of the year, the present disposition to overload lines and equipment, especially switches, and the failure of workmen to use the safety appliances furnished. Carelessness was rated as by far the most serious cause, and although on analysis of about ten thousand accidents Mr. Scott found that only 8 per cent were due to electrical causes, that 8 per cent included more than 70 per cent of the fatalities, the lost time and the accident costs. That the accident curve and the costs incurred rise rapidly during the hot weather was shown, the chief explanation being the tendency to mental sluggishness in the hot weather, though the greater number of employees had also to be borne in mind. The remedy, Mr. Scott held, lies in the enthusiastic backing of safety work by executives and the strict enforcement of printed rules by competent supervisory forces. He believed that no company is too small to print adequate safety rules for its system.

Frantz Herwig outlined the work of the Wisconsin Utilities Bureau, and P. V. Prather discussed the work of the various state and national associations, pointing out their necessity if the industry is to make its needs effectively known. The delegates inspected the new Lakeside plant of the Milwaukee Electric Railway & Light Company on Wednesday morning. The outstanding feature of the plant is its use of powdered coal exclusively. The annual banquet was held at the Hotel Pfister Wednesday night, and on Thursday papers on induction regulators, electrical merchandising, methods of power-factor correction and customer's demand as a factor in rate making were discussed.

Getting Back to Normal to Be Gradual, Jobbers Think

MANY varying views on the outlook for 1921 were heard at a meeting of the Central Division of the Electrical Supply Jobbers' Association held March 15 at the Congress Hotel, Chicago. The majority opinion seemed to be, however, that getting back to a normal business basis would be a very gradual process. Among other subjects discussed was that of salesmen's compensation, and various plans of giving bonuses and commission and paying straight salary were advanced. The matter of lower salary levels for salesmen was considered also. Various methods of co-operating with the dealer in establishing the consumer market for appliances were outlined.

Federation to Direct Work from Washington Office

WITH the opening this week of its suite of offices in the National Savings and Trust Company Building, in Washington, the American Engineering Council of the Federated American Engineering Societies will direct its work in the future from the national capital. L. W. Wallace, executive secretary of the organization, will not be able, however, to take up his residence in Washington for another month. In the meantime the offices will be in charge of A. C. Oliphant, the assistant secretary.

The principal effort being made at this time at the offices of the Federated Societies is in connection with the extension of the employment service of the organization. In addition to having one central controlling office, the plan is to have branch offices in several of the larger cities. A full report on the employment service is to be made when the executive board meets in Philadelphia on April 16. Secretary of Commerce Hoover, the president of the organization, expects to attend the executive board meeting. At this meeting a comprehensive report also is to be made on the activities looking to the establishment of a Department of Public Works.

Copies of a model bill on the matter of licensing engineers now are available at the office of the executive secretary. These bills are being sent out to those interested, not with the idea of offering a recommendation one way or the other in the matter, but in the hope that any state legislation which may be enacted will follow the general lines of the model bill.

Five-Million-Dollar Construction Program for Potomac Electric

THE Potomac Electric Power Company is anxious to carry through a five-million-dollar improvement program during the next three years. The plan is contingent, however, on Congress permitting the merging of the power company with the Washington (D. C.) Railway & Electric Company and upon the development which the government proposes to make at Great Falls on the Potomac River.

The power company is facing the necessity of raising $10,000,000 during the next year. Of that sum $5,000,000 is required for new financing and $5,000,000 for refunding.

To Make Comparative Tests of Flatirons

TESTS of from six to twelve or more brands of electric flatirons are to be made by the Electrical Testing Laboratories in New York for the standardizing and testing division of the N. E. L. A., of which R. S. Hale of Boston is chairman. The flatirons selected for tests will include those of good and medium reputation and also irons that are not considered so good as the others. Comparative tests and test methods have been made up.

The division plans to publish the results of the tests of all of the flatirons without naming the manufacturers or brands with the hope that the test results will serve as a basis for later judgment as to the quality of irons which may be tested by central stations or contractors.

Iron manufacturers have been informed of these tests. Manufacturers having such tests made at their own expense may have the data included in the report of the division.

New York State Administration Water-Power Measure Introduced

GOVERNOR MILLER'S bill for the development of New York State's water power reached the Legislature this week. It provides for a commission of five, to be composed of the Conservation Commissioner as chairman, the Attorney-General, the State Engineer, the temporary President of the Senate and the Speaker of the Assembly, who are to have charge of the leasing of the state's water power along the lines of the federal water-power bill.

Licenses granted by the commission will permit the "diversion and use for power or other purposes of any of the waters of the state in which the state has a proprietary right of interest, or of boundary waters of the state where the state has jurisdiction over the diversion of or interference with the same solely or concurrently with any other jurisdiction or power. Surplus barge canal water which the Superintendent of Public Works certifies the canal does not need may also be licensed."

The commission is to fix the charge of license for a period up to fifty years and at the time of granting the license is to accord preference to the applicant whose plans are best adapted properly to develop, conserve and utilize the water power of the watershed, stream or locality. Between two plans equally well adapted preference must be given a city.

Every license given is to reserve to the state the right to regulate through the Public Service Commission rates, service and capitalization.

The right of eminent domain is accorded the state and transmission companies in development of the power. A license is revocable for non-payment of rent or failure to prosecute work.

Maine Governor Recommends Taxing Water Power to Insure State Control

IN A SPECIAL message to the Maine Legislature Governor Baxter urges a constitutional amendment providing for the development of storage reservoirs and for the taxation of water-power developments as a means of insuring state control and of retaining such control against its acquisition by the national authorities under the federal water power law. It is proposed to tax hydro-electric energy exported from the state in order to protect Maine's hegemony in this field. The message reads in part as follows:

"Maine has 400,000 developed water horsepower, the fair value of which is not less than $100 per horsepower and in some developments even larger. There also is 1,000,000 hp. undeveloped in the state. These great values should be a source of revenue to the state. If the Legislature adopts this amendment and if the people later ratify it, the Legislature of 1923 will be in a position to pass some reasonable tax laws under which these valuable rights will share in the burdens of taxation."

Radio Manufacturers Consider Plan to Organize

IF PRESENT plans of the leading manufacturers of radio apparatus in this country materialize they will become affiliated with the Associated Manufacturers of Electrical Supplies as a section. The aim of the radio manufacturers in making this connection is to unite more closely the industry, to standardize and improve distribution methods as much as possible and to come into closer contact with other branches of the electrical business.

The preliminary steps in the matter were taken at an informal meeting of the twenty or so radio manufacturers conducting exhibits at the convention and exhibits held last week at the Hotel Pennsylvania, under the Executive Radio Council for the Second District. At this meeting the advisability of forming a separate radio association or of joining with electrical supply manufacturers in their association was discussed. A committee was finally appointed to confer with Charles E. Dustin, secretry of the Associated Manufacturers of Electrical Supplies.

At a second meeting held at the Hotel Pennsylvania on March 19 the members of the radio manufacturing group present, acting on the favorable report rendered by their committee, unanimously passed a resolution to the effect that each individual company apply for membership in this association, with the object of later forming a separate radio section thereunder. A committee composed of Daniel D. Murdock of the W. J. Murdock Company, Chelsea, Mass.; George Eltz, Jr., manager of the radio department of the Manhattan Electric Supply Company, New York City, and Louis G. Pacent, Pacent Electric Company, New York City, was chosen to carry out the necessary arrangements.

Government May Obtain Service Rates Lower Than Private Customers

DECISION by a lower court that gas companies may furnish their product at a lower rate to the government than to private consumers was sustained on March 21 by the United States Supreme Court. An extract from the opinion reads as follows:

"The notion that the government cannot make it a condition of allowing the establishment of gas works that its needs and the needs of its instrument, the District, shall be satisfied at any price it may fix, strikes us as needing no answer. The plaintiffs are under no legal obligation to take gas, nor is the government bound to allow it to be furnished.

"If they choose to take it, the plaintiffs must submit to such enhancement of price, if any, as is assignable to the government demands. We do not consider whether the commission has power to raise the price to the excepted class because, even if it has, the plaintiffs have no right to require equality with the government, and they have no other ground upon which to found their supposed right."

Ohio Electric Light Association Prepares Tentative Program

FROM July 12 to July 15 inclusive has been determined on as the time for the annual convention of the Ohio Electric Light Association, which will be held, as usual, at the Breakers Hotel, Cedar Point. The same general plan will be followed as last year, with exhibits on each side of the large convention hall, and it is expected that last year's registration of 138 will be exceeded. Entertainment features are being arranged. The tentative convention program follows:

TUESDAY, JULY 12

Afternoon.—President's address; secretary-treasurer's report; report of illumination committee, W. S. Merrill, Nela Park; symposium on street lighting.

WEDNESDAY, JULY 13

Morning.—Report of meter committee, S. C. Henton; address, "Rate Making."

Afternoon.—Report of transmission and distribution committee, Prof. A. M. Wilson, University of Cincinnati; report of farm-service committee, J. C. Matthieu, Dayton Power & Light Company.

THURSDAY, JULY 14

Morning.—Report of new business co-operations committee, industrial power and heating section, M. W. Arthur; lighting and merchandising section, J. L. Gaston, Union Light & Power Company, Covington, Ky.

Afternoon.—Address by a banker; address by G. C. Maxwell.

FRIDAY, JULY 15

Morning.—Report of station-operating committee, Prof. Henry B. Dates, Case School of Applied Science, Cleveland; election of officers.

Western Electric 1920 Sales $206,112,000

WITH an increase of 52 per cent over the previous year's business, the Western Electric Company, according to the annual report issued this week, broke all previous sales records in 1920 with total billings of $206,112,000. Of this amount $113,517,000 was sales to Bell Telephone companies and $92,595,000 to other customers, an increase of 62 per cent to the former and 41 per cent to the latter.

Sales for the past several years have been as follows: 1913, $77,533,000; 1914, $66,409,000; 1915, $63,852,000; 1916, $106,987,000; 1917, $150,340,000; 1918, $145,226,000; 1919, $135,722,000; 1920, $206,112,000.

The unfilled orders as of Dec. 31, 1920, aggregated $82,655,000, as compared with $47,442,000 in the year previous and $26,265,000 at the close of 1918. Since Jan. 1 there have been some cancellations, but the net reduction, it is stated, is not large. Of the total unfilled orders only $13,306,000 represented products sold but not made by the company.

A careful survey of the prospects for 1921, the report states, indicates that the business in the company's own manufactures will be about the same as in 1920, but in the products of others it will decrease from the 1920 volume unless there is a distinct business revival. On the whole, it is asserted, 1921 billings will probably fall back from the high mark of 1920, but it is believed they will exceed those of any year previous thereto.

Interconnection Will Fail Unless All Interests Work Together

INTERCONNECTION was defined by John C. Damon at a meeting of the transmission and distribution committee of the Ohio Electric Light Association at Youngstown on March 17 as the tying together of plants or groups of plants with lines of sufficient capacity to exchange relatively effective amounts of power. The meeting was devoted to the discussion of interconnection and interconnected system operating problems. Mr. Damon called attention to the increase in strain on the equipment and lines of a small system connected to a large one and to the probability that the apparatus of the small system would have to be strengthened, particularly the switching equipment.

The problem of interconnection between companies that wished to maintain their independence was likened to a three-legged race in which all goes well until the participants fail to work together. The first requisite is a just agreement that is sufficiently definite to administer. Rates must be such as to pay costs and some profit and not such as to tempt one or the other party to the agreement to "lie down" or such as to prevent use by either party because of being too high. On-and-off peak rates are desirable, and provision for periodical adjustment must be made. Limits of maximum power from each party should be fixed and a division of power in emergencies must be included in such an agreement. The frequency to be maintained must be agreed on. With even the best agreement failure is probable unless all are fair-minded and willing to co-operate to the utmost. Mr. Damon indicated his belief that whether interconnection pays depends on the judgment of the executives involved as to the value of the increase in reliability, service and the ability to serve additional territory.

C. E. Stone of the Duquesne Light Company pointed to the influence of available water supplies as a determining factor in steam-plant location, with fuel as the next consideration. The limits to interconnection of major systems were defined as the ability of manufacturers to supply apparatus that will withstand concentration of power. Present oil switches in production have a limit of 1,500,000 kva., and manufacturers have so far kept ahead of the actual demand and will probably be able to do so in the future, though the cost of equipment for higher rupturing values mounts rapidly

and is a big factor. The use of synchronous condensers was strongly urged by Mr. Stone to increase line capacity and better regulation by controlling load factor. Voltage regulation from the consumer's standpoint is becoming more and more important because of the refinement in apparatus design. In the interconnection of major and minor systems the regulation of the major system must be good, and that system must carry the fluctuations, otherwise the smaller system will suffer from overloads.

Personal contact between the chief load dispatcher and the operating force and the presence of a real willingness to co-operate and a desire on the part of all to get the most out of the available equipment were named by J. T. Williams, chief load dispatcher at the Windsor plant of the American Gas & Electric Company, as the basis of success in operating interconnected systems whose operating organizations are independent. The chief dispatcher must have undisputed authority over the plants as to loads carried and operations affecting the welfare of the whole system. If any portion of the interconnected system looks out merely for number one, the result must be failure.

Those in attendance at the meeting inspected the Lowellville plant of the Pennsylvania-Ohio Electric Company, a special car being provided to take the party to the plant.

I. E. S. to Meet at Rochester on Sept. 26

ANNOUNCEMENT is made that the annual convention of the Illuminating Engineering Society will be held in Rochester, N. Y., during the week of Sept. 26. Robert M. Searle, vice-president of the Rochester Gas & Electric Corporation, has been appointed chairman of the general committee of the 1921 convention.

At a meeting of the council of the society held on March 10 the following resolution on the standardization of lighting fixtures was adopted:

Whereas in the opinion of the council of the Illuminating Engineering Society the project for rendering lighting fixtures readily removable by the employment of suitable electric attachments, as discussed at the January meeting of the New York Section of this society, offers potentiality for large improvement in lighting conditions; and

Whereas realization of the potential value of this project is contingent upon such standardization as will make the electric attachments of fixtures completely interchangeable; and

Whereas failure so to standardize attachments would jeopardize the success of the project, entailing untold inconvenience and confusion to the public, be it therefore

Resolved, that in the best interest of the public and of the lighting industry the council hereby urges all concerned to co-operate to the fullest extent in bringing about complete interchangeability of removable lighting fixtures.

N. E. L. A. Executive Committee Completes Convention Plans

ONE of the best executive committee meetings of the National Electric Light Association ever held, and the most representative, convened in Chicago on March 15. Plans for the forthcoming convention were discussed and committees appointed to handle the details. The representatives of the geographic divisions present gave an intimate epitome of general conditions throughout the country. General Manager Aylesworth also reported on the status of the good-will campaign being conducted by the association and the manufacturers in the daily papers, popular magazines and trade press. The illustration shows those present at the meeting.



Reading from left to right, back: George F. Oxley, N. E. L. A.; Henry Harris, president Pennsylvania Electric Association; E. A. Phinney, president Rocky Mountain Division; W. H. Onken, Jr., editor ELECTRICAL WORLD (by invitation); O. H. Simonds, president Middle West Division; Walter Neumuller, member at large; A. Hardgrave, president Southwestern Division; M. S. Seelman, Jr., chairman Commercial National Section; E. J. Fowler, acting chairman Accounting National Section; I. E. Moultrop, chairman Technical National Section; W. H. Atkins, member at large; W. C. Lounsbury, president Great Lakes Division; H. C. Abell, treasurer.

Sitting, left to right: Frank W. Smith, vice-president N. E. L. A.; T. D. Crocker, president North Central Division; W. A. Layman, member at large representing manufacturers; R. H. Ballard, representing Pacific Coast Division; M. R. Bump, vice-president N. E. L. A.; H. A. Lane, secretary Southwestern Division (by invitation); E. H. Kifer, chairman membership committee, Southwestern Division (by invitation); J. E. Davidson, chairman Public Relations National Section; M. H. Aylesworth, executive manager N. E. L. A.; E. W. Lloyd, member at large; Martin J. Insull, president N. E. L. A.

New Jersey Again Has Utility Commission

AFTER a long period without a public utility commission, following the ouster of the former board, New Jersey now has a three-man commission. It began functioning this week as soon as the State Senate had confirmed the Governor's appointments. The present board is the result of new legislation. The Governor cannot remove members of the board under the new law.

The appointees finally confirmed by the Senate are former Judge John J. Treacey, president; Judge Harry V. Osborne and former Mayor Harry Bacharach of Atlantic City.

Co-operative Electrical Movement in Eastern Massachusetts

TO PROMOTE co-operation between central-station men, heads of municipal lighting plants, engineers of industrial plants and electric railways, managers of telephone districts, contractor-dealers and others the North Shore Electrical Club has been organized at Salem, Mass., S. Fred Smith, manager Salem Electric Lighting Company being president. Other officers are: Vice-president, E. R. Dickinson, Beverly; secretary-treasurer, G. E. Teele, Salem; executive committee, the foregoing with B. S. Lee, Beverly, and C. L. Stone, Danvers.

Commercial Topics Discussed at New England Meeting

EXTENDED discussions of commercial subjects were the feature of a meeting at Boston on March 18 of the Commercial Section of the New England Division, National Electric Light Association. With V. M. F. Tallman as chairman there were intensive forenoon and afternoon sessions at the American House, with a buffet luncheon at noon. About 125 members and guests attended. Norman Macbeth, president Artificial Daylight Company, New York, urged the sale of illumination on the basis of its productive service value.

Julius Daniels, Boston, for the lighting committee, stated that literature upon illumination is being sent to educational institutions in New England. The committee is compiling data to enable New England lighting development to be compared with that in other parts of the country. It was voted that makers of the foot-candle meter arrange for its marketing upon a profitable merchandising basis, so that jobbers and retailers can afford to handle this instrument and sell it to the general public. The meeting also voted to request lamp manufacturers to feature the foot-candle meter in their advertising. E. S. Mansfield, chairman Electric Vehicle Bureau, N. E. L. A., urged that every central-station staff shall contain one sales engineer with sufficient knowledge of the field and economics of electric vehicles to advise prospective purchasers intelligently.

William Gould, Boston, chairman Electrical Sales Associates of New England, outlined the recent co-operative meetings and dinners which led to the formation of the Associates. He pledged the co-operation of the commercial and manufacturing interests in electrical development. William Goodwin, assistant to the president Society for Electrical Development, New York, urged intensive sales effort, attacked price cutting as a present policy and declared that the individual workers within the industry must be "sold" the electrified home idea before the logical development of the business can be obtained. F. J. Allen, Boston, described the monthly sales talks which are being sent out to central-station commercial managers by the merchandising committee. C. B. Burleigh, Boston, urged higher salaries for commercial men in central-station service. Mr. Goodwin declared that the central station should continue in the merchandising business under fair competition, and that the profits of merchandising should be expended in advertising. The money received from energy sales, he said, must in part finance the cost of marketing new and substantial devices like electric refrigerating apparatus and dishwashers.

The meeting went on record in favor of selling lamps on a proper merchandising basis. E. S. Hamblen, Franklin, Mass., and J. E. Wilson, Boston, advocated conferences between local central-station companies and all sizes of contracting concerns before fixing unit prices in house-wiring campaigns.

F. R. Fowles, Portland, Me., reported that the rate committee has inaugurated a New England rate file at divisional headquarters, 149 Tremont Street, Boston. Recommendations regarding a satisfactory power-factor clause will shortly be sent to member companies, and these will be followed by recommendations as to service charges. It was the sense of the meeting that greater uniformity in rate structures would be helpful. John West, chairman power sales section, described the activities of the section. Meetings are held six weeks apart at which papers on commercial power topics are discussed. N. E. L. A. members will be welcome at these meetings, the next being scheduled at the Boston City Club at noon of March 30.

Utah Electrical Engineers Discuss Plans for A. I. E. E. Convention

AT THE March monthly meeting of the Utah Section of the American Institute of Electrical Engineers H. T. Plumb, chairman of the convention committee, outlined in detail the plans for the national convention of the institute, which will be held in Salt Lake City next June.

Prof. Joseph F. Merrill, president, and Paul P. Ashworth, secretary of the section, were named a committee of two to represent the electrical engineers on the recently organized Utah Engineering Council.

To Consider Federal Employee Measure Apart from Patent Office Bill

SEPARATE bills providing for Patent Office reorganization and vesting the administration of government employee patents in the Federal Trade Commission will probably be introduced at the opening of the extra session of Congress. The insistence of Senator Norris, chairman of the committee on patents, on retaining the government employee patent plan as a part of the Patent Office bill resulted in the loss of both measures.

Senator Norris probably will be chosen to head the committee on agriculture during the next Congress. He says that he will continue to take an active interest in both these patent bills, but the method of handling them will be in the hands of the new chairman. There is a very general demand in both houses that the government employee patent bill be considered separately and not as a rider on another bill.

Missouri Utility Men to Discuss Rate of Return and Other Topics

THE tentative program for the convention of the Missouri Association of Public Utilities at Kansas City on April 21, 22 and 23 includes the following papers: "Methods of Valuation and Rate of Return of Public Utilities," by R. A. Brown, attorney St. Joseph Railway, Light, Heat & Power Company; "The Indeterminate Franchise," by J. W. Dana, attorney Kansas City Gas Company; "Relation of the College to the Industry," by E. J. McCaustland, dean and director School of Engineering, University of Missouri; "Transmission-Line Cost and Development and Determining Rates and Minimum Charges," by N. T. Wilcox, Mississippi River Power Company, Keokuk, Iowa, and "Concentration of Generating Equipment at Centers of Economic Production and Transmission," by H. H. Kuhn, Kansas City Power & Light Company. "The Training and Handling of Public Utility Employees" will be the subject of another paper.

As announced in the ELECTRICAL WORLD for March 12, page 619, the first Kansas City Electrical Show will be held during the same week.

Standard for Control Equipment Issued by Electrical Safety Conference

THE first bulletin, or "safety standard," of the Electrical Safety Conference, dealing with industrial control equipment, has just been completed by a committee of the conference and is intended to be used in conjunction with Part 3 of the National Electrical Safety Code, to which it is supplementary. The other committees have been working on their respective subjects, the committees on oil circuit breakers, switchboards and rotating machinery having met in New York last week.

The Electrical Safety Conference is an association of representatives of national organizations interested in questions affecting accident hazards arising from design, construction, installation and use of electrical appliances. The co-operating organizations are: Associated Manufacturers of Electrical Supplies, Bureau of Standards, Electric Power Club, National Workmen's Compensation Service Bureau and Underwriters' Laboratories. The objects of the conference are: To promote by co-operative effort orderly, consistent and proper development of practice in electrical manufacture and installation with regard to accident hazards, to promote the development and adoption of safety standards for the construction and test of electrical appliances and for their application and installation, and to promote and make uniform the application of safety codes in regard to both general principles and particular classes of appliances and systems.

The recently published "Safety Standards" for industrial control equipment contains (1) general information on definitions, classes of apparatus and classes of persons to be protected, (2) the possible hazards, and (3) detailed methods of guarding against these hazards in (a) construction and (b) installation. A section on rules explains how the different kinds of protection shall be applied to the various hazards mentioned. A fifth section is in preparation for special application to elevators, cranes, printing presses, etc., which are not included in the present bulletin.

The officers of the conference are: Chairman, A. H. Moore; vice-chairman, A. W. Whitney, and secretary, Dana Pierce. The chairmen of the committees are as follows: H. D. James, industrial control equipment; J. B. MacNeill, oil circuit breakers; F. W. Paterson, switchboards; L. F. Adams, rotating machinery, and Dana Pierce, inclosed switches.

Busy Week in New England Meetings

UNUSUALLY active engineering society meetings were held in New England last week at widely separated points. On Monday E. L. Willson, president Connecticut Electric Steel Company, Inc., Hartford, addressed the Hartford branch of the American Society of Mechanical Engineers on "The Electric Furnace in the Manufacture of Steel Castings." C. C. Whittaker of the Westinghouse Electric & Manufacturing Company addressed the Providence Engineering Society on Tuesday upon "Railroad Electrification," and on the same date M. Luckiesh of the National Electric Lamp Association laboratories spoke upon "High Lights of Air Travel" before the New England Section of the Illuminating Engineering Society at Boston. The New England Electrical Supply Jobbers' Club met at Boston on Monday and was addressed by William Goodwin, C. L. Edgar, Bowen Tufts and others. The New England Division of the N. E. L. A. held an all-day session upon commercial topics at Boston Friday, and on the same evening the Electric Sales Associations of New England held a dinner at the Boston City Club.

Massachusetts Commission Opposes Interlocking Contractual Relations

THE chairman of the Massachusetts Department of Public Utilities, Henry C. Attwill, appeared recently before the legislative committee on joint judiciary at Boston in support of a bill forbidding officers and agents of public utilities from entering into contracts with themselves or corporations of which they are officers or agents except as the result of competitive bidding and also a bill to prohibit officers and directors of a public utility from holding office in subsidiary companies of a holding organization controlling the first company, and vice versa. The speaker called attention to managerial contracts which he stated had tended to result in overemphasis upon net earnings at the expense of maintenance and to the use of the credit of a public utility by a controlling banking house along the line of selling stock to retire notes which were then renewed.

A. E. Pillsbury, for the Massachusetts Gas Association, offered a substitute bill providing for a summary investigation by the department whenever the commission has cause to believe that an improvident contract is proposed or has been made. Chairman Attwill opposed this on the ground that it would tend to provide for a government of men and not of law. He questioned whether the commission would have the right to require the summary discontinuance of a contract under such conditions. Representative Lyman opposed the commission's bill on the ground that it would restrict membership on boards of directors of men valuable to companies because of their financial acumen. C. F. Rowley, appearing for the Turners Falls (Mass.) Power & Electric Company, pointed out that the bill would force the resignations of officers from the boards of some companies purchasing energy from the Turners Falls company, a wholesale distributer, and vice versa,

and that the contracts between these utilities are already subject to the supervision of the department.

E. W. Burdett, for the Massachusetts Gas and Electric Association, stated that while the practices cited by Chairman Attwill were not to be defended, he felt that the measure as drawn was too broad and would, to cite a particular case, tend to make a public utility official who happened to own stock in a manufacturing company from which his concern bought a turbo-generator or other equipment criminally responsible. He offered an amendment providing that the proposed act should not apply to any purchase or contract made or dealing had on behalf of a corporation owning or operating a public utility where the purchase, contract or dealing had been duly authorized by a majority of the directors of that corporation, no member of which majority was the individual, member of the firm or association, or employee, agent, trustee, director or officer of the firm constituting the other party.

Western New England Electrical Inspector to Discuss Practical Problems

AN ELECTRICAL conference for central-station, electrical contracting and manufacturing interests, wire men, fire and accident insurance inspectors and any engaged in the installation or use of electrical equipment of any character will be held under the auspices of the Western New England Association of Electrical Inspectors in the Municipal Building, Springfield, Mass., on Wednesday next, March 30. The program follows:

Morning—Discussion on the question "Should metal conduits be a mandatory requirement where they will be subjected to the fumes of animal waste matter, steam vapors, drippings in fish-packing plants, under soda-water fountains or ice-cream counters, where there is salt spray, or in permanently damp places?" including proxy discussions by George E. Bruen, superintendent electrical department Suburban Fire Insurance Exchange, New York, and C. R. Hodgdon, chief electrical inspector Board of Fire Underwriters, Allegheny County, Pittsburgh. Discussion on "The Inclosure of Fuses and Switches," including proxy discussions by Frank T. Wheeler, vice-president Trumbull Manufacturing Company; Mr. Glover, associate electrical engineer Underwriters' Laboratories, and Dr. M. G. Lloyd, assistant physicist United States Bureau of Standards.

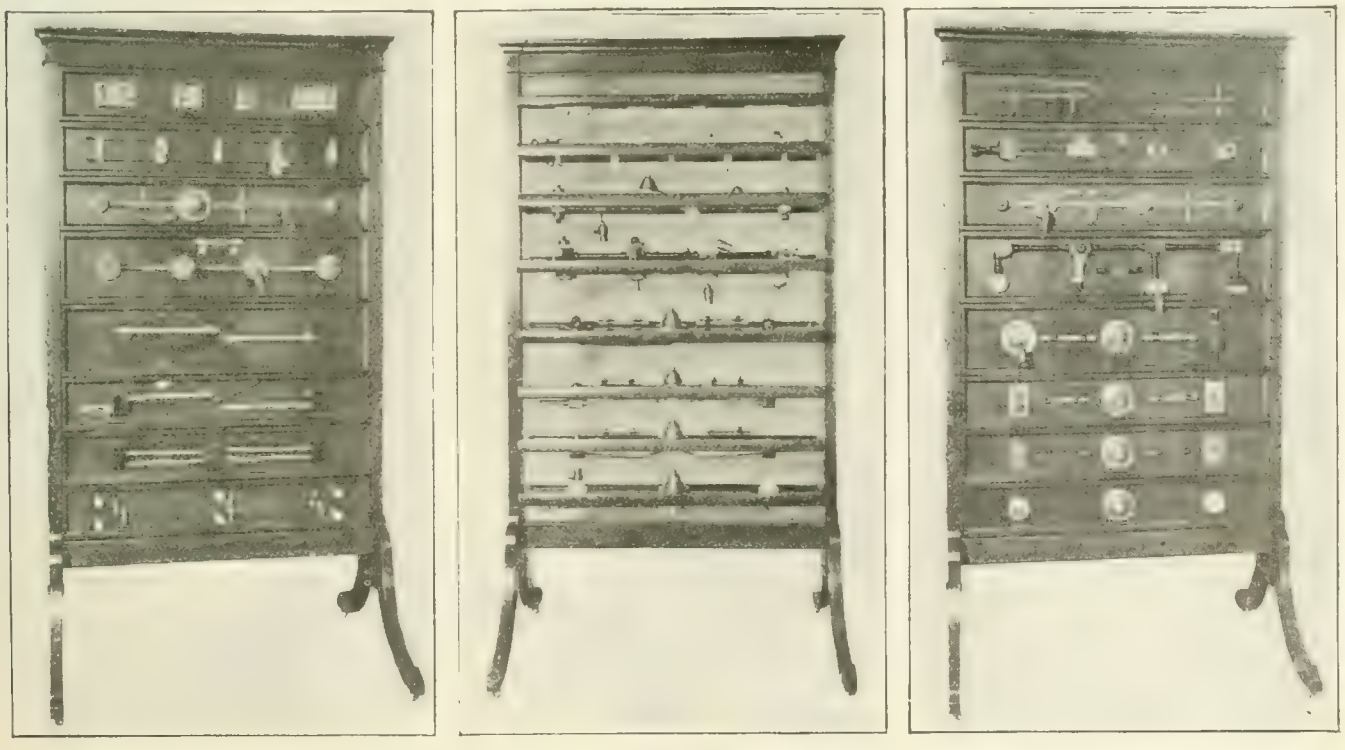
Afternoon—An explanation of Rule 15A of the 1920 issue of the National Electrical Code and of its economic value by a representative of the committee on rules for grounding, during which there will be a proxy discussion of Section N, third paragraph, by Timothy C. O'Hearn, city electrician, Cambridge, Mass.; George Welman, chief electrical inspector Louisiana Fire Prevention Bureau, New Orleans, and Herbert S. Wynkoop, past national president.

Different Kinds of Wiring Now on Display in N. E. L. A. Rooms

ALL of the different types of wiring permitted by the National Board of Fire Underwriters are on display at the National Electric Light Association headquarters in New York. The systems are arranged on eight pivoted panels on a display frame which stands 7½ ft. high and is 4 ft. wide. Both sides of each panel are utilized. In some cases the panel acts as a wall showing on the front the switches and outlets, while the reverse shows the necessary wiring behind the wall. In other cases each panel side shows all of the details of a single type of wiring.

Some of the types of wiring shown are open wiring, wood molding, metal raceway, concealed knob and tube (open), concealed knob and tube (in loom), surface conduit, concealed conduit and concealed flexible armored wire.

The board was prepared at the request of the wiring committee of the N. E. L. A. by the Commonwealth Edison Company of Chicago. On a second board which is being prepared other wiring methods, such as those used in foreign countries and in marine work, will be shown. This board will also be available for exhibiting new forms of wiring during their consideration by the industry.



WIRING DISPLAY RACK IN THE ROOMS OF THE N. E. L. A.

California Electrical Shows Planned for October.—Plans are being made by the California Electrical Co-operative Campaign to have an electrical show in San Francisco and one in Los Angeles about the middle of next October.

New Power Plant for Washington, D. C.—Preliminary plans for an electric generating plant to cost more than $2,000 000 are being considered by the Potomac Electric Power Company of Washington. It is the desire to have the new plant ready for service in 1922.

Power Project for Amarillo, Tex.—A Texas development now undergoing consideration involves the construction of a million-dollar dam across Palo Duro Canyon at Amarillo. Besides providing a water supply for the city and irrigating a large tract of land this development would include the construction of a hydro-electric plant.

Pennsylvania Edison Company Makes Its Advent.—The name of the Pennsylvania Utilities Company, which now supplies Easton, Pa., and vicinity, will soon be changed to Pennsylvania Edison Company. Application for a charter of incorporation under that name will be filed on March 28 with the State Department at Harrisburg.

Tidal Power in France.—The French Republic seems likely to be the first country to make an actual attempt to generate electricity through tidal power, two schemes of that kind being now under way at the mouth of the Rance, between St. Malo and Dinard, on the Brittany coast. The estuary of the Rance is said to provide conditions that should make the experiment successful if any conditions can, the difference between high and low tide being enormous.

American Capital Sought for Mexican Hydro-Electric Plant.—The municipal authorities of San Andres Tuxtla, a town of 15,000 population in the agricultural region of the State of Vera Cruz, are, according to the *Manufacturers' Record*, seeking to interest American capital in the construction of a large hydro-electric plant near there. A waterfall capable of generating 40,000 hp. is said to be available, and the electrical energy could be transmitted to a number of towns and cities in that region for industrial and domestic purposes as well as employed to run an electric street-railway system.

Reinforced-Concrete Penstock to Be Built by Washington Power Company.—Reinforced concrete instead of steel will be used by the Washington Power Company for the penstock which is to carry the water to the wheel in its new Spokane power plant. The penstock will be 385 ft. long, 18 ft. in diameter on the inside with a wall 18 in. thick, and it will be adequate to discharge 2,200 cu.ft. of water a second, or more than the normal low-water flow of the river. The capacity of the waterwheel will be 14,500 hp. The use of reinforced concrete for penstocks is comparatively new, there being few of this material in the Northwest.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Hydro-Electric Commission Proposed for Oregon.—Submission to the people of Oregon of a constitutional amendment creating a hydro-electric commission with power to issue bonds up to $40,000,000 for the development of water power from the Columbia River and other streams is being considered by the Legislature of the state named.

Montana Consumers Support Rate Increases.—Patrons of the Drummond Light & Power Company recently joined in asking the Montana Public Service Commission to increase the rates of the utility in order that it may meet the costs of operation and avoid risk of suspension. A rate of 20 cents for the first 25 kw.-hr., with a monthly minimum charge of $3.50, was indorsed by these petitioners.

Introducing Electrical Appliances Into China.—A unique method of familiarizing a backward public with electrical appliances has been adopted by the Western Electric Company for China. A houseboat rigged out at Shanghai is scheduled to make a 5,000-mile trip on the canals and rivers to bring home to the owners of land the advantages of farm-lighting plants. It carries a complete line of household devices, including motor-driven sewing machines, vacuum cleaners, flatirons and washing machines, and labor-saving apparatus for use on the farm. Experts will demonstrate the advantages of the plants, and though these can, of course be sold only to the wealthier residents, their introduction should indirectly benefit all the Chinese and spread a knowledge of electricity among millions of people who are strangers to it.

"Hydro" Monopoly in Ontario.—By the end of 1921, according to a statement of Sir Adam Beck, the Hydro-Electric Power Commission of Ontario will have a capital investment of $210,000,000 in fourteen districts, supplying 264 municipalities with electricity from twenty-one hydro-electric power plants, and, apart from the Decew Falls plant of the Dominion Power & Transmission Company and the Canadian Niagara Power Company's plant at Niagara Falls, the commission will have an absolute monopoly of hydro-electric energy in Ontario. According to Sir Adam Beck, the investment of the city of Toronto in cash and direct liabilities in connection with "Hydro" power and lighting is $47 803,000, of which $8,000,000 is guaranteed by the province, whereas the investment of the province itself is only a little more than $25,000,000.

Denmark's Largest Hydro-Electric Plant.—The Gudenaa power plant, the largest hydro-electric installation in Denmark, was started up on Jan. 8. The electric equipment of the plant came from the Swiss Brown-Boveri company, the turbines were made by a Swedish firm, and the electric generators by the Titan company of Copenhagen.

Municipal Ownership Defeated at Owatonna, Minn.—The overwhelming defeat recently of a municipal ownership project submitted to the voters of Owatonna, Minn., which included both electric and gas plants, is attributed to effective publicity work, an especially telling argument having been a list of 300 municipal plants which have failed in whole or part in the last few years.

Pacific Gas & Electric Financing.—Four applications affecting the power development of California have been filed with the California Railroad Commission by the Pacific Gas & Electric Company. One is for authority to issue $3,000,000 of preferred stock and another to issue $10,000,000 of bonds, the proceeds to be used to reimburse the company's treasury for expenditures made and to provide funds for carrying on construction work on the company's Pit River hydro-electric project. A third asks authority to transfer to the Mount Shasta Power Corporation Pit River properties obtained by the Pacific Gas & Electric from the Northern California Power Company. The fourth asks leave to include in its mortgage covering certain securities certain San Francisco properties.

Progress of Electrification in Switzerland.—A long period of drought, says the Swiss correspondent of the London *Engineer*, has brought home to the people Switzerland's dependence upon electricity and the need of an uninterrupted supply. As a result in part of this realization the Northeastern Swiss Power Stations Company has decided to spend 80,000,000 francs in erecting a high-tension station in a valley near the Lake of Zurich, and the city of Zurich, where electricity in Switzerland has its maximum use, has determined to contribute half the cost and in return to take half the power produced. This station, it is hoped, will be completed in three years' time. Another power station is being planned by the company in the same part of Switzerland, and for this, the correspondent says, it hopes to raise an American loan. As an illustration of the rapid growth in the use of electricity it is stated that in 1908 two power stations, at Beznau and Löntsch, supplied 46,000,000 kw.-hr. In 1919 their output was 238,000,000 kw.-hr., although as recently as 1916 it was calculated that not before 1928 would 200,000,000 kw.-hr. a year be required. One million horsepower is now given as the amount needed to run all the Swiss railways and supply the energy needed for all other purposes. The constant water power of the country is said to be capable of supplying 1,500,000 hp. Lack of capital delays development.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Definition of "Adequate Consideration" in Utah Case.—The important decision of the Supreme Court of Utah in the action brought by the United States Smelting Company against the Public Utilities Commission of the state, which decision sustained the commission in abrogating the discriminatory features of about fifty special contracts between the Utah Power & Light Company and large power customers and bringing this business under standard schedules. (see ELECTRICAL WORLD for Oct. 23, 1920, page 843; Nov. 27, 1920, page 1090, and March 5, 1921, page 555), hinged largely on a definition of "adequate consideration" as used in the clause cited from the public utilities act. Respecting this clause the court said: "By adequate consideration, as that term is used in the act, is meant such a consideration as when added to or considered in connection with the reduced rate agreed upon will make such rate non-preferential and non-discriminatory by reason of the fact that the additional consideration paid and received will prevent the reduced rate from being preferential in that the contract, within the purview of the act, is then 'founded upon an adequate consideration.' Where under such circumstances, therefore, a reduced rate is contracted for and allowed neither the public nor any other utility can complain, for the simple reason that there is in fact no preference or discrimination. The only reason for using that term in the statute was that a contract, in order to come within the exception, had to be founded upon such a consideration as would require the smelting company to pay, approximately at least, the same rate as the public or any other utility was required to pay for electrical energy which was being used under similar circumstances. The purpose of using the term was to protect the public as well as other public utilities from being discriminated against by having to pay a higher rate for electrical energy than those who are paying for the same energy under contracts. If, therefore, the consideration passing from the contract holder to the power company was approximately sufficient to prevent the contract rate from being preferential and discriminatory, then such a consideration was an adequate consideration, within the contemplation of the act, otherwise not. If, after a consideration of the foregoing elements, a rate, if continued, would be preferential and discriminatory, then, in our judgment, the commission should find that the contract fixing such rate is not founded upon an adequate consideration within the purview of the act, and the rate agreed upon should be modified so as to prevent it from being preferential and discriminatory. It needs no argument to demonstrate that whether a rate is founded upon an adequate consideration and is preferential and discriminatory or not is, to say the least, a mixed question of law and fact, and in most instances principally one of fact, and must, therefore, be determined by the commission from all the facts and circumstances, as before indicated."

Statement of Federal Courts' Duty in Protecting from Confiscation.—In deciding adversely to the city of Des Moines its suit against the Des Moines Gas Company to prevent the company from raising its rates the United States District Court for the Southern District of Iowa thus expounded the law: "The court is firmly bound by official oath to give to every man and every corporation his rights under the Constitution—no more, no less. A court has no power to say to a corporation, 'You made a lot of money a few years ago, you can run now without making any for a while.' No such power exists. If the corporation desires to abide by such a policy, very well; but when it comes into court and asserts that the community has fixed a rate which deprives it of its constitutional right to a fair rate of interest the court must act, not upon the wishes of the corporation nor with a view of benefaction—it must act under the words of the Constitution of the United States, the highest law in the land."

Contributory Negligence on Which No Testimony Was Taken Must Not Be Suggested in Charge to Jury.—The Court of Appeals of New York, reversing judgment for the defendant and ordering a new trial in Casualty Company of America vs. A. L. Sweet Electric Light & Power Company, in which the insurance company had sought to recover from the electric company damages paid because of the death of a workman who came into contact with badly insulated 2,300-volt wires strung 14 ft. above a street through which he was riding on the boom of a steam shovel, found two errors in the charge of the trial judge. The latter had refused to charge that the deceased was under no obligation to notify the electric company that the shovel was to be moved through the street—a request that should have been granted. He had also stated to the jury that the boom of the shovel could have been taken off, although no evidence had been given on that point and the implication that the deceased or his employer should have removed it raised a question of contributory negligence that was plainly one of fact for the jury and not one of law for the court. (129 N. E. 653.)*

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Southwestern Electrical and Gas Association.—This association will hold its 1920 convention at the Hotel Galvez, Galveston, Tex., on May 18-21.

Western Society of Engineers.—This society will meet jointly with the Chicago Section, A. I. E. E., on March 28, when Wilfred Sykes will discuss "Electric Propulsion for the Merchant Marine."

N. E. L. A., North Central Division.—The North Central Electric Association, which is a geographic division of the N. E. L. A., has determined to hold its next convention in Duluth, Minn., on June 14-16.

Ohio Electric Light Association.—Committee meetings of this association are scheduled for April as follows: April 21, transmission and distribution committee, Cincinnati; April 22, meter committee, Cincinnati; April 24, new-business co-operations committee, Youngstown.

Joint Meeting of A. I. E. E. and A. S. M. E. at New York.—The fifth and last joint meeting for the season of the A. I. E. E., New York Section, and A. S. M. E., Metropolitan Section, at New York will be held on Friday, April 22, when Prof. Comfort A. Adams will take charge of a discussion on engineering education.

April Meetings of A. I. and S. E. E.—The Philadelphia Section of the Association of Iron and Steel Engineers will meet on April 4, when D. M. Petty, superintendent of the electrical department of the Lehigh plant, Bethlehem (Pa.) Steel Company, will speak on "Generation of Power in Steel Mills." At the Cleveland Section meeting on April 11 N. H. Gellert will discuss "Electrical Cleaning of Gases as Applied to Blast Furnaces."

Coming Meetings of Electrical and Other Technical Societies

Western Society of Engineers—Chicago, March 28.

A. I. E. E. Section Meetings—Vancouver, B. C., April 1; Pittsburgh (joint session with A. I. and S. E. E.—for program see issue of March 19, page 672), April 16; New York (joint session with A. S. M. E.), April 22.

A. I. and S. E. E. Section Meetings—Philadelphia Section, April 4; Cleveland Section, April 11; Pittsburgh Section, April 16.

Missouri Association of Public Utilities—Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society—Washington April 23.

United States Chamber of Commerce—Atlantic City, April 27-29.

American Society of Civil Engineers—Houston, Tex., April 27.

Basis of Charge for Service Connections. — In proceedings relative to charges for service connections made by the Public Service Electric Company the New Jersey Board of Public Service Commissioners held that a rule providing for a charge for service connections beyond a distance which would include the great majority of those desiring service is not unreasonable, but that the propriety of a rule requiring the payment of a fixed sum by all those connected and within a former free limit is open to serious question. Charges for service connections beyond the free limits, the board held, should not be fixed sums, but should be based on the actual cost of materials used and labor employed.

Interest on Bonds Not an Operating Expense.—The Idaho Public Utilities Commission refused to accede to revised schedules filed by the Northwest Light & Water Company for the city of Wallace owing to the company's method of accounting, especially as regards the inclusion of interest on bonds in operating expenses. The interest on the bonded indebtedness of a utility, the commission holds, must be taken care of out of allowance for fair return. The commission, however, authorized an increase in the rate for excess energy above 1,000 kw-hr. a month from 2 cents to 3 cents, as the evidence showed the 2-cent rate to be less than the cost of the service.

Small Utility Gets Increased Rates in Advance of Improved Service.—Finding that the electric light and power plant serving Lakeview and other small communities in Oregon had deteriorated and that there was danger of cessation of service, owing to non-remunerative rates, the Public Service Commission of that state has allowed increased rates designed to permit improvement of the plant, a proper depreciation reserve and a fair return on the investment. The plant in question was originally owned and operated by the California-Oregon Light, Heat & Power Company, but was purchased in 1908 by the present operator, who had continued to run it as an independent enterprise but lacked the capital necessary for its improvement.

New Hampshire Commission on Valuation Methods.—In granting permission to the Concord Gas Light Company and Concord Light & Power Company to transfer franchises and property to the Concord Gas Company, the New Hampshire Public Service Commission remarked that the same valuation tests should apply as in the case of valuation for rate-making purposes. "This question of value," the commission said, "cannot be solved by any mathematical formula. In the end it is a matter of good judgment based upon all the relevant facts. The two factors given the most prominence by courts and commissions in determining value are costs of reproduction new and the original investment. This commission in previous cases has stated that if a single test is to be applied, then the original cost is the more equitable. We do not mean to say, however, that no consideration should be given to cost of reproduction new. This method may be in some cases the best evidence of value."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

War Conditions Did Not Excuse Errors in Bills.—The impossibility of obtaining competent clerical help during the war having been advanced as an excuse for errors made in bills to customers at that time, an alleged mistake of this kind being under review, the Illinois Public Utilities Commission declared that this difficulty was no concern of the customer's, his only interest being that he should receive a correct bill and, in case of error, courteous treatment and proper reparation. The utility, knowing the conditions under which its bills were being sent out, should have exercised particular care and have placed more than ordinary weight upon complaints. The commission declared emphatically that there is no more important department of a public utility's business than that devoted to the handling of complaints by consumers.

Stock Dividend Approved by Maine Commission.—In granting to the Rumford Falls Light & Water Company permission to increase its capital stock and declare a stock dividend the Public Utilities Commission of Maine made these observations on the principle involved in dividends of stock: "This company would have had the right to distribute to its stockholders in the form of cash dividends any amount which was properly available for that purpose if, after declaring such dividend, it could upon approval issue securities therefor, sell the same, and with money so obtained make the additions. Instead of this, the company has withheld from its stockholders those sums which might have been distributed as dividends and has used the amounts so accumulated to produce additional property. This property the stockholders own. As an evidence of such ownership they hold certificates of stock. If these stockholders desire to have in their possession in the form of certificates of stock additional evidence of the ownership of this additional property, no reason is conceived why the consent of this commission should not be given. In any rate case which we might be hereafter called upon to hear and determine the amount of outstanding capital stock would not be conclusive for the commission as to the value of the property. We should allow the company a fair return upon only such amount as we found the value of the property to be. The declaration of the stock dividend is merely placing in the hands of the stockholders further evidence of their ownership in the unencumbered property."

Relation of Stand-by Plants to Allocation of Costs.—The Wisconsin Railroad Commission, in granting to the Wisconsin Power, Light & Heat Company the right to increase its electrical rates in fourteen small communities, said in dealing with the possibility of uniform power schedules: "The steam stand-by plants are located, with a small water-power development, at one end of the transmission system, and the applicant's chief sources of power, the hydro-electric developments at Kilbourn and Prairie du Sac, are at the other end of its system. It appears to us unfair to allocate the transmission system to each community or group of communities on the basis of its demand on the system and its distance from the prime source of power, without giving due consideration to the costs of operating the stand-by plants, the distance the communities considered are from these plants, and to the advantages arising from operating the stand-by plant to assure the communities continuity of service."

Final Rulings of California Commission in Redding Case.—After a rehearing of the application of the city of Redding to fix the sum to be paid by it to the Northern California Power Company for the acquisition of its electrical system (see ELECTRICAL WORLD, Aug. 16, 1919, page 377), the California Railroad Commission found the fair value of the physical properties, plus overhead, including development cost, franchise value and going concern, to be $49,177. In addition, severance damages of $623 were allowed for the cost of rearrangement of the power and telephone circuits used for the company's own requirements, to create operating conditions as good as or better than existed in the Redding distribution system. The commission refused to make any allowance for good will as an element of value, holding that a public utility enjoys a monopoly of a particular business in the community it serves and the public has no choice but to buy from the utility or do without such service. The commission also held that profits made by the utility through rates fixed by the commission cannot be capitalized by the utility as a measure of value. The company was held to be entitled to reimbursement for reasonable development cost unless it can be shown definitely that this cost has been made up in later excess earnings. The commission refused to make allowance for severance damages to cover the loss of business. The commission included in its decision an extended discussion of the distinctions between valuations for rate-making purposes and valuations (as in this case) to determine purchase price.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

C. E. Houston, former district manager of the Southern California Edison Company at Oxnard, has been appointed district manager at Redondo. Mr. Houston was born at Sparta, Ind., in 1882 and went to California in 1904. He immediately entered the operating



C. E. HOUSTON

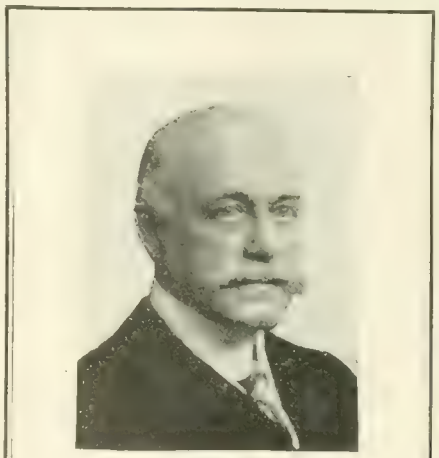
department of the Southern California Edison Company as inspector and since that time, with the exception of a temporary absence of two years, has been continuously in the employ of that company. His ability and conscientious efforts earned for him additional responsibilities with the company and in 1912 he was made assistant foreman of the Los Angeles district. Three years later he was promoted to be district foreman at Redondo and in 1919 was appointed district manager of Oxnard district. He now returns to Redondo to assume charge of the company's business in that important locality.

H. M. Platt, who has recently been appointed editor of the N. E. L. A. *Bulletin* and assistant to the director of publicity, is a graduate in electrical engineering of Cornell University of the class of 1911. After leaving college Mr. Platt spent a year in the shops of the General Electric Company at Schenectady and three years in work connected with the New York subways then being built. He then joined the business department of the McGraw Publishing Company as field representative of several of its publications. A short time later he was transferred to the editorial staff of the *Electric Railway Journal,* a position he held until December, 1918, when he was ordered into active service in the Naval Reserve. He served until the end of the war as radio officer of the U. S. S. Texas, which was in company with the British fleet in the North Sea and along the coast of Scotland. On leaving the navy Mr. Platt became engineering editor of the *Electrical Record,* holding that post till his present appointment.

W. G. Kelley has been appointed as assistant to Paul P. Williams, engineer of distribution of the Commonwealth Edison Company, Chicago. Mr. Kelley has heretofore been in charge of overhead construction for the company.

R. H. Ballard, vice-president and general manager of the Southern California Edison Company, Los Angeles, Cal., who came east to attend the recent executive committee meeting of the N. E. L. A., has spent some time in New York City and Washington, D. C., on company business. He also visited Poughkeepsie, N. Y., where his daughter is attending Vassar College. Mr. Ballard, when seen in New York on March 21, with the thermometer registering 81, was for once silent on the climate of southern California, of which he, with the others in the "Sunkist" region west of the Rockies, frequently have much to say.

T. C. Martin, for a number of years secretary of the National Electric Light Association and before that a co-editor of the ELECTRICAL WORLD, has been appointed to the engineering staff of the Superpower Survey, with headquarters

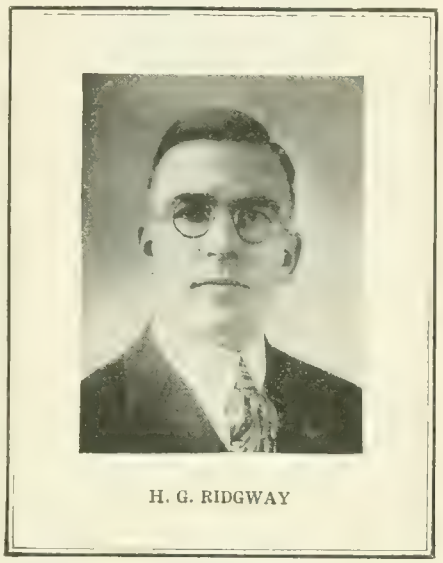


T. C. MARTIN

in New York City. Mr. Martin has devoted his entire life to a study of conditions in the electrical industry and has contributed much material of permanent value on many phases of central-station development.

John T. Sharp, Jr., superintendent of the Canton (Miss.) electric light and water works, has also been appointed manager of the Winona public utility plant and will have charge of the management and engineering of both plants. H. E. Johnson, formerly of Dyersburg, Tenn., is local superintendent at Winona, Miss.

H. G. Ridgway has been promoted to the position of manager of the North Bay division of the Pacific Gas & Electric Company of California. Mr. Ridgway is a "native son" of California, where he was born in 1881. From 1902 to 1906 he was with the Pacific Telephone & Telegraph Company and during the next year was assistant to the



H. G. RIDGWAY

president of the Stockton (Cal.) Gas Company. In 1909 he was first employed by the Pacific Gas & Electric Company. He filled various clerical positions until January, 1913, when he was appointed assistant manager of the Marin district. In 1918 he was promoted to be manager of that district and in 1919 had the Petaluma district added to his territory. In December, 1920, he was promoted to his present position. Mr. Ridgway has been active in the welfare work of his organization.

Carl C. Widener, former city engineer of Bozeman, Mont., and C. A. Truitt, formerly of Burns & McDonald of Kansas City, have become associated as consulting engineers with offices in the New Commercial National Bank Building, Bozeman, Mont. They will specialize in municipal and hydraulic engineering.

Alfred J. Cleary, who has held the position of chief assistant city engineer of San Francisco, has resigned to enter private practice as a consulting engineer, specializing in general construction work. Mr. Cleary was in the employ of the city engineering department for twelve years and was in charge of the construction of the Hetch Hetchy project, reporting directly to M. M. O'Shaughnessy, city engineer. Mr. Cleary is succeeded by Nelson A. Eckart.

John Hood, for a number of years connected with the General Electric Company in the capacity of engineer of the San Francisco office, has resigned to become associated with Catton, Neill & Company, Ltd., Honolulu, one of the largest engineering firms in Hawaii.

George Oliver Smith has recently joined the organization of the American Atmos Corporation, formerly the Draeger Oxygen Apparatus Company, as vice-president and chief engineer.



G. O. SMITH

Since January, 1913, Mr. Smith has been employed by Henry L. Doherty & Company, first in their engineering department and later in charge of the accident prevention department of the Doherty organization, having executive charge of accident prevention work and welfare activities. Mr. Smith entered the electrical field in September, 1905, as junior engineer of J. G. White & Company, Inc. He worked in all departments of this company until the fall of 1910, when he resigned to become junior engineer on examination of new projects submitted for financing with the banking house of Coggeshall & Hicks of New York City. In the spring of 1912 he became associated with the International Motor Company of New York as engineer in the sales department for motor-truck transportation. In January of the following year he joined the engineering staff of Henry L. Doherty & Company.

James J. Clifford has been elected president of the Res-Pro Industries, Inc., Boston, with offices at 209 Washington Street. Mr. Clifford has been active in certain manufacturing phases of the electrical industry and allied interests for the past twelve years. He was graduated in 1908 from Yale University, specializing in chemistry, and for ten years was employed by the Boston Woven Hose & Rubber Company at Cambridge, Mass., attaining the post of manufacturing superintendent. He then became president of the Plymouth Rubber Company, Canton, Mass., leaving Canton to become chief executive of the Res-Pro organization, which is developing a market for a new non-woven insulating tape and other products manufactured from the basic material fabricated by these interests.

Roland B. Respess has been elected vice-president of the Res-Pro Industries, Inc., Boston, in charge of new developments and patents. Mr. Respess has had an extended experience in the technical phases of manufacturing, including a connection with the McGraw Publishing Company prior to the addition of the Hill interests. Mr. Respess is the inventor of the processes owned by the Res-Pro organization. He will make his headquarters at Boston.

C. L. Brown, for a number of years district manager of the Chicago office of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been appointed sales manager of the company to succeed James E. Watson.

Robert E. Rae, who has been connected with the electrical industry for many years, has assumed the position of general manager of the Northwestern Electric Equipment Company, electrical supply jobber at 35 Vestry Street, New York City. Mr. Rae entered the service of the Western Electric Company in 1897 and devoted his attention particularly to shipping service and to making special stock studies. In this work he has been associated for varying periods with several of the Western Electric branches. In 1908 he was placed in charge of the local house for sales and service in New York City and in 1910 opened and managed the Buffalo house, but left that year to join the organization of Stanley & Patterson, New York City, as sales manager. In 1915 Mr. Rae went to the Columbia Graphophone Company as assistant to the general sales manager.

Henry B. Oatley has been elected vice-president in charge of engineering of the Locomotive Superheater Company, manufacturer of superheaters and boilers, with offices in New



H. B. OATLEY

York. In 1910 Mr. Oatley entered the employ of the Locomotive Superheater Company as mechanical engineer and in 1916 was appointed chief engineer for the company. Mr. Oatley is a recognized authority on superheating.

Frank V. Burton, who for the past nineteen years has been connected with the Bryant Electric Company, Bridgeport, Conn., and during the past three years served as general sales manager, has resigned to become general sales manager for Henry D. Sears, general sales agent for Weber wiring devices, Boston. Mr. Burton entered the electrical field about thirty years ago, and owing to the prominent positions which he has held he has become well known



F. V. BURTON

in electrical circles. In 1891, at the age of seventeen, he established an electrical contracting and supply business in Albany, N. Y. In 1895 he joined the supply department of the Western Electric Company as an understudy to Fred H. Wilkins, Samuel A. Chase and E. W. Rockefellow. Next came a short but important connection with Sanderson & Porter, consulting engineers of New York. In the summer of 1902 Mr. Burton entered the employ of the Bryant Electric Company and has since served successively as sales service manager, Eastern sales manager and general sales manager. During his connection with the Bryant Electric Company Mr. Burton compiled the Bryant catalogs, which now form an important contribution to the advertising literature of the trade. He has also been active in several sections of the Associated Manufacturers of Electrical Supplies.

Obituary

Howard S. Johnson, president of the Charleston (W. Va.) Electrical Supply Company, electrical jobber, died on Feb. 25 at his home in that city.

Fayon Ernest Lauderbach, assistant sales manager of the Bussman Manufacturing Company of St. Louis, Mo., died **Feb. 26** following an operation. He was an active member of the St. Louis Electrical Board of Trade and for years had been closely associated with all local electrical activities.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Fan Manufacturers Divided Over Sales Outlook

FAN manufacturers are divided in their opinion over the outlook for sales during the present year, according to a discussion which developed at the meeting of the Fan Motor Section, Associated Manufacturers of Electrical Supplies, held in New York City on March 16.

Virtually every manufacturer reported a large stock of fans on hand to start the year, so there should be little difficulty as to the supply unless sales are unusually large. This is especially true because jobbers in some sections of the country are carrying over large fan stocks from last year. In the East this is the main factor in the very cautious manner in which jobbers have ordered fans thus far. In the Middle West jobbers' stocks are large too, and advance buying is consequently conservative. The South and Southwest, however, have shown up well in the volume of orders placed to date.

Fan prices, following the cut of about 10 per cent earlier this year, are said to be as low at present as manufacturing costs warrant. Any further reduction would probably be in the nature of taking a loss in order to move goods, as present stocks of fans were largely manufactured when labor and raw materials were at peak prices. In view of the lower cost of material, however, and especially if the trend of labor cost continues downward, it is logical to expect decided reductions in fan prices for 1922. W. W. Mumma, manager of fan motor sales, Robbins & Myers Company, was chosen chairman of the Fan Motor Section of the A. M. E. S. for the ensuing year.

Radio Manufacturers See Need of Standardizing Distribution

DISCUSSION of ways and means to stabilize and improve the selling end of the radio apparatus manufacturing industry was one of the things which figured largely in the radio convention and exhibit held at the Hotel Pennsylvania, New York City, last week. At present there are any number of small so-called "back-yard manufacturers" making radio apparatus who have little or no knowledge of accounting methods or of labor costs, overhead expense, etc. Furthermore, amateurs with some knowledge of wireless frequently make and sell more or less efficient pieces of apparatus for whatever price they can obtain. This condition may be perfectly ethical under a system of open competition, but it undoubtedly does not work for the general good of the industry.

The more responsible radio manufacturers even admit that they themselves have at this time no very definite selling plan or sales outlet for their products. In fact, the general practice at present seems to be to sell apparatus to whoever will buy—be he hardware dealer, sporting goods dealer, electrical jobber or in some other line.

This situation was one of the things discussed at an informal meeting of the manufacturing interests at the above-mentioned convention on March 18. The consensus of opinion was that radio manufacturers must stop pulling at cross purposes as regards selling policy on their product. Various views pro and con were heard as to whether a manufacturer in this line should sell only through electrical supply jobbing houses with the formation of special radio departments, or direct to retail dealers, or whether jobbers handling nothing but radio apparatus were warranted. No decision was reached, but following the forthcoming organization of radio manufacturers, whose tentative plans for joining the Associated Manufacturers of Electrical Supplies as a separate section are described elsewhere in this issue, it is the intention to arrive at some solution of this problem.

Meter Supply Ample for Existing Demand

THE stock of watt-hour meters for residence use is now ample to supply existing needs throughout the United States and Canada. Where there may be a few back orders holding over they are more nearly overcome than at any time in the past two years. At the same time the general demand for meters has showed a decided falling off from normal buying because of the holding off in residence construction.

During 1920 and part of 1919, central stations were generally out of house meters and factories were away behind on orders. It would seem that in order to forestall such a condition occurring again, when building shall have started in, the central stations should watch very carefully for any indications of returning demand and attend to their requirements far enough in advance of the actual demand to allow the producers to get their factories going in full force. Present retrenchment methods must in time give way to foresightedness to forestall poor service in the future.

The outlook in the meter field for 1921 is reported to be good. Increased capacity in the last two years gives ample possibilities for production. Canadian business provides a good export market, and even with the unfavorable conditions of exchange, the other export fields present a good demand. An improvement in exchange would open this market to a large extent.

There is a tendency to larger sizes than 5 amp. and 10 amp. capacity for home service, and appliance and range loads are calling for sizes up to 25 amp. This is heaviest, as is expected, from districts where water-power service at a relatively low rate is available.

Appliance Dealers Forced to Carry Minimum Stocks

SOME resentment against the dealer has appeared among manufacturers of appliances and their jobbers in the Middle West, who claim that in the majority of cases the dealer has cut his stock far below normal, leaving the burden of preparing for future demand on the shoulders of the producer and distributer. To some extent this resentment has a basis in fact. It is a certainty that sooner or later the public will turn again to the buying of electrical devices in quantities, and though no date could possibly be set for this resumption of activity it is incumbent upon the manufacturer to continue producing and the jobber to continue stocking in order to prevent a temporary shortage and the resultant temporary inflation. In view of this condition of affairs it does not seem unjust for the manufacturer and the jobber to call on the dealer to carry his share of the load by stocking up to normal.

Investigation of many widely scattered retail stores in Chicago shows the truth of the charge made by the producers and distributers. Dealers are not carrying normal stocks of appliances and are doing the minimum of ordering. Stocks, of course, vary considerably, and where some dealers have reduced their supplies to a two weeks' basis others are doing business on a thirty-day or sixty-day basis

as compared with a former basis of sixty or ninety days respectively.

Dealers in the majority, however, are not cutting down stocks through any desire to harm the manufacturer or the jobber or even to escape their just part of the burden of the falling market. The retail dealer in the Middle West in the main is a small merchant whose capital is necessarily limited. He must deal in commodities which will give him a comparatively speedy turnover, and the demand for the smaller appliances, such as percolators, toasters and other hollow ware, and for heating devices of various sorts, is undeniably slow. Even so, if the dealer and the public considered prices for these goods in line with the general trend more liberal stocks undoubtedly would be carried.

Inquiries for hollow ware and heating devices, dealers report, are numerous, but dissatisfaction with prices is keeping sales down to a negligible few. An interesting sidelight is that washing-machine sales are in a number of cases being made to the persons who expect to spend $10 for a percolator retailing for $20 and are easily persuaded to deposit their money as a first payment on a washer. Washing machines are the "best sellers" of the present appliance market.

In answer to the charge that their stocks are entirely too low the dealers contend that the solution of the situation is in the hands of the manufacturers and jobbers, but particularly the manufacturers. Inquiries, they say, show that a decrease in appliance prices would have a considerably stimulating effect on demand and would enable them to stock up to normal again with confidence. Until such time as the manufacturers can afford such cuts, the opinion is, the present deadlock must continue.

Westinghouse Drops Price of Small Supply Items About 6 per Cent

EFFECTIVE on March 10 the Westinghouse Electric & Manufacturing Company has again reduced prices on the 60,000 to 80,000 supply items contained in catalog 10-A. The reduction varies, but averages on the whole about 6 per cent. Included in the items affected are commutator and controller copper parts, resistance grids, armature and field coils, brush holders, transformer replacement parts and parts for electrical machinery in general.

Wire Production Curtailed Under Light Demand

MANUFACTURERS report that demand for insulated wire is quiet. Jobbers are still for the most part endeavoring to get rid of supplies on hand, contractors have not much to do except small repair jobs, the promise offered by a return of the building industry yet hangs some months off on the horizon and utilities are short of money. For these reasons producers apparently do not expect a return of strong demand in the near future. Production is considerably curtailed, operation at from 50 to 75 per cent of capacity being about the general average. Stocks are gradually piling up, however, and deliveries are prompt, with shipment from stock up to two weeks prevailing.

Prices are thought to have reached rock bottom as copper, cotton and rubber are all about as low as they can go, it seems, while wage reductions have also been made to some extent. Consumers in many cases admit that present wire prices are attractive but say that money conditions prevent their stocking up. A carload lot of No. 14 rubber-covered wire is quoted by several representative producers at from $7.50 to $7.75 per 1,000 ft., but it is known that these quotations have been cut considerably by smaller producers. An average base working price for weatherproof wire at the present time would probably be about 16 cents, though most manufacturers are not quoting base prices.

Bare-copper wire business presents much the same conditions as does insulated wire. Utilities are buying some but not much, and demand from electric railways is very largely only for repairs. The finer sizes of bare wire, which last summer were so hard to obtain, are now even in less call than the large sizes, and stranded wire, as demand for purposes such as small motor manufacture, is especially slow. There is considerable optimism, however, regarding prospects of present conditions improving. Deliveries of bare copper wire are all that can be desired, as orders are filled in about ten days to two weeks. A representative base price would be about 14½ to 15 cents.

Russian Electric Industries at Low Rate

THE official Soviet gazette, *Prawda*, of Moscow, publishes some interesting figures regarding the electrotechnical industries in Russia. According to this official paper the Erikson works turned out 10,000 pieces of telegraph apparatus in 1916; at present it is turning out only 250. The Russian Siemens-Schuckert works formerly supplied machinery of 24,000 kw. a year; at present it is scarcely 6,000 kw. The cable works formerly used about 250,000 Russian poods of copper per year; present use is only about 25,000 poods. The Russian branch of Siemens & Halske formerly supplied 7,500 Morse instruments per year, while today the production has decreased to only 150 instruments. Measuring apparatus, radio telegraphic apparatus and similar articles are not manufactured at all.

The Soviet authorities are making great efforts to obtain the necessary workmen for the electrotechnical industries, for the telephone as well as the telegraph service is in a most deplorable condition. It is stated that the want of men is chiefly responsible for the conditions prevailing in the electrotechnical industries. In former times more than 30,000 hands were employed in these industries; today there are scarcely 6,000. Formerly nearly 70 per cent of the workmen were skilled laborers; at present hardly 10 per cent are skilled. The paper adds that in the district of Peterhof, where the large Putilow works are situated, the whole telegraph and telephone service is entirely out of order and no communication is possible. On account of lack of material and skilled workmen no repair work can be undertaken.

The Metal Market Situation

THE copper market shows no improvement as regards buying, although perhaps fewer of the small producers are willing to offer electrolytic for prompt delivery at 12 cents, at which price it can still be purchased. Foreign demand is light; in fact, the removal of 400,000,000 pounds of copper from the market for export shipment does not seem to have stimulated buying at all as yet. Wire drawers are ordering small quantities, and a slightly improved demand for radiator tubes and brasses is noted from the automobile industry; but general sales are not large enough to stiffen prices or to induce the rush of orders that it is believed will follow such a stiffening. Copper production is now probably below 50 per cent of capacity, and yet stocks continue to pile up. A further drastic cut in production seems necessary.

Zinc operation at present is only about a fourth of capacity, but the market continues dull. Demand for lead on the whole has continued to slacken, but the price holds firm.

NEW YORK METAL MARKET PRICE

	March 15, 1921	March 22, 1921
Copper	£ s d	£ s d
London, standard spot	67 0 0	68 0 0
	Cents per Pound	Cents per Pound
Prime Lake	12 25—12 50	12 37—12 62
Electrolytic	12 00—12 25	12 00—12 50
Casting	11 75	11 75
Wire base	15 00	15 00
Lead, trust price	4 00	4 00
Antimony	5 50	5 37
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 27½	5 20
Tin	28 50	28.50
Aluminum, 98 to 99 per cent.	28 00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 00—10 25	9 50—10 00
Brass, heavy	5 75— 6 00	5 75— 6 00
Brass, light	4.00— 4.25	4 00— 4 25
Lead, heavy	3.25— 3.50	3.12— 3.62
Zinc, old scrap	2 87½— 3 00	2 78½ 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

FROM the viewpoint of actual buying in the electrical supply field the condition of the industry has shown no change in the past two weeks. Buying from day to day to satisfy maintenance needs covers the principal situation pretty well, with here and there a little for some new construction. Stocks are being kept on as even a level as possible in order not to increase inventories. Manufacturers are small purchasers and are running their plants much below capacity. The future, however, appears bright.

Building shows better in the St. Louis territory, and the authorization in New York of the withholding of taxes on dwellings for ten years is proving a great inducement to builders in that city, a large increase in filed plans having been noted.

NEW YORK

Signs of an improvement in the building industry lend some encouragement despite the fact that present business is not increasing fast. The ordinance recently adopted which exempts new dwellings from taxation for ten years has already made its effect felt. In the two weeks following Feb. 26, when the ordinance went into effect, plans for homes for 1,076 families were filed, which represents an increase of 61½ per cent over the same period in 1920. There is also a considerable volume of building work of all sorts now on the boards, according to authoritative information, which has got no further than the architect as yet. Of course, it will take some time for the effect of this to be felt, but the last half of the year is pretty certain to see better business than the first half.

The week past presents no new developments to trade. There is some work being done in the way of repairing and wiring of houses, but individual jobs are small. Collections are fairly good.

Fuses.—Stocks in most cases are good in all sizes, but demand is slow. N. E. C. standard, non-renewable 30-amp. fuses sell for from 12 cents to 13½ cents in standard-package lots, with most jobbers near the lower price.

Lamps.—Demand is spotty as among different jobbers, for some are feeling the usual spring slump, while others report that sales hold up well. Manufacturers are down to a four-day-per-week production basis but are still slightly overstocked.

Lead-Covered Wire.—Very little is carried in stock except some No. 14 duplex and 1,000 ft. of this sells for from $42 to $60. Demand is small.

Heating Appliances.—Sales are badly off, and a few jobbers are overstocked, but for the most part small supplies are carried. There is a decided feeling among jobbers that prices will be reduced, and any ordering that is done is conservative.

Conduit.—Demand remains off and stocks are average. In 2,500-ft. lots ½-in. black brings from $69 to $72, and 1-in. black from $130 to $149 per 1,000 ft.

Locknuts, Washers and Bushings.—Demand is as light as for conduit, with fairly small stocks in general. Some jobbers do not sell on a discount basis, but others are quoting all the way from 50 to 65 per cent, depending upon the size of their stock.

Flexible Armored Conductor.—Demand continues poor, with little residence construction work on hand. Stocks are about normal, with a price of $62 to $66 per 1,000 ft. asked for No. 14 double-strip. Rumors of possible price increases continue to circulate.

Metal Molding.—There is some movement of this item, though nothing big. Stocks vary, but are mostly low. In 1,000-ft. lots the three-wire to four-wire size sells for $6.55 to $6.90 per 100 ft., though higher quotations are asked in some quarters.

Rubber-Covered Wire.—Demand is no better at prices of $7.75 to $8.25 per 1,000 ft. for No. 14 single-braid. Stocks are fairly small.

CHICAGO

Building permits amounting to more than $23,000,000 in the last seven weeks seem to point to an early reversal of present conditions of extreme quiet in the electrical field. An abnormally high percentage of the permits concern housing facilities, and every day's developments point to a continuation of this class of building. Certain strong financial interests have announced their willingness to loan money at 6 per cent in almost unlimited amounts for housing construction, and every architect is busy taking bids on about as many apartment house and residence propositions as he can handle.

The temper of the electrical industry is spotty. The manufacturers, in general, discerning evidence of approaching fair business, are optimistic. The jobbers, with stocks mounting in most lines and with customers still complaining about high prices, are able to say that they are not discouraged. Among the retailers the extremes of feeling can be found. It is more true now than ever before that the dealer who is out after business all the time and who keeps a small but representative stock is getting along nicely, while the lazy or unwise dealer is finding plenty of spare time in which to study his competitor's manner of doing business. In the appliance industry washing machines are showing real activity where they are properly pushed, although the used machine question is getting a good deal of consideration.

Collections are reported as easier than a month ago, probably because sales have been light and accounts receivable have thereby been automatically diminished. Installment collections have been delayed by non-employment, yet the consensus of opinion is that this feature is not so bad as had been expected. The employment situation is distinctly better in the automobile centers, the largest Detroit plant, for instance, running at about 70 per cent capacity as against 20 per cent a few weeks ago. The surplus of labor throughout the section is so great, however, that it is not felt a threatened packing-plant strike could be made sufficiently effectual to be serious for any great length of time.

Bare Copper Wire.—The market on electrolytic copper is even weaker than at last report and the price of wire is correspondingly low. Few transactions are noted. The published quotation on No. 8 in 1,000-lb. lots is 16 cents per pound, but this price is being shaded somewhat on all sides.

Insulated Copper.—Quiet prevails, uncertain price futures tending to scare off intending buyers, who apparently think it possible that copper will reach even lower levels than those prevailing. Promise of increased activity in construction points to good trade in insulated wire in the near future. No. 14 rubber-covered wire is offered at $7.75 per 1,000 ft. in 1,000-ft. lots, and No. 6 triple-braid weatherproof, quoted on a 19-cent base, can be obtained for from 19 cents to 19½ cents per pound on actual purchases.

Conduit.—As yet improved construction activity has failed to show reflection in demand for conduit. Contractors who will need supplies within the next ninety days are still holding off, evidently expecting lower prices. Present quotation on ½-in. black conduit is $64 per 1,000 ft. in 5,000-lb. lots. This price is held firmly.

Flexible Armored Conductor.—Here, too, contractors are holding off on purchases, regardless of building activity proposed. In 5,000-ft. lots $62 per 1,000 ft. for No. 14 two-wire, double strip, is being held well. There is plenty of conductor in jobbers' hands.

BOSTON

A better tone was evident in business last week, inquiries showing a tendency to increase, with some encouraging orders. Activity in the confectionery manufacturing field is apparent, following price reductions all along the line. Textile and leather manufacturers are not quite so busy as in January, but the outlook is good. Jobbers' stocks in the electrical field are running low and buying is on a hand-to-mouth basis, with nominal reserves. Prices show little change over last week. Collections, while leaving much to be desired, are far from gloomy. The continued strike of the building trades at Boston impedes the resumption of construction work badly needed by the public. With this out of the way, the sale of wiring material is expected to be extremely active. That labor must accept reduced pay generally is taken almost for granted by the public.

Motors.—Inquiries are in better volume and some sales are going through. Jobbers' stocks are equal to current demands in most of the lower sizes. A call for fairly large motor-generator sets was noted last week. Prices are firm.

Rigid Conduit.—Very little pipe is moving but stocks are not excessive. Long-delayed shipments have prevented over-accumulation in many cases. Prices are steady, following recent reductions. Galvanized 1-in. sells for $150.78 in less than 5,000-ft. lots and for $141.41 in 5,000-ft. to carload lots. Black pipe, same size is quoted at $147.65 and $131.20 respectively. The ½-in. galvanized sells for $80.62 and $72.40 on the foregoing quantity subdivisions, black conduit, ½-in., bringing $75.52 and $67.30.

Non-metallic Flexible Conduit.—Quiet demand and good stocks are the rule. The ⅜-in. size moves at $22 per 1,000 ft. in 5,000-ft. lots, and the ⅛-in. size commands $24.

Flexible Armored Conductor.—No. 14 two-wire double-strip sells at $67 per 1,000 ft. in 1,000-ft. lots. Little of this material is passing around on account of the limited demand.

Cross-arms.—Long-leaf yellow pine arms are moving well in response to the central-station demand. The two-pin arms, 3¼-in. x 4¼-in., bring 46 cents each in moderate quantities, price on four-pin, 5.5-ft. arms being 92 cents each and on six-pin, 8-ft. arms $1.23 each. Fair stocks are in hand.

Pole-Line Hardware.—Prices are rather upset on account of spotty stocks and over-accumulations in some quarters. Braces, bolts and screws are not hard to get, but are weak where the pressure to sell is heavy.

Wire.—Weatherproof base is unsteady, running from 15½ to 17 cents, with fair stocks. Rubber-covered wire is selling at $7.75 per 1,000 ft. in the No. 14 size, 5,000-ft. lots.

Magnet Wire.—Demand is dull and stock shipments are being made.

Appliances. — Business shows a little improvement in washers and vacuum cleaners. Stocks are pretty well reduced. Recent price reductions by a few makers of washers are declared to have stimulated business for only a fortnight or so. Vigorous sales efforts are yielding good fruit. Little fan buying is in progress yet, on account of the number carried over from last season.

ATLANTA

Little or no change in the underlying conditions throughout the district is to be noted this past week, although the opinion seems to prevail that conditions are going to improve slowly and will reach a normal basis before the early fall. The Atlanta, Birmingham & Atlantic Railway announces the operation of trains over the entire system and expects service to be nearly normal within the next few days.

Electrical contractors report that their business continues on the hand-to-mouth basis, with little or no evidence of heavy orders, and inquiries are again slumping off. Wholesale hardware lines, however, report a slight improvement in the volume of orders, and collections in this line are somewhat better than for several weeks past. Local building permits for the first half of March approximate $500,000, which equals the total value of permits for each of the prior two months. The labor supply in all the Southern cities is ample; in fact, non-employment is reported to have shown considerable increase over last month, the majority of unemployed, however, being in the unskilled class.

Exhaust Fans.—The early spring has caused a sudden and rather unexpected demand for exhaust fans in sizes from 18 in. to 48 in. Local stocks are in sufficient volume to take care of all orders up to the present time, and manufacturers report deliveries sufficient to maintain good shipments. Prices are approximately 10 per cent under those quoted last year.

Mangles.—Local campaigns have caused a healthy movement and local stocks were practically exhausted the first of this week, though shipments are on the road in sufficient quantities to relieve the situation.

Washing Machines.—The spring movement has not begun, although local campaigns have served to assist in moving a limited number of machines. Stocks are heavy with prices unchanged.

Schedule Material.—Jobbers report business in this line as rather slow, orders received being small in size with no immediate prospect for material increases. Stocks are reported in first-class shape.

Panelboards.—Completion of buildings undertaken in the late fall has served to sustain the movement in this line, the demand being for small power boards and three-wire lighting panels ranging in size from ten to thirty circuits per board.

Motor-Generator Sets.—There is quite a healthy demand for motor-generator sets and "compensarcs" for the motion-picture trade, a number of theaters nearing completion throughout the section. Shipments are somewhat slow, ranging from three to four months.

Fans.—The early spring has caused an unexpected activity in this line, both jobbers and retailers reporting their business as unusually good. Some of the largest jobbers are predicting a heavy season in this specialty.

Industrial Lighting Equipment.—A reawakening in this line is noted, numerous inquiries being received from large plants with a scattering of orders. Stocks are reported in excellent shape and prices remain unchanged.

Electric Ranges.—Despite a 10 per cent reduction in price very little activity is reported in this line. All jobbers have heavy stocks on hand, with little prospect of a brisk movement in the near future.

ST. LOUIS

The last week was marked by a definite improvement in demand, which, though not large, is causing a more optimistic feeling among electrical jobbers and dealers than has been experienced for some time. A small amount of residential construction work is developing as spring opens up, but industrial building is about at a standstill. The industrial concerns are, however, doing considerable maintenance work, and that is aiding the demand for electrical goods, chiefly wiring and its accessories. The sale of power is about the same as it has been for the last few months, though with indications of improvement, but a number of isolated industrial plants are making inquiries for central-station service. From inquiries received by the jobbers it is also apparent that considerable construction work on the part of the utilities is under consideration. Sales are reported to be from 10 per cent to 15 per cent better than a month ago although considerably less than a year ago. Credit conditions show little change for the week, the average basis being about sixty days, though one concern reports a forty-five-day basis.

A recent change in the city's wiring requirements prohibits the further installation of open-wiring work, and this ruling is causing a marked inrease in the demand for conduit and armored conductor. This demand should prove quite attractive when construction is again on a normal basis. Stocks of the various jobbers vary widely in some items and an interchange of stocks is being carried on successfully. Orders on the manufacturers will consequently

not increase materially until the stocks of all the jobbers are about in line.

Wire.—Through interchange of stocks of Nos. 8, 10 and 14 rubber-covered, the total supply in jobbers' hands is ample for present requirements. The demand is dull in all kinds of wire, especially for No. 6. No. 14 sells for from $8 to $8.10 per 1,000 ft. in 5,000-ft. lots, and there is a tendency to lower the price slightly when bidding in large lots. No. 6, weatherproof, is quoted at $19.75 per 100 lb., and bare copper is on a 16½-cent base.

Flexible Armored Conductor.—Demand is considerably better and stocks are in good shape. No. 14 two-wire, double-strip is quoted at $65 per 1,000 ft. in 5,000-ft. lots.

Conduit.—There is a fairly steady demand for ½-in. black but the demand for the larger sizes is quiet. Quotation on ½-in. black is from $65 to $71 per 1,000 ft.

Knobs and Tubes.—The market is still competitive because of unduly large stocks in the hands of a number of the jobbers. Based on present replacement costs, the selling price should be around $30 per 1,000 for knobs with nail; from $22 to $28 is being quoted, depending on stocks, and demand is quite low.

Ranges. — Notwithstanding reductions of approximately 10 per cent in range prices, the demand is exceptionally dull. This is attributed to the still comparatively high price, the lack of desire on the part of the public to invest in equipment of this kind, and in some localities to the discouragement on the part of the utilities of the sale of ranges because of the difficulty in obtaining money for the necessary additions to plant and distribution system to serve the load. No improvement is expected for some time in the range market.

Vacuum Cleaners and Washing Machines.—Normal demand in these items is an unexpected feature of the appliance sales this spring. Sales are reported to be as good as they were a year ago. The demand in the Southern States is somewhat less than normal, but this is offset by the unusually good demand in the coal-mining regions and the Northern agricultural centers. Stocks are in good shape in most jobbers' hands with immediate shipment available.

SAN FRANCISCO

Generally speaking, business is a bit better, and contractors report that there are numerous jobs, many of considerable size, on which they are figuring. Retail business is fair, and although certain dealers claim that it is much poorer than last year, yet other dealers who have made a specialty of the appliance business find that good displays, a fair location and skillful salesmanship are producing orders.

Through the work of the California Electrical Co-operative Campaign much attention is being paid to the accounting end of the business, the present discussion on margin of profit, turnover and overhead on household appliances having revealed the fact that no tangible arguments can be advanced by most dealers because of their lack of actual experience and knowledge in this important branch of their business.

Weatherproof Wire. — The base sizes of triple-braid weatherproof have recently decreased 1 cent per pound and are now selling for 21½ cents per pound. Coast stocks are excellent while sales are scattering and of rather small quantities.

Fans.—Many contracts on the basis of a twenty-five-lot original order are reported, and Eastern stocks are now arriving in the jobbers' warehouses.

Motors.—With the 10 per cent price decrease, motor sales, especially in the interior cities and larger towns, are holding up very well. Local stocks are excellent and, taking all in all, are far better than they have been out here for at least five years.

Schedule Material.—A new price of 70 cents each on the Benjamin No. 92 two-way plug in lots of 500 is being announced. Business on these extra socket devices and on combined sockets and current taps is very good. The new electrical home in Los Angeles has played a large part in educating southern California to the necessity of convenience outlets. This home was filmed, and the pictures are shown throughout the state in the best theaters. Fixture dealers report a great popularity in the sale of cluster shells for portable standards.

SEATTLE—PORTLAND

According to reports from the more important jobbers and dealers in the Puget Sound field some show a slight increase in the general demand while others say that business is merely holding its own. Dealers during the last two weeks have experienced slightly heavier sales, due to increasing residence construction and a pickup in sales of domestic appliances. Competition between dealers continues to be strong, and price cutting, especially on hollow-ware devices, with which retailers are overstocked, still obtains. Jobbers' stocks are being reduced as rapidly as possible, and ordering is being done on the basis of immediate needs. Contractors, especially in Seattle and Tacoma, are figuring on considerable work, but actual jobs at present under way are few.

In Spokane actual residence contruction costs have declined approximately 12 per cent from the peak prices of last year, and it is claimed in Puget Sound cities that costs have decreased more than 20 per cent. Still, builders are holding off. Lumber prices and orders continue declining, but the industry as a whole is hopeful that freight-rate adjustments effective April 1 will bring about better conditions.

Collection demands are being rigidly enforced, and although some complaint is heard as to tightness of money the situation, especially in the larger cities, is not very pressing.

Portland territory states that manufacturing business is slack, and jobbers say there has been an appreciable decrease in volume although inquiries are still active. Contractors say that business is virtually at a standstill, while retailers say it is very quiet but shows signs of early improvement. Labor in the Oregon field has thus far refused to consider any general wage reduction, and this is probably one of the most important single factors at present delaying industrial recovery.

Ranges.—Sales in the Seattle district are not showing the increase expected, although there is a slight improvement from week to week. The high prices obtaining, coupled with cost of wiring in service, no doubt are the main factors in retarding the movement. Stocks of all standard lines are reported in good condition.

Vacuum Cleaners.—Easy payments are stimulating sales, and from present indications this spring's volume will compare favorably with that of last year. Stocks are in good shape and replenishments easy to obtain. Prices have shown no recent change.

SALT LAKE CITY—DENVER

The employment situation is not so favorable as it has been during the winter months. Large industries, particularly railroads, are laying off men in large numbers. The immediate result, however, is affecting business adversely by reducing the potential market for electrical and other merchandise. Farmers and sheep men are still seeking loans and banks are reported to be operating on close margins. With a dull market for held-over crops and big expense looming in the financing for putting in crops for the coming season, agriculturists find themselves hard put to it for money.

Mining activites are at a low ebb. Mines find it almost impossible to operate on a profit basis because of the low prices for metals and high transportation rates. The smelting industry, being the most intimately connected with the mining industry, has been the first and greatest sufferer. The curtailment of this industry as a consequence has reacted against the coal industry, and these three industries have affected many others from which they are drawing supplies and to which they are in the habit of furnishing labor.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Capital Electric Officers Elected

At the annual meeting of the directors of the Capital Electric Company held at Salt Lake City on March 1 the following officers were elected: J. A. Kahn, president (formerly vice-president and treasurer); H. D. Randall, vice-president; C. B. Richmond, treasurer; R. S. Folland, secretary. Plans were outlined for the coming year, and a general spirit of optimism prevailed regarding the company's activities for the future.

Conveyors Corporation Doubles Factory Force

The steady increase in business of the Conveyors Corporation of America, formerly the American Steam Conveyor Corporation, Chicago, has necessitated doubling the number employed in the South Bend (Ind.) plant. The Conveyors Corporation manufactures the American trolley carrier and the American steam ash conveyor.

Cooper Hewitt Enlarging District Office Space

The Cooper Hewitt Electric Company, Hoboken, N. J., has announced removals of three of its district offices in order to get larger space. The Philadelphia office goes to the Drexel Building, with an addition of two salesmen to the force; the St. Louis office takes new quarters in the Title Guaranty Bank Building, and the Milwaukee office moves to enlarged space in the Security Building, its former address.

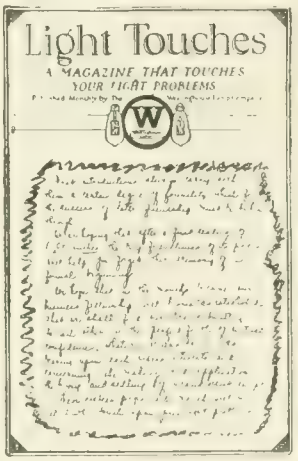
Although business has not returned to normal, the awakening of the automotive, textile and motion-picture industries to increasing activity gives rise to the expectancy of a returning market.

Central Electric Holds Own Lighting Exhibit

The Central Electric Company, 316 South Wells Street, Chicago, Ill., has equipped a lighting demonstration room on the fifth floor of its building, to be maintained during the month of March. Lectures on proper illumination for shops and offices were given on the evenings of March 8 and 9 by A. L. Arenberg, manager of the lighting division of the company, engineers, manufacturers, jobbers and dealers being invited to attend. The audiences were provided with foot-candle meters, enabling them to test the lighting qualities of each type of illumination, beginning with the carbon lamp and including the indirect method of lighting. Mr. Arenberg predicted that the next few years would see a further advance in standards of lighting from the present normal of 15 foot-candles. The demonstration room will be maintained for the rest of the month for the use of any organizations that wish to take advantage of the lectures.

Westinghouse Lamp Adds New House Magazine

A new monthly house magazine, *Light Touches*, is scheduled by the Westinghouse Lamp Company to make its appearance some time during the first ten days of April. Within its sixteen pages the company purposes to deal with the activities of its "A" and



"B" agents and its lighting, service and engineering activities. It will be technical only to a slight degree—one article an issue—and will replace *Commercial Engineering News*, which until March 1 was the semi-technical house magazine. Articles of interest to dealers and jobbers will take up the remainder of the section containing the main features.

Electric Machinery Corporation Organized at Boston

With C. A. Cotton as president and C. E. Van Bibber as treasurer, the Electric Machinery Corporation has been organized at Boston to handle the New England business of Willis L. Adams, engineer-contractor, Niagara Falls, N. Y., and to act as a manufacturers' agency. The new concern is capitalized at $100,000 and has established offices at 92 Pearl Street, Boston. Mr. Cotton is well known in the New England electrical field as a distributer of machinery, having maintained offices at Boston as manufacturers' agent for about twenty-seven years. Mr. Van Bibber has had a world-wide experience in the electrical construction field and for many years has made his headquarters in Boston, specializing in construction engineering for railroads, industrial and mining companies. The new company has taken the following agencies: Valley Electric Company, St. Louis; Imperial Electric Company, Akron, Ohio; Sunlight Electric Company and Enterprise Electric Company, Warren, Ohio, and the Balldor Electric Company, St. Louis.

Insulator Plant of Ohio Brass at Full Capacity

Despite the falling off of new orders for high-tension insulators the plant of the Ohio Brass Company, Mansfield, Ohio, is running to full capacity turning out this product. Incidentally, the capacity of the insulator factory is continually being increased. Part of this production is being taken up at present with the order recently placed by the Pacific Gas & Electric Company. The delivery of these insulators is to begin not later than May 1. The company expects 1921 business to be at least as great as in the past and can see nothing at present which would justify any slowing down in production.

Emerson Employees Present Tablet to Officials

The employees of the Emerson Electric Manufacturing Company, St. Louis, recently presented a bronze tablet to three officials of the company, Herbert L. Parker, Thomas M. Meston and Herbert L. Finch, as a token of esteem and a tribute to their achievement and business success. The presentation was made on the occasion of the opening of a new plant just completed by the company. According to the presentation address, the employees took this method of showing to the three officials their "appreciation of the fair and liberal manner in which you have always dealt with us."

Worthington Pump's Business Analysis for 1920

From its fifth annual report, for the fiscal year ended Dec. 31, 1920, the Worthington Pump & Machinery Corporation, 115 Broadway, N. Y., booked orders to the extent of $27,478,019, as against $19,760,556 for 1919, although the billings dropped to $27,924,745 from a 1919 figure of $32,074,592. The volume of orders booked early in the year was satisfactory, but the partial suspension of buying which developed in the latter part of the year has continued to the present date. "The total of the orders now being booked is below normal, but the volume of inquiries is large."

The major portion of the year's billings was for normal commercial business, and only a small portion was due to the completing of war orders. Unfilled orders on hand Dec. 31, 1920, amounted to $9,724,011, as against $8,784,542 the year previous.

During the past year the board of

directors authorized additions and betterments to buildings and equipment of $1,782,098, and during this time there was expended for this purpose $1,263,602.

In its development of new products sufficient progress has been made at the Snow-Holly Works in the development of the marine Deisel engine, also usable in the field of electrical stationary generating service, and in the heavy oil engine at the Blake & Knowles works to justify the placing of these two lines on the market. Moreover, the development of a hydraulic turbine at the Worthington works has been completed and the product placed on the market.

Manufacturing and trading profit declined from $4,905,474 in 1919 to $2,026,302 in 1920.

Monroe Lamp Still Adding New Supply Lines

The Monroe Lamp & Equipment Corporation, 314 West Fourteenth Street, New York City, which for more than three years had been operating as the Monroe Lamp Company in the distribution of lamps, since its reorganization last September as the Monroe Lamp & Equipment Corporation has here and there added new lines of electrical supplies. On its reorganization the company branched out as wholesaler only of electrical supplies and has taken on the distribution of lines manufactured by Thomas & Betts, R. B. Corey, W. A. Bonnell, Edwards & Company, Duplex Lighting Works, and in addition Packard "Mazda" lamps, "Indiana" wire, "Economy" fuses, "A-B" products, and just recently Emerson fans. Other lines have not yet been filled.

Charles W. Culkin is president, James J. Hagan vice-president, and James M. McCunn treasurer. J. A. Hawkes, formerly in the New York office of the National Metal Molding Company, is purchasing agent. The building occupied is 25 ft. x 150 ft., of which the corporation has taken three stories, leaving room for expansion.

Chicago Pneumatic's Net Income for 1920 Shows Increase

Net income transferred to surplus for the year ended Dec. 31, 1920, amounted to $1,273,061.36, according to the report of operations submitted by the board of directors of the Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York, and its subsidiaries. The corresponding figure for 1919 was $657,051.35.

"The net sales of the company for the fiscal year, while suffering from the depression felt about the middle of the year, still slightly exceed those for the year preceding. While the gross earnings show a decrease from the previous year, the discrepancy is accounted for by the continued increase in the cost of manufacture and the larger proportionate sales of the less profitable varieties of the company's product.

"As was announced in the annual report for the fiscal year ended Dec. 31, 1919, the company's capital stock was increased during 1920 to a total of $13,000,000. The cash made available by this increase has been used to redeem the company's funded debt, and for improvements which are now complete. The earnings of the subsidiaries for the year were materially reduced because of the unsatisfactory condition of foreign exchange."

United States Rubber Opening New Foreign Offices

The United States Rubber Export Company, 1790 Broadway, New York, as distributing unit of the United States Rubber Company in foreign fields, has new branches in process of being opened in Batavia, Java, as the Dutch East Indies branch, in Brussels, Belgium, and in Copenhagen, Denmark. A full line of electrical conductors, insulating friction tape and rubber splicing tape is to be carried in each branch as is now carried in existing branches in Havana, Rio de Janeiro, Montevideo, Buenos Aires, Santiago de Chile, Manila, London, Madrid and Johannesburg. Exclusive distributing arrangements are mantained in Mexico, Venezuela, Porto Rico, Barbados, Peru, Colombia, Bolivia and India, where stocks are also carried.

Standard Insulator Units for 220,000-Volt Line

Orders for the necessary suspension unit insulators to equip two 200-mile circuits of the Pacific Gas & Electric Company, San Francisco, for ultimate operation at 220,000 volts have been distributed among three manufacturers. The Locke Insulator Manufacturing Company will supply about 25,000 units and the R. Thomas & Sons Company about the same number. The Ohio Brass Company's share is about 80,000 units, as noted elsewhere in this issue. Delivery will extend through the summer. It is understood that orders for about 50,000 units are yet to be placed. The acceptance of standard catalog insulator units in all three instances for operation at this extremely high voltage should in large part tend to reassure consumers who have doubted whether present insulators were applicable to such high voltages.

Approved Locomotive for Use in Gaseous Mines

The United States Bureau of Mines has issued the first approval for a storage-battery locomotive for use in gaseous mines to the George D. Whitcomb Company, Rochelle, Ill. The approval, dated March 14, covers a 6-ton storage-battery locomotive, which may be equipped with a battery consisting of either 80-G-14 Edison cells or 48-L-149-29 plate Gould cells. Caustic potash is specified as the electrolyte for use with the Edison battery. As approved, the Bureau of Mines recommends this locomotive for service in gaseous mines and considers it much safer than the types heretofore used.

The idea of developing a special storage-battery locomotive for use in gaseous mines was suggested some years ago. As a result of a conference of locomotive storage-battery manufacturers in 1916 the bureau prepared a set of tentative specifications. These were again revised and republished as Schedule 15, "Procedure for establishing a list of permissible storage-battery locomotives for use in gaseous mines." Several applications for tests leading to approval were received during 1920.

Robbins & Myers Extends Motor Line

A new type of frame 208 motors has been put in production by the Robbins & Myers Company, Springfield, Ohio. This will bring the company's line of polyphase motors from the 30-hp. size up to 50 hp., and this in turn will be extended up to a capacity of 100 hp.

The Fletcher Manufacturing Company, Dayton, Ohio, which has been operating for several years as a partnership, manufacturing electrical construction supplies, has been incorporated with a capital stock of $40,000. J. R. Fletcher and E. M. Razoor are incorporators.

The Alt-Le Lighting Fixture Company, 262 Broadway, New York City, has filed notice of increase in capital stock from $15,000 to $75,000.

The Alpha Electric Company, 151 West Thirtieth Street, New York City, has filed notice of increase in capital stock from $50,000 to $200,000.

The Automatic Reclosing Circuit Breaker Company, Columbus, Ohio, announces the opening of an office at 510-512 Brown-Marx Building, Birmingham, Ala., in charge of B. M. Rogers.

The Maring Wire Company, Muskegon, Mich., manufacturer of enameled, cotton and silk-covered magnet wire, anonunces the appointment of Harry S. Simpson, 904 Westminster Building, Chicago, as its sales representative for the Chicago territory.

The R. B. Corey Company, Inc., marine, electrical engineer and contractor, 183-187 Varick Street, New York City, announces its intention of establishing a branch in Atlanta in charge of R. H. Witherspoon, who has been identified with the electrical industry in the South for several years.

Westinghouse Providence Offices Moved. — The local offices of the Westinghouse Electric & Manufacturing Company at Providence, R. I., have been relocated at 302 Grosvenor Building. Arthur S. Hall is in charge representing the company in Rhode Island and eastern Connecticut.

The Aqua Electric Heater Company, 250 West Fifty-fourth Street, New York City, has filed notice of increase in capital stock from $200,000 to $1,000,000. The proceeds, it is understood, will be used for proposed expansion.

Foreign Trade Notes

HYDRO-ELECTRIC PLANT IN CZECHOSLOVAKIA.—The Czechoslovakian Government, according to a communication from Europe, has approved of the plan for the utilization of the large power resources of the River Thaya, which when completed will be one of the largest hydro-electric power plants in Europe. At first only a part of the whole project will be carried out, providing approximately 80,000,000 kw.-hr. per annum. This part of the plant comprises two dams and several weirs a little above the town of Znaim. The plans are completed in every detail, and the Czechoslovakian Government is endeavoring to arrange for financing the project without delay. The utilization of the Thaya water power resources has been under contemplation since many years and was planned long before the Czechoslovakian state was established.

A GERMAN-ARGENTINIAN WIRELESS COMPANY FORMED.—The Compañia Radiotelegrafica Transradio has been formed with headquarters in Buenos Aires, equipped with a share capital of $10,000,000. The preferred stock has been subscribed in the Argentine, while the ordinary stock has been taken up by a German syndicate consisting of Siemens & Halske, the Allgemeine Elektricitäts-Gesellschaft and the German South American Bank. The company has been granted the privilege of exploiting the German "Telefunken" system by the Argentine Government and will proceed immediately, it is reported from Europe, to erect a wireless station in the Argentine in connection with the German station at Nauen. The enterprise appears to be mainly German, its chief object being apparently to advance commercial relations between Germany and the Argentine.

THE SYDNEY E. JUNKINS COMPANY, LTD., Winnipeg, Manitoba, and Vancouver, B. C., Canada, engineering and construction engineer, is distributing a booklet entitled "Engineering and Construction Notes," describing work done under the supervision of the company.

DWIGHT P. ROBINSON & COMPANY, INC., 125 East Forty-sixth Street, New York City, engineer and constructor, has recently opened offices in the Dominion Express Building, Montreal, Canada.

MARKET FOR ELECTRICAL SUPPLIES IN SOUTH AFRICA.—Owing to a shortage of electric plant equipment and supplies many public authorities and companies, according to the *South African Engineer and Electrical Review*, are unable to meet the demand for electrical service. Only in the supply of electric lamps, which were overimported in 1918 by speculators, has the South African demand been adequately met. Electrical goods, such as heating and cooking apparatus, telephone, conduit, supplies, etc., have been at times unprocurable at any price and electrical glassware too is short.

COMMERCIAL AND INDUSTRIAL FAIR AT BORDEAUX.—The annual commercial and industrial fair of the city of Bordeaux, France, according to Consul Jackel of Bordeaux, will be held from June 15 to June 30. A. D. Straus & Company, 18 Broadway, New York City, have been appointed official representatives of the fair committee in the United States, and particlars regarding shipments and space may be obtained through their office.

THE AMERICAN INSULATOR CORPORATION, New Freedom, Pa., announces the appointment of G. L. MacGillivray & Company, Ltd., 103 Notre Dame Street, Montreal, Canada, as exclusive sales representatives in eastern Canada. The company will handle the "Aico" line of products of the American Insulator Corporation, consisting of cold-molded insulating parts for electrical and automotive units.

ELECTRICITY FOR INDUSTRIAL PURPOSES IN NEW BRUNSWICK.—According to the London *Electrician*, steps have been taken by the government of New Brunswick, Canada, to supply hydro-electric power for industrial purposes throughout a large portion of the province. The water power at Musquash, N. B., is being developed by a special committee appointed for the purpose. The initial cost is estimated at £250,000, and the commission will furnish energy to the municipality of Halifax, N. S., which will distribute it direct, after erecting its own distributon system, or sell power in bulk to an existing company.

ESTABLISHMENT OF NEW INDUSTRIES IN AUSTRALIA.—The movement for the establishment of new industries in Australia, according to the London *Electrician*, is extending rapidly, especially in New South Wales and Victoria. The total amount of new capital for industrial extension sanctioned by the federal government, according to statistics compiled by the Minister for Trade and Customs, during the past twelve months was £20,000,000. More than half of the new industries will be established in New South Wales—Newcastle and Port Kemble being the most favored centers. It is understood that several companies contemplate the establishment of plants in the vicinity of Springvale, one reason being that the district will be in a favorable position when the Morwell electric power project is in operation. These new industries will mean an increased demand for electric motor and other plant equipment and also a demand for skilled workers.

ELECTRIFICATION OF RAILWAY IN BRAZIL.—The Paulista Railway Company, Brazil, last December authorized an increase in capital stock from 100,000 to 132,000 contos of reis by t e issue of 160,000 shares of reis 200 each, the proceeds to be used to provide funds for the electrification of its system.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A company of manufacturers and importers in India (No. 34,542) desires to be placed in connection with firms for the importation of electrical goods, telephones, etc.

A firm in Italy (No. 34,553) desires to secure an agency for the sale of vacuum cleaners, electrical household appliances, etc.

A commercial agent in Spain (No. 34,561) desires to purchase or secure an agency for the sale of electrical supplies and machinery, etc.

New Apparatus and Publications

TACHOMETERS AND INDICATORS.—The Consolidated Instrument Company of America, 461 Eighth Avenue, New York City, is distributing two four-page leaflets, one covering the Jones tachometers and the other the Hasler speed indicator.

RADIO APPARATUS.—"Radio Receiving Apparatus for Short-Wave Telegraphy and Telephony" is just off the press of the Westinghouse Electric & Manufacturing Co.

SWITCHES.—The Cutler-Hammer Manufacturing Company, Milwaukee, is distributing publication 2016, describing the C-H bulletin 9116 switch for starting motors.

PORTABLE INSTRUMENTS. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently placed on the market its type PI portable instruments for battery testing.

COMBUSTION.—The Mono Corporation of America, 25 West Broadway, New York City, is distributing a four-page leaflet describing its new "Duplex Mono" instrument for analyzing and recording the combined percentages of three combustible gases, CO, CH_4 and H_2 along with CO_2.

MOTOR STARTER. — The Rowan Controller Company, Baltimore, is placing on the market a new push-button-operated, oil-immersed automatic starter for small alternating-current motors.

PULL SOCKETS.—The Bryant Electric Company, Bridgeport, Conn., has added to its line of wiring devices key, keyless and pull sockets with Spartan outlets, having ratings of 660 watts, 250 volts, on each outlet.

PANEL PIPE FITTINGS. — The Erie Electrical Equipment Company, Inc., Johnstown, Pa., is distributing eight sheets published in January and February, 1921, covering its panel pipe fittings, etc.

BATTERY JUMPER.—The Mueller Electric Company, 2135-45 Fairmount Road, Cleveland, is distributing a leaflet describing its "Attacho" battery jumper.

LOW-SPEED GENERATORS.—To meet the need of the small and medium size low-head water-power applications the Westinghouse Electric & Manufacturing Company has placed on the market a line of low-speed vertical-shaft generators, consisting of 112 different kva. and speed ratings, which is described in leaflet No. A 3797.

LIGHTNING ARRESTER.—A new type of oxide-film lightning arrester has recently been developed by the General Electric Company for voltage ranges between 1,000 and 7,500.

DIESEL ENGINES.—The Fulton Iron Works Company, St. Louis, has just issued bulletin No. 801, a comprehensive treatment of the history and development of the Diesel engine.

PHONOGRAPH MOTOR.—The General Electric Company, Schenectady, N. Y., has developed a new type of phonograph motor, which is a small induction motor.

STEEL CASE TRANSFORMER. — The Killark Electric Manufacturing Company, 3940-48 Easton Avenue, St. Louis, has recently placed on the market the "Ferro-case" bell ringing transformer.

FIXTURE STEM.—The Peerless Light Company, 663-671 West Washington Boulevard, Chicago, has recently developed a new "Hangstrate" fixture stem.

PAPER MILL DRIVE.—The Westinghouse Electric & Manufacturing Company is distributing reprint No. 94, describing the Westinghouse system of sectional individual motor driver for paper machines.

WIRELESS.—"Radio in a New Role" is the title of folder 4446 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describing the Westinghouse radio receiving apparatus.

SERVICE STATION EQUIPMENT. — The Automotive Electric Service Corporation, 116-118 East Thirty-third Street, Chicago, is distributing catalog 102, entitled "Garage and Battery Service Station Equipment," covering its line of battery-charging outfits and automotive equipment.

EQUIPMENT FOR BATTERY STATION. —"Everything for the Busy Battery Shop" is the title of catalog No. 3 issued by the Pack Battery & Equipment Company, 1409-11 McGree Street, Kansas City, Mo., covering the "Pabeco" equipment for battery service station.

MOTORS AND TRANSFORMERS.—The Wagner Electric Manufacturing Company, St. Louis, is distributing bulletin 128, covering its distribution type transformers. Bulletin 127 issued by the company describes its single-phase motors.

KINEMATOGRAPH EQUIPMENT.—The Metropolitan-Vickers Electrical Company, Ltd., Trafford Park, Manchester, England, is distributing a booklet entitled "Pictures," describing the electrical equipment of the modern kinematograph theater. The company has also issued a small booklet covering its different types of buffing motors.

New Companies

THE NEW JERSEY LAMP & BRASS COMPANY, Newark, has been incorporated by Ralph Cortese and F. D. Masucci, 185 Market Street. The company is capitalized at $100,000 and proposes to manufacture electric lamps, brass goods, etc.

THE DETROIT RADIO LABORATORIES, INC., Detroit Mich., have been incorporated by Arthur L. Smith and E. B. and Irving G. Dietterich, 3663 Pulford Avenue, to manufacture wireless equipment for telegraph and telephone service. The company is capitalized at $50,000.

THE MERCEDES WATER, LIGHT & POWER COMPANY, Mercedes, Tex., has been incorporated by C. B. and E. B. Witmer and A. J. Summers, with a capital stock of $100,000.

THE UNIVERSITY BATTERY & ELECTRIC COMPANY, Enid, Okla., has been incorporated with a capital stock of $100,000 by G. E. Garland, C. P. Harris and I. F. Conkling.

THE ELECTRIC MOTOR & APPLIANCE COMPANY, 69 Washington Street, Belleville, N. J., has been organized to manufacture electrical equipment and appliances. Thomas H. Brooks, Jr., 177 Delevan Avenue, heads the company.

THE ROMER MOTORS CORPORATION, Boston, has been chartered with a capital of $5,000,000 to manufacture motors, electric, steam and gas engines; Albert J. Romer, 64 Huntington Avenue, Boston, is president and James L. Roope, Salem, is treasurer.

THE AUTOMATIC ELECTRIC SHOE POLISHING MACHINE COMPANY, Bryan, Tex., has been chartered by J. T. Maloney, J. L. Edge and C. E. Harris, Bryan. The company is capitalized at $75,000 and proposes to manufacture special electrically operated machinery.

Record of Electrical Patents

Notes on United States Patents

(Issued March 1, 1921)

1,370,093. RECEIVING PANEL; George B. Crouse and Isaac H. Mills, Brooklyn, N. Y. App. filed March 10, 1919. Radio telegraphy or telephony.

1,370,104. SANITARY COVER FOR TRANSMITTER MOUTHPIECES; Sidney Flack, Erie, Pa. App. filed Dec. 11, 1919.

1,370,114. MAGNETO CONTACT; John Jepsen and John R. Connolly, Maricopa, Cal. App. filed March 20, 1918. Used with Ford automobile.

1,370,119. PRIMARY GALVANIC BATTERY WITH UNALTERABLE ELECTROLYTE; Ernst W. Jungner, Kneippbaden, Sweden. App. filed Aug. 16, 1918. Economical renewals.

1,370,136. ELECTRIC HEATING DEVICE; Edwin N. Lightfoot, New York, N. Y. App. filed April 2, 1919. For soldering, branding, etc.

1,370,143. CURRENT COLLECTOR; Joseph F. Montine, Chicago, Ill. App. filed Aug. 25, 1919. Trolley.

1,370,144. TROLLEY-WIRE SUPPORT; Joseph F. Montine, Chicago, Ill. App. filed Aug. 26, 1919. Package-conveyor system.

1,370,156. CONDUCTOR AND ELECTRIC MACHINERY PROVIDED WITH IT; Reinhold Rudenberg, Charlottenburg, near Berlin, Germany. App. filed Sept. 18, 1913. Conductor contains cooling duct.

1,370,157. MAGNETO FOR EXPLOSION MOTORS; Theodor Ruhlmann and Carl Kottmann, New York, N. Y. App. filed Aug. 9, 1916. High-tension.

1,370,161. METER; Rudolph F. Schuchardt, Chicago, Ill. App. filed July 5, 1919. Records kw., kva. and demand.

1,370,162. ELECTRIC LIGHTING AND STARTING SYSTEM FOR MOTOR VEHICLES; Franklin W. Springer, Minneapolis, Minn. App. filed Nov. 9, 1916. For motor vehicles.

1,370,179. MOVABLE ELEMENT FOR METERS; Donald J. Angus, Indianapolis, Ind. App. filed May 20, 1918. For graphic meter.

1,370,260. ELECTRIC GUN OR APPARATUS FOR PROPELLING PROJECTILES; André L. O. Fauchon-Villeplée, Paris, France. Propelling effected by means of electric current.

1,370,230. MECHANICAL RECTIFIER FOR MAGNETOS OF AUTOMOBILES; Harry F. Slocum, Santa Ana, Cal. App. filed July 16, 1917. Used upon magneto of Ford type.

1,370,250. SEALING DEVICE; Arturo W. Wildner, Buenos Aires, Argentina. App. filed July 22, 1920. For stamping sealing wax.

1,370,257. LONG-DISTANCE SIGNAL AND CONTROL APPARATUS; Walther Akemann, Essen, Germany. App. filed Sept. 3, 1920. For indication at a distance of the position of pointers.

1,370,276. ELECTRICAL INSULATOR; Henry H. Buckman, Jacksonville, Fla. App. filed Oct. 10, 1919. Spark plug.

1,370,277. ELECTRIC BRUSH HOLDER; Ernest Buerrosse, Milwaukee, Wis. App. filed Nov. 8, 1920. To effect and maintain uniform and true contact.

1,370,286. ELECTRICAL WELDING APPARATUS; Alexander Churchward, New York, N. Y. App. filed June 24, 1919. Arc welding.

1,370,295. PROCESS OF AND APPARATUS FOR OBTAINING OXIDES OF NITROGEN FROM ATMOSPHERIC AIR; Francis I. du Pont, Wilmington, Del. App. filed July 15, 1919. Electric arc.

1,370,300. TOLL-TELEPHONE SWITCHING APPARATUS; Herbert M. Friendly, Portland, Ore. App. filed June 17, 1915.

1,370,333. SYSTEM OF COMMUNICATION; William W. MacFarlane, Elkins Park, Pa. App. filed May 15, 1919. Audio frequency in wireless or semi-wireless apparatus.

1,370,341. SPARK INTENSIFIER; Henry L. Miller, St. Louis, Mo. App. filed Feb. 19, 1920. Auxiliary gap.

1,370,402. AUTOMATIC TELEGRAPH SYSTEM; George R. Benjamin, Jersey City, N. J. App. filed Dec. 11, 1916. Synchronous system.

1,370,502. INDUCTION COIL; Stanley D. Livingston, Meriden, Conn. App. filed Jan. 10, 1920. Combined coil and condenser.

1,370,504. TELESTEREOTYPE; John H. Hammond, Jr., Gloucester, Mass. App. filed Nov. 30, 1912. Reproducing forms and shapes of surfaces and solids at a distance.

(Issued March 8, 1921)

1,370,509. ELECTRICAL CONNECTOR DEVICE; Reuben B. Benjamin and Walter A. Alden, Chicago, Ill. App. filed Oct. 22, 1917. Connection made without arcing.

1,370,524. ELECTRIC HAIR SINGER; Louis J. Dumaine, Montreal, Quebec, Canada. App. filed April 24, 1920.

1,370,527. ELECTRICAL HEATER; Edmond C. Floriot and George F. Cody, New York, N. Y. App. filed Jan. 23, 1920. To warm room.

1,370,554. TEST CONNECTOR; John M. Peirce, South Charleston, Ohio. App. filed July 5, 1918. For mechanically connecting two or more wires.

1,370,558. MACHINE RINGING SYSTEM; William A. Rhodes, New York, N. Y. App. filed March 1, 1918. Telephone.

1,370,562. TRUNK CIRCUITS; Samuel P. Shackleton, New York, N. Y. App. filed June 4, 1919. For eliminating disturbances from hook impulses.

1,370,578. CHECK-CONTROLLED MACHINE; Alfred D. Antoine, Chicago, Ill. App. filed April 19, 1917. Coin-slot shocking machine.

1,370,619. HOT-WATER HEATER; Charles H. Whitehead, Kingsville, Ontario, Canada. App. filed Dec. 1, 1919. Household.

1,370,631. ELECTRIC CIGAR LIGHTER; Dudley B. Clark, Jamestown, N. J. App. filed Dec. 17, 1919.

1,370,632. ELECTRIC FURNACE; Walter R. Clark, Bridgeport, Conn. App. filed May 6, 1918. For melting brass and similar scrap.

1,370,638. INSULATOR-TESTING DEVICE; William G. B. Euler, San Francisco, Cal. App. filed March 15, 1920. By measuring difference of potential between conductor and insulator support.

1,370,646. TREATMENT OF LEACH LIQUOR; Carle R. Hayward, Quincy, Mass. App. filed Dec. 8, 1919. Recovering in valuable form incidental metals.

1,370,651. STICK FOR HANDLING HIGH-VOLTAGE LINE CONDUCTORS; Tomlinson F. Johnson, Jr., Atlanta, Ga. App. filed July 30, 1918. For handling live line.

1,370,669. MACHINE TELEGRAPH; Louis M. Potts, Baltimore, Md. App. filed Dec. 14, 1915. Perforated strip for receiving and sending.

1,370,670. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; Andrew P. Riedele, St. Cloud, Minn. App. filed July 29, 1919.

1,370,726. PLANER AND SYSTEM OF MOTOR CONTROL THEREFORE; Harold L. Blood, Plainfield, N. J. App. filed June 10, 1920. Reversing motor.

1,370,728. RESISTOR ELEMENT FOR ELECTRIC CURRENT CONTROLLERS AND PROCESS OF MAKING THE SAME; Lynde Bradley, Milwaukee, Wis. App. filed July 29, 1916. Resists pressure, shock and heat.

1,370,731. CABLE AND METHOD OF MAKING THE SAME; Philip H. Chase, Cynwyd, Pa. App. filed Nov. 2, 1916. For high-voltage power work.

1,370,735. AËRIAL SYSTEM FOR WIRELESS SIGNALING; Charles S. Franklin, London, England. App. filed Sept. 30, 1920. Combination of single frame and double frame.

1,370,744. WINDING MACHINE; Frederick Diehl, Elizabeth, N. J. App. filed May 19, 1914. For winding pole coils.

1,370,751. ELECTRIC CIRCUIT TESTER; Louis L. Kroupa, Berwyn, Ill. App. filed Sept. 4, 1917. Circuits separately and expeditiously tested for breaks or poor connections.

1,370,914. ALTERNATING-CURRENT MAGNET; Charles H. Rippl, Cleveland, Ohio. App. filed June 7, 1919. Laminated core reduces eddy currents.

1,370,916. ELECTRIC SADIRON; Samuel I. Russel, Chicago, Ill. App. filed Oct. 6, 1920. Terminals of heating element do not overheat.

1,370,926. ELECTRIC WELDING METHOD, MACHINE AND WELDED CHAIN; Frank E. Stahl, Tonawanda, N. Y. App. filed July 7, 1920. Bulge on inside of link.

1,370,934. IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Harry R. Van Deventer, Newark, N. J. App. filed April 7, 1919.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

DOVER, N. H. — Improvements to the street-lighting system are contemplated. Service is furnished by the Twin State Gas & Electric Company.

BOSTON, MASS.—Plans have been filed by the Boston Insulated Wire Company, 65 Bay Street, for improvements to its power house.

WESTFIELD, MASS. — The Municipal Light Commission has ordered extensions to the electric lines for service in the villages of Mundale and Wyben. The cost is estimated at about $7,000.

WEST NEWBURY, MASS.—The installation of electric lamps on Main Street is under consideration.

WORCESTER, MASS.—Plans are under consideration by the board of directors of the Worcester State Hospital for the construction of a cold-storage plant at the institution to cost about $50,000.

Middle Atlantic States

BROOKLYN, N. Y.—Electrically operated centrifugal pumping machinery and mechanical equipment will be required for the new drydock to be installed at the shipyard of Theodore A. Crane Sons' Company, foot of Columbia Street.

FAR ROCKAWAY, N. Y.—The Queens Borough Gas & Electric Company has plans under way for the erection of a large service and general power station at Beach Street and Fifty-third Street, Edgemere.

MALONE, N. Y.—The Malone Light & Power Company has filed notice of increase in capital stock from $300,000 to $600,000. The proceeds, it is understood, will be used for proposed extensions and improvements.

TONAWANDA, N. Y.—Electrical equipment will be installed in the new plant to be built here by the J. Spaulding Sons' Company, 484 Broome Street, manufacturer of fiber products. The plans provide for one five-story building and two one-story structures, 107 ft. x 300 ft., 60 ft. x 180 ft. and 50 ft. x 200 ft. respectively. George F. Hardy, 309 Broadway, New York, is architect and engineer for the project.

WATERFORD, N. Y.—The Public Service Commission has ordered the Northern Adirondack Power Company to complete its power plant at Au Sable Chasm, install new switchboard, switching and other electrical equipment, construct a new substation at Au Sable Forks, and make a number of extensions and improvements to its transmission and distribution system. Thomas O'Connor is president.

JERSEY CITY, N. J.—Electric hoisting equipment and other electrically operated machinery will be installed at the proposed new freight terminal to be erected here by the Delaware, Lackawanna & Western Railroad Company, 90 West Street, New York City, to cost about $2,000,000.

ALLENTOWN, PA.—The Lynn Township Light & Power Company and the Wessenburg Township Light & Power Company, recently organized, are planning to install electric system in Lynn and Wessenburg Townships respectively.

ELIZABETHTOWN, PA. — Plans have been completed by the Hershey Traction Company, Hershey, for the construction of a new electric power plant at Conewago Creek, near Elizabethtown.

PHILADELPHIA, PA.—Plans have been filed by the Reyburn Manufacturing Company, Thirty-second Street and Alleghany Avenue, for the construction of a new one-story power house at its tag manufacturing plant, to cost about $25,000.

PHILADELPHIA, PA.—Plans have been filed by W. S. Diamond for improvements and extensions to the power plant at his factory at Tulip and Westmoreland Streets.

NEW CASTLE, DEL.—The City Council has adopted resolutions authorizing the purchase of the present lighting and waterworks system. Bonds to the amount of $100,000 will be provided for this purpose.

A number of improvements and extensions will be made.

WILMINGTON, DEL.—Steps have been taken by the property owners on King Street for the installation of an improved lighting system along the thoroughfare.

BALTIMORE, MD.—The Public Service Commission has granted the Northern Maryland Electric Company permission to extend its lines to certain sections of Cecil County, including the Rising Sun District.

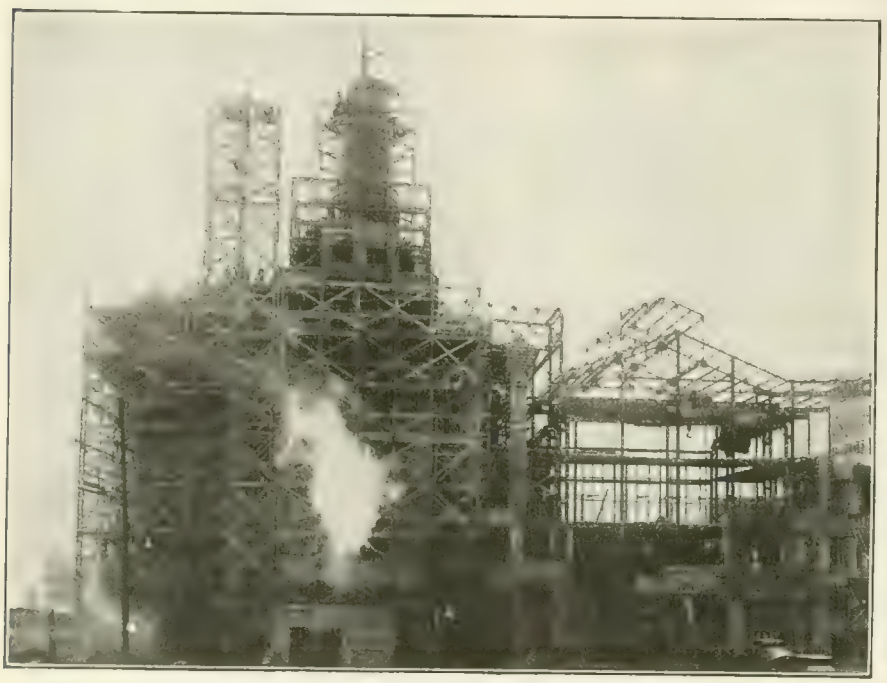
BALTIMORE, MD.—Electrical equipment will be installed in the proposed new plant to be erected by the Sexton Stove & Manufacturing Company, 500 West Conway Street. The plans include the construction of three buildings consisting of a foundry, 100 ft. x 135 ft., metal and iron works, 67 ft. x 160 ft., and one-story assembling shop, estimated to cost about $75,000. W. R. Sexton is president.

BALTIMORE, MD.—The United Railways Company has submitted to the City Electrical Commission a statement to the effect that the company is planning to expend $100,000 a year for the installation been prepared for an addition to the municipal power plant and boiler house to cost about $102,450. Forelich & Emery, 403 Second National Bank Building, Toledo, Ohio, are engineers; S. E. Dickenson is general superintendent.

BYRON, ILL.—The Illinois Northern Utilities Company, Dixon, plans to erect a transmission line from Byron to Stillman Valley.

CHICAGO, ILL.—The Creamery Package Manufacturing Company, 61 West Kinzie Street, contemplates the construction of a group of buildings, including a power plant, four-story factory, general offices, etc., at West Division Street and Kostner Avenue, for which plans, it is reported, are being prepared by M. Tullgren & Sons, Milwaukee, Wis.

SADORUS, ILL.—Arrangements have been made by the Sadorus Light & Power Company, recently incorporated, for the purchase of energy from the Central Illinois Public Service Company to supply the village of Sadorus. The plans include the erection of a 4,600-volt line from the Public



NEW 40,000-HP. PLANT FOR DODGE BROTHERS

One of the largest power plants built for an individual user is about to go into operation the first of April. This $3,500,000 plant is but a part of the expansive program in the automobile field

of underground feeder lines in different parts of the city.

QUINWOOD, W. VA.—Developments in the New River coal fields in the Meadow Creek district, involving an expenditure of about $3,000,000, have been planned by Quin Morton and W. S. Wood of Charleston, W. Va. Electrically operated machinery will be used in the mines.

CHATHAM, VA.—The Chatham Light & Power Company contemplates doubling the capacity of its plant.

North Central States

DETROIT, MICH.—Bids, it is understood, will be received early in April by the Board of Water Commissioners for the construction of two electrically operated pumping plants, one to be 63 ft. x 75 ft., to cost about $200,000, and the other 90 ft. x 100 ft., to cost about $100,000.

GRAND HAVEN, MICH.—The Beech Tree Light & Power Company has been granted permission to erect transmission lines along the highway.

RAVENNA, MICH.—Plans have been prepared for the construction of a hydro-electric power plant to cost about $70,000. Holland, Akerman & Holland, 106 East Liberty Avenue, Ann Arbor, are engineers. T. Rogers of the Ravenna-Conklin Electric Light & Power Company may be able to give further information.

GREENUP, KY.—The construction of a power house to cost about $50,000 is under consideration. For further information address Col. W. P. Stickey, Room 513, Government Building, Cincinnati, Ohio.

KENDALLVILLE, IND.—Plans have Service Company's plant near Tolono to Sadorus.

WAUKEGAN, ILL.—The Public Service Company of Northern Illinois, it is reported, will start work soon on the construction of an electric plant north of Waukegan. The plant will develop an ultimate capacity of 200,000 kw. and is estimated to cost about $25,000,000.

CAINSVILLE, MO.—W. N. Albertson & Company, electrical engineers and operators, First Wisconsin National Bank Building, Milwaukee, Wis., have acquired the property of the Missouri Electric, Gas & Water Company and contemplate the installation of new power-plant equipment. The erection of a number of transmission lines to adjoining towns is also planned.

MORGANVILLE, KAN.—The City Council is having plans prepared for the construction of a new transmission line and the installation of a local distributing system, estimated to cost about $25,000. W. B. Rollins & Company, 209 Railway Exchange Building, Kansas City, Mo., are engineers.

Southern States

LENOIR, N. C.—The United Mills Company, Hickory, contemplates a hydro-electric development on Harpers Creek in Caldwell County.

MADISON, N. C.—Electric light bonds to the amount of $30,000 have been issued.

JACKSONVILLE, FLA.—The Mecca Hotel & Sanitarium Company, 501-5 Hill Building, is considering the construction of a $4,000,000 group of buildings for sanitarium and hotel purposes. Tentative plans include an electric lighting plant to cost $350,000; electric elevators, $100,000; etc.

MEMPHIS, TENN.—The Memphis Gas & Electric Company, 16 South Second Street, contemplates the construction of a new power plant to cost about $2,000,000.

BIRMINGHAM, ALA.—The Alabama Power Company contemplates the installation of a 13,500-kva., 6,600-volt, three-phase, 60-cycle, 100-r.p.m. generating unit at Lock 12 on the Coosa River. The cost is estimated at $500,000. W. N. Walmsley is vice-president and general manager; O. G. Thurlow is chief engineer.

MOUNT OLIVE, MISS.—Improvements to the power plant and extensions to the water system are contemplated to cost about $10,000.

LEXINGTON, OKLA.—The construction of an electric light plant and improvements to the water-works to cost about $18,000 are under consideration.

MUSKOGEE, OKLA.—The Muskogee Gas & Electric Company contemplates improvements to electric light, gas and power facilities, including the installation of additional equipment at its power plant, to cost about $200,000.

TULSA, OKLA.—The Wilcox Oil & Gas Company plans to construct a number of new electrically operated pumping plants. The company also has plans under way for the construction of a new refinery to cost about $2,000,000, including equipment.

STAMFORD, TEX.—Extensions will be made to the ornamental street-lighting system. Seventy 250-cp. lamps will be added.

Pacific and Mountain States

OLYMPIA, WASH.—The Straits Power Company, 25 Broad Street, New York City, has applied to the Federal Power Commission for preliminary permit to develop power in the Olympic Peninsula.

PUYALLUP, WASH.—Steps have been taken by the Commercial Club to secure a better street-lighting system for Puyallup.

BANDON, ORE.—Bonds to the amount of $110,000 have been voted for the purchase of the property of the Bandon Power Company and the installation of a municipal hydro-electric plant on Willow Creek.

HOLLYWOOD, CAL.—At an election to be held April 5 the proposal to establish an ornamental street-lighting system in Hollywood will be submitted to the voters. The plans include one-arm standards carrying lamps ranging in size from 100 cp. for residence streets up to 500-cp. lamps for Cahuenga Avenue. The cost is estimated at $1,500,000.

LOS ANGELES, CAL.—Application has been made by the Los Angeles Gas & Electric Corporation to the State Railroad Commission for authority to issue $2,000,000 in stock for improvements and extensions to its lines. William Bauhryte is vice-president.

SACRAMENTO, CAL.—Plans have been prepared for the installation of seventy-five electrolier standards on a section of Twelfth Street.

SAN BERNARDINO, CAL.—The construction of a municipal lighting plant is under consideration, for which estimates are being prepared by Harry Rouse, city electrician.

SANTA ANA, CAL.—The Southern California Edison Company, Los Angeles, has had plans prepared for the construction of a new power plant on South Main Street, Santa Ana, to cost about $250,000.

HELPER, UTAH.—Extensive improvements to the street-lighting system are contemplated.

Canada

LEDUC, ALTA.—The installation of an electric lighting system in Leduc is under consideration.

BLOOMFIELD, ONT.—Plans are under consideration for extensions to the street-lighting system. Charles H. Saylor is clerk.

MERLIN, ONT.—The Town Council contemplates the construction of a hydro-electric plant to supply electricity for lighting and power purposes. Address A. Bell.

PRESTON, ONT.—A movement has been started for the installation of a new lighting system in the business section of Preston. Mr. Ord is secretary of the Water and Light Commission.

MONTREAL, QUE.—All overhead wires in Montreal are to be removed by the Underground Conduits Commission and underground conduits substituted. The cost is estimated at $200,000. R. S. Kelsch and others are members of the commission.

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Time to Give Consideration to Coal Supply

THIS is usually the season of the year when dealers offer some slight encouragement to householders to purchase their year's supply of coal. So far no inducements have been forthcoming to the large electric light and power companies in the shape of preferential freight rates to cause them to purchase an abnormal supply of coal at this time and store a large part of it. Unless some such proffer is made, however, there is no incentive to store much coal, because storage means rehandling, deterioration and added expense. All prudent managers, of course, see to it that they have ample supplies of fuel on hand to insure them against shutdown due to strikes or failure of delivery for a reasonable length of time. For those who have no long-term contracts for coal, however, it might be well to give the present situation consideration. Production of coal has fallen off owing to lack of buying, and it may be that advantageous arrangements can be made. However, one must be careful to discern between what is legitimate and what is propaganda. For obvious reasons, the railroads and the coal operators would like to have the public believe that another fuel crisis stares it in the face, and already Jeremiahs are stalking through the land chanting this lamentation. Managers should guard themselves against being stampeded into a decision which might not be to their best interests. None should be made until all the facts have been ascertained, and then action should be calm and dispassionate. It would be the height of folly to order if the result would be to bring about a rise in price.

Water-Power Legislation Urgent in New York State

AN INTEREST spreading much farther than the state's boundaries attaches to the water-power bill introduced into the New York State Legislature on the recommendation of Governor Miller. This is partly because the population and importance of the state and its abundant water power make any example set by it loom large in the eyes of sister commonwealths with similar problems and partly because of the possibilities glimpsed for a combat over jurisdiction with the federal government. The bill itself follows in large measure the lines of the congressional act. It provides for a water-power commission made up of state officials which will make surveys and investigations and issue licenses to prospective hydro-electric companies. These may be organized under franchises running for fifty years, the government licenses to run for a similar term. Rates, service and capitalization are to be regulated by the state through the Public Service Commission. The bill contains many provisions designed to protect the public interest and, again following the trend of federal legislation, bars the use of power for manufacturing purposes within the Adirondack State Park. It will doubtless be thoroughly thrashed out in the Legislature and will receive the full impact of the attack of those who believe in government ownership and operation of water-power projects. With the Governor behind it and the large party majority at Albany, it is likely to win. At any rate, it will again direct the attention of the whole state to the tremendous amount of water now running to waste in its streams and rivers and to the ever-growing urgency of transmuting this lost power into electricity for the benefit of all the inhabitants.

Executive Duties of Industrial Electrical Engineers

IN THOSE industrial plants sufficiently large to maintain an electrical department to look after the efficiency of operation and repair of electrical equipment the responsibilities of the head of such a department require more than a technical and practical knowledge of apparatus employed. Although the value of electrical energy is usually a small part of the total production cost of a manufactured product the possible economies that may be effected through its application as light, heat and power and the improvements in quality of the product or increases in output can be shown to pay a handsome dividend on the amount expended in the maintenance of the electrical organization. In too many plants, both large and small, the man whose duties are those of combined production manager and industrial electrical engineer is poorly equipped both with assistants and investigating facilities. In such instances he is compelled to spend his time doing routine work that a handy electrician can do equally well under proper supervision, with no time to devote to original thinking or the conducting of investigations and research leading to possible improvement of the operation of productive processes. The value of studies of lighting to improve production and of speed control to accelerate output or improve the quality of product have been recognized, and in such work the industrial electrical engineer functions as a plant executive just as effectively as the executive whose duty it is to see that the greatest possible return is earned for stockholders on the capital invested. In times like the present, when plant managements are looking for ways and means to economize, the professional side of plant engineering is often overlooked unless the engineer charged with this work is far sighted enough to see the opportunity to apply his ability as an executive and express the results in terms of operating economies, detailed costs and other terms of plant production that

the executive head of the business can recognize as important aids in the interpretation of monthly balance sheets of complete plant operation. A practical application of the homely definition of the engineer as a man who can do more with one dollar than a non-technical man can do with two is that it often defines the difference in the position of the ordinary engineer electrician and the industrial electrical engineer with a recognized executive standing.

Which Are Navigable Streams?

DURING the last nine months something like 180 applications have been made for preliminary permits to develop water-power sites on navigable and nearly navigable streams. These permits when granted will maintain priority of application for licenses to develop these particular sites under the terms of the new water-power law for a period not exceeding three years, this time being allowed for making examinations and surveys and the necessary financial arrangements. But before such work can be definitely undertaken it is essential that the applicant shall know whether or not the stream for which the application has been made will be declared by the Federal Power Commission navigable and subject to such provisions. Complaints are being registered that so far action on this point is being delayed by the commission beyond what seems a reasonable time.

There are many small streams that are not now navigable and never will be, and still others which it is highly improbable will ever be used for purposes of navigation. It is sufficiently absurd to include in a definition of navigable waters an entire stream from its source to its mouth, but it is superlatively so to include small streams which are obviously outside the definition altogether. These small streams might at least be declared non-navigable for a period of ninety-nine years or some other reasonable time to allow the present generation to provide those who follow with sufficient data to determine to what extent builders of water-power plants are the desecrators of our natural resources they are now imagined to be.

The Federal Power Commission is handicapped somewhat in the matter of giving prompt decisions on whether or not any specific stream is navigable because when a preliminary permit covers the development of a power site on that stream the commission must in each case await a report from the Corps of Engineers of the army. Yet the references to "navigable waters" in Section 3 of the water-power act, and again in the last paragraph of Section 23, seem to give the commission wide latitude in its definition of this term, for the language of the sections cited makes it certain that "navigable waters" are not necessarily such as can be navigated. The Niagara River is, according to the definition in the act, "navigable waters," despite the fact that the great cataract has prevented successful navigation on that river past the city of Niagara Falls. Delays in defining the actual point at which a stream is navigable will only postpone definite action on the part of the applicant for a license to build and will retard unduly the needed construction program. Apparently the Federal Power Commission is disposed to act promptly, and since the Secretary of War is a member of the commission he should see to it that the Corps of Engineers renders prompt rulings.

Interesting Bus and Switch Layout of New Chicago Station

AS GENERATING stations grow larger the problem of control of short circuits becomes of increasing importance. Two conditions are to be considered in design. The first is that caused by the grounding of one phase of the bus. This condition can be brought under control by grounding the generator neutral and by the use of a ground resistance. The current can be limited to any desired value. The design problem then becomes one of mechanical strength and proportioning of conductors to care for the stresses due to magnetic influences and heating effects due to current values. The second condition is that caused by interphase short circuits. This factor in the problem is not only beyond control but it is impossible to provide any design that will limit the effect when such a short circuit occurs. The destructive results are limited only by the capacity of the generating equipment feeding into the short circuit.

The design problem is one of preventing such short circuits. Elsewhere in this issue B. G. Jamieson describes the bus and switch layout for the new Calumet plant of the Commonwealth Edison Company, an extremely interesting departure from the conventional design in the attempt made to preclude interphase short circuits by segregating the phases. The distance between phases in this layout is such that there seems to be no possibility of short circuits occurring. Although applied so far only to the indoor type of apparatus, Mr. Jamieson points out the possibility of readily adapting the method to the semi-outdoor type of switch house, and in addition there would seem to be no reason why it should not be applied to outdoor layouts. With the increase in short-circuit capacities in power plants and the rapid increase in the use of higher voltages the Calumet layout deserves the careful study of all designers interested in power-plant or substation work. It contains a decided promise of simplification on indoor installations combined with an increased safety to operators and to the service that cannot be ignored, and it is not improbable that its application to outdoor layouts will result in benefit. A feature that is not brought out particularly in the article is the tendency toward the unit system of design. This is very marked, as will be seen from a study of the drawings.

A Valuable Steam-Station Byproduct

THE amount of combustible thrown away in power-plant ash is a loss which utilities might have overlooked when coal was cheap but which they cannot now afford to neglect at the prevailing price of coal and with inflexible rates for service. Electric light and power companies in the Middle West find that 25 per cent or more of their ash is of combustible material, and as the coal they use has a high ash content it not infrequently happens that companies lose in this way 5 per cent or more of the total heat value of the coal. Attempts have been made to reclaim the combustible from the ash, but apparently with very little result. The advisability of setting aside one or more boilers to reburn the ashes has been considered, but tests made by the Commonwealth Edison Company years ago indicate that fuel containing more than 40 per cent ash is not satisfactory for making steam. Before the war

one of the large companies planned to wash ashes over agitators, but nothing has been done in this direction up to now. However, if mining and other industries can successfully reclaim valuable products from what was once considered waste, it would seem that the heat units which are being thrown away in power-plant ashes are not entirely unrecoverable. What is needed is more careful firing at the start and apparatus suitable for the fuel used.

Operating Ratio of Light and Power Systems

MUCH has been written during the past few years concerning the prodigious growth of the electric light and power industry, and executives have pointed with enthusiasm to the fact that, despite the present widespread depression in most industries, the electrical energy market has been greater than at any time during the war rush. Moreover, a new high record for gross revenue from sale of energy has been reported during the past winter. But these sweet morsels would turn to sour if further investigation showed that the operating and maintenance expenses were relatively on the increase. Such is not the case, however, as is proved by the data on operating and maintenance expenses published in this issue, the ELECTRICAL WORLD having added the collection of figures covering this outlay to its monthly survey of central-station operations. From these data the ratio obtained between operating and maintenance expenses and gross revenue shows a decided drop during the past year. This is particularly noticeable where companies are operating systems made up of both steam and hydro-electric plants. In such cases the operating ratio has decreased from 46.5 in January, 1920, to 38.7 in January, 1921. The operating ratio in January of both years has been found for companies reporting operations of steam plants only, for hydro-electric plants only and for systems composed of both steam and hydro plants, and for comparative purposes these ratios are given for each section of the country. The figures presented on operating ratio are encouraging in the extreme. They form, with the data on output and gross revenue, an argument for the soundness and stability of electric light and power securities which, if used to advantage, should clear away many of the clouds through which the investing public has viewed these securities in the past.

Regulation of Electrical Service in Mines

THE steadily increasing use of electrical equipment in coal mining is certain to have eventually a very important bearing on the cost of production. However, it is quite possible to make regulations so severe as substantially to prevent the general use of electrical coal-mining machinery. On the other hand, it is possible to treat the matter so loosely as not properly to protect the workmen against needless risks. In this issue L. C. Ilsley of the United States Bureau of Mines gives a good summary of the present situation.

Twenty-one states refer in one way or another to electrical coal-mining equipment. Only four go into the matter to any material extent, and but one goes far enough to insist on the employment of a competent electrician in mines where electricity is used underground for power purposes. There is no general agreement as to the voltages which may be employed or requirements for insulation. Some states allow high-tension wiring to be taken underground with proper restrictions. Others limit the underground voltage to 600 or less, whereas in point of fact a badly installed 600-volt circuit is much more dangerous than one for four times that voltage installed with suitable care.

Conditions are such that further regulation with some approach to uniformity of conditions from state to state is highly desirable for the sake of everybody concerned. The makers of machinery want to know what they will be permitted to do. Its users should know the precautions which they are expected to take and the provisions which they must make for inspection. Workers have a right to be sure that their safety is adequately guarded. An agreement ought to be reached for community of action in the establishment of a reasonable and workable code, but care must be taken that all interests concerned have a voice in such standardization.

Where a Superpower Plant at Mine Mouth Is Feasible

PROPOSALS made in the last few years to locate superpower plants at mine mouths have confused the fundamentals of good engineering by the omission of a complete consideration of the problems involved. However, there are conditions under which superpower plants so located are feasible and desirable, and we are glad to give a detailed account of one in this issue, the Colfax station of the Duquesne Light Company, Pittsburgh. Connected by a private railroad with a coal mine only one mile away, and situated directly on the Allegheny River, which has ample circulating water for a 300,000-kw. development, this station possesses two advantages that cannot be found everywhere. Furthermore, it is strategically placed only 15 miles from Pittsburgh and on the opposite side of a double power loop from Brunot's Island generating station—the next largest station on the company's system. With facilities for receiving coal by water or rail in addition, and with the ever-growing steel center of Pittsburgh as a market for energy, a station could not be much better situated for generation of energy at the mine on a gigantic scale. When completed Colfax will be rated at 300,000 kw. in six mighty triplex units, one of which will be a spare. One of the turbo-generator sets, rated at 70,000 kw. (maximum), is installed, and it is more than likely that others will be called into service rapidly.

The station is such an excellent example of up-to-date design embodying time-proven methods that rather than point here to any of its features we refer our readers to the detailed account on page 753. Information of interest is there given on how delivery of coal to the boilers is assured, on an unusual mounting of boilers, a rather uncommon method of maintaining a heat balance, methods of operating the triplex turbo-generators under abnormal conditions, and other provisions for securing maximum economy, reliability and simplicity.

Full data on the performance of the plant are not yet available, but indications are that the unit now operating will show a coal consumption of 1.39 lb. per kilowatt-hour at 50,000 kw. load. With a capacity ultimately to be very big, this record is most encouraging for a start-off, the more so since simplicity and careful planning of the plant have brought the actual cost to about $105 per kilowatt—a remarkably low figure considering the time at which the plant was built.



Frank Shreve Price

One of the builders of the electrical trade and a leader in any co-operative movement within the industry which has its foundation in efficient organization

LEADERSHIP in any industry demands qualities of mind which respond to varying stimuli and achieve success through the power to resolve complex situations into clear-cut working programs. When such abilities are combined with unselfish devotion to the common good the result is a realization of ideals in every-day affairs which turns competitors into friends and wins widespread regard. A man with these qualities is Frank S. Price, president of the Pettingell-Andrews Company of Boston and one of the foremost electrical supply jobbers of America. A native of Salem, Mass., Mr. Price entered the electrical business about thirty years ago as a store boy in the organization which he now heads, gradually rising to the posts of office manager and sales manager, filling every position ably and making a growing reputation for high-minded service in the wholesaling field.

Himself a master of detail, Mr. Price has never practiced putting petty restrictions upon his subordinates, but has won their intense loyalty through his confidence in them and his backing of them in sound and progressive methods. He has spent without stint his own time and money in experiments for the good of the industry. Hard work, vision, prompt decisions, an analytical mind and a sympathetic understanding of the broad problems of the industry, as well as an insight into the relationships existing and possible between its branches, have given Frank Price an influence for sound merchandising in national counsels.

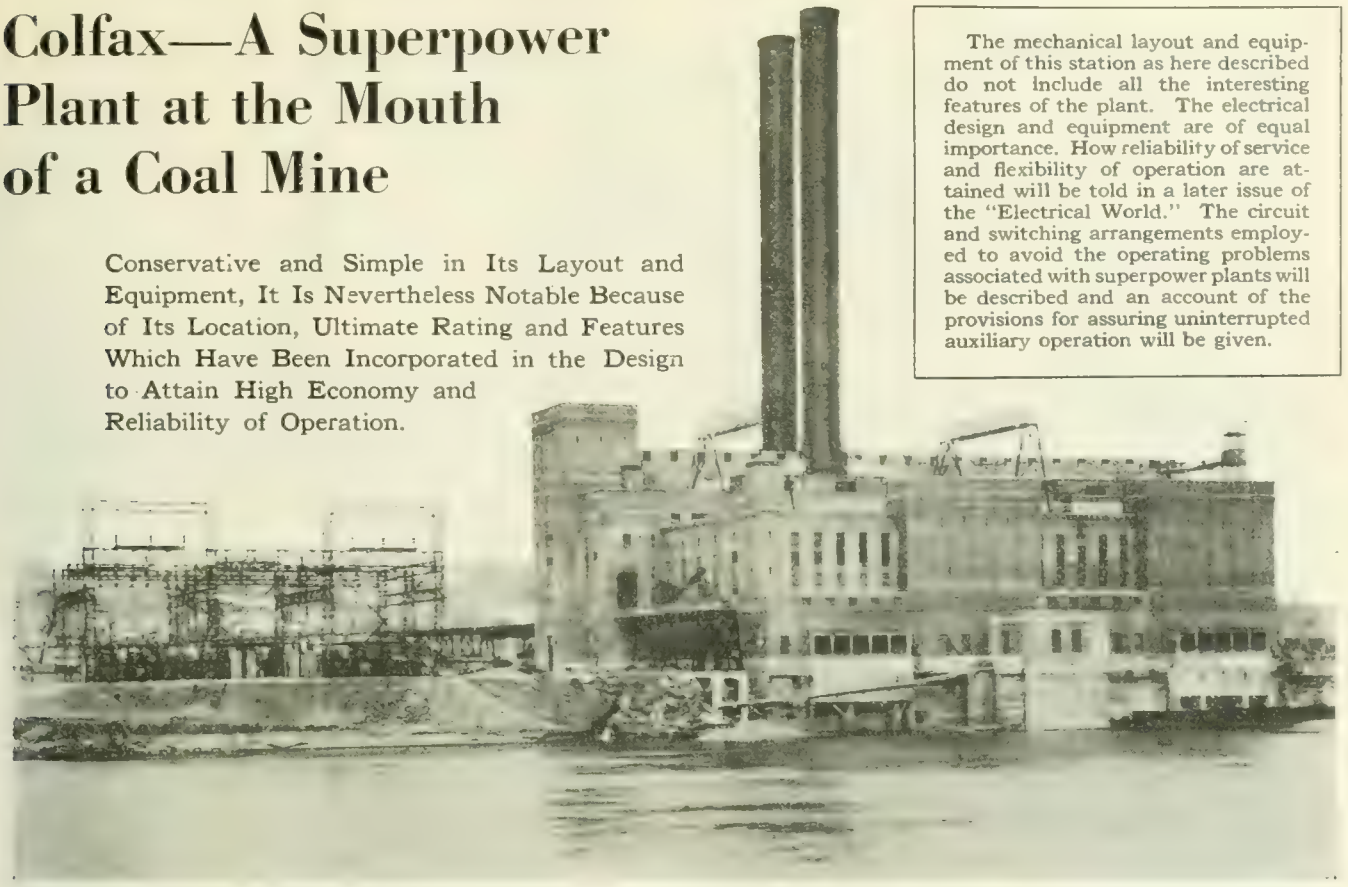
He is a former chairman of the Atlantic Division of the Electric Supply Jobbers' Association and is at present an executive committee member of that organization. He is also a member of the National Electric Light Association and of the New England Electrical Supply Jobbers' Club. Constructive co-operation and unswerving championship of the square deal in business have characterized Mr. Price's work from the beginning and have enriched the industry of his choice.

Recognized by the War Industries Board as being a factor in the economical distribution of electrical merchandise the electric supply jobbing business has made a secure place for itself largely because of the principles adhered to by its leaders, among whom is Mr. Price. It is not surprising therefore that there are few industries in which the jobbing branch commands so great respect. From being merely a handler of orders between the customer and the producer the jobber is now a merchant maintaining a stock sufficient to meet the demand even under the most trying conditions. Quality goods at the lowest price commensurate with such a high degree of service and a fair profit now characterize the electrical supply jobbing business of the United States, which last year, it has been conservatively estimated, did a wholesale business considerably in excess of four hundred millions of dollars.

Colfax—A Superpower Plant at the Mouth of a Coal Mine

Conservative and Simple in Its Layout and Equipment, It Is Nevertheless Notable Because of Its Location, Ultimate Rating and Features Which Have Been Incorporated in the Design to Attain High Economy and Reliability of Operation.

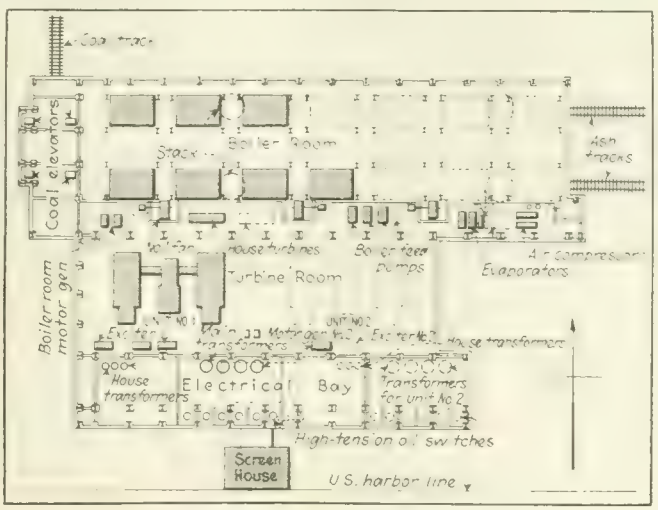
The mechanical layout and equipment of this station as here described do not include all the interesting features of the plant. The electrical design and equipment are of equal importance. How reliability of service and flexibility of operation are attained will be told in a later issue of the "Electrical World." The circuit and switching arrangements employed to avoid the operating problems associated with superpower plants will be described and an account of the provisions for assuring uninterrupted auxiliary operation will be given.



FIRST STEP OF 300,000-KW. COLFAX POWER STATION TO HOUSE TWO 60,000-KW. UNITS

TO PROVIDE Pittsburgh, the steel center of the United States, with ample and dependable power, the Duquesne Light Company has built around the city a double "power ring" into which energy is fed by the most reliable generating stations that present engineering knowledge can provide and from which distribution lines radiate to places of energy utilization. In anticipation of increased power demands and to increase still further the reliability of electric service a new generating station, known as Colfax, has recently been completed and connected to the "power ring." This station is notable in many ways, chief among which are its ultimate rating and size of units, the low unit cost of construction, the simplicity of design and the reliability and economy of operation which are anticipated. Neither the designers nor the operators of this station claim for it any radical departures from general practice, but place emphasis rather upon its simplicity and conservatism. The method of construction and general layout represent a combination of some of the best ideas available in power-plant engineering for the conditions involved.

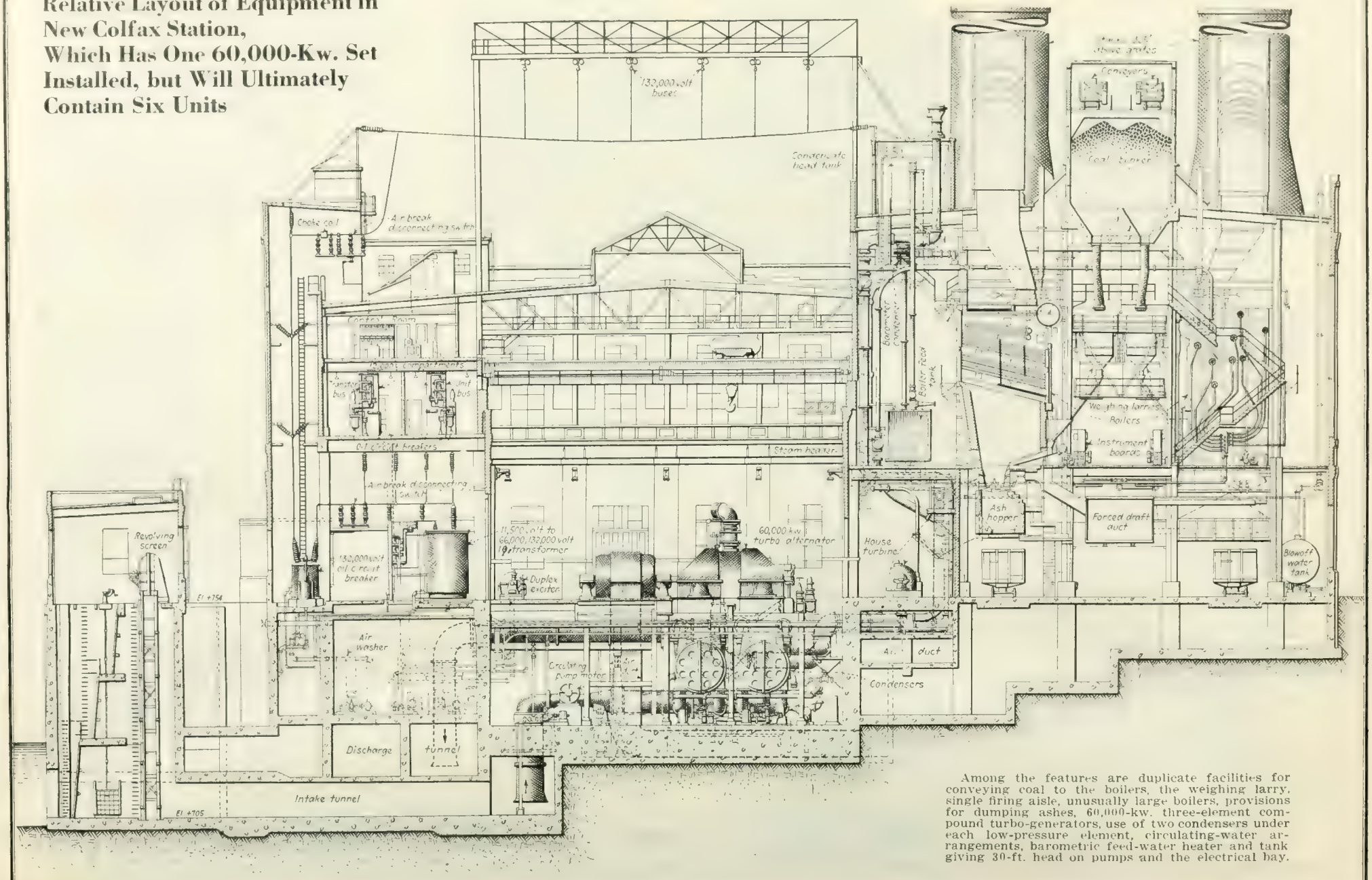
Colfax station is situated on the Allegheny River about 15 miles (24 km.) from the center of Pittsburgh and only one mile (1.6 km.) from the Harwick coal mine, which is owned by interests affiliated with the Duquesne Light Company. Although only 60,000 kw. in generating equipment is operating at the present time, 60,000 kw. more is on order, and the plant is designed for an ultimate rating of 300,000 kw.—the capacity fixed by the minimum flow of the Allegheny River, from which the station receives its condensing water. The size of the units chosen, 60,000 kw. nominal and 70,000 kw. maximum, is such that the ultimate development may be divided into five or six steps and will not be complicated by a large number of small units.



FIRST SECTION OF COLFAX DEVELOPMENT
Single firing aisle, arrangement of turbo-generators and respective transformers are features of plant layout

Arrangement of the station was influenced chiefly by the relative floor space occupied by the turbines and boilers. The latter, which are 34 ft. wide by 22 ft. deep (10.2 m. x 6.6 m.), are arranged in a double row with a single firing aisle, while the turbo-generators, which are three-cylinder compound units, are arranged side by side with the high-pressure element in the middle and one low-pressure element on each side. With this ar-

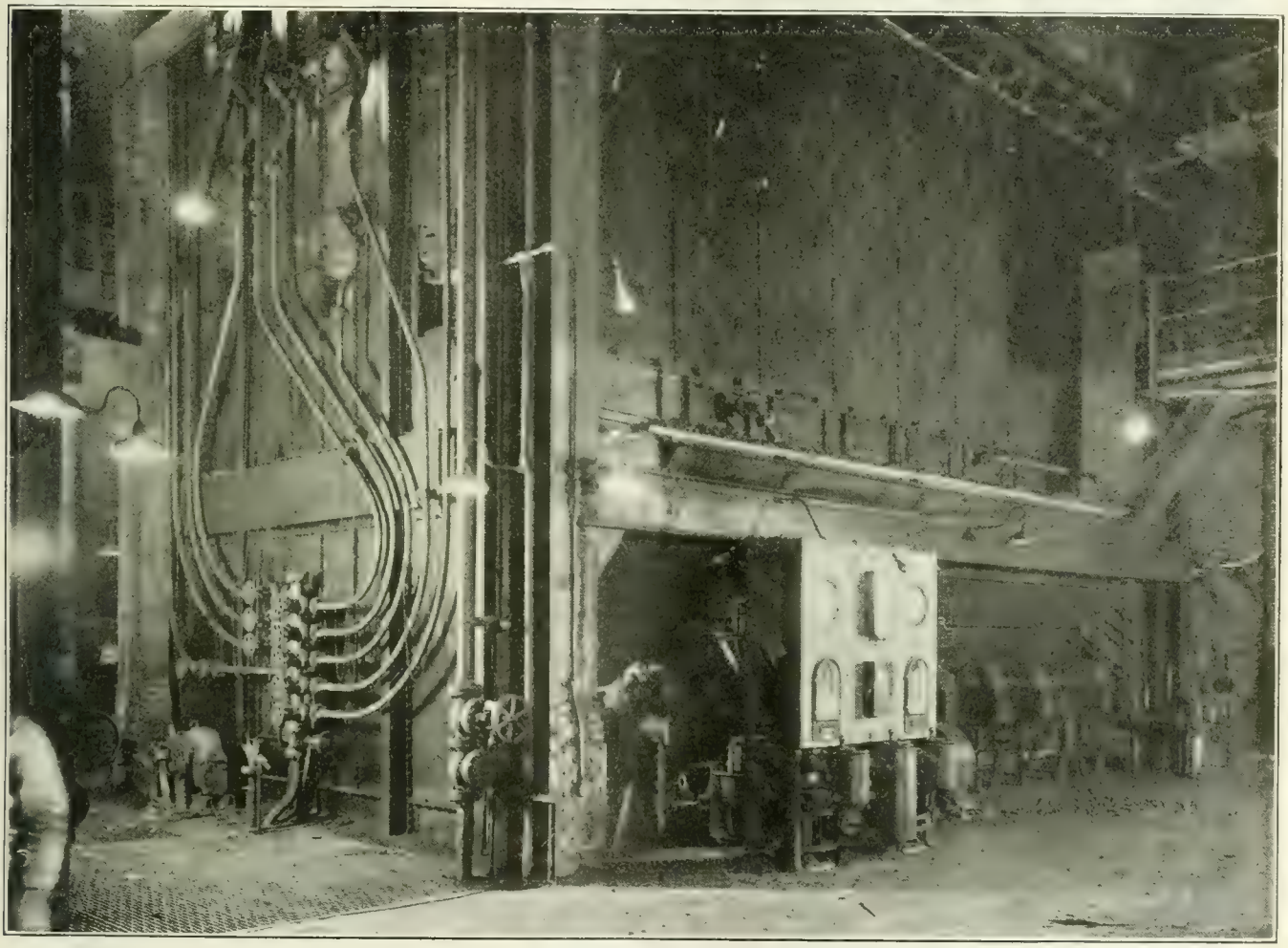
Relative Layout of Equipment in New Colfax Station, Which Has One 60,000-Kw. Set Installed, but Will Ultimately Contain Six Units



Among the features are duplicate facilities for conveying coal to the boilers, the weighing larry, single firing aisle, unusually large boilers, provisions for dumping ashes, 60,000-kw. three-element compound turbo-generators, use of two condensers under each low-pressure element, circulating-water arrangements, barometric feed-water heater and tank giving 30-ft. head on pumps and the electrical bay.

rangement each turbine (that is, the three elements) occupies a space of about 51 ft. (15.3 m.) in the direction of the shafts by 79 ft. (23.7 m.) at right angles to the shafts. Allowing for a pit between each pair of turbines into which parts may be lowered for repairs or overhauling, the turbine room measures 278 ft. (84.7 m.) in length, compared with 350 ft. (106.6 m.) for the boiler room, so that there is an approximate balance between the two rooms. Including the electrical bay, which runs parallel to the turbine room, the station is 240 ft. (73.1 m.) wide over all, made up of 108 ft. (32.9 m.) for the boiler room, 84 ft. (25.6 m.) for the turbine room and 48 ft. (14.6 m.) for the electrical bay.

To permit the movement of coal with the least rehandling and to utilize gravity for this purpose wherever possible, hopper cars are brought to the plant on an elevated trestle, from which they may be dumped into the storage yard or directly into duplicate track hoppers at the station. If necessary, the cars may be dumped directly into barges for delivery to Brunot's Island or other stations. When the cars are dumped in the storage yard the coal may be picked up by a clamshell bucket operated from a hoisting tower on a traveling bridge and discharged onto a reversible belt conveyor, also on the bridge, which carries it to the point where it is dumped by an automatic tripper. Coal



SEVEN CROSS-DRUM BOILERS ARE NOW INSTALLED WITH INSTRUMENT AND CONTROL BOARDS IN FRONT OF EACH BANK

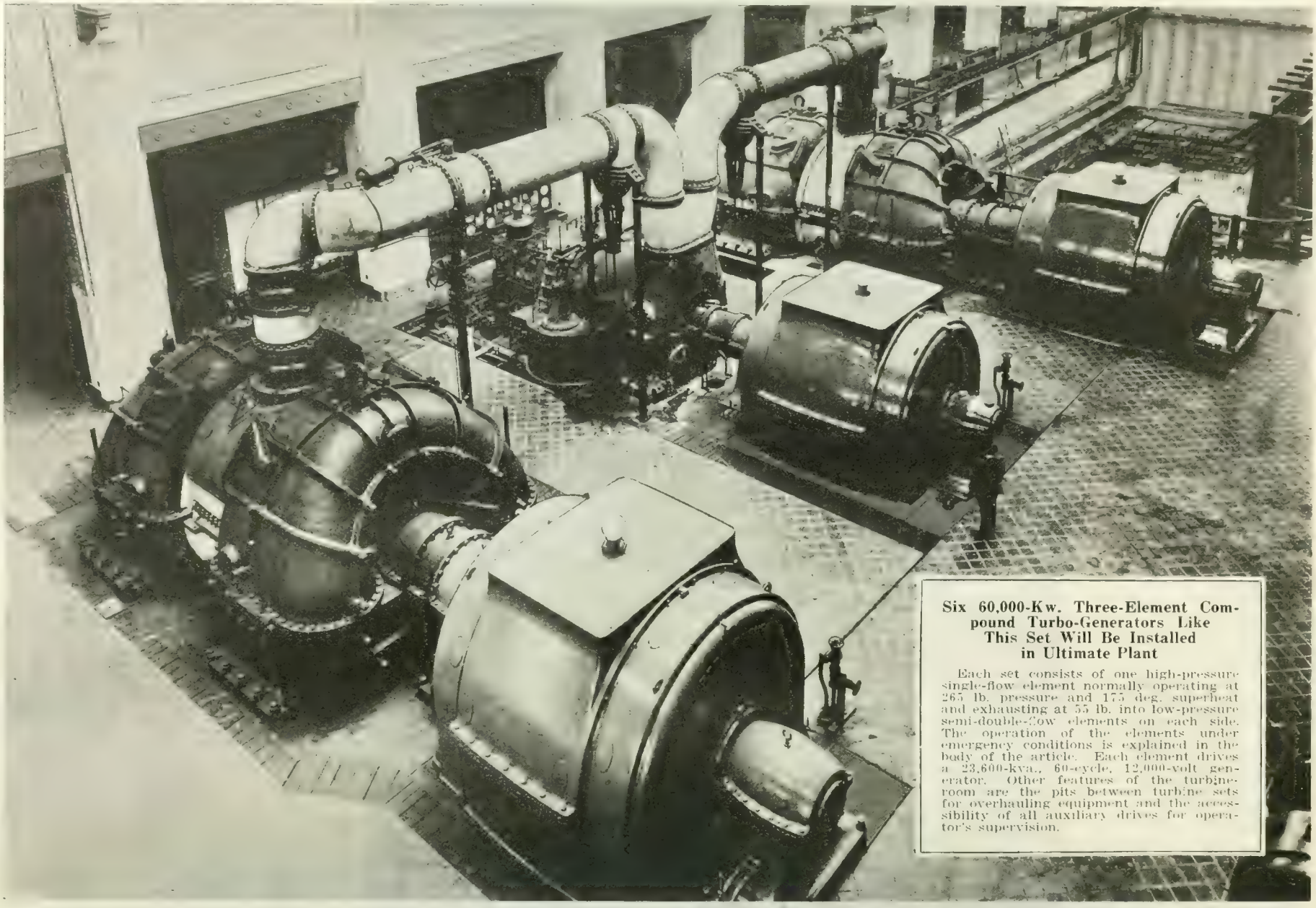
The ways in which economy, reliability and simplicity of operation were attained can best be explained by considering the plant in detail.

By locating Colfax station where it is several sources of coal supply are afforded and the maximum condensing water consistent with other advantages is made available. Furthermore, the location places the station at the opposite side of the "power ring" from Brunot's Island generating station, which is the next largest source of energy. The normal supply of coal will come direct from the Harwick mine over a private railroad, although fuel can also be received by water or over the Pennsylvania Railroad. The additional precaution of providing space for 150,000 tons of storage within a few feet of the station makes interruption of fuel supply a remote contingency. By piling the coal 40 ft. (12 m.) high an emergency storage of 250,000 tons may be obtained.

may be reclaimed by the same equipment, in which case the conveyor will discharge into hoppers on the end of the bridge over the trestle.

To provide for the receipt of coal by barges, a high-speed hoisting tower will be erected at the river end of the coal trestle. This will dump onto either of two belt conveyors parallel to and above the trestle. Coal may be dropped from one belt into the power-house hoppers or from either belt into the railway cars if coal is to be placed in outdoor storage.

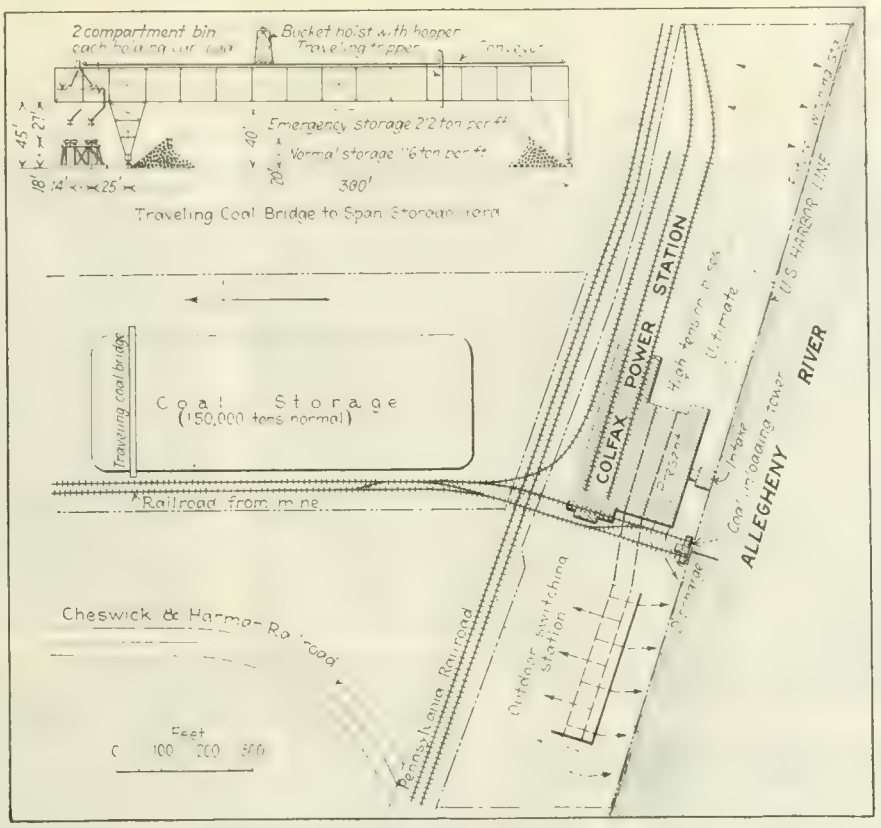
To avoid the difficulties usually experienced in repairing or overhauling coal crushers in this plant the crushers have been placed directly under the track hoppers where they are readily accessible. They discharge into bucket elevators which transfer their load at the top of the coal tower to belt conveyors running over the boiler-room bunker, into which coal is distributed by automatic traveling trippers. The duplication of coal-handling



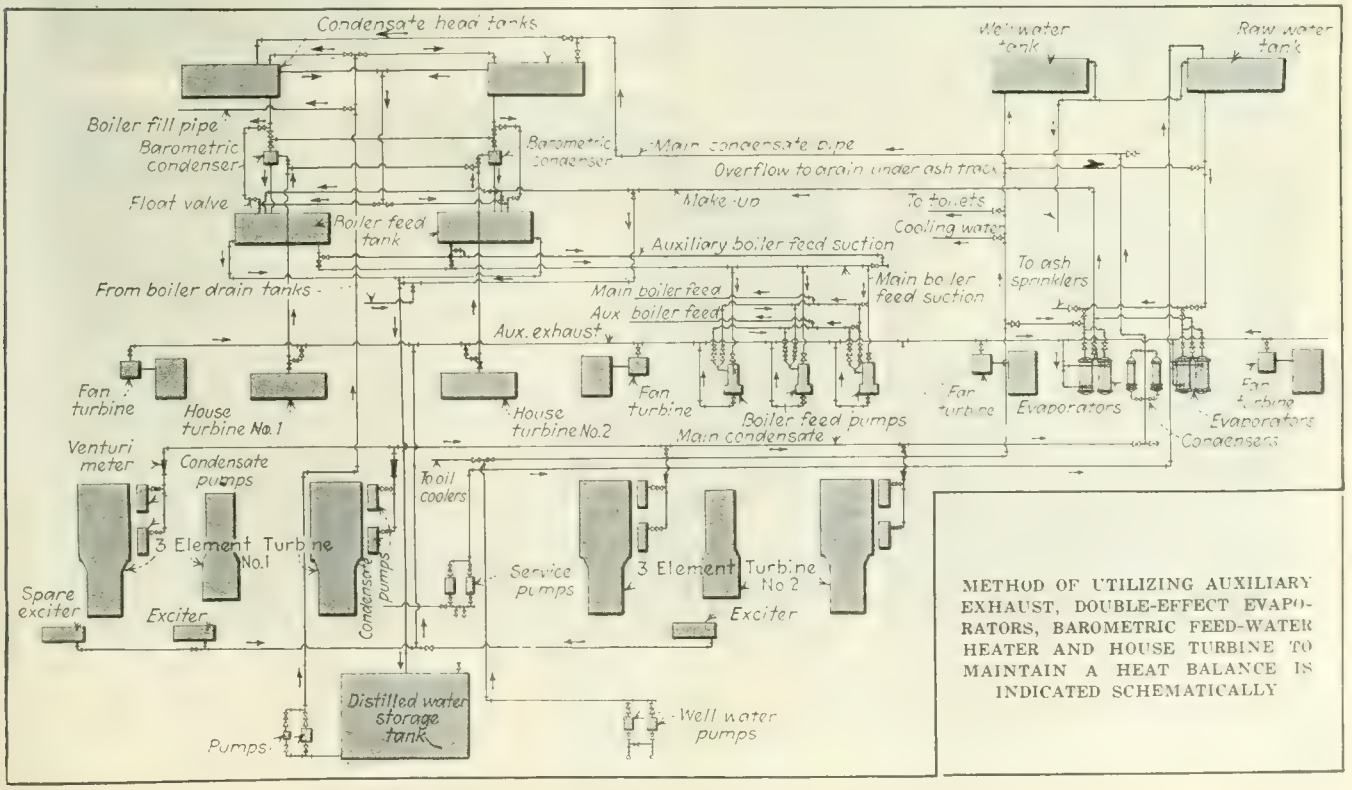
Six 60,000-Kw. Three-Element Compound Turbo-Generators Like This Set Will Be Installed in Ultimate Plant

Each set consists of one high-pressure single-flow element normally operating at 265 lb. pressure and 175 deg. superheat and exhausting at 55 lb. into low-pressure semi-double-flow elements on each side. The operation of the elements under emergency conditions is explained in the body of the article. Each element drives a 23,600-kva., 60-cycle, 12,000-volt generator. Other features of the turbine-room are the pits between turbine sets for overhauling equipment and the accessibility of all auxiliary drives for operator's supervision.

facilities, together with the provision of 240 tons storage over each boiler, virtually precludes any chance of interruption in delivery of coal to the stokers. A continuous sample of the coal is automatically taken from the belts which distribute the coal to the bunker. To avoid the use of weightometers in the chutes to each stoker weighing larries with recording registers are used. Extra-long seventeen-retort stokers are provided so that the boilers may be operated at 300 per cent of rating during peaks. However, the load factor of this station will be so high that the boilers will be operated at 200 per cent to 225 per cent of rating normally to keep down the annual cost of operation. Double-roll clinker grinders cooled by a continuous water spray are installed. Under them are brick-lined concrete hoppers affording ample space for accumulation of ashes, the hopper having a capacity of 1,900 cu.ft. (53.2 cu.m.) per boiler. Air-operated ash gates empty the hoppers directly into standard-gage cars. Seven exceptionally high boilers with drums 35 ft. (10.5 m.) above the floor level are installed to give liberal furnace volume and thus permit complete combustion even at high rates of evaporation. Each boiler has a heating surface of 20,876 sq.ft. (1,920 sq.m.). The ratio of furnace volume to boiler rating is 3.45 cu. ft. (0.09 cu.m.) per rated horsepower. Being eighteen tubes high by fifty-one tubes wide, the boilers give a maximum amount of heating surface per foot of furnace width. As may be noticed from the cross-section of one of the boilers, they are fired from the side on which the tubes are lowest and no bridge wall is employed, the inclined rear wall serving this purpose. To prevent the formation of clinkers, perforated blocks are built into the furnace walls at the coal level. Air leakage is reduced by steel boiler castings. Another feature of the boilers is the arrangement of the steam pipes feeding

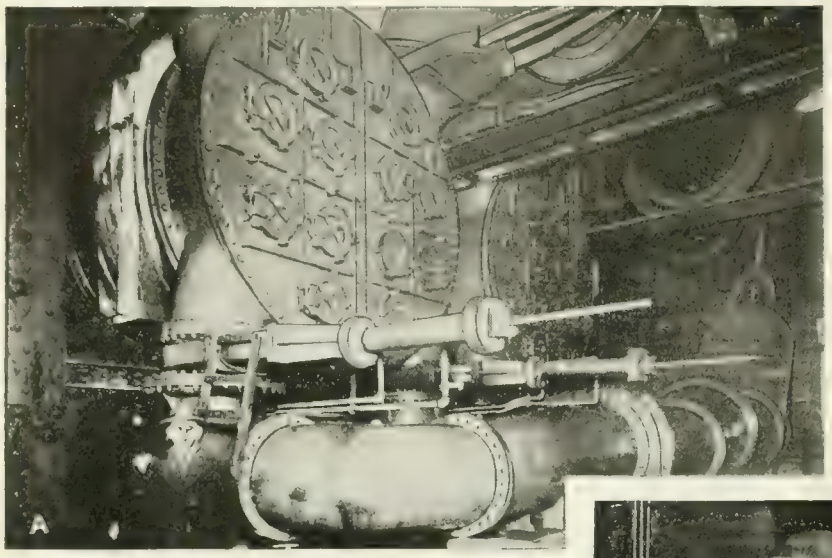


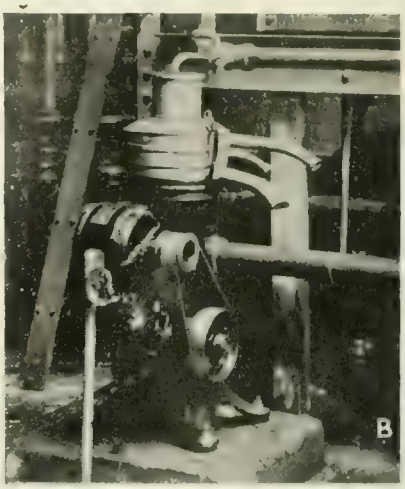
COAL CAN BE RECEIVED DIRECT FROM MINE OR BY RAIL OR WATER

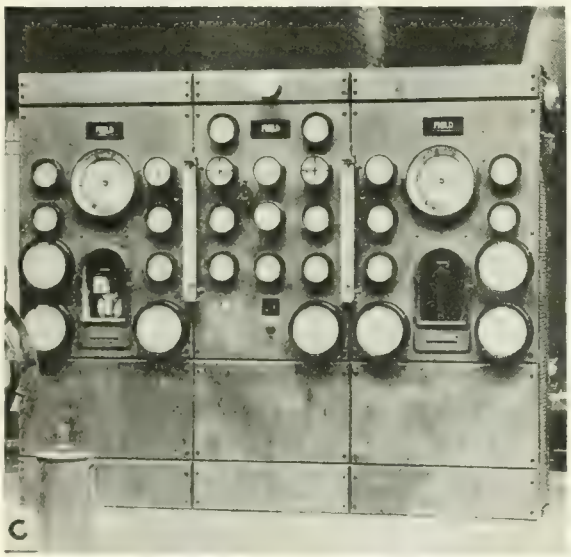


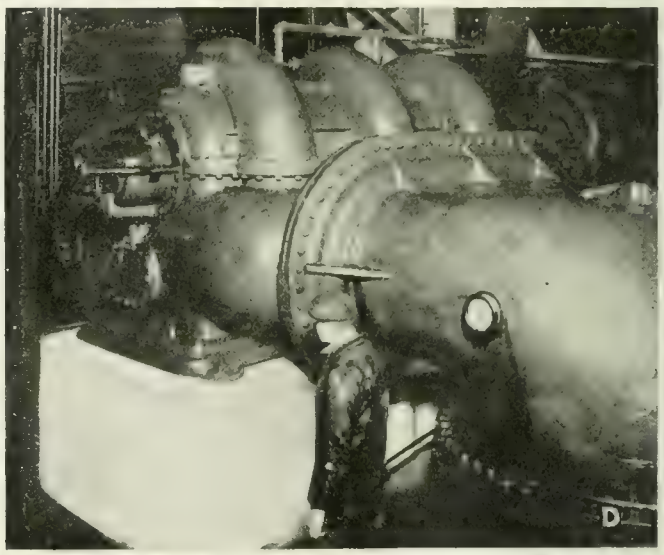
METHOD OF UTILIZING AUXILIARY EXHAUST, DOUBLE-EFFECT EVAPORATORS, BAROMETRIC FEED-WATER HEATER AND HOUSE TURBINE TO MAINTAIN A HEAT BALANCE IS INDICATED SCHEMATICALLY

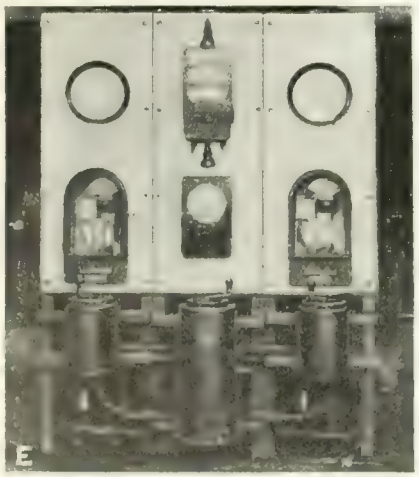
Condensers, Evaporators and Instrument Boards Are Interesting Parts of Colfax

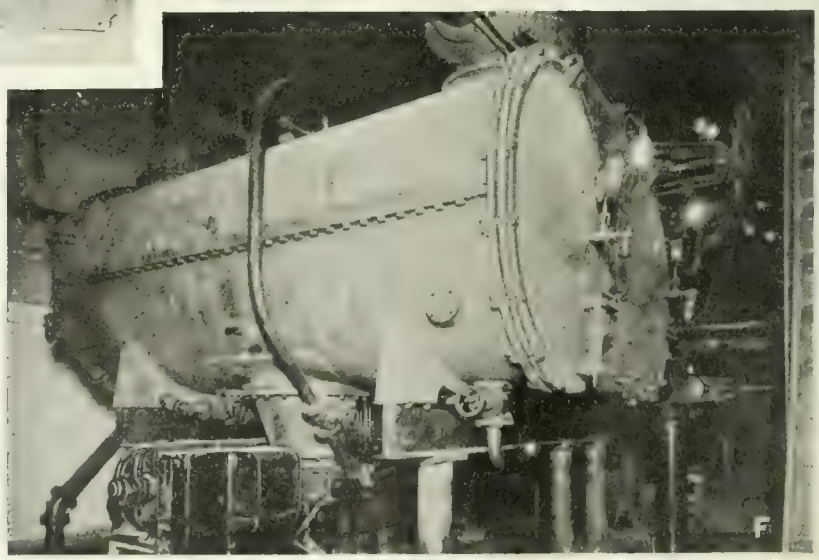












A—In the foreground is one two-pass condenser shell with 25,000 sq.ft. of condensing surface receiving exhaust steam from one end of a low-pressure element. Three other shells complete the condenser equipment for one 60,000-kw. turbine.

B—For separating impurities from lubricating oil motor-driven centrifugal separators are used.

C and E—Turbine room and boiler-room instrument boards respectively.

D—One of the three circulating pumps for each turbine set driven by 600-hp., 2,200-volt motor.

F—Reversible double-effect dry-tube evaporator used to distill raw water for boiler make-up.

the soot blowers. This is shown in the general cross-section of the station.

To enable convenient and economical operation of the boilers an instrument and control board is placed in front of each one on which are mounted two steam-pressure gages, two indicating and recording feed-water meters, one three-in-one draft gage, one CO_2 recorder, a six-pen pyrometer and controllers for the stoker and clinker grinder motors. In addition to the equipment on the boards each boiler has feed-water regulators, front-mounted blow-off valves and extended water columns that are only 5 ft. above the floor level.

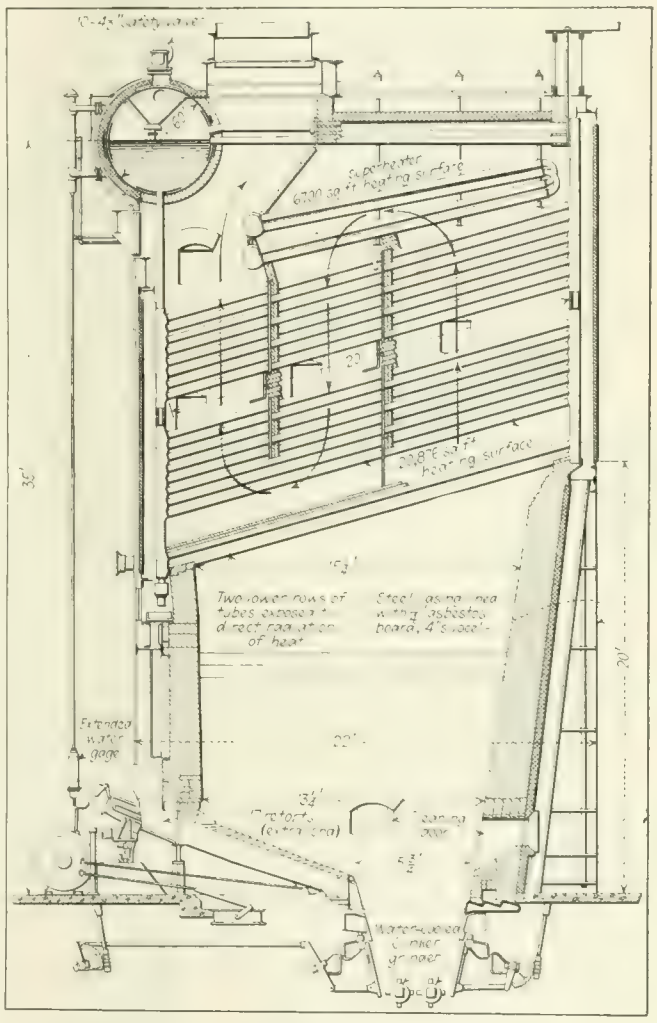
Each group of four boilers is served by one forced-draft fan, which draws a part of its supply of air through the generators, reclaiming the heat radiated therefrom. A duct under the firing aisle permits interconnection of the groups, thus enabling greater flexibility of operation. To make the air pressure correspond with the furnace requirements the fan speed is controlled by the boiler pressure, while the boiler outlet damper is controlled by draft intensity over the fire.

Balanced draft is employed, the gases being drawn away from the boilers through flues on the roof that connect with self-supporting steel stacks 325 ft. (99 m.) high. Placing the flues on the roof saved building expense and avoided overheating the boiler room.

Distilled make-up water for boiler feed is obtained by passing raw water through a reversible double-effect dry-tube evaporator and then condensing it. To obtain the maximum plant economy advantage is taken of part of the exhaust from the steam-driven station auxiliaries to evaporate the raw water and of the main-turbine condensate to condense the water evaporated. The make-up water, the auxiliary exhaust condensed thereby and the condensate from the main turbines are then combined and fed through a barometric condenser to condense the auxiliary exhaust which was not used in evaporating the make-up water. The tail pipe of the barometric condenser terminates in a large tank which is back of one row of boilers and affords a 30-ft. (9-m.) head on the feed-pump suction line.

By regulating the supply of exhaust steam from station auxiliaries the temperature of the tailwater from the barometric condenser can be maintained at the desired feed-water temperature (about 200 deg. Fahr.) without waste of either water or heat. This is done as follows: With the exception of the steam-driven feed pumps, forced-draft fans and house generator, virtually all of the station auxiliaries are operated by induction motors normally supplied from the house-generator circuit. Connected with this circuit, however, is a second source of supply afforded by a generator driven by an induction motor fed from the main generators. When the house generator runs at the same frequency as the main generators the motor-generator will carry no load and the house turbine will carry all of the electrical station auxiliaries. By reducing the speed of the house turbine the motor-generator can be made to pick up some of the auxiliary load on the house circuit and the exhaust steam from the house turbine can thereby be reduced. Since the exhaust from the fans and the feed pump turbines is always less than required in both the evaporators and barometric condenser at any station load liable to exist, the speed control of the house turbine can always maintain the desired heat balance.

Because of the size of the turbo-generators selected for this station it was considered advisable to employ units which are divided into three mechanically distinct elements. Thus the total temperature drop is divided into two approximately equal steps which are utilized in separate machines. Any one or two of the three elements may be operated in case the remainder must be taken out of service for any cause whatsoever. The high-pressure elevator and one low-pressure element may be operated together and carry a load of 30,000 kw. with a steam consumption of 12.6 lb. (5.6 kg.) per kilowatt-hour, or the low-pressure elements may be operated independently, developing a load of 30,000 kw. with a steam consumption of 13.8 lb. (6.6 kg.) When operating at the most efficient load the complete



EXCEPTIONALLY LARGE CROSS-DRUM BOILER, FIFTY-ONE TUBES WIDE BY EIGHTEEN TUBES HIGH

60,000-kw. unit is guaranteed to generate a kilowatt-hour with a steam consumption of 10.58 lb. (4.7 kg.)

Normally, all steam to the three elements is under the control of the governor on a high-pressure element, but each low-pressure element is also equipped with a governor and direct steam connection. If one of the low-pressure elements overspeeds when all elements are operating together, the governor on that element (normally inactive) will close a butterfly valve in the steam pipe between the high-pressure and low-pressure cylinders, thus cutting off all steam to this low-pressure element. The excess steam then coming from the high-pressure element is discharged to the atmosphere through a 25-in. (63-cm.) relief valve set to open at about 60 lb. (27 kg.). This valve will remain open until the operator adjusts the load to the new conditions.

DETAILS OF SOME OF THE MECHANICAL EQUIPMENT

Equipment	Number, Type, Capacity and Size	Manufacturer
Coal crushers	Two 36-in. double-roll, 48 in. wide	Link Belt Co.
Coal elevators	Two overlapping, pivoted bucket, 36 x36 in.	Link Belt Co.
Coal conveyors	Two 30-in., each with automatic traveling tripper	Link Belt Co.
Weighing larries	One, 20 tons capacity	Heyl & Patterson, Inc.
Ash gates	Twenty-one, 5x5-ft., air-operated	Baker-Dunbar-Allen Co.
Boilers	Seven, cross-drum; 20,876 sq.ft. surface, 51 tubes wide, 18 tubes high, 275 lb. pressure	Babcock & Wilcox Co.
Superheaters	Seven, Foster; 6,700 sq.ft.; 180 deg. superheater	Power Specialty Co.
Clinker grinder	Fourteen-double-roll	Westinghouse E. & M. Co.
Soot blowers	Seven, 18 units per boiler	Diamond Power Spec. Co.
Stokers	Seven, 17-retort, extra-long	Westinghouse E. & M. Co.
Forced-draft fans	Three, radial flow: 250,000 cu.ft. per minute at 6-in. pressure	Green Fuel Economizer Co.
Forced-draft turbines	Three, 420-hp., geared	Westinghouse E. & M. Co.
Stacks	Two, self-supporting steel, 21 ft. diameter, 325 ft. above grates	American Bridge Co.
Boiler-feed pumps	Three, Jeanesville; 1,500 gal. per minute; four-stage centrifugal	Worthington Pump & Mchry. Co.
Boiler-feed turbines	Three, 400-hp.	Westinghouse E. & M. Co.
Evaporators	One, Lillie, double effect; 15 tons per hour	Wheeler Condenser & Engrg. Co.
Feed-water heater	One, barometric-condenser type	Westinghouse E. & M. Co.
Condensers	Four, surface type, 25,000 sq.ft. each.	Westinghouse E. & M. Co.
Turbines	One, three-element compound, consisting of one high-pressure and two low-pressure elements	Westinghouse E. & M. Co.
Exciter turbines	Two, 650-hp.	Westinghouse E. & M. Co.
Air washers	Two, 115,000 cu.ft. per minute	B. F. Sturtevant Co.
Oil purifiers	Two, 100-gal. per minute	Turbine Equipment Co.
Relief valve	One 25-in.	Pittsburgh Valve, Fdry. & Cons'n Co.
Circulating pumps	Two, 42-in. Three, 44,000-gal. per minute	Atwood & Morrill Westinghouse E. & M. Co.
Air pumps	Three, Le Blanc, 30 cu.ft. per minute.	Westinghouse E. & M. Co.
Condensate pumps	Four, 1,000 gal. per minute, centrifugal	Westinghouse E. & M. Co.
Intake screens	Two, revolving; each 7½x54 ft.	Chain Belt Co.
Traveling crane	One, 75-ton main hoist; 25-ton auxiliary hoist	Niles-Bement-PondCo.
House turbine set	One, 2,000-kw. turbo-generator, 3,600 r.p.m.	Westinghouse E. & M. Co.
Recording pyrometer	One, six-pen	Thwing Instrum't Co.
Boiler damper regulators	Seven, balanced-draft	The Engineer Co.
Fan controllers	Three, operated by steam pressure	The Hagan Corp.
Draft gages	Seven, 3-in. one	Precision Instr'm't Co.
CO_2 recorders	Seven	Joseph W. Hays Corp.
Feed-pump governors	Three	Edward Valve & Mfg. Co.
Boiler-feed controllers	Eight, Stets Six, Copes	Williams Gauge Co. Northern Equipmt. Co.
Boiler-feed meters	Fourteen, 4-in.	Simplex Valve & Meter Co.
Large condensing water gate valves	Motor and hydraulically operated.	Pittsburgh Valve Foundry & Cons't'n Co.
Indicating and recording flow meters	Two, 18-in.	General Electric Co.
Condensate meters	Two, 8-in.	Simplex Valve & Meter Co.
Coal gates	Twenty-one, duplex	C. W. Hunt Engrg. Co.
Smoke flues and forced-draft ducts	Sheet metal	Connery & Company
Evaporator meters	Two, Venturi type	Simplex Valve & Mfg. Co.
Pipe and flue covering		H. W. Johns-Manville Co.

Of the remaining mechanical equipment expansion joints were furnished by E. B. Badger & Son Company., Westinghouse Electric & Manufacturing Company, U. S. Rubber Company and Pittsburgh Valve, Foundry & Construction Company; miscellaneous pumps by Blackmer Rotary Pump Company, Yeomans Brothers Company, Worthington Pump & Machinery Company, Lawrence Machine Company and Westinghouse Electric & Manufacturing Company; miscellaneous valves by Pittsburgh Valve, Foundry & Construction Company, the Edward Valve & Manufacturing Company, the Chapman Valve Manufacturing Company, Fairbanks Company and Golden-Anderson Valve Specialty Company.

If the automatic stop valve on the high-pressure element closes, because of overspeed or other causes, when the three elements are operating, all steam to the group will be shut off and the unit will slow down. As soon as the speed falls approximately 3 per cent, however, the valves admitting boiler steam to the two low-pressure elements are automatically opened and these elements continue to carry load under the control of their independent governors.

Should the automatic stop on a high-pressure element function when the high-pressure and one low-pressure elements are operating together, the low-pressure element will continue to carry load, taking steam direct from the boilers. Should the governor on a low-pressure element close the butterfly valve in the steam line between the high-pressure and low-pressure units, the high-pressure element will continue to carry its load, exhausting to atmosphere until the load is either removed or the other low-pressure element is brought into service.

Similar turbines have been used by other operating companies (see ELECTRICAL WORLD, May 10, 1919, page 933; Dec. 28, 1918, page 1213, and May 13, 1916, page 1089), and therefore the features of the construction will not be described.

Being of a semi-double-flow construction, each low-pressure element is provided with two exhausts, each discharging into a condenser shell. Connections are made by means of elliptical tubes of §-in. (1.58-cm.) molded rubber 2 ft. (0.6 m.) in length, the ends being clamped to the turbine and condenser flanges respectively. Each condenser shell contains 25,000 sq.ft. (2,300 sq.m.) of condensing surface and is divided into two compartments so that one-half may be isolated for cleaning while the unit is in operation.

For the four condenser shells under each turbine set there are provided three motor-driven circulating pumps discharging into a common header so that any pump or combination of pumps may be operated. Two condensate pumps and two spares are provided to discharge the condensate through the evaporator condenser to the head tank of the barometric feed-water heater. Air pumps of the Le Blanc type are employed instead of steam jets. A somewhat unusual feature made possible by the turbine room being parallel to and near the river is that there is a separate circulating-water tunnel and revolving screen well for each two units. This not only defers the investment in future intake capacity but results in the ultimate cost of the complete plant being less (so far as intake flumes are concerned) than it would be if an intake common to all units were used.

Records are not yet available to show the normal performance of the plant under actual service conditions, but calculated figures indicate that at a load of 50,000 kw. the coal consumption should be about 1.39 lb. (0.62 kg.) per kilowatt-hour, using semi-bituminous coal having the following proximate analysis by percentage: Fixer carbon, 54; volatile matter, 34; ash, 9; moisture, 3; heat value of coal as received, 13,500 B.t.u. per pound (6,075 B.t.u. per kg.).

The information presented in this article as well as that which is to appear later with reference to the electrical features of the station was obtained through the courtesy of C. S. Cook, general manager, and J. M. Graves, assistant general manager of the Duquesne Light Company, and various members of the organization of Dwight P. Robinson & Company, Inc., engineers and constructors.

New Type of Switch House Prevents Bus Short Circuits

Wide Separation of Bus Phases in New Calumet Plant of Commonwealth Edison Company Precludes Interphase Short Circuits · Current-Limiting Reactors Are Utilized for the Purpose of Excluding Outside Disturbances

By B. G. JAMIESON
Engineer of Inside Plant Commonwealth Edison Company, Chicago

ONE central-station company has answered the challenge of concentrated power with a switch house of a semi-outdoor type. Superpower systems of the future will spread their distributing buses country-wide and thus partly escape the challenge. This article describes what is being done toward the attainment of maximum safety with the indoor type of switch house housing breakers of 1,000,000-kva. interrupting capacity and having predominant high-voltage distribution characteristics. Future articles will describe in more detail the electrical equipment of the plant concerned, the new Calumet plant of the Commonwealth Edison Company in Chicago.

That portion of the large modern distribution central station known as the switch house has developed from a humble beginning as a gallery or series of galleries within the room housing the prime mover to a structure of great magnitude and cost. An analysis of the constituents of the cost emphasizes the importance of this primary distribution center. In no other part of the central station is there power concentration equal to that on the bus system of the switch house, and mute reminders of the destructive possibilities of this energy when beyond control urge a higher factor of safety as the concentration increases. For this reason the most important consideration in the design of a switch house is the provision against a bus short circuit, and involved therein are two fundamentals aside from apparatus of adequate design—the proper interphase spacing and phase-ground spacing of conductors. Obviously any arrangement which will eliminate short circuit possibility will greatly increase the factor of safety of the bus system.

It is entirely practicable to design a switch house so as to exclude the possibility of an interphase short circuit upon the bus or any of its tributaries. In any short circuit from a bus phase to ground the current can be limited by a resistance in the generator neutral ground connection and is therefore under control.

In minor switching centers out on the system and away from the concentrated energy center comparative immunity from destructive possibilities may be obtained by the employment of barriers, insulation, armor or its equivalent; but at the energy center where a higher factor of safety is needed because of its relative importance such safeguards are in the main inadequate. Of course, the factor of safety which such safeguards afford can be theoretically increased by simply using more of any one of the three elements, but it is preferable to employ methods which will lessen the need for such safeguards, and a proper grouping and distant spacing of conductors of like phase will entirely eliminate the possibility of an interphase short.

This principle is embodied in the design of the 200,000-kva. (ultimate), 12,000-volt, 60-cycle plant of the Commonwealth Edison Company of Chicago, now under construction, its feasibility at this time being largely due to a willingness on the part of several manufacturers of electrical apparatus to undertake the development of oil breakers adapted to the purpose, which is the largest single accomplishment in this undertaking.

Fig. 1 shows the most elementary type of such construction, but its use would be limited to a small station not requiring duplicate buses, though perhaps for special reasons, other than kilowatt capacity, requiring an extra factor of safety. It is of interest only in making clear the elements of the general scheme.

Figs. 2 and 3 show the essential proportions of a section of the Calumet switch house, and particularly the extreme spacing of the phases of the buses. Fig. 4 is a corresponding under-ceiling plan. The initial impression created by this design is one of prohibitive space requirement, but actual dimensions of the developed plans show little if any additional space required

Important Developments in High-Power Switch-House Design

1. It is entirely practicable to design a switch house so as to exclude the possibility of an interphase short circuit upon the bus or any of its tributaries. In any short circuit from a bus phase to ground the current can be limited by a resistor in the generator neutral ground connection and is therefore under control.

2. At the concentrated energy centers a proper grouping and distant spacing of conductors of like phase will entirely eliminate the possibility of an interphase short.

3. The widely separated phases of the bus should have energy-limiting reactors at points just ahead of the convergence of its tributaries.

4. Energy-limiting reactors are depended upon to exclude all disturbances due to trouble originating outside the station. The theoretical pre-eminence of the reactor as a protective device justifies the responsibilities thus centered upon it.

5. This type of structure could be easily modified to include the additional factor of safety of the semi-outdoor type of switch house by omission of certain walls.

6. An element of safety is introduced by the elimination of the disconnecting operation within heavy-duty breaker or bus chamber.

7. The presence of a minimum number of men is required in the breaker chamber for repair and inspection work at times when the hazard is greatest.

over existing switch houses of the conventional design —actually less than is required by some.

The general scheme of the distant-phase bus system is realized in its entirety when reactors are installed on the generator leads at the bus injunction, in which

The line grouping, as shown in Fig. 5, has given all the operating flexibility required over a period of years in two other Commonwealth Edison central stations where the sub-systems served were diverse in character but severe in reliability requirements. The

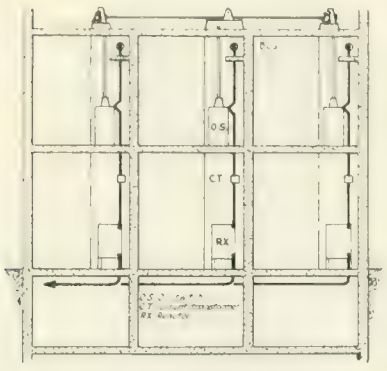
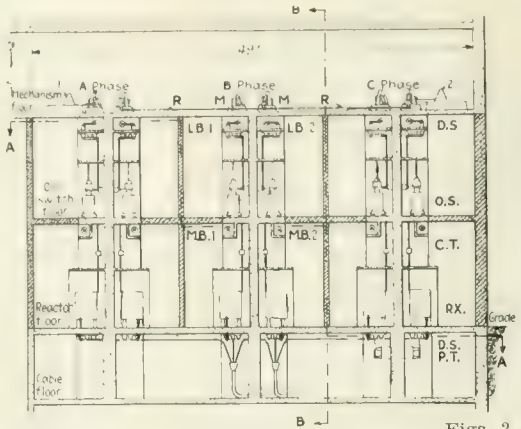
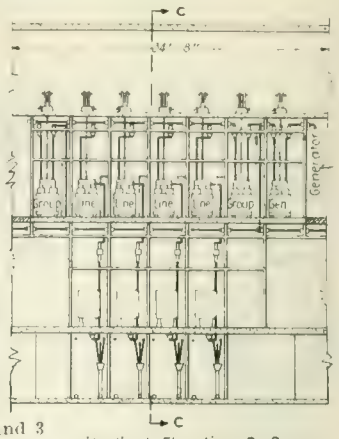


Fig. 1.



Section C-C



Figs. 2 and 3

Longitudinal Elevation B-B

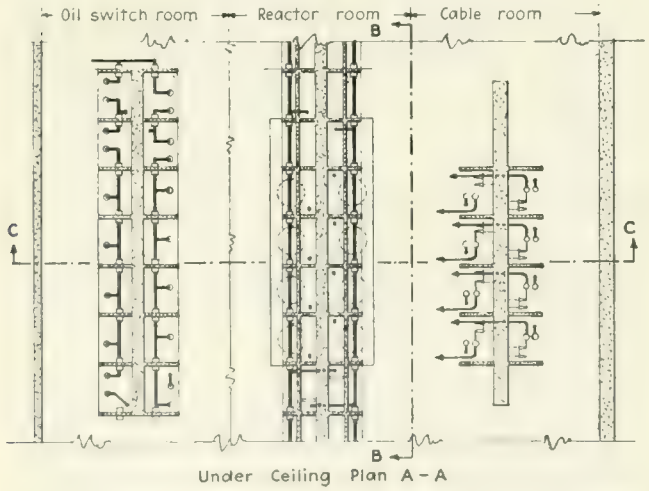
M Oil switch mechanism
R Oil switch control rod
LB Line bus
OS Oil switch
CT Current transformer
MB Main bus
DS Disconnecting switch
PT Potential transformer
RX Reactor

Fig. 1—Simplified arrangement upon which Calumet station was designed, all switch poles in one row belong to the same phase. Figs. 2 and 3—Calumet switch-house arrangement provides for extreme spacing between phases. Oil circuit breakers are of the truck type, permitting removal for inspection and repairs. This reduces the time that men must spend in the breaker chamber following system disturbances when hazards are the greatest. Similar apparatus is placed on one floor.

FIGS. 1, 2 AND 3—NEW TYPE OF SWITCH-HOUSE CONSTRUCTION THAT PREVENTS INTERPHASE SHORT CIRCUITS BY REARRANGEMENT OF PHASES WITH WIDE SPACING BETWEEN

case there is no proximity of phases on any of the tributaries of the bus except beyond energy-limiting reactors. In other words, the widely separated phases of the bus should have energy-limiting reactors at points just ahead of the convergence of its tributaries in order to realize in the fullest measure the essential safety possible with this system.

Attention is directed to the simplicity of the generator bus and line interconnections (Fig. 5) accommodated by this structure, to the fact that each floor has a distinct function, and also to the essential symmetry of the three main interior walls, each of



Under Ceiling Plan A-A

FIG. 4—UNDER-CEILING PLAN FOR FIGS. 2 AND 3, FOR THREE FLOORS OF SWITCH HOUSE

which carries like phases of the duplicate bus system. This proximity, without loss of effective isolation, makes possible in a great measure those economies of the space factor which might otherwise count adversely in the design.

sectionalizing of the bus—a basis of three 30,000-kw. units contemplates ultimately two 100,000-kva. sections, each capable of serving approximately thirty-two lines ranging in capacity from 5,000 kva. to 9,000 kva. Note that the units from a switching standpoint are generators, groups of lines and sections of main buses. No effort has been made to establish the conventional composite unit combining a certain number of line groups with one generator.

On the top or switch mechanism floor mechanism 1 (Fig. 2) controls breakers operating on bus 1 and mechanism 2 those operating on bus 2, the remote mechanical control being transmitted through rods *R1* to parallel motion mechanism *M1*.

A type of mechanism which will eliminate this remote-control feature and drive directly from the top of each phase group of switches is also being developed.

Another feature of the mechanism *M* is its control of the disconnecting switches *DS*, located as shown. A selective manually operated lever gives the operator complete control at this point of the "disconnects" or enables their automatic operation by the breaker mechanism. Another element of safety is introduced, namely, the elimination of the manual disconnecting operation within heavy-duty breaker or bus chambers.

Disconnecting switches are of the double-throw type, the extreme position making a ground connection for the conductor attached to the moving element. This action is possible only while "disconnects" are under manual control and is suitably protected against maloperation. Semaphores at the breaker mechanism will denote the position of the "disconnects."

In the breaker chamber are the line group buses, the disconnects *DS* and the oil breakers *OS*. Breaker elements *OS* are of a truck type to facilitate removal to a shop for inspection and repairs. This reduces the necessity of the presence of men in this chamber for such purposes and at times when the hazard is greatest

—usually following some disturbance which has weakened the system or station equipment.

In the reactor chamber are the through buses *MB1* and *MB2*, current transformers *CT* of the single-bar primary type and the energy limiting reactors *RX*, which are depended upon to exclude all disturbances due to trouble originating outside the station. The theoretical pre-eminence of the reactor as a protective device justifies the responsibilities thus centered upon it.

Beyond the reactors in the cable room where convergence of phases occurs are the line "disconnects" and the potential transformers (open type). These "disconnects" are also controlled from the upper mechanism floors by the operator, or automatically. These "disconnects" complete, in connection with those at the bus, the isolation of the indoor section of the line with all its apparatus (except potential transformer) from all sources of potential.

How Design Might Be Adapted to Semi-Outdoor Construction

In the construction of the building great care has been taken to minimize structural steel or iron, as experience has shown that its proximity to a possible source of an arc greatly increases the seriousness of the possibilities ensuing. Under conditions which would warrant, this type of structure could be easily modified to include the additional factor of safety of the semi-outdoor type of switch house. This is apparent if switch-room floor and walls, shown hatched in Figs. 2 and 3, are omitted or modified. Such an arrangement would still leave the operating mechanisms properly protected from the elements.

Other advantages incident to this type of bus structure are the broad survey of the mechanism room floor which is possible from one point, the increase in the self-protective character of the bus system due to the added reactance of the distant phase arrangement, and also lessening of short circuit stresses on adjacent reactors under some conditions. Other interesting features such as the actuating and safety mechanisms of the oil breakers will be described in future articles covering the plant in detail.

State Regulations on the Use of Electricity in Coal Mines Increasing*

Uniformity in Codes Would Be Helpful to Electrical Development—Care Should Be Taken Not to Impose Burdensome Restrictions

By L. C. ILSLEY
Electrical Engineer United States Bureau of Mines

THERE is an increasing tendency in the coal-mining states toward the enactment of legislation regulating the use of electrical equipment in the mines. The attitude that the lawmakers take in any state with respect to such revision will have a direct bearing on the economical production of coal in that state. Unwarranted restrictions with respect to electrical equipment upon the statutes of any state hamper coal production and impose a penalty upon that state when in competition with neighboring states not thus hampered.

Well-considered regulations add to the progress of the electrical industry and tend toward safety and economy. The nearer the different states come to reaching a common basis in their regulations the better it will be for all concerned. The manufacturer of electrical mine equipment will be benefited since he will not be under the necessity of building machinery to meet the requirements of several states. Those states having similar enactments will benefit for two reasons: First, having the same kind of regulation, the same outlay for electrical protection will be necessitated, at the same relative cost per ton of coal mined; second, the manufacturer of electrical mining equipment, having to meet the requirements of one code instead of several codes at variance with each other, will need to supply fewer types and therefore can furnish these at a lower price.

Adequate state inspection is necessary if the greatest benefit of the code is to be realized. Any one who has

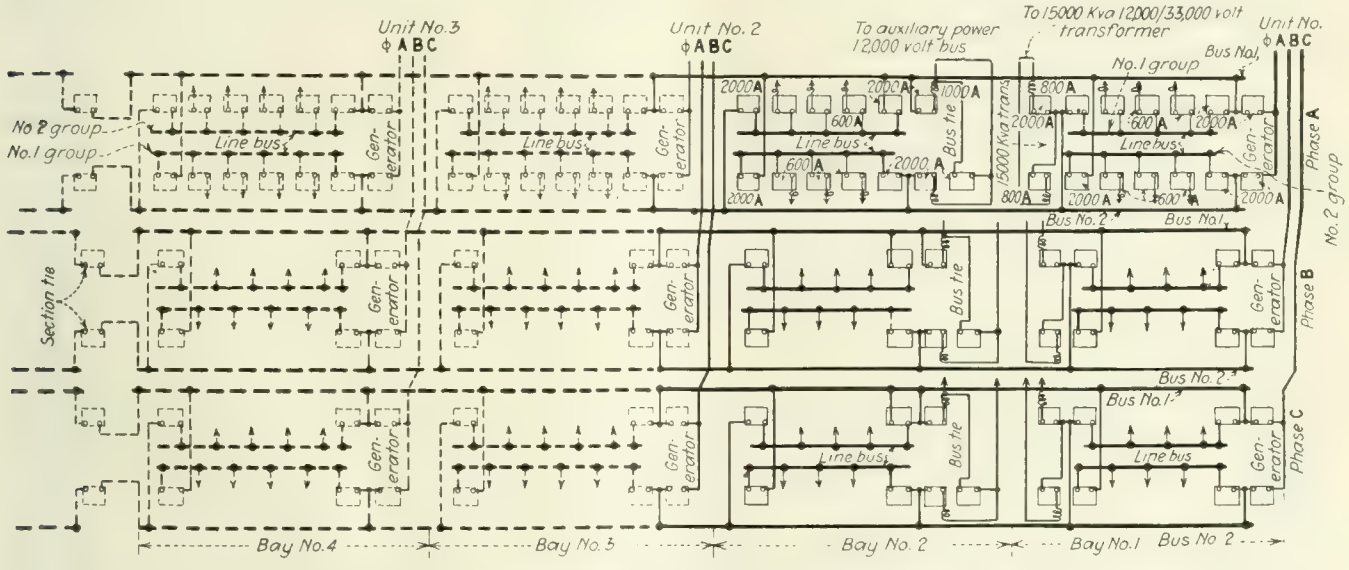


FIG. 5—LINE GROUPING AS DEVELOPED FROM PRACTICE IN TWO OTHER COMMONWEALTH EDISON GENERATING STATIONS

Details are omitted from phase B and phase C wiring for simplicity. It is evident that phases B and C are replicas of phase A wiring.

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spent any considerable time about coal mines realizes the great need in this respect. State inspection can be provided for in three ways—first, by making provision for state electrical inspectors; second, by the employment of properly qualified persons to operate under the direction of the state mine inspector, and, third, if there be such men available, by the appointment of inspectors who are qualified for electrical inspection as well as for the many other duties required of a mine inspector.

Inspectors of Equipment Should Be Qualified

State mine inspectors are usually selected because of their knowledge of mining and are qualified neither by technical training in electrical engineering subjects nor by practical experience to act as expert inspectors of electrical equipment. Thus frequently they may not recognize real electrical hazards and are often misled as to the true cause of electrical accidents. An example illustrative of non-technical reports came to the writer's attention through the investigation of a fatal accident in a coal mine. The press report of the accident was that the lightning struck a railroad track leading into the mine, followed one of the steel rails about 60 ft. inside the mine to where four men were standing, killed one of the men and shocked two others. As a matter of fact, the lightning struck and splintered a nearby tree above the point where the men were, followed down its roots, continued through crevices of the rock and passed to ground through the man who was killed.

TYPE OF REGULATIONS GOVERNING USE OF ELECTRICAL EQUIPMENT IN COAL MINES

State	Voltage Classification — Low: Alternating Current	Low: Direct Current	Medium: Alternating Current	Medium: Direct Current	High: Alternating Current	High: Direct Current
Alabama	240	300	240–480	300–600	Above 480	Above 600
	No apparatus or conductors carrying a high voltage shall be allowed in or about working places. Portable apparatus using high voltage is prohibited. Electrical equipment installed after April 18, 1911, shall not use any voltage higher than low in or about working places.					
California	300	300	300–450	300–650	Above 650	Above 650
	No higher than medium voltage shall be used underground, except for transmission or for application to transformer, motors or other apparatus in which the whole of the high-voltage circuit is stationary.					
Illinois	Trolley wires and other exposed electric wires shall not carry a voltage above 275.					
Kentucky	In new installations positive conductors carrying more than 300 volts shall be insulated.					
Ohio	No voltage in excess of 650 at switchboard shall be used underground. No voltage in excess of 325 shall be used in or about a working place.					
Pennsylvania (bituminous)	300	300	650	650	Above 650	Above 650
	Same as California.					
Utah*	300	300	650	650	650–4,000	650–4,000
	No higher voltage than 4,000 will be permitted underground until all the plans for the installation of the equipment and its wiring have been first approved by the Public Service Commission in writing. No higher voltage than 650 shall be used underground, except for transmission or for application to transformers, motors or other apparatus in which the whole of the high-voltage circuit is stationary, and no bare signal wires shall be used that carry over 50 volts. After the adoption of these orders, no higher voltage than 275 shall be installed underground, except as above noted, or as extensions to existing electrical systems which are at present permitted.					
Washington	300	300	600	600	Above 600	Above 600
	Same as California, with additional provisions that in gaseous mines high-voltage transmission cables shall be installed in intake airways only.					

* Utah has a fourth voltage classification, termed "extra high voltage," for voltages above 4,000

All electrical rules, regulations and laws relating to the use of electricity in coal mines have as their aim one or more of the following objects: To prevent persons or animals from receiving an electric shock, to prevent mine fires, to prevent accidents caused by explosives, to prevent mine explosions, to prevent other accidents that may be due to the use of electrical equipment, and to prolong the useful life of the apparatus.

At present twenty-one states make some reference in their coal-mining laws or regulations to the use of electricity or to the operation of electrical equipment. Four states—California, Pennsylvania, Washington and Utah—have enacted laws that embrace more than 50 per cent of the subjects that should properly be covered in an electric code for coal mines. Other states have electrical regulations but have not shown the same progress.

The question of voltage classifications and voltage restriction is of prime importance and should be considered with deliberation by those preparing electrical mining codes. Too drastic voltage regulations practically legislate electricity from the mine, while lax and ineffective regulations permit dangerous and questionable practices. At present eight states have dealt with this question as shown by the accompanying table.

Voltage Restrictions Should Be Carefully Considered

The voltage restrictions tabulated afford examples of good and bad legislation. For instance, Kentucky's requirement that "positive conductors carrying more than 300 volts must be insulated" is not a good rule. The kind of insulation is not specified. Neither weatherproof nor rubber covering can be depended upon over any period of time as a safeguard against shock. Moreover, if too much dependence is placed upon such insulation a false security will result which may bring about a greater hazard than would come from a bare wire known to be dangerous. Again, the reference to positive wires does not cover alternating-current installations and does not adequately cover a two-wire ungrounded direct-current circuit. Ohio has seemingly hampered the mining industry in that state unnecessarily through its voltage restrictions. When properly installed, high-voltage alternating-current circuits can be brought into mines with reasonable safety. There are many instances where the saving of copper by the use of high voltage is a large item and where it would pay the operator to go to considerable expense in installing safe high-voltage circuits rather than purchase this additional copper. In other words, the danger does not necessarily depend upon the voltage used. One cannot say that 650 volts is safe and that 660 volts is dangerous. A carelessly installed 650-volt circuit may be much more dangerous than a properly installed 2,300-volt circuit. It is evident also that it would be permissible to use higher voltage on stationary motors than could be used with equal safety on portable equipment.

The question of supervision of electrical equipment is one that has as yet had very little attention in state mining regulations. This is to be expected since the introduction of electrical equipment has been so rapid that the regulations have not had time to catch up with electrical development. A large proportion of the mines using electrical equipment have it in such quantities and

variety that it becomes an economic necessity to have its installation and maintenance carefully supervised.

Only one state—Pennsylvania (bituminous)—has such a requirement in force, and since this seems a well-considered regulation, it is quoted in full: "At every mine where electricity is used below ground for power there shall be employed a competent mine electrician who shall have full charge of the electrical apparatus in the mine but shall be subject to the authority of the mine foreman."

Periodic Inspection Important

Several states now require a certain amount of periodic inspection of electrical equipment, but no state as yet has adequate regulations relating to this point. The reason for such inspection is readily acknowledged when proper consideration is given to its nature and scope.

Parts such as commutators, brushes, bearings and controller contacts deteriorate by wear and should be repaired or replaced before the apparatus has been damaged. Dirt, grease and coal dust accumulate and if not removed may cause grounds or short circuits. Oil and battery electrolytes evaporate, leak out, become dirty and lose their mechanical and electrical effectiveness. Insulation deteriorates with continued exposure to heat or dampness, and grounds and short circuits result.

Falls of roof, wrecks, timbering and blasting cause damage to apparatus and circuits. Protective apparatus, such as relays, circuit breakers, fuses, headlights, signals and bells, need to be carefully maintained.

The following suggested rule is one that might be used to cover inspection:

"At each mine where electricity is used underground a systematic inspection of all wiring and equipment shall be made at regular intervals, at least once every month. A report of each inspection shall be made by the mine electrician or inspector, and a copy of this report shall be furnished to the mine foreman and kept on file at the mine. The report shall definitely state the condition of each main and branch power and lighting circuit and of the motors and controlling appliances of each locomotive, mining pump, hoist or other piece of electrical apparatus connected to the electrical system of the mine."

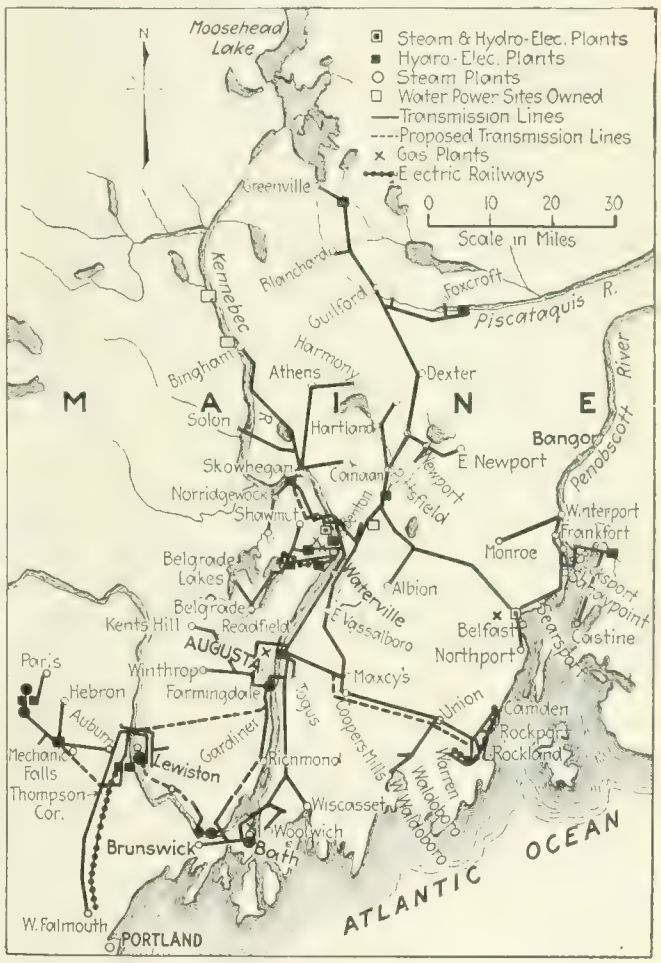
Better Refractories Needed for Electric Furnaces

THE increased demands on the refractories used in electric furnaces have about reached a point where advances in the design and use of furnaces are said to be held back by the shortcomings of the refractories. No doubt many of the difficulties can be met and solved by improvements in present methods of molding and burning refractories. Thus higher calcining temperatures and finer aggregates will undoubtedly help in minimizing slag corrosion difficulties and might possibly increase the life of silica bricks used in roofs. Nevertheless, there seems to be room in this field for the introduction of new refractory materials having new physical and chemical properties to supplement and occasionally replace materials now in use.

It is expected that zirconia minerals, now being produced on a commercial scale and made into refractory shapes, will be of distinct value in the electric furnace field. Zirkite, for instance, possesses nearly all the fundamental requirements for any of the parts of an electric furnace. Its melting point is such as to fit it for use in hearths or in side walls, and especially at the slag line, but for roofs zirkite alone would probably make bricks too heavy to give satisfactory results for all types of furnaces. This information from the research laboratories of the Foote Mineral Company was presented before the Columbus meeting of the Electric Furnace Association.

Central Maine System Serves 12,000 Square Miles

AS A result of the acquisition by the Central Maine Power Company of the Androscoggin Electric Company and other utilities, to form an organization with $17,500,000 aggregate capitalization, the combined system, illustrated by the accompanying map, will serve a territory about 120 miles (192 km.) long by 100 miles (160 km.) wide, extending from Greenville,

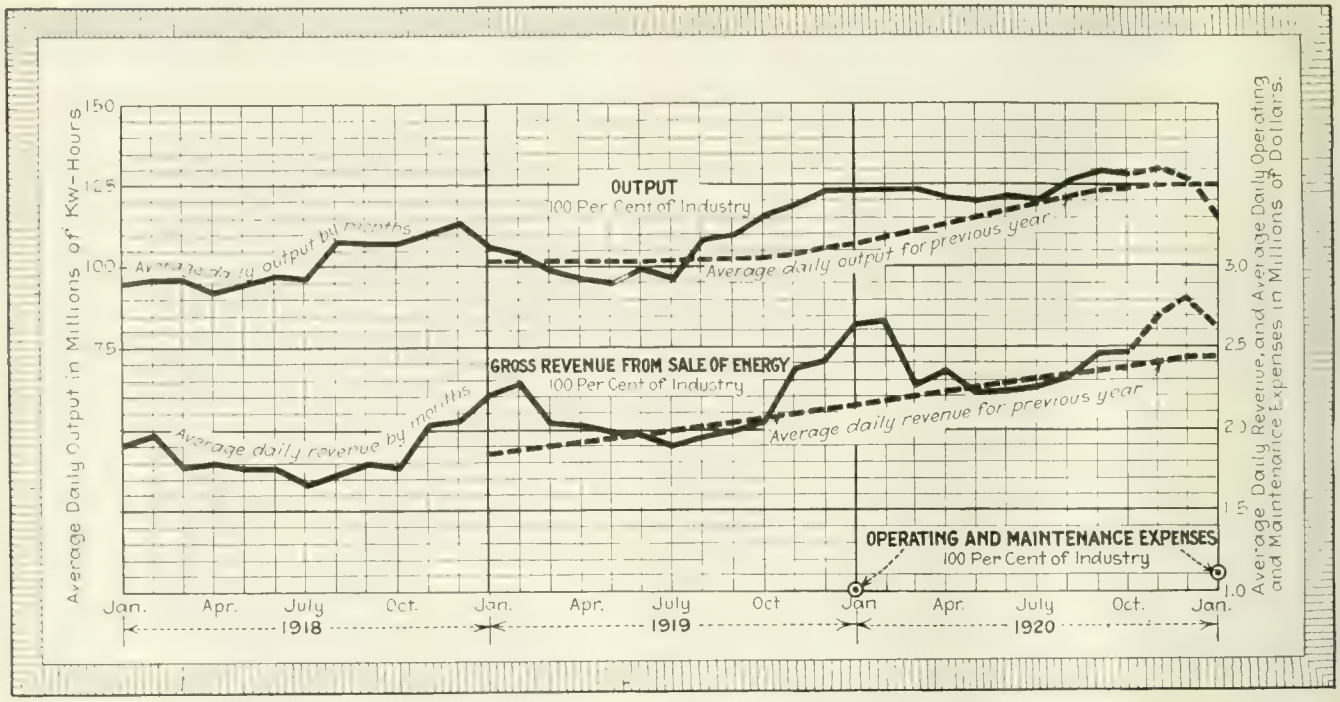


MAP SHOWING COMBINED SYSTEM OF CENTRAL MAINE POWER COMPANY

Me., to the outskirts of Portland, and from Norway to Castine.

By a tie line to be built between Gardiner and Lewiston the plants of the Androscoggin, Kennebec, Piscataquis and Messalonskee Rivers will be interconnected, and other lines will tie together the Lewiston-Bath-Augusta sections as shown. Improved service will be afforded the Rockland district by a new line from Maxcy's to Rockland. The central location of the new hydro-electric station now under construction at Skowhegan will enable all parts of the system to benefit from the capacity that will be available at that point.

Operating Ratio Decreasing



CENTRAL GENERATING STATIONS REPORT DECREASED OUTPUT DURING JANUARY

THAT the operating ratio of the electric light and power industry is on the decrease is indicated by returns received by the ELECTRICAL WORLD from the central generating stations of the country for the month of January. A decreased operating ratio was especially noticeable in companies reporting for a combined system of steam and hydro-electric plants, in which the ratio dropped from 46.5 in January, 1920, to 38.7 in January, 1921.

The ELECTRICAL WORLD has extended the scope of its statistical work and will hereafter receive regularly monthly returns of operating and maintenance expenses in addition to the revenue and output data, which have been reported monthly since 1914. These additional statistics will make available monthly study of the operating ratios of the electric light and power industry of the country. For convenience of analysis, operating ratios will be determined separately for companies reporting operations for steam plants only, for hydro plants only, and for systems composed of both steam and hydro plants. For comparative purposes these ratios will be given for each section of the country.

Operating and maintenance expenses for January, exclusive of interest, taxes, depreciation or sinking fund, are estimated at $34,550,000, and the gross revenue from sale of energy at $81,750,000. The output during January decreased very materially under that of December, the average daily output decreasing to 115,000,000 kw.-hr.; but this figure is still larger than the output reported in November, 1918, which marked the high point in war-time industrial activity.

Another remarkable fact is that although the output for January was 4.8 per cent less than that reported in January, 1920, yet the gross income for January was 16.8 per cent greater than that for the same month in 1920.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase
Feb.	69	2,494,764	1,986,493	25.3	63	$45,881	$37,502	22.1
Mar.	70	2,698,890	2,103,587	28.0	65	46,155	36,840	25.0
April	70	2,603,692	2,098,559	24.1	65	45,547	36,541	24.5
May	70	2,631,560	2,179,916	21.2	65	43,888	35,512	23.4
June	71	2,630,831	2,175,645	20.2	66	44,434	35,528	24.5
July	71	2,677,131	2,234,215	20.0	66	46,608	36,265	28.5
Aug.	71	2,769,175	2,303,099	20.1	66	47,410	36,713	29.1
Sept.	71	2,734,179	2,327,460	17.4	66	49,224	38,209	28.5
Oct...	71	2,797,625	2,499,488	11.9	66	51,370	41,055	25.1
Nov	71*	2,741,705	2,503,402	9.6	66*	54,620	44,711	22.0
Dec.	71†	2,800,418	2,648,892	5.7	66†	57,422	48,456	18.5
		1921	1920			1921	1920	
Jan.	76‡	2,707,234	2,844,616	-4.8	70‡	57,186	49,021	16.4

	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies reporting) 1921, Thousands of Dollars	1920, Thousands of Dollars	Per Cent Increase	OPERATING RATIO Steam Plants 1921	Steam Plants 1920	Hydro Plants 1921	Hydro Plants 1920	Combined Systems of Steam and Hydro 1921	Combined Systems of Steam and Hydro 1920
Jan.	36	12,417	11,194	11.0	56.3	55.5	26.8	27.0	38.7	46.5

* Includes estimates for thirty-five companies, representing 4.6 per cent of the total installed rating of all central stations.

† Includes estimates for fifty-six companies, representing 11.3 per cent of the total installed rating of all central stations.

‡ Includes estimates for eighty-four companies, representing 17.6 per cent of the total installed rating of all central stations.

Every section of the country showed a material decrease in output under that of December. The New England States appear to have been the first to feel the revival in industrial activity. There were numerous resumptions of textile mill activity during January, 1,350,000 more spindles being in operation than were reported in December. A revival of activity in the boot and shoe industry and other industries of this section

was also apparent. Because of the advancing season a decreased lighting load was reported, but the New England States returned a smaller decrease below December in total electrical energy output than any other section.

In the Atlantic section the United States Steel Corporation was reported as working at near capacity during January, but the independent steel mills were working at only about 12 per cent capacity in the Mahoning Valley and at 35 per cent capacity in the Philadelphia district. Textile mills were operating at about 35 per cent capacity, although the South Atlantic States reported several textile mills to be resuming full operation. The Southern Pine Association reported that the lumber mills were operating 51.5 per cent below usual. These large industrial curtailments are reflected in a decrease of 12 per cent in the output of the electric light and power stations of that district under the December output.

The independent iron and steel mills in the North Central States were operating at between 30 and 40 per cent capacity during January, and other large manufacturing industries, such as the milling and shoe industries, reported between 50 and 60 per cent curtailments below normal. A decrease in average daily output from 39,500,000 kw.-hr. in December to 35,600,000 kw.-hr. in January resulted from these and other industrial curtailments and from the reduced lighting load.

Marked decrease in drilling activities in the oil fields of Texas, Oklahoma and Kansas, as well as a continued industrial depression throughout the South Central States, contributed to the 8 per cent loss in electrical output in that section below that of December. Mining activities in the Mountain States were heavily curtailed during January, and the Pacific States reported many large industries operating in most cases at less than 50 per cent below normal. The output of the electric light and power stations in the Mountain and Pacific States, while some 7 per cent below that of December, was still slightly above that reported in January, 1920.

Nearly complete returns indicate that the total output of the central generating stations of the country for 1920 was 45,678,000,000 kw.-hr., and the gross revenue from sale of energy during the same period was $882,750,000. The output in 1919 was estimated at 38,878,000,000 kw.-hr., indicating an increase of about 17.5 per cent during 1920. The gross revenue in 1919 was estimated at $773,000,000, indicating an increase of about 14.2 per cent during 1920. A study of the operating ratio figures indicates that the operating and maintenance expenses of the electric light and power generating industry during 1920, exclusive of interest, taxes, depreciation or sinking fund, was about $354,500,000.

TABLE III—AGGREGATE OPERATING RATIO OF COMPANIES REPORTING DATA MONTHLY TO ELECTRICAL WORLD

Type of Generating Plant	New England States	Atlantic States	North Central States	South Central States	Mountain and Pacific States
Steam Plants:					
Operating ratio—Jan., 1921 ..	54 0	53.5	61.5	54 0	69 0
Operating ratio—Jan., 1920...	60 8	50.9	62 1	54.7	60 5
Hydro Plants:					
Operating ratio—Jan., 1921...	26 5	21 2	25.0	26 4	28 4
Operating ratio—Jan., 1920...	35.2	21 2	20 8	20.1	27.9
Combined System osf Steam and Hydro Plants:					
Operating ratio—Jan., 1921...	45.3	45 3	42 8	38 6	35.0
Operating ratio—Jan., 1920...	53.5	48.1	44.8	46.6	45.5

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States		
		Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase
KW.-HR. OUTPUT	Feb.....	82	187,264	148,103	26.2	62	809,865	672,836	20.1	73	858,939	663,523	29.4	56	130,473	98,098	33 0	79	508,223	403,933	26.1
	Mar.....	82	198,603	148,512	33.7	64	897,327	711,828	26.0	74	913,659	711,761	28.1	56	137,306	102,545	33.6	79	551,995	428,941	28.6
	April....	82	187,174	144,922	29.1	65	883,264	701,778	25.9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May.....	82	188,566	148,186	27.5	65	854,631	711,276	20.0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June....	82	189,934	149,607	26.5	66	865,714	721,688	19.9	74	855,013	681,780	25.5	56	132,733	99,660	33.2	79	587,437	522,901	12.2
	July.....	82	190,668	159,000	20.0	66	881,241	714,485	23.5	74	841,351	702,302	19.7	56	138,937	106,460	30 1	79	614,934	551,959	13.4
	Aug.....	82	194,028	171,002	13.5	66	905,170	728,097	24.2	74	891,712	750,787	18.6	56	147,082	111,573	32.0	79	631,183	541,640	16.5
	Sept. ...	82	194,730	170,593	14.1	66	905 872	758,737	19.5	74	878,237	758,017	15.9	56	147,524	113,649	30.0	79	607,816	526,464	15.5
	Oct.....	82	196,310	191,132	2.7	66	964,739	841,694	14.5	74	896,241	817,757	9.5	56	157,267	126,769	24.1	79	583,068	522,136	11.7
	Nov....	82	193,231	183,624	5.4	66	953,436	825,011	15.5	74	895,229	861,352	10.5	56	144,889	125,438	15 0	79	554,920	507,977	9.2
	Dec.....	82	210,591	227,395	-7.5	66	973,701	916,657	6.2	74	905,943	851,910	6.4	56	141,103	134,366	5.0	79	569,080	517,715	10.0
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.....	81	198,325	247,440	-19.6	77	1,005,565	1,037,367	-0.3	73	806,422	864,161	-7.0	65	150,603	149,675	1.7	81	546,319	545,973	0.1
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
REVENUE	Feb.....	82	$5,354	$4,368	22.1	61	$17,245	$14,343	20 4	55	$13,191	$10,403	26.0	53	$2,949	$2,360	24.7	79	$7,142	$6,028	18.3
	Mar.....	82	5,136	4,044	27.0	63	17,696	14,299	23.7	57	13,270	10,469	26.5	54	2,910	2,287	27.8	79	7,148	5,741	24.2
	April....	82	5,087	3,943	29.0	64	17,700	14,383	23.5	57	12,690	10,042	26.9	54	2,952	2,181	35.2	79	7,118	5,992	19.2
	May.....	82	4,897	3,741	30.1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32.0	79	7,067	6,147	15.1
	June....	82	4,948	3,778	30.5	65	16,525	13,449	22.1	57	12,412	9,776	26.9	54	2,849	2,127	33.9	79	7,700	6,398	20.5
	July....	82	5,009	3,802	28.5	65	16,899	13,438	25.5	57	12,822	9,793	30.9	54	2,747	2,194	35.0	79	9,131	6,948	31.5
	Aug.....	82	5,075	4,093	24.0	65	17,210	13,731	25.9	57	13,497	10,151	32.9	54	3,168	2,281	38.1	79	8,460	6,457	31.1
	Sept. ...	82	5,409	4,296	25.9	65	18,081	14,456	24.5	57	13,834	10,522	31.5	54	3,262	2,386	36.5	79	8,638	6,549	32.0
	Oct.....	82	5,675	4,623	22.7	65	19,201	15,722	22.0	57	14,458	11,667	23.9	54	3,504	2,551	37.3	79	8,532	6,492	31.5
	Nov....	82	5,898	5,017	17.5	65	20,938	17,119	22.2	57	15,158	12,561	20.8	54	3,853	2,910	32.4	79	8,775	7,104	23.5
	Dec.....	82	6,548	5,743	14.0	65	22,373	19,145	16.8	57	15,619	13,125	18.9	54	3,770	3,012	25.2	79	9,112	7,431	22.8
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.....	81	6,439	6,200	3.8	74	22,490	19,046	18.1	59	14,584	12,771	14.1	64	4,238	3,513	20.6	81	9,435	7,491	25.8
OPERATING EXPENSES:																					
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.....	33	$1,077	$1,260	-1.45	43	$5,194	$4,523	14 8	21	$3 119	$2 583	20 6	33	$904	$807	12 0	54	$2,123	$2,021	5 0

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Lighting for Dusty Places

To the Editor of the ELECTRICAL WORLD:

SIR: In the Jan. 22 issue of the ELECTRICAL WORLD Messrs. Dows, Fox and Blackwell made some interesting observations on the illumination of dusty places. However, from my experience I cannot agree that the marine type of fixture solves the difficulty. The coal-grinding plant of a cement mill presents one of the most difficult illuminating problems I have encountered. In four or five days dust will accumulate on an open lamp in sufficient quantity to cut off all the light, and it will be impossible to tell whether the lamp is burning or not. This applies to "Mazda C" lamps up to 300 watts. While this dust is highly inflammable, I have been unable to note any occasion where actual ignition occurred from this source. With other types of coal ignition would probably occur. The vapor-proof fixture will accumulate this dust coat as rapidly as the open lamp. Thus, while increasing safety, it does not remove the necessity for cleaning. The wire guard adds to this cost, and it appears that the dust will accumulate more quickly with this guard than without it.

By a process of elimination we have attacked this problem from another angle. We started with the assumption that the dust settled from above, and we used a flat-cone enameled reflector. This improved matters somewhat. A ventilated-hood, deep-bowl type was then tried as we were afraid of the confined heat in the closed type. The current of air passing through the top resulted in a quicker coating of the lamp than when exposed with no reflector. This gave the key to the whole situation as being purely a matter of air currents around the lamp. By preventing the air currents we can prevent the accumulation of dust on the lamp. Since that time I have made several installations with the deep-bowl RLM enameled reflectors under these conditions and have found that a cleaning once a month will give excellent results.

The one-piece reflector with the socket mounted inside the top usually gives the best results, it being more nearly air-tight than other types. My theory is that by creating an air pocket of dead air the dust-laden air can be prevented from entering. This will prevent any accumulations on the lamp or reflector. The dust will accumulate, however, on the inside of the bottom rim for a width of one to two inches. In an attempt to prevent this a glass was placed over the bottom of the reflector. An accumulation started at the circumference and gradually worked toward the center.

Fair results can be attained with angle reflectors by using a very deep type and a smaller lamp than the reflector design calls for. Here, again, the dead air space remains clean while the other portion soon becomes coated with dust. T. H. ARNOLD.

El Paso, Tex.

Life Tables and Extraordinary Replacements

To the Editor of the ELECTRICAL WORLD:

SIR: There is a need for public utilities to work out a method of setting aside out of earnings annuities to cover replacements on a more reasonable basis than at the present time. The principal questions involved in such a consideration are the life tables of the various portions of the physical plants of the utilities, the recognition of the effect of obsolescence and inadequacy, and the element of what might be termed rapid or extraordinary replacements.

Any life table must take into some consideration obsolescence and inadequacy because, for example, a monolithic concrete structure, such as a diversion dam, may continue in existence for upward of two hundred years, but life tables generally specify a much shorter period than that, thereby recognizing obsolescence or inadequacy. The question is, how far should obsolescence and inadequacy be considered. Some tables give dams as having a life of one hundred years, although recently the life of such structures has been considered as only fifty years, while line distribution transformers are specified at twenty years, rather than ten years, which appears more reasonable.

There is, therefore, a need for a uniform life table and a uniform acceptance of the degree of obsolescence and inadequacy and agreement as to the extent of the element of special replacements which must be considered.

By special replacements is meant where a normal life period may be given, as, say, fifteen years for a transmission line, but, owing to unusual circumstances, a substantial transmission line may be rebuilt because of the discovery that the insulators used are rapidly deteriorating or that a more recently designed insulator can be more economically operated. In some instances an unanticipated industry might develop in a certain territory served by such a transmission line so that it would become necessary to exchange a conductor, which, in turn, would make it necessary to provide a different type of insulator support, cross-arm, etc., all but the poles being thus replaced. This is an expense which cannot be entirely capitalized as a betterment, but it is one which should be charged off over a longer period than one year or less, the ordinary operating period. J. M. BUSWELL.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Checking Meter Connections

To the Editor of the ELECTRICAL WORLD:

SIR: In your Feb. 26 issue, page 487, there appeared an item entitled "Meter Installation Which Permits Easy Check on Connections," by Albert R. Thomas of the Southern California Edison Company. I wish to call your attention to the fact that the method of checking connections proposed is not infallible. The method recommended was discussed in my paper before the American Institute convention of June, 1916, and is published on page 133 of Vol. 35 of the *Transactions* of the Institute.

The paper in question shows that this check fails to differentiate between the correct connections and certain incorrect connections. (See page 201 of the volume referred to.) WILLIAM B. KOUWENHOVEN,
Johns Hopkins University, Associate Professor.
Baltimore, Md.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Standardization of Meter Leads Is Desired

RECOMMENDATIONS on the position of meter leads, the fastening of meter disks to the shafts and the interior painting of meters were made at the Miami convention of the N. E. L. A. The recommendations were a summary of opinions of member companies of the Southeastern Section. This summary was given in the meter committee's report.

In this report standardization of the method of bringing out the leads of polyphase meters was strongly recommended. The committee urged that the potential leads be on the outside of the meter, near the ends, and the current leads adjacent to each other on the inside. It was generally thought that the interior of meters should be painted white to facilitate inspection. More care, it was held, should be taken in selecting and applying paint to the frame and base to prevent the paint peeling off and stopping the meter disk. This trouble had been experienced by a number of companies.

Alabama Power Company, S. A. FLETCHER,
Birmingham, Ala. Superintendent of Service.

Repairing Waterwheel Runner by Electric Welding

REPAIRING a worn waterwheel runner by electric welding was found to add 350 kw. to the power available from an old 3,000-kw. wheel in the Naches power house of the Pacific Power & Light Company, near Yakima, Wash. This is a 36-in. Victor turbine built by the Platt Iron Works Company. It is directly connected to a 3,000-kw. General Electric alternator. The runner on this unit is of bronze, and several months ago serious pitting took place so that the discharge ends of the vanes were pitted clear through and the bases of the vanes pitted so that one broke out, cracking several others before the machine could be brought to a standstill. A thorough examination was made, and it was found that the clearance on the discharge end of the runner was 0.22 in., while on the opposite end it was 0.14 in. These clearances were too great.



WATERWHEEL BEING REPAIRED BY ELECTRIC WELDING

At left—Runner with some of the holes in the vanes closed up. At right—Clearance rings and shaft built up ready to be turned.

At first it appeared that it would be necessary to junk the runner. However, electric welding was tried and 168 lb. of bronze was used to build up the runner where it had been pitted and also at the clearances. The clearance rings were then removed and machined true, after which the runner was put in a lathe and the clearance machined to proper size. The vanes were smoothed by means of a small electrically driven emery wheel and finished off with files by hand where possible. The shaft also was built up and machined to size. A test showed that the power of the station was increased 350 kw. by the changes. The average clearance on the exhaust end of the runner was 0.025 in., and on the head end, 0.033 in.

Pacific Power & Light Company, J. H. SIEGFRIED,
Pasco, Wash. Superintendent of Power.

Numerous Advantages Possessed by Secondary Networks

SOME of the advantages of a secondary network over individual transformer installations are enumerated as follows: (1) It permits the use of a few large transformers instead of a large number of small ones, and the iron loss per kva. is less for large transformers than for small ones. (2) Large transformers cost less per kva., and hence the investment charge is reduced. (3) By taking full advantage of the diversity factor the total required transformer kva. is materially reduced, thereby reducing iron loss. (4) For the same reason the investment charge is reduced. The principle is the same as when station generators are operated in parallel. (5) Reduced resistance loss results for equal copper investment, because the maximum demands do not occur on the same section of secondary at the same time. (6) The energy saving due to distributing at 230 volts, three-wire, instead of 115 volts, two-wire, makes possible the distribution over a given area with the same copper and much smaller resistance loss. (7) Better voltage regulation results, because each customer is served from two or more directions. (8) Better continuity of service is secured, because each customer is served from two or more transformers.

For the successful operation of a secondary network it is most important that each transformer be sectionalized from the others by means of a secondary sectionalizing switch, which should be installed at approximately the neutral load point between any two or more transformers. There have recently been developed very satisfactory switches for this purpose. Caution, however, should be exercised not to insert a sectionalizing switch in the grounded neutral wire of a transformer secondary. In the event of failure of any transformer primary fuse, the secondary sectionalizing switches will, immediately upon overloading, dis-

connect the transformer from service, and only that section within the radius of this transformer will be inconvenienced by an interruption of service. By encouraging the customers to report immediately any interruption to their service or any dimness of their lights a trouble man can quickly be sent out.

In banking transformers together great care should be taken to see that they are of the same make, type and ratio. If the characteristics of two banked transformers are not the same or nearly so, they will not divide the load properly.

THEODORE H. RICE,
Operating Department.

Henry L. Doherty & Company,
New York, N. Y.

Heavy Equipment Transported Over Steep Mountain Roads

PRACTICALLY all the equipment for the 50,000-hp. Kerckhoff plant of the San Joaquin Light & Power Corporation was hauled along difficult mountain roads over a route about 5 miles long and which contained sharp turns and a maximum grade of 12 per cent. This plant was described in the ELECTRICAL WORLD for Feb. 26, page 471.

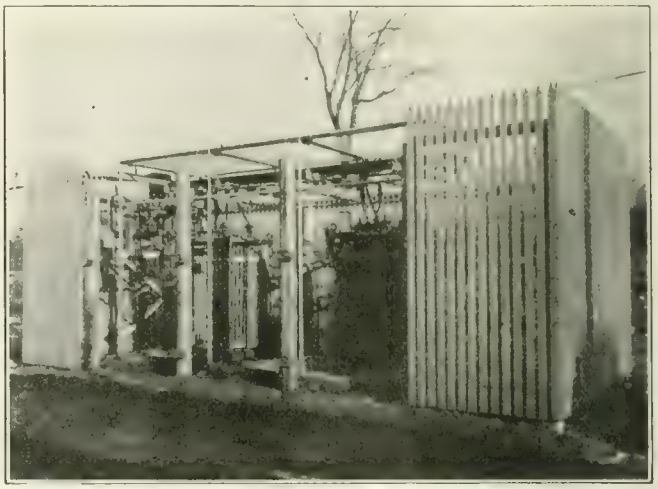
The total weight hauled was 33,300 tons, of which 8,000 tons was a back haul of salvaged rails and lumber, supplies and equipment. The equipment used in hauling the material consisted of one 75-ton Holt caterpillar tractor, one 45-ton Holt caterpillar tractor, six 10-ton Holt double-end trailers, one 35-ton Holt trailer, three 5-ton Mack trucks, three 5-ton two-wheel trailers, one 5-ton White truck and seven 2-ton White trucks. All express and mail service was maintained with three Dodge commercial-type cars. All of this equipment rendered a satisfactory and economical service. R. C. Starr is the company's construction engineer.

FIELD EDITOR ELECTRICAL WORLD.

San Francisco, Cal.

Materials Required for Standard Outdoor Transformer Installation

TO FACILITATE the construction of outdoor transformer installations, a standard layout for these has been developed by the engineering department of the Worcester (Mass.) Electric Light Company. A 1,000-kva. layout is shown herewith. The transformers are mounted on 4-in. channel-irons resting on a rein-



STANDARDIZED OUTDOOR TRANSFORMER INSTALLATION FOR 13,200/675 VOLTS

forced-concrete platform 6 in. deep, with a cinder foundation 12 in. deep. Over all the platform measures 16 ft. 8 in. by 6 ft. 4 in. A three-phase, 13,200-volt cable from the underground or overhead system of the company is carried to a pothead at the top of a frame built of 1¼-in. iron pipe. From the pothead No. 4/0 solid rubber-covered wire leads are carried to disconnecting switches and thence to the buses, which are supported on insulating clamps carried on the pipe

MATERIAL FOR A STANDARD 1,000-KVA. TRANSFORMER STRUCTURE, 13,200 TO 675 VOLTS

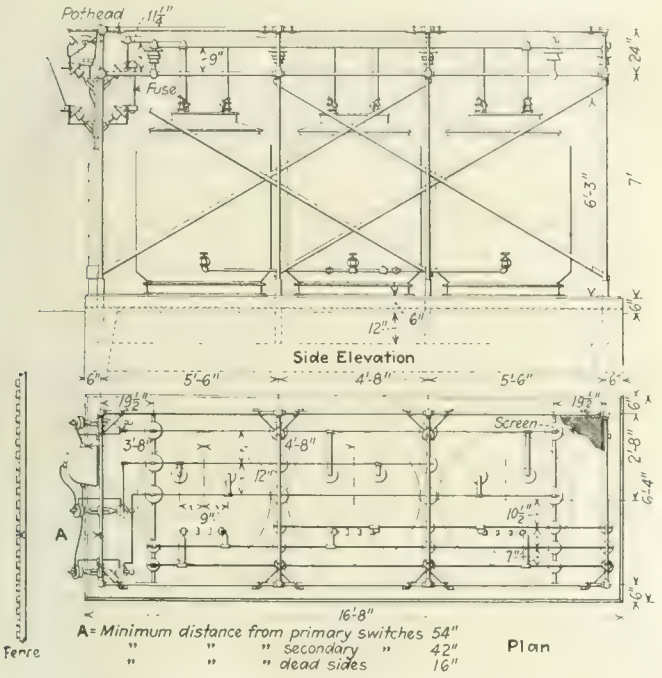
Six 16-ft. x ¾-in. reinforcing rods.
Eight 2-in. galvanized iron pipes 2 ft. long.
Eight 1¼-in. black iron pipes 10 ft. long, R.H. thread one end.
Eight 1¼-in. black iron pipes 5 ft. 2 in. long, one R.H. and one L.H. thread.
Two 1¼-in. black iron pipes 5 ft. 2 in. long, two R.H. threads.
Eight 1¼-in. black iron pipes 5 ft. 4 in. long, two R.H. threads.
Four 1¼-in black iron pipes 4 ft. 6 in. long, two R.H. threads.
Two 1¼-in. side outlets ("L"s), three R.H. threads.
Two 1¼-in. side outlets ("L"s), two R.H. threads, one L.H. thread.
Two 1¼-in. side outlets ("T"s), four R.H. threads.
Two 1¼-in. side outlets ("T"s), three R.H. threads, one L.H. thread.
Two 1¼-in. side outlets ("Ts"), three R.H. threads, threads on run removed.
Two 1¼-in. side outlets ("T"s), two R.H. threads, threads on run removed.
Two 1¼-in. side outlets ("T"s), two R.H. threads, threads on run removed.
Two 1¼-in. side outlets ("T"s), three R.H. threads, threads on run removed.
Four 1¼-in. side outlet clamps, E.E.E. Co., No. 1634.
Eighteen bags cement.
3½ yd. gravel (run of bank).
2 yd. sand.
Twelve screen supports, 2-in. x ¼ in. 14 in. long.
Two braces, 3 in. x 1¾-in. angles, 5 ft. 7½ in. long.
Four braces, 2 in. x ¼-in. angles, 7 ft. 6¼ in. long.
Four braces, 2 in. x ¼-in. angles, 11 ft. 11¼ in. long.
Forty-six U bolts made up of ½-in. stock with nuts.
One 1½-in. diamond-mesh screen ¾-in. L, No. 10 wire, 5 ft. 1 in. x 4½ ft.
One 1½-in. diamond-mesh screen ¾-in. L, No. 10 wire, 5 ft. 1 in. x 5 ft. 3 in.
One 1½-in. diamond-mesh screen ¾-in. L, No. 10 wire, 5 ft. 1 in. x 6 ft. 6 in.
Three 333-kva. single-phase self-cooled Pittsburgh transformers, with taps for 13,200-12,870-12,540-12,210-11,880/575 volts.
Fourteen Delta-Star insulators, type VUO, catalog number 72,003.
Eleven Delta-Star insulators, type VUO, catalog number 72,201.
Three G.E. clamps, catalog number 131,949, 2 in. x ¼-in., with bolts.
Six G.E. clamps, catalog number 123,352.
Six G.E. clamps, catalog number 123,353.
Nine G.E. clamps, catalog number 174,465.
Nine G.E. clamps, catalog number 174,466.
Twenty-seven galvanized bolts, ⅜-in. x 2 in.
Eighteen galvanized bolts, ⅜-in. x 1½-in.
Four galvanized bolts, ½-in. x 2-in.
15 ft. No. 4/0 solid rubber-covered, D.B. 13,200-volt wire.
Three Delta-Star outdoor fuse mountings, type G-2, catalog number 63,205.
Three Delta-Star outdoor disk switches, type G-2, catalog number 63,120.
Three 200-amp. S. & C. fuses, Delta-Star, catalog number 10,761.

Busbar Copper
1½-in. x ¼-in., two 13 ft. long, one 9 ft. 9 in. long, and two 2 ft. 9 in. long.
2½-in. x ⅜-in., two 14 ft. 6 in. long, one 11 ft. 3 in. long.
2½-in. x ¼-in., two 9 ft. long.

One Pothead type 30, No. 304 E.E.E. Company.
Twelve fence posts, 13 ft. 6 in. long.
Eight spruce fence rails, 2 in. x 4 in., 5 ft. long.
Five spruce fence rails, 2 in. x 6 in., 4 ft. 8 in. long.
Two spruce fence rails, 2 in. x 4 in., 4 ft. 8 in. long.
Two spruce fence rails, 2 in. x 4 in., 11 ft. 2 in. long.
Two spruce fence rails, 2 in. x 6 in., 11 ft. 2 in. long.
Two spruce fence rails, 2 in. x 4 in., 7 ft. 2 in. long.
One spruce fence rail, 2 in. x 4 in., 3 ft. 0 in. long.
Two spruce fence rails, 2 in. x 4 in., 16 ft. 4 in. long.
One spruce rail, 2 in. x 6 in., 16 ft. 4 in. long.
Two spruce fence rails, 2 in. x 4 in., 8 ft. 4 in. long.
One spruce fence rail, 2 in. x 6 in., 8 ft. 4 in. long.
Three spruce fence rails, 2 in. x 4 in., 3 ft. 4 in. long.
220 spruce pickets, 1 in. x 2½ in., 9 ft. 6 in. long.
Twelve angles, 3 in. x 2 in., 9 in. long.
Twenty carriage bolts, ½ in. x 2½ in.
Twenty-four wood screws, ½ in. x 6 in. long, No. 40.
Ten lag bolts, ½ in. x 6 in., special.
Ten washers, ½ in.
Three 10-in. x 2-in. strap hinges.
One 6-in. loop.
One padlock.
10-lb. No. 8 nails.
5 lb. 6-in. spikes.
½ gal. red lead
3 gal. gray paint.

framing at the top of the structure and directly above the transformers. The 13,200-volt buses are spaced 12 in. apart horizontally and at one side, and in the same horizontal plane are mounted the secondary buses, carrying 675 volts.

The secondary buses are spaced 7 in. apart, and from these the necessary feed is made to the customer,



LAYOUT OF STANDARD 1,000-KVA., 13,200/675-VOLT TRANSFORMER STATION

usually by underground cable. The material required is shown in the table on page 770. A diamond-mesh screen mounted above the buses protects the service from possible interruption due to foreign bodies striking the buses.

In estimating costs labor is taken as about 7 per cent of the total cost of material.

F. L. LOVETT,
Distribution Engineer.
Worcester (Mass.) Electric Light Company.

Motor on Waterwheel-Driven Exciter Saves Power and Shutdowns

THE water necessary for continuously driving a spare exciter represented an undesirable loss in the Mill Creek No. 3 station of the Southern California Edison Company. This exciter is for use only in case the small nozzle of one impulse-type waterwheel-driven exciter should become plugged. As this station operates under a head of 1,900 ft. each second-foot of water represents considerable energy and at times of low water is quite valuable. To save this loss it was decided to equip one of the exciters with an induction motor on the opposite end of the shaft from the waterwheel and float the motor on the station bus so that when the waterwheel was operating the motor would act as an induction generator and supply some energy to the bus, thereby utilizing a small amount of water that might otherwise be wasted at times when the whole output of the waterwheel was not needed for furnishing power for excitation.

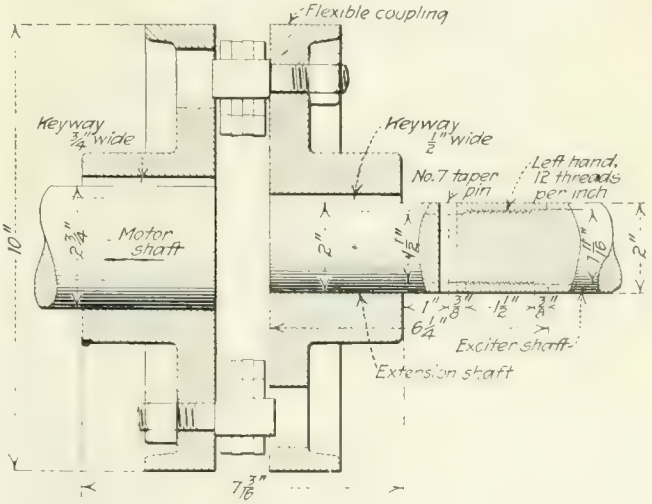
It was desirable to place a flexible coupling between the motor and exciter, but, as the shaft of the exciter ended flush with the outer edge of the bearing, it was necessary either to make a new shaft for the exciter and waterwheel, with an extension long enough for mounting the coupling, or to devise an extension for the existing shaft. On account of the high cost of the former method and the difficulties which would be encountered in using it, the latter method was decided upon, and this was accomplished as illustrated in the drawing.

A male and female threaded joint was used. The dimensions of the hollow shaft and the solid shaft were proportioned to give the same torsional strength. The exciter shaft in the bearing was 2 in. in diameter. The shaft extension was made of $2\frac{5}{16}$-in. cold-rolled shafting. This extension was fitted in place to the exciter shaft, tightened, and an $\frac{1}{16}$-in. hole was drilled through the shaft at right angles to its axis and through the plane of contact of the shaft and its extension. This hole was then reamed through with a No. 7 taper-pin reamer and then reamed from the other end to a depth of $\frac{3}{8}$ in.

A No. 7 taper pin $2\frac{1}{2}$ in. long was driven into the hole and beaded in the small end of the hole. The extension was then trued up to the same diameter as the exciter shaft, a keyway was cut and a flexible coupling mounted for connection to the motor.

This coupling has been in successful operation for about three years under varying load conditions from full load as a motor to about half full load as an induction generator. This range of load is obtained with a speed variation of about 5 per cent. The rated speed of the exciter set is 1,050 r.p.m., and the synchronous speed of the motor is 1,000 r.p.m. Under certain operating conditions the output of this motor operating as an induction generator is greater than the energy required for station light and power, and the meter measuring the load is run backward. The exciter is rated at 35 kw. and the motor at 50 hp.

If the nozzle of the waterwheel becomes plugged, the motor automatically picks up the load when the speed



THREADED SHAFT EXTENSION SAVED COST OF NEW SHAFT

of the exciter falls below the synchronous speed of the motor.

A considerable saving of power has been effected by the installation of this motor.

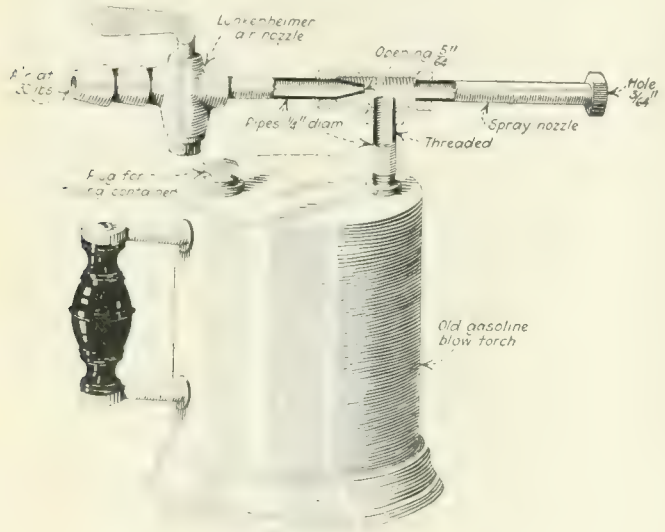
J. W. ANDREE,
Assistant Superintendent of Generation.
Southern California Edison Company,
Los Angeles, Cal.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Air Brush Made from Old Torch for Applying Insulating Paint

FOR applying insulating varnish to windings of motors which have been repaired and for other painting work an air brush has been made by the writer from an old gasoline blowtorch. By means of this brush the paint is thoroughly applied into all crevices, and painting is done about five times as fast as with the ordinary hair brush. To make the brush the burner was removed from the torch and a nozzle was inserted for spraying the paint. This nozzle is made of three



INSULATING PAINT APPLIED WITH THIS AIR BRUSH ENTERS SMALL CREVICES

pipes ¼ in. in diameter. The first pipe is connected to an air supply at a pressure of 35 lb. per square inch. This air is forced through a 5/64-in. opening and passes as a jet across the top of the vertical pipe, which is screwed down into the torch. The suction thus produced raises the paint in the vertical pipe, and the jet of air forces it into the second horizontal pipe and through the 3/64-in. hole in the nozzle. A Lunkenheimer air valve is installed in the supply line to regulate the flow of air. The pump was removed from the blowtorch and a plug was substituted which can be easily unscrewed for the purpose of filling the container.

The nozzle opening of 5/64 in. has been found very satisfactory for all the grades of paint which have been tried. These include a No. 913 "imperial compound" (Canadian General Electric Company), which is used for general insulating and preservative purposes. Its brilliant surface is of great durability on iron work of all kinds, and it is air-drying. A glossy finishing varnish of the Westinghouse Electric & Manufacturing Company has been successfully used. This is an oil-proof insulating varnish which dries quickly. Another varnish manufactured by the same company is a medium-glossy black, air-drying, insulating and protective paint which is flexible under most conditions and resists acids, alkali, fumes and moisture. Another paint which has been applied successfully is switchboard lacquer, a dead-black paint for producing a velvety finish on rough or smooth surfaces. Although this varnish will dry in air in fifteen minutes, it gives the best finish if it is baked two and one-half hours at 35 deg. C.

Trail, B. C., Canada. R. H. N. LOCKYER.

Design of Lighting System Must Consider Cost of Cleaning Fixtures

IN DESIGNING a lighting system the cost of maintenance should always have careful consideration. A system which requires very frequent cleaning may be much more expensive in the long run than a system with a higher first cost. The frequency of cleaning lighting fixtures depends upon the following factors: (1) Illumination required; (2) illumination provided by clean equipment; (3) type of fixture; (4) design of fixture; (5) materials of fixture; (6) cleanliness of the air; (7) season of the year; (8) method of cleaning.

The illumination required is determined by the sort of work to be done in the light produced by the system. The smaller the margin between the illumination required and the illumination provided the more frequently will the lamps and reflectors or other fixtures have to be cleaned.

The shape of the fixture largely determines the amount of dust and dirt it will catch. From the point of view of cleanliness only, the ideal shape is of such design that there is no exposed upward transmitting or reflecting surface lying anywhere near the horizontal. This is obtained in the direct-lighting reflector, but it is not commonly found in the semi-indirect fixture and never in the indirect.

Except for one shape (RLM standard) the design of lighting fixtures has not yet been standardized. The design largely determines the amount of light lost by cross-reflection and absorption. There are on the market automatic cut-out hangers which enable the usual industrial reflector to be lowered to the floor for cleaning. When for any reason the use of such an arrangement is impossible (as with the lamps in the roof trusses over traveling cranes) fixtures may be used of such design that the dirty reflector can be detached and a clean one put in its place without disturbing the socket or mountings.

The materials in the fixture determine to some extent the light absorption and the degree to which the dirt in the air will adhere to the surfaces, as well as the difficulty which will be met in its removal. Some materials cannot be washed as clean as they originally were, and some turn yellow with age. The amount and the character of the dirt in the air and its adhesive

qualities differ, of course, in different cities, locations and industries.

In the winter cleaning may have to be done more frequently owing to the shortening of the days and the increase in the amount of dirt collected. As the days become shorter the difference between the illumination available (including the natural light) and that required becomes smaller.

There is no longer any excuse for installing a lighting system without a careful illumination design having first been made. If an illuminating engineer cannot be retained, any large lamp or fixture manufacturer will gladly draw up his design free of charge on receipt of the required information.

D. W. BLAKESLEE.

Pittsburgh, Pa.

Close Inspection Insures Good Motor Service

CLOSE inspection of motors, depending in frequency upon their location and the character of service they perform, has been a vital factor in the maintenance of production with few interruptions from motive-power troubles at the factory of the Seymour Manufacturing Company, Seymour, Conn. In this plant 179 motors are installed and operating, totaling 3,058 hp. and ranging in size from "fractionals" to 500 hp.

If the motor is installed in a clean location and is not used continuously, it may not require inspection or oiling more than once a month. But if it is in a hot, dirty place, with perhaps a heavy belt pull, it may be blown out and oiled weekly. Air-gap testing depends on the motor service. If the motor is belt-connected or geared to the driven equipment, air gaps are inspected every fortnight and in some cases weekly. Extreme care is used in watching air gaps and replacing worn bearings before any harm has been done to the motors. Direct-connected motors are not watched so closely, since these give almost no trouble. The motors are divided into two sections, with a man in charge of each section who is held strictly responsible for operating results. These men oil the motors, and in case a motor becomes dirty they make arrangements to have it blown out, cleaned and the windings revarnished and perhaps painted. The inspections require on the average one full day of ten hours for two men each week. Instruction sheets are not used to check inspections. If a motor is in good operating condition, no report is made, but if repairs are necessary, the inspectors report and make preparations for such work. More than 95 per cent of the motors are three-phase, 440-volt, 60-cycle machines, and of these about 10 per cent are slip-ring motors, the rest being of the squirrel-cage type. No dollars and cents record of motor maintenance is kept.

Up to about Jan. 15 the company employed five men who, in addition to motor maintenance, handled all new installation work and change-overs of all electrical equipment in the factory, besides having care of transformers, lamps, meters, clock, autocall and fire-alarm systems, looking after six electric trucks equipped with alkaline batteries, and being charged with the maintenance of all cranes and hoists.

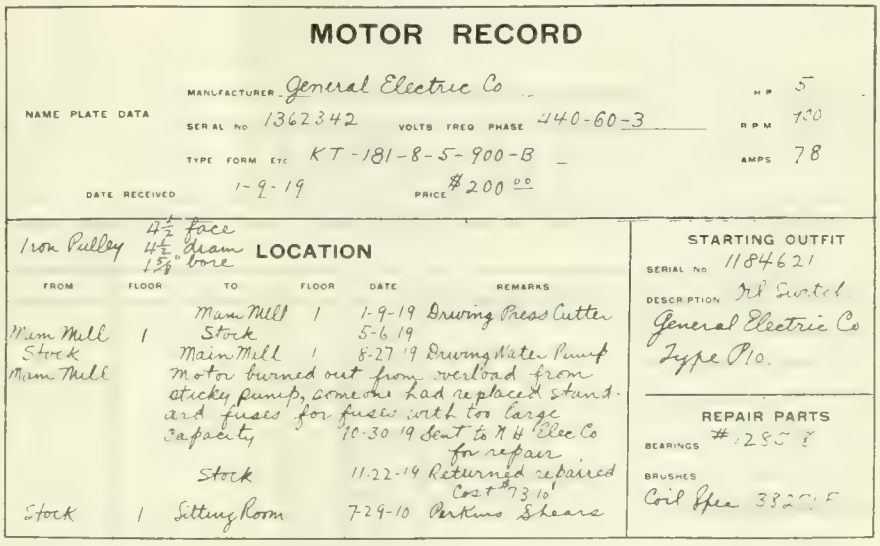
SUBDIVISION OF MOTORS TOTALING 3,058 HP., WHICH ARE INSPECTED PERIODICALLY

No. of Motors	Size, Hp.	Sets of Bearings Carried	No. of Motors	Size, Hp.	Sets of Bearings Carried
1	500	1	10	15	2
2	250	1	25	10	5
1	200	1	33	7½	6
1	150	1	36	5	7
2	75	1	20	3	4
2	50	1			
2	40	1	5	2	1
5	30	1	5	1	1
10	25	2	16	Fractional	
3	20	1			

The company does not rewind motors, having found that it does not pay to keep supplies and equipment for this purpose in view of the small amount of work required. Only five motors have burned out in the past four and one-half years, and these were all 15 hp. or below in rating.

On motors of above 50 hp. the company does not make a practice of carrying spare bearings unless the motor is operating under hard service in a dirty location. Then it is considered safer to carry one set for each size. As the plant is within 16 miles of New Haven, a large jobbing center, it is unnecessary to carry as much spare material as would be the case in a more remote situation. A fair average of spare bearings carried for smaller motors is about one set for every five motors. For slip-ring motors one set of brushes is carried in stock for each size and a new set is ordered when these are drawn. On controllers for slip-ring motors so many different sizes are used in the plant that no spare parts are carried in stock. These controllers, however, are closely watched and new parts are ordered well in advance of wearing out, and of course promptly in case of burn-outs. Spare parts would be carried if enough controllers of one size were in use in the factory.

Motors of 7½-hp. ratings and below are equipped almost exclusively with small oil switches, and for these the company carries about one complete set of switches and fingers for every fifteen oil switches. This has proved sufficient because it is seldom necessary to change a whole set, and usually only one or two of a



MOTOR RECORD

NAME PLATE DATA
MANUFACTURER General Electric Co
SERIAL No 1362342 VOLTS FREQ PHASE 440-60-3
TYPE FORM ETC KT-181-8-5-900-B
DATE RECEIVED 1-9-19 PRICE $200.00
HP 5 RPM 900 AMPS 7.8

Iron Pulley 4½ Face 4½ Diam 1⅝" bore

LOCATION

FROM	FLOOR	TO	FLOOR	DATE	REMARKS
		Main Mill	1	1-9-19	Driving Press Cutter
Main Mill Stock	1	Stock		5-6-19	
Stock		Main Mill	1	8-27-19	Driving Water Pump
Main Mill		Motor burned out from overload from sticky pump, someone had replaced standard fuses for fuses with too large capacity		10-30-19	Sent to N H Elec Co for repair
		Stock		11-22-19	Returned repaired Cost $73.10
Stock	1	Sitting Room		7-29-10	Perkins Shears

STARTING OUTFIT
SERIAL No 1184621
DESCRIPTION 3/4 Switch General Electric Co Type P10.

REPAIR PARTS
BEARINGS #1285 F
BRUSHES Coil Spec 3820 F

RECORD FORM WHICH GIVES THE HISTORY OF A MOTOR THROUGH ITS VARIOUS LOCATIONS AND REPAIRS

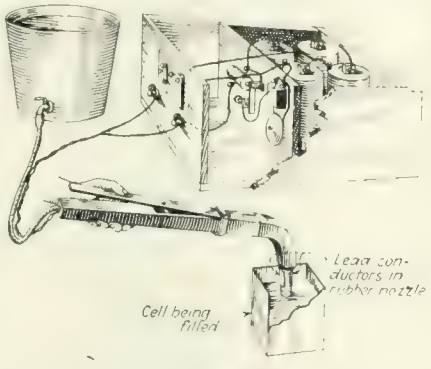
set. On compensators about the same proportion as on oil switches is followed. As oil switches are constantly in use, at least four are generally carried in stock in order to replace any broken ones.

Motor records are kept on cards about 5 in. x 8 in. in size, as shown. Data relative to make, size, speed, type, etc., are kept, with notes on the number and type of starter used, repair parts with manufacturer's number, and pulley data. Space is provided on each card to show the location and duty of each motor, and transfers from one location to another are indicated, with dates of repairs (when required), period in stock and dates of withdrawal for later service.

L. N. Burhoe,
Electrical Engineer.
Seymour Manufacturing Company,
Seymour, Conn.

Filler for Storage Batteries Indicates When Proper Level Is Reached

When storage batteries are being filled by means of the device shown in the accompanying drawing the ringing of a bell announces that the level of the electrolyte is at the proper height, and therefore no close watching by the battery man is necessary. Besides this feature, the filler prevents spilling of water on the top of the cells, thus preventing grounds which cause burning of the rubber jars and deterioration of the trays, and it also serves as a check on the specific gravity of the electrolyte, keeping it constant by not allowing more water to be put into the cells than the quantity lost by evaporation. The filler consists of a wooden handle through which soft rubber tubing and insulated wires pass to the rubber nozzle. This nozzle is joined to the lower end of the handle. The end of the nozzle fits into the vent hole in the top of a cell, while a shoulder larger than the hole prevents the nozzle from going too far. Inlaid in the nozzle are two lead conductors attached to the rubber and connected to the two insulated wires which are run through the handle. When the electrolyte in the cell reaches the proper height it short-circuits these two lead conductors, closing the circuit through a relay and a battery of three or four cells, as conditions of the battery may require. The closing of the relay throws the bell into the circuit with the dry cells. When the bell rings the operator cuts off the flow of water by compressing the lever, which has a projection that presses on the rubber tube in the handle and shuts off the flow of liquid.



SHORT-CIRCUITING OF LEAD CONDUCTORS CAUSES BELL TO RING WHEN ELECTROLYTE REACHES PROPER LEVEL

The filler also serves another function. If the gravity of a cell is very low, the bell will not ring until the electrolyte rises to such a height that it overflows the top of the plates.

When the electrolyte is of such a low specific gravity it indicates that the cell is internally short-circuited and should be removed from service.

The function of the switch is to make a circuit of three dry cells when the battery is filled in time and the level of the solution has not been allowed to fall much below the tops of the plates. If, however, the water in the solution has been allowed to evaporate so that its level is much lower than the tops of the plates, or, if for some cause the specific gravity of the electrolyte is very low, the switch is utilized to add the fourth cell to the circuit and thus overcome the increased resistance of the medium through which current must pass, in order to bring about the ringing of the bell when the proper level is reached.

This filler, which is patented, has been used successfully for some time in the vehicle-battery departments of the New York Edison and Consolidated Gas companies of New York City.

A. Sheinaus,
Fore Battery Man, Auto Department.
New York Edison Company,
New York.

Study of Ratings Makes Possible Reduction in Number of Motor Sizes

By a careful consideration of the motor ratings in a plant it is often possible to reduce the number of sizes and types, and consequently the number of spare parts, carried in stock for emergency repairs. It should be realized that no matter how well apparatus is built, how carefully it may be installed and looked after, some of the parts will wear out in continuous hard usage and must be replaced—wherever possible before an actual breakdown occurs. Preparedness in the form of an ample supply of spares and repair parts, which permit quick renewal of defective parts, is therefore wise. But a large stock of such parts, aside from space requirements, involves a large investment. It is for this reason that pressure is exerted by the management upon those in charge of electrical equipment to reduce to a minimum the amount of money tied up in spares and repair parts, and it is in this direction that efforts should be made through standardization of ratings.

TABLE I—STANDARD LIST OF 239-VOLT DIRECT-CURRENT MOTOR RATINGS PREPARED BY ONE PLANT OF THE UNITED STATES STEEL CORPORATION

Open Frame, Constant Speed,		Open-Frame, Adjustable Speed,			Totally Inclosed Frame, Constant-Speed,	
Hp.	R.P.M.	Hp.	R.P.M.		Hp.	R.P.M.
2	1200	2½	1,100	2,200	1½	1,500
3	775	3½	660	2,000	5½	1,150
7½	975	6½	450	1,800	10	975
15	825	18	780	1,560	13	875
20	750	25	600	1,800	18	900
30	725	35	650	1,300	25	900
65	875	50	700	850	.	.....
75	635	75	600	1,200	.	.....
100	500	100	475	900		....

Many of the older plants still suffer from past sins of commission or omission and have a veritable museum of makes and types and sizes of motors on their hands. Sometimes, owing perhaps to a natural development, both alternating and direct current are in use and different voltages and frequencies as well.

Further than that, the writer strongly feels that standardizing on a certain rating for motors which shall be used in a certain plant and limiting the number of such ratings as much as possible will result in a great economic advantage to both user and maker. An analysis of conditions at various plants has demonstrated the possibilities along this line. By tabulating the various motors in use as to capacity, speed and

other characteristics it becomes evident in every large plant that a considerable reduction in the number of sizes can be made. This not only results in relieving the spare-parts situation, but also facilitates the shifting around of motors as operating conditions or changing requirements of production may demand.

It has also been found that such standardizing of certain ratings, particularly when several large users of motors get together and agree on a common list of ratings, results in better service and deliveries from the motor manufacturer, as the latter is then in a position to prepare for the requirements of a customer on the basis of the standard list of selected ratings. The fact that so many different sizes of motors are used in a plant at times is in part due, not to the selection of the ultimate user, but rather of the machine-tool builder, crane or pump manufacturer. In such cases large plants should provide, as a few of them have provided, their suppliers of machine tools and other motor-driven equipment with a list of selected ratings and limit the motors to these sizes.

TABLE II—STANDARD LIST OF 230-VOLT, DIRECT-CURRENT MOTORS AND 220-VOLT ALTERNATING-CURRENT MOTORS, PREPARED BY ANOTHER PLANT OF THE UNITED STATES STEEL CORPORATION

Alternating-Current, 220-Volt Three-Phase				Direct-Current, 230-Volt			
25-Cycles		60-Cycles		Shunt or Compound Wound		Shunt-Wound Adjustable-Speed	
Hp.	R.P.M.	Hp.	R.P.M.	Hp.	R.P.M.	Hp.	R.P.M.
5	720	5	675	5	1,100	5	400 to 1,200
7½	725	7½	680	7½	1,150	7½	400 1,200
10	725	10	680	10	1,150	10	400/1,200
20	730	20	685	20	1,100	20	400 1,200
40	725	40	685	30	1,150	32½	400 1,200
50	730	50	690	50	750	50	350 1,050
75	725	75	700	75	635	.	.
100	725	100	700	100	625		
150	725	150	700	....	....		
200	485	200	700	.		.	. .

The above will best be understood by referring to Tables I and II, which show ratings as selected and standardized some time ago by two of the large steel companies. Considering the large number of motors used in these plants and the many different service requirements, the present small number of ratings is remarkable compared with past practice. In selecting the ratings listed particular attention was given to picking out ratings which would result in a minimum number of different mechanical parts or frame sizes. The entire list of twenty-four direct-current ratings, for example, is covered by ten different frame sizes, which therefore required only ten different sizes of bearings.

C. W. STARKER,
Electrical Engineer.

Roth Brothers & Company,
Chicago, Ill.

Proper Combination of Motor and Flywheel Increases Power Factor

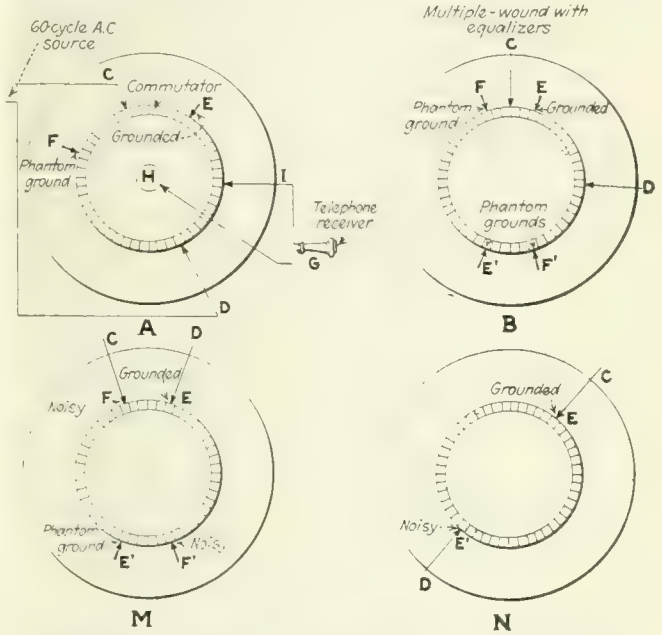
IN PLANTS using shears, punches, rolls and other machines equipped with flywheels the low power factor often caused by overmotoring can be eliminated by a careful study to obtain the best combination of motor and flywheel. In many cases it will be found that the motor installed has sufficient power to perform the duty cycle without the flywheel. In one mill, which had a power factor varying from 40 to 60 per cent, there was found a special welding roll which was driven by a 200-hp. squirrel-cage motor. A heavy flywheel was used, but the motor had only about 2 per cent slip and therefore carried virtually the entire load. This condition lasted only a few seconds out of several minutes, so that most of the time the motor was running idle. By a proper combination of motor and flywheel it was possible to substitute a 50-hp. motor which materially reduced the wattless kva.

C. W. DRAKE,
General Engineer.

Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Locating Solid Ground in Armature

FOR locating a solidly grounded coil of a direct-current armature use may be made of a telephone receiver. Often a coil makes such good contact with the iron of the machine that it cannot be detected by passing direct current from coil to frame and noticing the point where smoke comes out. A machine with a solid ground is shown in sketch A. This is a multiple-wound armature without equalizers, having a ground at *E*. Sixty-cycle current is passed through the armature from two opposite points on the commutator, *C* and *D*. The current should be limited by a rheostat to about 5 per cent to 10 per cent of the full-load current of the winding. If one side of the alternating-current line is grounded the motor frame should be insulated from ground while making the test. The armature is placed on horses and the leads of a telephone receiver are connected to the shaft *H* and the commutator. The lead on the commutator is moved around until it reaches bars where the noise in the receiver ceases. These bars will be at *E* and *F*. The bar *F* will be silent because it is at the same potential as *E*. After these two bars are marked the alternating-current leads are attached to *E* and *F*. On testing with the receiver *E* will now be silent and *F* noisy, proving that *E* is grounded.



METHOD OF LOCATING A GROUND WITH A TELEPHONE RECEIVER

In a multiple-wound armature with equalizer rings, as shown in sketch B, silent points will first occur at *E* and *F* and at *E′* and *F″*. Then connect leads *C* and *D* at *E* and *F* as in *M*. With this connection *E* and *E′* will be silent and *F* and *F′* noisy. Then connect the

current leads to E and E' (sketch N). Under this condition E' will be noisy and E will be silent, showing the grounded point to be at E. The point always remaining quiet is grounded.

If alternating current is not available, direct current may be used, interrupting it with a knife switch moved steadily in and out for low-resistance armatures or with a buzzer connected in series for high-resistance armatures. The buzzer, or course, should be used on its rated voltage.

F. W. Gay.

Newark, N. J.

Decreasing Electrode Consumption in Electric Furnace

UNWARRANTED oxidation is the most frequent cause of excessive electrode consumption. When this wasteful oxidation occurs under the furnace roof it is known as "spindling" of the electrode. When oxidation occurs only near the furnace roof, or some distance above the charge in an open furnace, it is known as "wasping" of the electrode. Spindling is caused either by the evolution of oxidizing gases from the charge (due to insufficient carbon) or by a leaky furnace door allowing air to be drawn into the furnace and then up and around the electrode and out through the roof ports. Wasping is caused by the electrode becoming excessively hot above the roof. This excessive heating may be caused by an electrical overload so heavy that the electrode is carrying more current than it was designed to carry, or by faulty operation of the furnace making the arc too near the roof.

It is a generally accepted fact that the main waste of an electrode in the ordinary steel furnace does not take place at the arcing end but results from surface burning in the form of spindling as described. In furnace operations where the ordinary causes of spindling cannot be otherwise overcome various attempts to prevent this waste have been made, such as these: (1) Covering the electrode with asbestos coating held in position with wire netting; (2) coating the electrode with non-burning paint; (3) surrounding the electrode with steel collars held together with springs or hinges; (4) surrounding the electrode with a water-cooled collar extending well into the furnace.

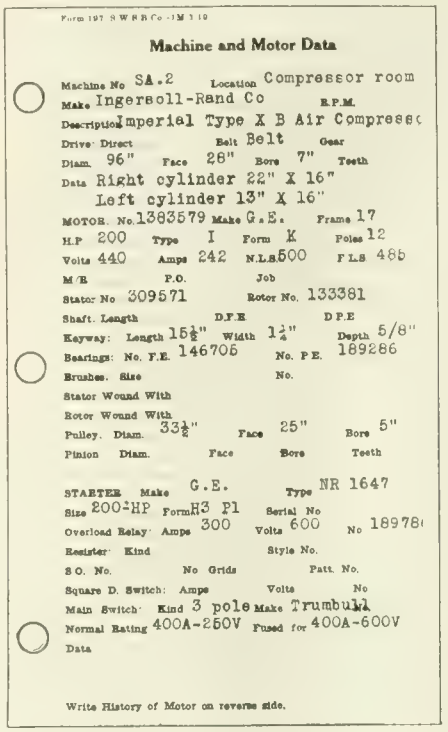
One of the most important factors in insuring minimum oxidation of an electrode is the proper handling of the furnace after it has been shut down. The following suggestions are sometimes heeded as a help in getting lower oxidation upon the stopping of furnace operation: (1) Lute the clearance between the roof glands and the electrodes with fireclay, and (2) before closing the furnace doors place a large piece of soft coal on the sill of each. The heat of the furnace will drive the gas from the coal, producing in the melting chamber of the furnace a non-oxidizing atmosphere in which the electrode may hang for a long time without burning. Care should be used to remove the luting around the electrode upon resuming the operation of the furnace.

If wasping has started on an electrode, it is almost impossible to stop it, and it is advisable to discard the affected electrode. Care should be taken that the support is directly over the center of the roof gland; also that the electrode holder is vertical so as to avoid subjecting the electrode to strain.

The National Carbon Company, Inc., furnished this information.

Machine and Motor Records Aid Speedy Repairs

ONE of the chief aids in keeping track of the equipment, and thereby speeding repairs, in the plant of the Southwestern Shipbuilding Company has been motor and machine records kept on cards and in loose-leaf books. The cards constitute a cross-index for the records in the loose-leaf books. The former are filed according to the motor horsepower. They contain full information on the motor and tell on what machine it is installed. In the loose-leaf books the sheets are filed according to the shops in which the motors are located, the sheets for each shop being filed by machine serial numbers. These sheets contain information on the machine, including data on motor and control equipment necessary for ordering new parts.


Machine and Motor Data

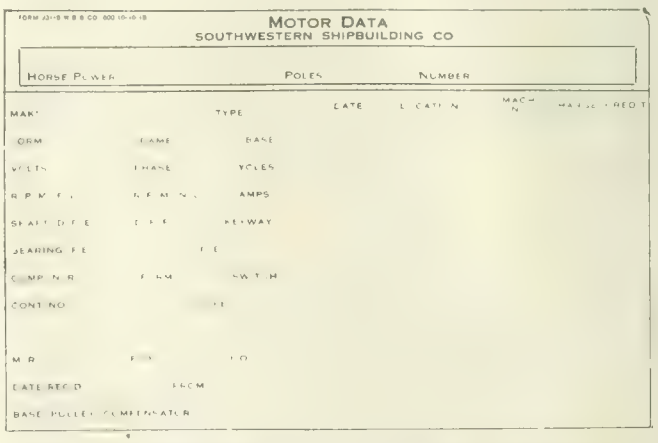
Machine No SA.2 Location Compressor room
Make Ingersoll-Rand Co R.P.M.
Description Imperial Type X B Air Compressc
Drive: Direct Belt Gear
Diam. 96" Face 28" Bore 7" Teeth
Data Right cylinder 22" X 16"
Left cylinder 13" X 16"
MOTOR. No. 1383579 Make G.E. Frame 17
H.P 200 Type I Form K Poles 12
Volts 440 Amps 242 N.L.S 500 F.L.S 485
M/R P.O. Job
Stator No 309571 Rotor No. 133381
Shaft. Length D.F.E D.P.E
Keyway: Length 15½" Width 1¼" Depth 5/8"
Bearings: No. F.E. 146705 No. P.E. 189286
Brushes. Size No.
Stator Wound With
Rotor Wound With
Pulley. Diam. 33½" Face 25" Bore 5"
Pinion Diam. Face Bore Teeth

STARTER Make G.E. Type NR 1647
Size 200-HP Form H3 P1 Serial No
Overload Relay: Amps 300 Volts 600 No 18978(
Resister: Kind Style No.
S.O. No. No Grids Patt. No.
Square D. Switch: Amps Volts No
Main Switch: Kind 3 pole Make Trumbull
Normal Rating 400A-250V Fused for 400A-600V
Data

Write History of Motor on reverse side.

SHEET FOR DRIVEN MACHINE GIVES MOTOR NUMBER AND SIZE

The terms and abbreviations used which are not self-explanatory are: M/R, material request form on which material needed is requested from the purchasing agent; P.O., the purchasing agent's orders; Job, the job numbers under which jobs costing over $50 are done; D.F.E. and D.P.E., diameter respectively of front and pulley end of shaft; Bearings No. F.E. and P.E., numbers respectively of front-end and pulley-end bearings; Rotor, or Stator, Wound With, size of wire given.


MOTOR DATA
SOUTHWESTERN SHIPBUILDING CO

HORSE POWER POLES NUMBER

MAKE TYPE CATE L CATI N MAC N MAKE RED T
ORM FRAME BASE
VOLTS PHASE CYCLES
R P M F L R P M N L AMPS
SHAFT D F E D P E KEYWAY
BEARING F E P E
COMP N R F S M SWITCH
CONT NO
M R FOR TO
DATE REC D FROM
BASE PULLEY COMPENSATOR

CARD WITH COMPLETE MOTOR DATA FILED ACCORDING TO HORSEPOWER OF MOTOR

Southwestern Shipbuilding Co. A. G. Humphrey,
East San Pedro, Cal. Electrical Engineer.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Buffalo Company's Customers Increased 900 per Cent in Past Decade

IN THE accompanying diagram is shown the number of customers connected to the lines of the Buffalo General Electric Company at the end of each year from 1892 to 1920. The number on Dec. 31, 1920, was 85,008, an average of one customer to every six of the population of the city of Buffalo, which the last census gives as 506,775. The diagram shows a remarkably rapid growth in the number of customers from year to year. For the year 1920 the increase is a little more than 30 per cent. It is interesting, however, to compare the increase in customers with the increase in Buffalo's population over the same period. Going back to the 1900 census, the population was 352,387, while the number of electric customers at that time was approximately 1,000—only one customer to every 352 of population. In 1910 Buffalo had a population of 423,715, a 20.2 per cent increase, while electric consumers had increased to about 8,500, or 750 per cent. During the ten years just past the population increased by 19.6 per cent, but in the same period the Buffalo General Electric Company increased its customers by 900 per cent. In other words, the users of electric light and power in Buffalo have increased forty-six times faster than has the city's population.

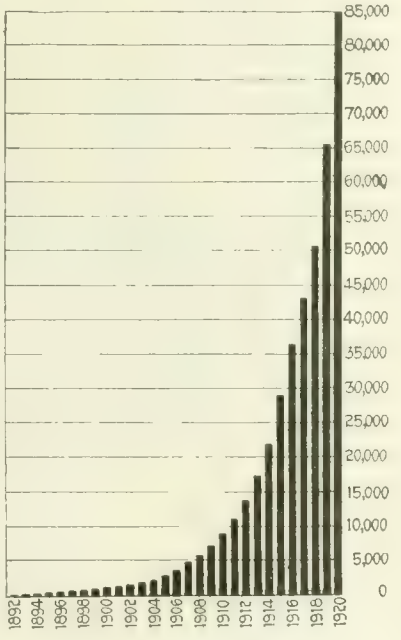


DIAGRAM SHOWING INCREASE IN CUSTOMERS

Equalizing Seasonal Rates for Energy

A METHOD of equalizing seasonal energy rates which has proved remarkably acceptable to the public was described at a meeting of the Commercial Section of the New England Division, N. E. L. A., March 18, by Frank R. Fowles, Cumberland County Power & Light Company, Portland, Me. A heavy summer cottage and hotel business is handled by this company along the southern Maine coastline, and the rate schedule now in force charges the customers of the company 15 cents per kilowatt-hour throughout the four summer months, including both summer and permanent residents. Every customer, however, is allowed to purchase as much energy during the winter season at 5 cents per kilowatt-hour as he purchased at 15 cents per kilowatt-hour during the summer. The remainder of the energy consumed is billed at 10 cents per kilowatt-hour. This arrangement avoids discrimination between summer and year-around customers' bills during the summer season and leads to the carrying of a proper share of the cost of serving these seasonal customers by those who reside in the territory for a short time only.

"The People's Project"—An Address by R. H. Ballard

IN AN address which had for its subject "The People's Project," made at a meeting of the district managers of the Southern California Edison Company in Los Angeles on Feb. 17 last, R. H. Ballard, vice-president and general manager of the company and past-president of the National Electric Light Association, emphasized the fact that the section served cannot reach its highest development and the money for construction needs be obtained except through patriotic co-operation of the people at large with the public utility. In developing this subject he said:

"Public utility service is created for serving the public, which means that every individual in the community which it serves is a patron. The service must be ready at all times to supply all the people with water, gas, electricity, transportation and telephone and telegraph message transmission. Stripped of its legal and technical definitions, a public utility is the servant of all the people. The utilities should be one good lap in advance of the demands of their patrons because, under the conditions of modern life and bearing in mind the conveniences which the people now demand as necessities, no community can grow in advance of the service which the public utilities render.

"Every project which has for its ultimate aim the building up of a domain such as southern California into one of the great centers of the nation's population, and the building up of which multiplies almost beyond mathematical conception both individual and community wealth, should be a project of the people. A better understanding will be reached when the people fully understand that under government and state regulation public utility companies are public agencies and not money-making machines. They function for the public as contractors, providing service at cost. Labor, material, supplies, money and everything that enters into their service must be purchased and accounted for at cost. The state imposes certain duties and obligations for the utility to meet, and the right of the state to regulate involves the obligation to protect.

"To southern California has come a phenomenal growth in industrial and agricultural activities relatively not surpassed in any section of the country, and, in addition, we receive a continual procession of cultivated people who look for and expect the highest form of public service. This has placed upon these public contractors a phenomenal burden, since the demands for service are at least twice those which were expected based on only normal growth. It is their duty, nevertheless, to keep their service ahead of the demand, otherwise those who seek to make their homes in our community might be deterred.

"Think of what is transpiring! It is indicated by all of the public service records—water, gas, electricity, telephones and railways—that the population of Los Angeles alone has increased by 100,000 in the past year. This 17 per cent increase is in contrast with an accumulative increase of 6½ per cent a year during the previous ten years.

"Take the telephone situation as an illustration: Notwithstanding the installation of 9,000 additional phones during the past year, there remain unfilled orders of more than that number.

"What we have virtually done in the last year is to plant another city of 100,000 population on the map of the United States, within our own boundaries, and in a measure this growth has been repeated on a smaller scale in other centers of population in southern California. The unthinking person imagines that the public service company can jump in instantly and fill all the requirements created by this unprecedented growth. The manufacturing facilities of all of the great electric concerns of America could not accept such an order without casting aside the demands of their other customers in Europe and America. At this juncture it is well to remember that the consumption in utilities, and therefore the demand on public service agencies, increases in a ratio much greater than the ratio of increase in population.

Increased Demand for Service

"It was only a few years ago that the supply of gas in southern California was greatly augmented by the bringing in of enormous quantities of natural gas from distant fields at tremendous expense. Nevertheless, both last year and this year, during certain months, we have been confronted with a gas shortage.

"Our street railways have added hundreds of additional cars to their service lines, yet one can hardly find standing room in them through many hours of the day. The water service in Los Angeles has been adequate so fas as the supply of water is concerned, owing to the foresight of those who conceived and carried through the construction of our great aqueduct system; but the cost has been very great and millions of additional funds will be constantly needed for extensions, reinforcement of distributing systems and reservoirs.

"In ten years the population of the State of California increased about 45 per cent, but the electrical output increased more than 300 per cent. During the past year we passed through a power shortage in California that was one of the most critical periods in its history. The electric companies operating in the territory managed to function, although the demand upon them was greatest of all, owing to the exhaustion or greatly increased cost of other forms of energy and the increasing number of uses to which electricity is applied.

"Our steam railroads have recently had their systems thrown back on their hands after the governmental experiment which resulted in enormous increases in operating expenses, many of which were unnecessary, and a deplorable lack of care of the property through insufficient maintenance and inefficient upkeep expenditures. Electrification of the steam railroads is one of the problems which confront the power companies.

Hydro-Electric Development Most Essential

"Without enormous hydro-electric development southern California cannot become the manufacturing and agricultural center which it should be destined to be because of its favorable situation with respect to the world's markets. The realization of its destiny depends upon the enhanced development of hydro-electric energy to provide the motive force for industrial and agricultural purposes and for commercial and domestic uses.

"Because of the diversity of its use, the development of 50,000 hp. of electric energy will provide ample service for 32,250 residences and 300 factories and for the irrigation of 100,000 acres of land. This is, approximately, the present annual increase in demand, to provide for which requires the expenditure of $15,000,000 for power development and distribution, with a consequent expenditure by the consumers of twice that amount for house and factory wiring and in the purchase of motors and installation of thousands of useful and necessary electrical household appliances. Thus $45,000,000 of business is created annually. This, however, is only incidental to the increase in community wealth, population, payrolls and production which follows the development and use of the power. This increase has been capitalized by some authorities at more than $250,000,000 a year. Electrical energy is one of the three component parts entering into the creation of public wealth, namely, products of the soil, brains of man, power. Other sources of power are becoming exhausted, but as long as nature functions and the snows fall hydro-electric power will be available for the service of mankind.

"If we are to continue to grow, then all the people must realize that the public utilities are fundamental necessities and for the most part must be provided considerably in advance of actual needs, since great hydro-electric power plants, railway and telephone systems cannot be built over night. Intelligent, earnest co-operation with those who have studied the utility problems and have scientific assurance of coming demands is the answer to the great question of keeping utilities in advance of our expected necessities and stimulating the growth and advancement of our richly endowed Southland. Fair earning under strict regulation is fundamental if a utility is to provide adequate service and market its securities for construction work.

"To provide these services requires some form of public ownership, and the kind of public ownership which has been proved successful is ownership by the public at large in the securities of its local utility companies operated under rigid state regulation. This forms a partnership which leads to complete understanding and co-operative efforts in development and retains in the management and operation of the utilities those trained by long experience to perform the task. A sound financial showing, backed by such public support, will induce the people in the territories served to purchase the junior securities or stock of our utilities to the extent of, say, one-half of the funds necessary to be secured in financing new development. Automatically, the util-

ity is then placed in a position to borrow the other half in the Eastern money market, by the sale of bonds, and thus a local investment of one dollar insures a local development of two dollars.

"When the people of southern California understand and appreciate that every dollar they invest in the securities of our local public utilities brings additional dollars to be expended in labor, material and merchandise and for the upbuilding of those things which are essential to the doubling and trebling of the population, I do not think that they can fail to see it in the light that I see it—the people's project.

"No longer can it be truthfully said that a public service company is a thing apart, an alien in the community, with interests antagonistic to the general welfare. These public agencies are integral parts of the communities they serve, and especially is this true of those companies whose capital is widely owned by the people who depend upon them for an essential service."



Electric Servantless Apartment

PARTICULARLY appealing to the city dweller who is constantly confronted by the servant problem is an electric apartment recently opened in the Borough of Queens, New York City. A six-room apartment in the Garden Apartments was completely equipped with electrical labor-saving devices and additional floor and wall outlets were provided.

Reproduced here are an exterior view of the apartment building and the kitchen and nursery of the electrical apartment. In the kitchen the following electrical appliances were in operation: Electric range, cooker, dishwasher, cake and dough mixer, refrigerator, washing machine, iron and fan. In the nursery were a milk warmer, miniature electric heating pad, toy electric range, electrically heated toy steam engine, electric boat and suitable nursery lamps.

The equipment of the dining room consisted of an electric percolator, toaster-stove, chafing dish, ovenette, waffle iron, grill and an egg beater and mixer. In addition to the usual table and floor lamps and ceiling fixtures in the living room an electric player piano and an electric phonograph were installed. In one bedroom were an electric heating pad, vibrator, curling iron, radiator and bedside lamp, while in the other bedroom, which was also used as a sewing room, an electric sewing machine, violet ray outfit, boudoir electric iron, headlight heater and electric hair drier were installed.

The electric servantless apartment is being conducted co-operatively by the Queensboro Corporation, builders of the apartment house; the electric appliance manufacturers and one of the leading furniture dealers of New York as a demonstration of how completely servants can be eliminated by the use of electric labor-saving devices.





VIEWS OF THE ELECTRIC SERVANTLESS APARTMENT, SHOWING THE NURSERY AND KITCHEN AND THE EXTERIOR OF THE APARTMENT BUILDING

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

The Story of the Induction Motor.—B. G. LAMME.—This paper covers the history of the technical side of induction-motor development. The various stages are indicated from the early Tesla motor with polar-field construction to the distributed-field construction and from the early wound-rotor type to the later universal cage type. Reference is made to the development of the cage motor with high starting torque and the reasons which led up to it. The early single-phase induction motor is also treated, indicating various stages in its development. The latter part of the paper covers the applications of the induction motors to various unusual services such as heavy mill work, locomotive operation, ship propulsion, etc. The paper refers principally to American practice and primarily to development work of the company with which the writer is connected.—*Journal A. I. E. E.*, March, 1921.

Lamps and Lighting

Removable Fixtures.—A series of discussions dealing with the advantages and practicability of using electrical fixtures of a removable type. The significance of the proposition is outlined by O. H. Caldwell, its relation to better lighting by M. Luckiesh, the fixture man's viewpoint by W. R. McCoy, and how the proposition affects the contractor-dealer by W. J. Shore.—*Transactions I. E. S.*, March 21, 1921.

Merchant Marine Searchlamps.—G. E. YOUNG.—The importance of searchlamps for marine use is evident from consideration of the following uses: (1) Locating man overboard, (2) assisting another ship in distress, (3) passing through wreckage, (4) signaling between ships or between ship and shore, (5) lighting buoys and other navigational marks, (6) lighting docks in landing or during coaling operations. Some elements in the control of searchlamps for marine use are given.—*General Electric Review*, February, 1921.

Generation, Transmission and Distribution

Calculation of Voltage Drop in Three-Phase Transmission Lines.—G. HULDSCHINER.—The voltage drop in three-phase lines is investigated for differently arranged wires, and it is shown that a considerable improvement of the drop (as much as 50 per cent) may be obtained by subdividing the totally required copper cross-section into two parallel lines, carrying half the current each. The mathematical and vectorial deductions are accompanied by an actual example, calculated for each of the four-wire arrangements considered.—*Elektrotechnische Zeitschrift*, Jan. 27 1921.

Coil-End Leakage of Armature Windings of Single-Phase Commutator Motors.—F. UNGER.—No accurate way of calculating the coil-end leakage of so-called direct-current windings is as yet known, owing to the difficulty introduced by the dense interlinking of the coil ends. The author devised a new method giving fairly exact results. A highly mathematical analysis of the new method is given in two installments.—*Elektrotechnik und Maschinenbau*, Jan. 9 and 16, 1921.

Electrical Distribution System for Modern Concrete Factory.—C. P. TRUEAX.—Details of power and lighting installation involved in the construction of a concrete factory. Rigid conduit is laid in concrete during the process of building construction.—*Electrical Review*, Feb. 5, 1921.

Traction

Electric Trucks for the Berlin Suburban Lines.—WECHMANN.—A complete suburban train consisting of twelve coaches is propelled by a front and a rear electric truck controlled from the front platform of the first coach. This has been made possible by the very low height of the truck, which is less than 5 ft. (1.5 m.), and by mounting the pantagraph current collector on the roof of the first coach. The trucks contain a single-phase forced-air-cooled commutator motor of 460-kw. one-hour, or 365-kw. continuous rating, driving by 1:3.54 reduction gear a jack shaft, which in turn is rod-coupled to the two driving axles. Directly above one of the axles is mounted the main transformer of 650 kva. one-hour rating, of the dry, air-blast type, 105 kva. being required for train heating. A 15-kw. fan provides the forced air for transformer and motor. An air compressor rated at 60 cu.m. per hour supplies the brakes, oil switch, pantagraph and the rail sanders. Nine taps on the low-voltage winding of the transformer, two choke coils and two small resistances provide twelve positions of the controller. The main data of the truck are: Weight complete, 34,000 kg.; maximum speed, 65 km. per hour; maximum r.p.m. of motor, 900; drawbar pull at start, 9,600 kg. Under most unfavorable conditions the acceleration amounts to as little as 0.21 mile per second per second. Assuming an average station stop of twenty-five seconds, a shortest train sequence of 100 seconds could be reached, corresponding to thirty-six trains per hour. The illumination of the trains in both types is derived from a small transformer with a 10-volt secondary. This permits the use of heavy-wire tungsten lamps which burn with a steady light in spite of the low frequency of $16\frac{2}{3}$.—*Zeitschrift des Vereines Deutscher Ingenieure.*—Feb. 12, 1921.

Installations, Systems and Appliances

Operating Details of Electric Furnaces.—EDWARD T. MOORE.—Results of a questionnaire reported by the electric furnace committee of the A. I. and S. E. E. which had been submitted to steel manufacturers operating electric furnaces. The data secured indicate that the greatest need at present is for better electrode economy, which may be brought about by watching the handling of electrodes closely, storing them in a warm, dry location and attending to their proper joining. It is said that the improvement of the roof cooling ring will have a large effect on electrode consumption. Lack of tensile strength is also said to be one of the causes of electrode

trouble, and other difficulties due more or less to the methods of charging or handling the material are brought out.—*Chemical & Metallurgical Engineering*, Jan. 26, 1921.

Speed Regulator for Motors Driving High-Frequency Generators.—W. DORNIG.—Customary regulators of, for example, the Tirrill type permit of a regulation of voltage and speed within about 0.5 per cent to 1 per cent. A new type of extremely delicate speed regulator is described, operating relays at a change of speed of as little as 0.01 per cent to 0.002 per cent, the latter being a fineness required for the drive of high-frequency generators in wireless work.—*Elektrotechnische Zeitschrift*, Jan. 6, 1921.

Electrophysics and Magnetism

Some Applications of the Method of Images—II.—C. M. HERBERT.—The author derives the general equation for potential, given by Kunz and Bayley in another paper, directly from Euler's infinite product expansion of the sine, thus avoiding the use of elliptic functions. Equipotential lines and lines of force are shown for two cases, a square and a rectangular tube; also curves giving the fall of potential along certain important lines.—*Physical Review*, February, 1921.

Effect of the Rate of Cooling on the Magnetic and Other Properties of an Annealed Eutectoid Carbon Steel.—C. NUSBAUM and W. L. CHENEY.—Specimens of a eutectoid carbon steel were cooled from 800 deg. C. in air, in lime and at various rates in a furnace. The effect of these rates of cooling on the magnetic properties—viz., maximum and residual induction, coercive force, permeability and the magnetic reluctivity relationship—also on the resistivity and scleroscope hardness, are shown in tables graphically and their significance is discussed. Micrographs illustrating the structure are presented. It is shown that the change in structure from an essentially sorbitic one to "divorced" pearlite causes a gradual shifting of the bend in the reluctivity line and a greater difference between the values of the "real" and "apparent" saturation intensities.—*Scientific Paper No. 408, U. S. Bureau of Standards*, Jan. 22, 1921.

Electrochemistry and Batteries

The Hall Effect and the Nernst Effect in Magnetic Alloys.—ALPHEUS W. SMITH.—In the iron-copper series a maximum Hall effect was obtained with 1.5 per cent copper. The variation with composition is very similar to the variation of electric resistance. In the nickel-copper series the effect reaches a maximum with about 26 per cent copper, when the composition corresponds to the formula $CuNi_{11}$ and then drops suddenly to a small fraction of its maximum value. In the iron-nickel series, although the effect is positive for iron and negative for nickel, the effect increases linearly with the proportion of nickel added to iron until for 13 per cent nickel it is six times as great as for pure iron. In certain alloys the variation of the effect with field strength is anomalous, the effect being negative for weak fields and positive for strong ones. An explanation based on the theory of Borelius is suggested which assumes that in addition to the positive part of the effect which is proportional to the field strength there is a negative part which reaches a limiting value for strong fields. Concerning the Nernst effect in magnetic alloys it is said that in the nickel-copper series the effect varies with the composition in nearly the same way as the Hall effect. In the iron-nickel series the effect decreases with the addition of nickel, becoming zero for about 2.2 per cent nickel and positive for higher concentrations. With 13 per cent nickel the effect is about five times as great as in pure iron.—*Physical Review*, January, 1921.

Units, Measurements and Instruments

A New Method of Testing Current Transformers.—R. S. J. SPILSBURY.—The direct electrostatic system previously in use, according to the author, while capable of the necessary accuracy, demands great steadiness in two circuits and very careful observation, the deflections obtained being small. The time required is also considerable. The method outlined in this article is said to overcome these difficulties and has the advantage that it employs only apparatus already available. A wiring diagram and complete description of the method are given in the original.—London *Electrician*, March 11, 1921.

Telegraphy, Telephony and Signals

Guided-Wave Telephony.—CHARLES A. CULVER.—After dealing with the principal equipment required for systoms using wires already in place for radio telephony the author summarizes the uses and advantages of guided-wave telephony as follows: (1) It gives more nearly perfect reproduction of the voice than wire telephony. (2) It gives a higher degree of secrecy in communication. (3) Communication may be maintained between two points when the physical circuit is out of commission for ordinary telephone service. (4) The system possesses great flexibility. (5) An important possible application of telephony by guided waves is that of train dispatching. (6) An application of a similar nature to the one last mentioned would be the dispatching of electric railway traffic by this type of telephony In conclusion the author asserts his belief that in guided-wave multiplex telephony and telegraphy a distinct branch of communication engineering has been developed which should command close study.—*Journal Franklin Institute*, March, 1921.

Submarine Cables.—F. A. WESTBROOK.—An article dealing with the manufacture of submarine cables for communication purposes, giving the construction of such cables and the tests which should be made on the cable during and at completion of the manufacturing process.—*N. E. L. A. B.*, February, 1921.

Miscellaneous

Stress Determination by Means of the Coker Photo-Elastic Method.—A. L. KIMBALL, JR.—The optical system of the apparatus used for determining stress by polarized light is analyzed in this article, and an explanation is given of the operation of a polarizing prism and of the quarter-wave plate. The nature of stress and how it influences polarized light is briefly considered with an explanation of the color effects produced. A proof of the quantitative law of variation of light intensity with stress for one color is given for the standard set-up of the apparatus. The method has important applications in investigation of stresses in electrical machinery.—*General Electric Review*, January, 1921.

Flow of Water in Concrete Pipe Lines.—An extensive series of tests provides data showing the effect of variations in the character and condition of concrete pipe on the coefficients of retardation for use in various formulas.—*Canadian Engineer*, Jan. 6, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Bill Providing Commission Regulation for Delaware Defeated

BY A vote of 18 to 14 the Assembly branch of the Delaware Legislature has defeated a bill providing for the creation of a state board of public utility commissioners. The bill as presented provided for the appointment of four commissioners by the Governor, each to receive compensation at the rate of $3,000 a year, and appropriated $30,000 for operating expenses. Delaware is one of the eight states having no form of state regulation over electric public service corporations.

Manufacturers' Council to Take Up Freight Classification

THE Electrical Manufacturers' Council announces the creation of a transportation committee to take up matters of railroad freight classification. The committee is composed of W. B. Everest, chairman; M. C. FitzGerald, A. T. Zwaek and F. C. Bryan.

Shiras Morris, president of the Hart & Hegeman Manufacturing Company, Hartford, Conn., and the recently elected president of the Associated Manufacturers of Electrical Supplies, has been elected treasurer to fill the unexpired term of the late Edward B. Hatch.

Resolutions of sympathy on the death of Mr. Hatch have been passed by the council. Mr. Hatch, who died on Feb. 18, had been a member of the council since its organization on Feb. 7, 1916, and its treasurer from Nov. 7, 1919.

Weeks Would Complete Muscle Shoals Project

IF SOME commercial organization will show faith enough in Muscle Shoals to agree to take over the project after it shall have been completed the Secretary of War will ask Congress to furnish the $30,000,000 necessary to finish the Wilson Dam. A reply to the foregoing effect was made by Secretary Weeks when the correspondent of the ELECTRICAL WORLD asked him if he had any personal opinion as to what should be done in the matter. Secretary Weeks stated that he had formulated no policy with regard to Muscle Shoals, but "if it is a good thing some one should be willing to demonstrate their faith in the proposition by agreeing to take it over when completed."

The work on the Wilson Dam is being slowed down rapidly and the project put in such shape as to deteriorate as little as possible during the period that no funds for continuing the work will be available. There is a very generally held opinion that some plan will be devised which will permit the completion of the dam. None of the contracts for electrical machinery has been canceled.

Secretary Weeks has suggested that it may be well to have the Federal Power Commission investigate the possibilities of marketing power in the vicinity of Muscle Shoals.

Friendly Solution Pledged of Inductive Interference Problems

A BROAD spirit of co-operation can easily overcome present legal and engineering inductive-interference problems, according to the unanimous opinion of those present at the first meeting of a joint committee of representatives of the American Telephone & Telegraph Company and of the National Electric Light Association at the office of O. D. Young, vice-president of the General Electric Company, March 26.

This meeting was called by agreement between the public policy committee of the N. E. L. A. and the executives of the telephone company for the formulation of a national policy on all inductive-interference matters between the Bell telephone companies and N. E. L. A. member companies, in the expectation of eliminating inductive-interference controversies and litigation. The two utilities agreed that every effort shall be made to arrive at a friendly solution of all present existing differences.

A careful study of all existing statutes, commission rules and regulations and court decisions which govern the question of inductive interference in the different states is to be made by Charles Neave of New York City, who was engaged for that purpose. A sub-committee is composed of Bancroft Gherardi, vice-president of the American Telephone & Telegraph Company; R. F. Pack of Minneapolis, as representing the N. E. L. A., and four engineer members, two from the N. E. L. A. inductive-interference committee, to be associated with Mr. Pack, and two from the engineering organization of the American Telephone & Telegraph Company, to be associated with Mr. Gherardi. This committee will report on the general engineering phase of the problem as a basis for formulating general rules of procedure.

The members of the joint committee are O. D. Young, vice-president General Electric Company, New York City; E. K. Hall, vice-president American Telephone & Telegraph Company, New York City; R. H. Ballard, vice-president and general manager Southern California Edison Company, Los Angeles; Martin J. Insull, vice-president Middle West Utilities Company, Chicago; Ber Read. president Mountain State Telephone & Telegraph Company, Denver; W. W. Freeman, president Union Gas & Electric Company, Cincinnati; Bancroft Gherardi. vice-president American Telephone & Telegraph Company, New York City; H. W. Byllesby, president Byllesby Engineering & Management Corporation, Chicago, represented by R. F. Pack, vice-president and general manager Northern States Power Company, Minneapolis; Col. John J. Carty, vice-president American Telephone & Telegraph Company, New York City; Guy E. Tripp, chairman of the board, Westinghouse Electric

& Manufacturing Company, New York City. Those present at the Saturday meeting were O. D. Young, chairman; Col. John J. Carty, R. H. Ballard, E. K. Hall, R. F. Pack, Bancroft Gherardi and M. H. Aylesworth., executive manager N. E. L. A.

N. E. L. A. Convention Arrangements Nearing Completion

WITH still two months to go, arrangements are fast being completed for the National Electric Light Association convention, to be held this year at the Drake Hotel in Chicago, May 31 to June 3. E. W. Lloyd, Commonwealth Edison Company and past-president of the association, has been appointed chairman of the committee on arrangements, and the following have accepted appointment: G. H. Atkin, W. H. Coleman, C. E. Allen, E. H. Cheney, G. A. Hughes, H. E. Niesz, F. R. Jenkins, E. A. Edkins, G. A. Freeman, O. R. Hogue, D. H. Howard, G. B. Foster, W. S. Kline, W. W. Low, J. G. Learned, H. V. Prather, E. J. Doyle, W. L. Abbott, W. H. Hodge, G. E. Cullinan, G. H. Jones and W. H. Ott.

Chairman Lloyd has announced the appointment of F. R. Jenkins, Commonwealth Edison Company, as chairman of the hotel committee; G. H. Atkin, Electric Storage Battery Company, as chairman of the transportation committee; O. R. Hogue, Commonwealth Edison Company, as chairman of the registration committee, and H. E. Niesz, Commonwealth Edison Company, as chairman of the entertainment committee.

Federal Water-Power Regulations Reopened



THE water-power committee of the National Electric Light Association and others appearing before the new Federal Power Commission in Washington, D. C., on March 25 submitted a number of suggested changes to the rules and regulations promulgated by the previous commission on March 4. Some of these rules, it was claimed, are of a nature to discourage if not altogether retard development because of inability to finance properly under them. In the group shown on the steps of the State, War and Navy Building in Washington, reading left to right, are: Front row—Thomas W. Martin, president Alabama Power Company, Birmingham; Henry J. Pierce, Washington Irrigation & Development Company, Seattle; O. C. Merrill, secretary Federal Power Commission; Franklin T. Griffith, president Portland (Ore.) Railway, Light & Power Company and chairman of the N. E. L. A. water-power committee; W. A. Brackenridge, vice-president Southern California Edison Company, Los Angeles; Guy W. Talbot, president Pacific Power & Light Company, Portland, Ore. Second row—O. G. Thurlow, chief engineer Alabama Power Company, Birmingham; R. H. Ballard, vice-president and general manager Southern California Edison Company, Los Angeles; Harrison B. Freeman, Connecticut River Company, Hartford, Conn.; W. H. Onken, Jr., editor of the ELECTRICAL WORLD; Hugh L. Cooper, consulting engineer, New York City; Paul Wooton, Washington, D. C. Third row—Dr. George L. Hoxie, consulting engineer, Los Angeles; C. M. Clark, president Tennessee Railway, Light & Power Company, Chattanooga, Tenn., and member of the firm of E. W. Clark & Company, bankers, Philadelphia; Senator J. Newcomb New York; Fred W. Herbert, N. E. L. A., and W. V. King, chief accountant Federal Power Commission.

Demand-Charge Rate Form Favored at Wisconsin Electrical Meeting

THE demand or service charge as a legitimate part of any rate structure was advocated by L. B. Andrus, American Public Utilities Company, in a paper on "Customer's Demand as a Factor in Rate Making," presented before the convention of the Wisconsin Electrical Association at Milwaukee on Thursday of last week. The total energy consumed, the maximum rate of consumption and the time at which the maximum occurs must be known of every service, as well as the costs dependent on the number of consumers, the costs involved in the cost of equipment to serve consumers and the costs depending on the kilowatt-hours produced. Equipment costs are independent of the two other costs, and Mr. Andrus pointed out the unfairness of a rate that buries this cost in a kilowatt-hour charge. Unless these charges are contained in a service charge it is possible to make consumers who are not properly chargeable with the demand costs bear the burden of other consumers. This may occur particularly when industries shut down.

The shortage of real salesmen and the presence in the merchandising field of men who were not real salesmen was dwelt upon by C. E. Michel of St. Louis in a talk on electrical merchandising.

F. A. Coffin of Milwaukee discussed the power-factor problem and methods of correction, and the use of induction-voltage regulators was discussed by Frank Hershey.

The independent telephone association of the state asked the appointment of a joint committee on inductive interference, the request being referred to the incoming executive committee for action.

Officers for the coming year were elected as follows: President, J. B. Pulliam; first vice-president, Harold L. Geisse; second vice-president, P. D. Kline; third vice-president, H. R. Ellis; secretary and treasurer, W. M. Chester.

Marine Committee of A. I. E. E. Issues Revised Recommendations

RECOMMENDATIONS of practice for electrical installations on shipboard issued by the marine committee of the American Institute of Electrical Engineers a few years ago and adopted by the committee of the American Bureau of Shipping did not cover the entire field and the committee was therefore continued, with instructions to prepare a more nearly complete set of rules. This has now been accomplished and the revised edition of the rules is ready. They are in part the result of a careful comparison made by the committee of similar rules prepared by American, English and German bodies.

No definite arrangements have yet been made for the approval of apparatus and accessories, but it is expected that through the co-operation of the Underwriters' Laboratories arrangements will be made later by which apparatus or appliances used on shipboard may be inspected and approved. In the absence of approved standards for merchant ships appliances approved by the Navy Department will in general be satisfactory.

American Telephone & Telegraph Stock Goes on 9 per Cent Dividend Basis

ANNOUNCEMENT by the directors of the American Telephone & Telegraph Company this week that they had established 9 per cent as the regular annual rate of dividend to be paid upon the company's shares indicates a recognition by this company of the necessity of offering a high rate of interest to attract new capital in the present money market.

"The change in dividend rate is nothing more than an adjustment to a new set of conditions," said H. B. Thayer, president of the company. "It has always been the policy of the company to pay such a dividend as would maintain the market value of the stock at a premium sufficient to attract subscription to new stock issues. The issue of a fair proportion of new capital rather than an increase of debt to take care of growth is a necessary part of any sound financial program.

"Not only present financial conditions governing the status of this and other investment securities have been considered, but also probable conditions in the future, and the action of the directors is based on the conclusion that a higher rate of return is necessary to attract capital from shareholders."

March Financing Shows Higher Yields

MARCH electric light and power company financing totaled $24,399,090, thereby exceeding February by almost $6,000,000. The tendency toward long-term securities is still evident. There is no appreciable change over last month in the interest rates, but the yields appear to be slightly higher. Of the thirteen issues the largest and most interesting is the $7,000,000 in bonds offered by the San Joaquin Light & Power Corporation of California. Of this issue $5,000,000 in thirty-year bonds is offered at 97.50, to yield 7.20 per cent, and $2,000,000 in one- to five-year serials is offered at from 99.06 to 97.95, to yield from 8 to 7.5 per cent.

Name of Company	Amount of Issue	Period	Class of Security	Purpose of Issue	Rate of Interest	Per Cent Yield	Offered At
San Joaquin Light & Power Corp.	$5,000,000	30-year	Unifying and refunding mortgage bonds	Refunding and new construction	7	7.20	97.50
San Joaquin Light & Power Corp.	2,000,000	1-5 year (Serially)	Unifying and refunding mortgage bonds	Refunding	7	8-7.5	99.06-97.95
Abitibi Power & Paper Co., Ltd., (Canada)	4,000,000	10-year	Consol. mtge. sinking fund gold bonds	Refunding	8	[illegible]	Par
Great Western Power Co. of California	2,500,000	15-year	Gen. lien convertible gold bonds	New construction	8	8	Par
California-Oregon Power Co.	2,000,000	20-year	First and refunding mtge. sinking fund gold bonds, series A	Refunding	7.5	7.5	Par
Denver Gas & Electric Light Co.	1,000,000	25-year	Gen. mtge. gold bonds, series A	Refunding	7.5	7.85	96
Charlestown (Mass.) Gas & Electric Co.	200,000	10-year	Gold notes		7	6.85	101
Los Angeles Gas & Electric Corp.	2,500,000	5-year	General and refunding mortgage gold bonds, series A	Refunding	7	7.40	98.25
Albany Municipal Gas Co.	1,250,000	1-year	Gold notes	Refunding	8	8	Par
Public Service Co. of Northern Illinois	2,000,000	15-year	Convertible gold debentures		7.5	8.10	95
Merchants' Heat & Light Co. (Indianapolis)	700,000	15-year	Gold bonds	Refunding	7.5	[illegible]	95.67
Edison Electric Illg. Co. of Brockton	594,090		Stock	Floating debt			115
Ohio & Western Utilities and Ohio Utilities Co.	[illegible]	2-11 year	Joint serial gold notes	Refunding	8	9.10-8.25	98
Total	$24,399,090						

Kansas Electric Show Attracts Much Attention in Southwest

ELECTRICAL interests of the Southwest are concentrating their attention on the week of April 18, when the big electrical show will be held in Kansas City, Mo. Both the Missouri and the Kansas state utilities associations will convene at Kansas City during show week as well as the Missouri Association of Electrical Contractors and Dealers and the Western Electrotherapeutic Association. This is the first exhibition of its kind to be held in Kansas City, and already it has a list of eighty-five exhibitors. A number of interesting diversions are planned.

The committee which has worked out the details consists of F. M. Bernardin, H. C. Blackwell, W. B. De Forest, F. S. Dewey, A. P. Denton, C. F. Farley, Sam Furst (who is the manager of the show), W. M. Hand, J. E. Launder, P. L. Lewis, F. F. Rossman, W. B. Satterlee, A. J. Selzer and J. D. Todd.

Construction Begun on Ford's Hydro-Electric Plant at Troy, N. Y.

STONE & WEBSTER, INC., Boston, Mass., have received the contract to design and construct an 8,000-hp. hydro-electric plant at Troy, N. Y., for Henry Ford, and construction work began March 21. The station is understood to be the first to be started under license of the Federal Water Power Commission, and it is to be completed for power generation by June 1, 1922. The plant will utilize the waters of the Hudson River and will be situated on Green Island, near the heart of the city of Troy. The head to be developed will be about 13 ft. At this writing it has not been decided whether six or eight units will be installed, but the generating sets are to be of the vertical type, and the estimated cost of the plant is between $1,750,000 and $2,000,000.

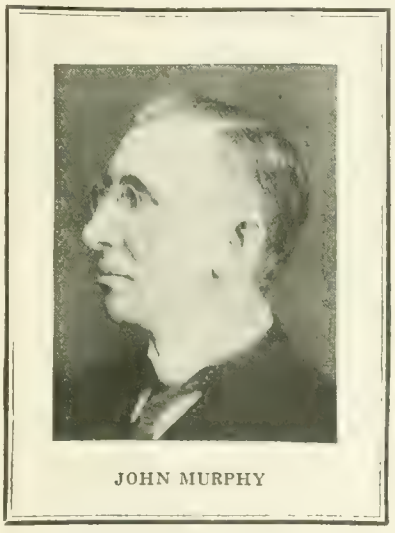
Chicago Electrical Men Oppose Regulation of Sale of Electrical Goods

A NEW ordinance regulating the sale, installation and use of electrical devices created a flurry in Chicago in the early part of this week. The ordinance was submitted to the Council on Monday and referred to a committee for consideration. It calls for a $50 license fee for all dealers in electrical devices, and no device that is not approved by the Commissioner of Gas and Electricity can be sold in the city. The routine for approval requires a preliminary fee of $5 to be paid with each application, and the city will submit each device to such examination and test as may be deemed necessary for its approval. The cost of such examination and test will be assessed against the applicant on the basis of time and expense involved. Provision for the acceptance of such approval as that of the Underwriters' Laboratories is made. The ordinance as originally submitted was so loosely drawn that gross misuse of the inspection fee provisions would be possible, and there was no differentiation between manufacturers going to the trouble and expense of obtaining the Underwriters' approval and those not doing so.

A strong protest against the ordinance as drawn has been made through the electrical section of the Association of Commerce. Among other things charges have been made from various sources that the ordinance is sponsored by union labor interests and that it is an attempt to provide another source of revenue for the city of Chicago. It is stated by the sponsors that the ordinance is an attempt to prevent the sale of unsafe devices in the city, and it is understood that insurance interests are backing the ordinance as a measure which they hold will aid the elimination of fire and other hazards due to the use of cheap and carelessly built devices. A strong fight against the ordinance in its present form will undoubtedly be made. It is stated that the ordinance will not come up fo. passage for some months and will not be effective before Jan. 1, 1922. It is understood that the committee in charge will hold public hearings on the subject.

Formation of Frazil Ice Easily Prevented

BETWEEN the continuous operation of a hydro-electric plant and its shutdown because of frazil-ice formation there lies only one-thousandth of a degree of heat. Thus did John Murphy, electrical engineer of the Canadian Department of Railways and Canals, voice to a representative of the ELECTRICAL WORLD his opinion of the ease with which ice can be combated. Mr. Murphy has been studying ice formation and successfully fighting it at power plants for nearly twenty years. A few years ago he astounded the engineering world with his motion-picture study of ice formation. "Others," said Mr. Murphy, "have been deterred from trying to combat ice because they could not be persuaded that it did not require large amounts of heat energy. They were positive that the temperature of all the water had to be raised. Now, as a matter of fact, the problem has but two phases—(1) preventing ice from adhering to things, and (2) preventing ice from forming in a stream. No water warming or ice melting is involved in either.



JOHN MURPHY

"Preventing ice from adhering to dams, valves, gates, racks and turbine cases is now becoming quite common—not by employing large quantities of heat, but by merely raising the temperature of the exposed surfaces the slightest fraction of a degree above the freezing point. Ice simply won't form on objects that are above the freezing temperature.

"On the other hand, the ease with which the formation of ice may be prevented is not yet widely understood, although 'nature' is doing that very thing every winter at 'air holes' by simply turning up new water which has not given up its latent heat. Thus the small quantity of heat needed to prevent ice from forming at a given point in any river is quite comparable with the small quantity of moisture which if applied to inflammable material will prevent the starting of what might be a serious fire.

"Toward the end of many winters a block of ice con-

taining 6,000 cu.ft. can be cut from a one-foot length of the St. Lawrence River at points where it is 3,000 ft. wide, when the ice is two feet thick. However, it has taken the whole winter's frosts to make that much ice at that point. The average flow of the St. Lawrence is 240,000 cu.ft. per second. Therefore in one-fortieth of a second—the flick of an eyelid—as much water passed the point in question as was turned into ice in four months. It must be realized, therefore, that it is not necessary to do something to all the water in order to prevent ice from forming in a small part of it."

Utilities Oppose Proposed Administrative Code for Ohio

PUBLIC utilities in Ohio are opposed to some of the provisions of House bill No. 249, commonly known as the "administrative reorganization code bill," recently introduced in the Ohio Legislature. These objectionable provisions are in the section which places public utility companies under the control of a proposed director of commerce, giving to him power of appointment and removal of the Public Utilities Commission's staff of assistants, such as inspectors, engineers, accountants, statisticians and clerks. The bill also makes this official the secretary of the commission.

The utilities are opposing these provisions of the bill on the ground that the work of the commission would be seriously retarded thereby, and that inasmuch as the director of commerce would control at least four other departments he would have very little time to devote to his duties as secretary of the commission.

Honest, Dispassionate, Constructive Thinking Needed, Mr. Hayes Says

A DECLARATION that the basic need of the hour is honest, dispassionate and constructive thinking was made by Paul F. Haynes of the Indiana Public Service Commission in talking of the utility problems at the annual banquet of the Oklahoma Utilities Association at Oklahoma City on March 9. The present difficulties are partly the fruit of the old-time "public-be-damned" policies that are now dead, and the demagogues and the politicians form two groups that still present an effective barrier against the solution of utility problems that the public honestly desires. Mr. Haynes said that it was his belief that the utilities were largely responsible for the barrier, because they had not recognized that adequate service was an obligation concurrent with the public obligation to pay.

In defining adequate service Mr. Haynes pointed to proper public relations as the first essential and indicated this essential as the one in which the utilities had failed, even though in the narrower sense they had furnished service that was adequate from an electrical standpoint. Too much of the utilities' public relations work has been carried out in a spirit of anticipated opposition. This attitude only stirs up the opposition it assumes to exist. Another fault pointed out by Mr. Haynes was the failure in approaching the public to use language that the ordinary individual understands. If the people are to grasp utility problems, the explanations must be devoid of the technical language of the industry.

It is the duty of the public to maintain not only solvency but utility health as well, and Mr. Haynes expressed the belief that utility regard for utility obligations to the public should be liberally rewarded and lack of such regard should result in restriction of earnings. In conclusion, Mr. Haynes dwelt on the danger lying in the control of the commissions by the public when that public had not been taught the true situation through proper development of public relations by the utilities.

At the sessions on March 10 C. L. Mitchell of Cushing discussed the problems of the small-town utility, pointing out strongly the part that the minor employees play in the relations of the smaller utility with its public. That the quality of service depends on the handling of complaints was Mr. Mitchell's belief, and therefore troublemen and others who handle complaints must not be mediocre types of men. Complaints were viewed as a safety valve. They should be encouraged and not suppressed. Few business ventures give the opportunity to display courtesy that is afforded by the public utility business. Mr. Mitchell defined a utility man's place in the community as depending on his ability to think individually, act collectively and keep out of politics.

Steel Electrical Engineers' Convention to Be in Chicago in September

SPECIAL emphasis will be given to steel-mill problems and steel-making practices at the fifteenth annual convention of the Association of Iron and Steel Electrical Engineers, which will be held in September at the Hotel La Salle, Chicago.

Papers will be presented by R. B. Gerhardt, electrical superintendent Bethlehem Steel Company, Sparrows Point, Md.; R. D. Cousins, electrical engineer Illinois Steel Company, Gary, Ind.; Wray Dudley, electrical superintendent Ashland Iron & Mining Company, Ashland, Ky.; W. N. Flanagan, steam engineer Ohio Works, Carnegie Steel Company, Youngstown, Ohio; F. B. Crosby, electrical engineer Morgan Construction Company, Worcester, Mass.; A. C. Bunker, electrical engineer Crocker-Wheeler Company, Ampere, N. J.; A. M. MacCutcheon, designing engineer Reliance Electric & Engineering Company, Cleveland, and E. T. Moore, electrical engineer Holcomb Steel Company, Syracuse, N. Y. Other papers will be presented on the following subjects: Education standardization, safety and electrical development in steel mills, by the chairman of the respective committees. In connection with the convention there will also be the regular exhibition of electrical products.

Dallas Electric Club Working to Build the Southwest

PLANS are being worked out by the Dallas Electric Club to build up the Southwest electrically, and to this end it will appoint a committee made up of representatives of the several branches of the industry. This activity has come as the result of recommendations by the retiring president, A. Hardgrave, manager of the Insull properties in Texas. Among his recommendations are a permanent electric exhibit building at the state fair grounds, an annual electric parade during the state fair, a movement in conjunction with the Chamber of Commerce to make Dallas the electrical jobbing and distributing center for the Southwest and a renewal of the efforts to build up the work of "co-operation within the industry."

Analysis of Power Situation During the War

ALMOST instructive and interesting report on the power situation in the various industrial sections of the country during the late war has just been issued by the War Department. The main portion of the report is by Colonel Charles Keller, Corps of Engineers, as the officer in charge of the work of the War Industries Board and of the power section of that board. Summarized and detailed reports are given on the power shortages existing and the methods taken to relieve them in the following important industrial districts: Niagara Falls and Buffalo, Pittsburgh and eastern Ohio, the New England States, the State of New Jersey, Philadelphia and eastern Pennsylvania, Wilmington and Baltimore districts and the Pacific Coast.

The summary of the various investigations and reports made by the officers of the Power Section of the War Industries Board is written by Major (now Colonel) Charles F. Lacombe, who acted as Adjutant for the Power Section. The main portions of this summary as pertaining to the great industrial centers in New England and the Middle Atlantic States was published in the ELECTRICAL WORLD of May 15, 1920, under the title "Urgent Need of Super-Power Developments." This summary report contains many very valuable transmission-line maps and diagrams, most interesting of which perhaps are several production charts of various industries showing the cumulative effect of shortage of power, labor and transportation facilities.

SECTIONAL REPORTS

The power situation in western Pennsylvania and eastern Ohio is ably covered in a report on that section by Capt. Lyle A. Whitsit. An extract from this report was published in the ELECTRICAL WORLD on Nov. 13, 1920, under the title "Power Service for a Middle West Section." Valuable maps, diagrams and tables accompany the report.

Major Carroll H. Shaw's report on the "Production, Transmission and Distribution of Mechanical and Electrical Power in New England" is most comprehensive and gives in detail the status of the power industry in each of the New England States. The main portions of this report were published in the ELECTRICAL WORLD on Sept. 11, 1920, under the title "Survey of New England Power Situation."

Electrical power in New Jersey and eastern Pennsylvania is covered in a report by Major Malcolm MacLaren. The future power demand of this district is thoroughly analyzed, and the costs of various hydroelectric developments necessary to provide the energy are given.

A review of the electric power resources of the Southern States at the close of the war, with recommendations for efficient development to accommodate estimated demands for the future, is contained in a report by Capts. George K. Miltenberg, Lyle A. Whitsit and Robert W. Lamar. An extract from this report was published in the ELECTRICAL WORLD of Oct. 16, 1920. One of the most valuable parts of this report is the appendix, in which data are given on the load factors of various Southern systems, as well as cost data on steam generated power.

The final report is by Major George F. Sever on the "Electric Power Problems on the Pacific Coast." Major Sever takes up in detail the present and probable future power demands of these states and makes definite recommendations. A detailed list of the various interconnections in this section forms one of the most valuable portions of this report.

Meter Lecture and Slide to Be Made Available for Meter Departments

THIS year's convention report of the meter committee, Technical Section, N. E. L. A., will include as an appendix a lecture on meters which has been in the course of preparation for a long time. After the report has been published copies of the lecture will be printed separately. Together with about thirty lantern slides, they will be available for use by meter departments throughout the country. The lecture will be used extensively in the educational work which the meter committee is doing, including the university courses for metermen and similar activities.

The scope of the lecture is very broad. It covers the historical development, units of measurement, operating principles, construction essentials, testing and commission regulations.

Peace-Time Industrial Co-operation Under Government Supervision Urged

ENCOURAGEMENT of permanent intimate combinations or associations of industry under government supervision, involving a radical change in the present attitude of the government toward such groupings, is recommended in the final report of the United States War Industries Board, just completed by Bernard M. Baruch, who was the board's chairman. It is held that great public benefits in the way of prices and abundance of goods, resulting from economies in production and distribution, are capable of being effected through the mutual co-operation of members of industrial groups and that the present governmental policy of enforced isolation and costly competition is not conducive to the general welfare.

The first part of the book traces the origin of the War Industries Board in the Council of National Defense, defines its purposes and treats of the process by which the board became the one governmental body that dealt comprehensively with the exceptional military and civil industrial requirements caused by the war and the resources and facilities with which to meet them, and how the balance between them, on the success of which hinged industrial mobilization and the outcome of the war itself, was sought and attained through the administration of clearance, priorities, conservation, price-fixing, labor administration and the work of the board's foreign mission.

As a result of the successful uniting of government and business under the War Industries Board for national purposes the report advises that there should be established some sort of government tribunal which should sanction in the public interest the intimate associtions of industries which resulted in such economies and enlargement of production during the war. The report, therefore, recommends that purely as a civic measure legislation be adopted that will permit the continued functioning of the industrial groups represented by the war service committees and the related associations of manufacturers, whose establishment was forced by the war exigency.

Telluride Power Wants More Time to Complete Beaver River Project

BECAUSE of the difficulties in obtaining labor and material during the war the Telluride Power Company was unable to complete its power project in Beaver River Canyon within the time limit and has petitioned the United States District Court for relief. The court is asked to set aside the ruling of State Engineer George F. McGonagle allowing only a one-year extension and to grant two years instead.

A permit for diverting the waters of the canyon was granted in 1917, with a time limit to Dec. 31, 1920. Already more than $100,000 has been spent on the project in roadways, bridges and the laying of 12,700 ft. of 36-in. wood-pipe line. This will be a loss if sufficient time is not granted to complete the original scheme, according to the bill of complaint which has been filed.

Engineers of Utah Organize State Council

AN ENGINEERING council for Utah, including representatives from all branches of the engineering profession—civil, mining, electrical and mechanical—has just been organized with headquarters at Salt Lake City. The purposes of the organization are united consideration of and action on matters of common concern to engineers, as well as matters of public welfare embodying the application of engineering principles; the advancement of engineering knowledge and practice, the maintenance of a high professional standard among engineers and the correlation of the local activities of engineering societies.

The Engineering Council of Utah will be directed by a governing board consisting of two representatives from each of the member societies. The governing board, as represented at the first meeting of the Engineering Council, included the following men: American Society of Civil Engineers—R. K. Brown and Theodore A. Beyer; American Institute of Electrical Engineers—Dr. Joseph F. Merrill, Paul P. Ashworth; Utah Society of Engineers—Hylom T. Plumb, A. C. Watts; American Institute of Mining Engineers—Henry M. Adkinson, Edward R. Zalinski; American Association of Engineers—Charles J. Ullrich, Charles S. Fisher; American Society of Mechanical Engineers—Louis J. Seckles, L. Douglas Anderson.

Temporary organization was effected by the election of Hylom T. Plumb as chairman and Theodore A. Beyer as secretary. Plans were laid for a general ratification meeting to be held in the form of a banquet for all engineers of the state at an early date.

Must Guard Against Effects of Prosperity

A NOTE of caution to utility executives was sounded by Adam Gschwindt, president of the Illinois State Electric Association, at the banquet which closed the annual convention at Chicago, March 15 and 16. Mr. Gschwindt said that prosperity often had a deteriorating effect on the personnel of a utility and that this should be most carefully guarded against now that the utilities were over the hill of high costs and could see an easier road ahead.

Other speakers were Congressman Ira C. Copley, President David Kinley of the University of Illinois, and Charles A Munroe, president of the American Gas Association, who advised that all gas and electric companies endeavor to show regulatory bodies the necessity of "service" charges.

Electrochemists to Meet at Atlantic City April 21-23

A LARGE attendance is looked for at the forthcoming convention of the American Electrochemical Society at the Hotel Chalfonte, Atlantic City, April 21-23. At this time the action of the board of directors authorizing the formation of an electrothermic division will be put before the membership for confirmation. This new division will absorb the Electric Furnace Association. Acheson Smith, president of the Electric Furnace Association, has been named to organize the new division.

The convention program includes a symposium on corrosion, to be held on the morning of the twenty-first, running over into the next morning. This is followed by five electrical papers: "Phenomena of Arc Welding," by O. H. Eschholz; "Electric Furnaces for Non-Ferrous Metals," by H. W. Gillett; "Electrodynamic Forces in Electric Furnaces," by Carl Hering; "Recent Progress in High-Frequency Induction Heating," by E. F. Northrup, and "The Regulation of Electric Steel Arc Furnaces Using Movable Electrodes," by W. G. Mylius.

The closing session on Saturday morning will be devoted largely to electrolytic papers and will include a paper by C. W. Hazelett entitled "A new High-Capacity Storage Battery."

The Engineering Council Gives an Account of Its Stewardship

FROM June, 1917, to December, 1920, the Engineering Council, a department of the United Engineering Society, functioned, chiefly at Washington. On the latter date its duties were taken over by the American Engineering Council of the Federated American Engineering Societies. A brief history of some of the Engineering Council's activities has now been issued in pamphlet form by J. Parke Channing, who succeeded Ira N. Hollis as chairman in February, 1918; Philip N. Moore and Alfred D. Flinn. The United Engineering Society had as its constituent members the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials and the American Railway Engineering Association. This "final report and brief listing" of what it accomplished during the war and in the reconstruction period deals with its origin and powers, its membership and meetings, its financial resources, its offices, officers and committees, its publications and publicity, its "American Engineering Service" and employment bureau, and the "contacts" established by it among engineering societies and the technical professions. As the forerunner of the American Engineering Council it demonstrated, in the words of the pamphlet, "the feasibility of a joint representative organization of technical societies to deal with questions of general interest to engineers and to the public and made definite progress in determining the extent of the field which such an organization could wisely cultivate."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A Canadian Railroad Electrification Project Postponed. — The Canadian Minister of Railroads has announced that there is no possibility of the Dominion government's giving any consideration to the electrification of the London, Huron & Bruce branch of the Grand Trunk Railway until the whole Grand Trunk system, which is the subject of arbitration proceedings, becomes definitely the property of the government.

Great Artificial Lake Advocated for Asheville District.—Very large hydroelectric possibilities are held to inhere in a plan advocated by Dr. Joseph Hyde Pratt, State Geologist of North Carolina, for the creation of an artificial lake on the upper French Broad River, extending from a point south of Asheville to one near Brevard. Such a lake would be about 30 miles long and cover an area of more than 20,000 acres and would add to the beauty of the Blue Ridge Mountains. It is hoped to form an association to carry out the project.

San Joaquin Light & Power Asks for Complete Revaluation.—Application has been filed with the California Railroad Commission by the San Joaquin Light & Power Company asking for a complete revaluation of its properties in order that a just rate base may be established. The company asserts that the last valuation, made as of Jan. 1, 1916, no longer represents the fair value of its properties, and that the great demands upon it resulting from the remarkable growth and development in the San Joaquin Valley necessitate a new rate schedule.

Engineers on the Severn Barrage.—Under this title the London *Engineer* summarizes some views expressed by delegates at a joint meeting of civil, mechanical and electrical engineers held in Birmingham, England. One delegate said that the cost of machinery with a rating of 476,000 kw. would work out at something more than £17,000,000 and that if the Thury system were employed this could be reduced to £11,000,000. Another estimated the cost of machinery, switchgear and transmission lines at £20,000,000. For financial and other reasons the meeting showed itself opposed to the scheme in anything like its entirety, though one engineer thought that with its aid it would be possible to transmit a maximum load of 100,000 kw. from the Severn to the Birmingham district by overhead lines at a capital cost of £1,000,000, which would make it possible to supply Birmingham with energy at 0.8d. (1.6 cents) per kilowatt-hour. The whole project was thought worthy of further inquiry, although the "brass band" advertising by the government was held to have retarded any possible realization of its practicable features.

Emergency Service in Cork.—Owing to a strike in the troubled city of Cork, in Ireland, a sudden stoppage of electric supply recently took place. How this handicap was overcome in one factory by the use of tractors is thus related: Energy for small machines and for lighting was supplied by a group of twelve tractors driving a length of line shafting from which in turn dynamos were driven. Six 20-hp. and four 25-hp. electric motors were driven as dynamos, while one tractor drove a 20-hp. motor to supply the shunt-field current required by the others. The system of the shop was 460-volt, three-wire, direct-current, and a balancer had to be provided. This consisted of two 20-hp. motors directly coupled. The installation gave an average output of 200 hp. and is said to have worked admirably.

Transcontinental Radio Signals Reach Moving Automobile.—Signals sent out by Atlantic Coast radio stations were received recently by apparatus carried in an automobile moving along the streets of San Francisco. This is said to be the first time that such long-range signals have been received by light portable equipment of this sort. The antennas consisted of a stranded copper wire aërial hung about 10 ft. above the ground by means of bamboo poles at the front and rear of the automobile. Nothing but the frame of the machine was used for a "ground." The signals were clearly audible without the use of amplification, only one bulb being used. Except for a 6-volt storage battery the receiving set was entirely contained within a small cabinet of about the same size as an ordinary suitcase. The set was not specially made up for this purpose but is a standard product turned out by a San Francisco radio manufacturer. The first tests were made on top of Twin Peaks, an eminence in a part of the city where power lines and street cars would not interfere with the signals. The test was so successful there that the automobile was driven down into the city and the signals continued to be clearly audible even when the automobile was driven close to electric cars in operation. E. A. Portal conducted the demonstration.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

N. E. L. A., Southwestern Geographic Division.—The annual meeting of this division of the N. E. L. A. will be held in Hot Springs, Ark., on May 13-14.

Pennsylvania Electric Association.—The Western Geographic Section of this association (which is the state section of the N. E. L. A.) will meet at Pittsburgh on Friday, April 15.

Electrical Supply Jobbers' Association.—The thirteenth annual meeting of the Electrical Supply Jobbers' Association will be held at the Homestead, Hot Springs, Va., on May 25-27.

A. I. and S. E. E., Philadelphia Section.—The date of the meeting of this section announced for April 4 has been changed to April 2 (tonight). D. M. Petty, as already stated, is to speak on the topic "Generation of Power in Steel Mills."

Ontario Municipal Electric Association.—Officers of this association for the ensuing year have been elected as follows: President, Willoughby Ellis, Hamilton; first vice-president, J. E. Banwell, Windsor; second vice-president, Controller Maguire, Toronto; third vice-president, R. F. Elliott, Kingston; fourth vice-president, W. K. Sanderson, St. Thomas; secretary-treasurer, T. J. Hannigan, Guelph.

Chicago Section, A. I. and S. E. E.—The following nominations for officers for the coming year were made at a meeting of this section held on March 22: For chairman, J. L. Mills and Elbert Lewis; vice-chairman, C. W. Donovan; executive committeemen, G. E. Adams and H. E. Davis. A paper on "Control Equipment for Auxiliary Motors," read by J. D. Wright of the Schenectady plant of the General Electric Company, was followed by a general discussion of the subject of motor control. It was announced that the April meeting would be a joint one with the Chicago Section, A.I.E.E., and that the meeting for May would consist of an inspection trip through the Allis-Chalmers plant at Milwaukee.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Philadelphia Section, April 2; Cleveland Section, April 11; Pittsburgh Section, April 16.

A. I. E. E. Section Meetings—Pittsburgh (joint session with A. I. and S. E. E.; for program see issue of March 19, page 672), April 16; New York (joint session with A. S. M. E.), April 22; New York, May 20.

Missouri Association of Public Utilities — Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society — Washington, April 23.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers — Houston, Tex., April 27.

American Association of Engineers—Buffalo, May 9-11.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

American Society of Mechanical Engineers —Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A.—Annual convention, Chicago, May 31-June 3.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Prevention of Competition Is Meant to Serve Public, Not Utility.—In approving the entrance of a light and power company into territory previously served by another on condition that the new company agree to purchase such portion of the existing utility's property as may be useful to it the Public Service Commission of Missouri observed that the protection from competition of an established utility in occupied territory is incidental to the protection of the public interest and does not warrant the exclusion of a competing utility rendering more efficient service at cheaper rates than the existing company is willing or able to do.

Advance in Rate by Producing Company Does Not Warrant Corresponding Increase by Distributing Company.—In granting increased rates to the Pine Grove Electric Light, Heat & Power Company, found warranted by increased operating costs and additional investment in plant extension, the Public Service Commission of Pennsylvania declares that an advance in price for energy by a producing electric company is not in itself a sufficient reason or excuse for an increase in the tariff of a distributing company. Such a method of increasing rates by a distributing company is wrong in theory and practice, the commission held, and should not meet with approval in any instance unless supported by data showing that the utility initiating the increased rate was warranted as a proper operating economy in promulgating it.

Effect of Abrogation of Special Contracts in Utah.—In granting temporary permission, pending valuation, to the Utah Power & Light Company to revise its rates in the case of 2,000 power customers, thereby gaining about $200,000 additional annual revenue, the Public Utilities Commission of Utah said, referring to the recent decision of the State Supreme Court in the "special contract" cases: "If these special contracts had been continued in effect, it would have been necessary in order to provide the power company with revenues shown to be needed to enable it to continue giving adequate service to the public generally that power consumers not enjoying special contract service pay very much higher rates than are herein found to be reasonable, thus placing the total burden of the increase upon the customers already paying highest rates. The rates hereinbefore fixed for the various classes of power users are intended to be applied to all power users of the respective classes, including the special contract holders." The increased revenue in sight because of the commission decision referred to and the Supreme Court decision together represent less than half the amount asked for in the power company's petition for increased power rates, filed Dec. 4, 1919.

Relation of Depreciation Reserve to Valuation.—In fixing the value of the Wood River Power Company, the Public Utilities Commission of Idaho made no deduction for accrued depreciation, declaring: "Because it is not possible to meet the factor of depreciation from day to day or year to year, the full serviceability of the utility's property can be maintained only when there is a provision against the time when retirement or replacement must be made. From the nature of the obligation which rests upon the utility this provision is as much a part of the utility's property as any physical unit in it, and when present it makes the immediate physical condition of the property unimportant, as whatever may have gone from the physical property through use is represented in a ready financial ability to retire or replace."

Discrimination Not Necessarily Involved Where Rates of Supplying Company to Transmission Company Are Lower than to Others.—Rates of a supplying electric utility to a transmission utility lower than rates to other consumers within the same classification are not unlawfully discriminatory, the Missouri Public Service Commission held in granting financial relief to the St. Joseph Transmission Company, so long as the difference in charge does not result in a burden being placed on the consumers of the supplying utility or an undue burden upon the supplying utility itself, whereas rates of a transmission electric utility to a local distributing utility which result in the rendition of such service at an actual loss and so reflect upon operation as a whole as to occasion operation at a loss are clearly discriminatory and unlawful.

Tennessee Commission's Attitude on Valuation.—In valuing the property of a Tennessee gas company for the purpose of rate fixing the Tennessee Public Utilities Commission considered three estimates made by experts on the basis respectively of historical cost, cost to reproduce new less depreciation based upon average prices for 1915-1919, and cost to reproduce new less depreciation based upon present prices, and indicated its attitude toward these varying methods in the following terms: "The public should not be made to bear the burden of the abnormally inflated present-day prices of both labor and material, as a rate of return upon a value reached alone by such a method would be prohibitory. At the same time the company should not be made to bear the burden of too low a valuation based upon an estimate of its historical or original cost less depreciation, as a return upon a value reached alone by such a method might prove confiscatory."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Corporations Cannot "Pick and Choose" Their Customers.—"Corporations which devote their property to a public use may not pick and choose, serving only the portions of the territory covered by their franchises which it is presently profitable to serve and restricting the development of the remaining portions by leaving their inhabitants without the service which they alone render," the Supreme Court of Missouri has declared in upholding a ruling of the State Public Service Commission ordering the Ozark Power & Water Company to serve the city of Diamond with electrical energy at 15 cents a kilowatt-hour.

What Constitutes an Injury Arising Out of or in the Course of Employment.—It has been held by the Supreme Court of Iowa, in Young vs. Mississippi Power Company, that when the engineer of an electric pumping station attempted to repair a crossarm broken during the unloading of a transformer in which he was assisting and lost his life from contact with high-tension wires he was not a volunteer but was killed by an injury "arising out of or in the course of his employment" within the meaning of the workmen's compensation act, the peril threatening his employer's property being an emergency justifying his conduct. (180 N. W. 986.)*

Property of Utility Devoted to Public Use Cannot Be Condemned Under General Authority.—The Supreme Court of Vermont has, in Vermont Hydro-Electric Corporation vs. Dunn, denied the power of the Mayor and Aldermen of the city of Rutland to condemn water rights owned by the plaintiff for the purpose of increasing the city's water supply, declaring that to bring property within the immunity from condemnation under general legislative authority that inheres in property already appropriated to a public use it is not necessary that it shall have been acquired by eminent domain or that it be actually in use for the public purpose. It is exempt from condemnation for a different public use when it is in immediate and necessary connection with a public trust or when acquired by a public service corporation for a necessary purpose pertaining to its franchise and held in anticipation of future needs, with bona fide intention to use it for such purpose within reasonable time. (112 At. 223.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

S. M. Kennedy, vice-president of the Southern California Edison Company, Los Angeles, in charge of business development and public relations, recently delivered an address in Los Angeles before about 600 employees of the American Railway Express Company. Mr. Kennedy's invitation to address the express company came from J. F. Baker, general manager, who had been inspired by Mr. Kennedy's new book, "Winning the Public," and saw in its philosophy something of direct application to the company's policy of endeavoring to establish closer relations with the public. Mr. Kennedy has spent a great many years in the study of public relations, and the book referred to is an interesting key to the success which he has attained in bringing about a better understanding of the essential service rendered by a public utility.



S. M. KENNEDY

E. F. Pegg has opened a consulting engineering office in Cleveland for the purpose of handling contractors' equipment of all kinds. Mr. Pegg has been associated with various manufacturers for the past twelve years.

D. K. Lewis has been appointed electrical engineer of the Winnipeg (Man.) Electric Railway, succeeding L. Trott. Since December, 1918, Mr. Lewis has been electrical engineer of the Fort Dodge, Des Moines & Southern Railroad, Boone, Iowa. Mr. Lewis was graduated from Clemson College, S. C., in 1903 in electrical and mechanical engineering. He entered the testing department of the General Electric Company at Schenectady, N. Y., and was later transferred to the engineering office in Chicago, where for twelve years he was construction foreman, installing apparatus in various towns and cities in the Western States. He enlisted in the United States Army in April, 1917, and was discharged in December, 1918.

R. F. Gooding, formerly a member of the engineering department of the Westinghouse Electric & Manufacturing Company, and more recently engineer with Mees & Mees, consulting engineers at Charlotte, N. C., has recently become associated with Tucker & Laxton of Charlotte and is engaged on transmission-line work between the United States nitrate plants Nos. 1 and 2 in northern Alabama. His position with the company is superintendent of construction. A biographical note on Mr. Gooding appeared in the ELECTRICAL WORLD of May 29, 1920.

Fremont L. Lovett, who has been appointed general superintendent of the Montpelier (Vt.) & Barre Light & Power Company, was born at Warren, Vt., in 1890 and was graduated in 1913 from the electrical engineering course of Norwich University. He was employed for about a year each by the Vermont Marble Company, the State of Massachusetts and in New York school work. He then entered the employ of the Worcester (Mass.) Electric Light Company as inspector of underground installations, later being promoted to the post of distribution engineer, which he resigned to go to Montpelier in the capacity above named. The company is managed by Charles H. Tenney & Company of Boston.



F. L. LOVETT

Julius L. Hecht has been elected by the board of directors of the Public Service Company of Northern Illinois to the position of assistant to Vice-president Frank J. Baker. Mr. Hecht has been in the employ of the company since 1905. He became mechanical engineer in charge of the operation of stations in 1907 and later was made superintendent of the electrical production department. He has been chairman since its inception of the central committee on co-operation, maintained by the company to govern relations between its employees and itself. Mr. Hecht is a vice-president of the Western Society of Engineers, having been interested in the affairs of this society for a number of years. He is also president of the National District Heating Association and is a member of the American Society of Mechanical Engineers and various other technical organizations. He was graduated from the Massachusetts Institute of Technology in 1904. Mr. Hecht will assume the responsibilities of the position held by the late George H. Lukes, general superintendent.



J. L. HECHT

H. C. Hoagland, formerly vice-president and general manager of the Central Oklahoma Light & Power Company, a Byllesby utility, has resigned to become general manager of the Oklahoma Natural Gas Company. Mr. Hoagland has been a member of the Byllesby organization for about ten years, serving at different times as manager of the Muskogee Gas & Electric Company and the Fort Smith Light & Traction Company, in addition to filling the position he is now leaving.

J. D. Sullivan, who has become the chief electrician of the Ray (Ariz.) Consolidated Copper Company, was formerly superintendent of the Tucson (Ariz.) Gas & Electric Company, where he had supervision over the construction, operation and maintenance of the electric, gas and street-railway departments. After attending the University of Arizona Mr. Sullivan was employed for two years in the office of the Tucson city engineer, leaving that office to

enter the employ of the Tucson Gas & Electric Company. His term there was interrupted by three years' war service.

Charles A. Collier, who recently underwent an operation for appendicitis and was absent from his office for several weeks, has again taken up his duties as assistant to the general sales manager of the Georgia Railway & Power Company, Atlanta.

A. M. Little, whose resignation as president and director of the Mohawk Electrical Supply Company, Syracuse, N. Y., was mentioned in the March 15 issue of the ELECTRICAL WORLD, has become associated with the J. F. Buchanan Supply Company, Philadelphia, as manager. This company is affiliated with the J. F. Buchanan Company, composed of J. F. Buchanan and Gilbert S. Smith, which is one of the oldest electrical concerns in the country. Under the latter name the company operates a large electrical contracting business and has installed some of the most important electrical work in Philadelphia and surrounding country, particularly of the industrial type. Some years ago an electrical supply business, both wholesale and retail, was developed, and the J. F. Buchanan Supply Company was organized to handle this activity. Mr. Little brings to the Buchanan interests a wide experience. He has been actively engaged in the electrical supply business since 1889, when he was employed by the Central Electric Company of Chicago as an office boy. Later he was salesman in the East for the Pass & Seymour Company. As chief executive of the Mohawk Electrical Supply Company during the last twelve years, he has developed the business into one of the largest of the jobbing concerns in the country. The first dealers' conference, at which the jobbing firm called together all of its qualified dealers to discuss questions of mutual interest, was conceived and carried out by the Mohawk company under Mr. Little's initiative in May, 1919. This practice has since become general throughout the country. In many other ways Mr. Little has taken the lead in plans to encourage and develop dealers and in the wider use of electrical appliances and supplies. In national affairs he has been correspondingly active, particularly in the Electrical Supply Jobbers' Association. Of that organization he has been a member of the executive committee and was recently chairman of the Atlantic Division. He first advanced the idea of a campaign of publicity through the trade press and other mediums to bring before the entire industry the service the jobber is rendering, and as chairman of the publicity committee that was appointed to carry out the plan he has aided in putting the campaign into effect and carrying it on, to the resultant advantage of all electrical jobbers.



A. M. LITTLE

R. Lee Switzenberg, who has been appointed superintendent of plants and lines of the Anderson (S. C.) branch of the Southern Public Utilities Company, succeeds R. T. Long, who recently resigned. Mr. Switzenberg joined the company as a dynamo attendant at the Portman plant. About five years ago he was made superintendent of the Portman plant. Six months later he was made assistant superintendent of plants and lines under Mr. Long.

C. L. Drapher, formerly with the Kansas City office of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been appointed district sales manager of the St. Louis office.

M. C. Sickels, of the Cleveland office of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been appointed district sales manager of that office, succeeding D. S. Tucker.

N. C. Hoyles has been appointed manager of the Cincinnati branch of the Pittsburgh Testing Laboratory, inspecting engineers and chemists, with offices at 813 Race Street. For the last year Mr. Noyes has been assistant manager of the Pittsburgh Testing Laboratory's New York office.

W. D. Morton, Jr., has been appointed purchasing agent of the Holt Electric Company, Jacksonville, Fla., succeeding C. H. Avery, who recently resigned.

Frank T. Groome has completed the work undertaken by him in connection with the industrial lighting campaign of the Electrical League of Cleveland and has returned to Toronto. Mr. Groome was invited to Cleveland by the Erner Electric Company to aid in organizing and in carrying on a city-wide campaign of education among industrial plant executives. As a member of the industrial lighting committee of the Electrical League, his work was very effective. Mr. Groome is best known as an organizer of the Ontario Association of Electrical Contractors and Dealers in Toronto. Later he organized both the electrical jobbers and the electrical manufacturers of Canada.



F. T. GROOME

Obituary

Harry F. Tate, for a number of years Western manager of the National Conduit & Cable Company, Hastings, N. Y., died in Chicago, March 14.

William F. Reynolds, for the past thirty years on the staff of Lockwood, Greene & Company, Boston, and lately district engineer in the Boston office of the Lockwood, Greene & Company Engineers, died at Quincy, Mass., March 9. Mr. Reynolds was born at Providence, R. I., in 1870, and his early career included work in architectural offices at Lynn and Providence. He was a brother of President Frank W. Reynolds of the engineering organization named above, and had broad executive supervision over various engineering departmental activities of the company at Boston.

Robert W. Nicol, founder of the Capital Electric Company and president and general manager of that concern until two years ago, died Feb. 22 at a hospital in Salt Lake City. Mr. Nicol was born in Quincy, Ill., fifty-nine years ago, and for thirty-five years was identified with the electrical contracting business. He was well known throughout Utah, Idaho and Montana. Mr. Nicol retired from active business two years ago, when the Capital Electric Company was sold to the General Electric Company.

Henry Clyde Parrish, formerly manager of the Southern Berkshire Power & Electric Company, Great Barrington, Mass., died recently after a protracted illness. Mr. Parrish was born in 1876 at West Stockbridge, Mass., and at the age of fourteen entered the employment of the Great Barrington Electric Light Company, working up to the superintendency in 1896. He was made manager when the company was taken over by the Southern Berkshire company, under the management of C. D. Parker & Company, Boston.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Many Plans on Foot to Stimulate Home Building

FROM various sources, for one reason or another, come reports of plans for stimulating construction, particularly of dwellings. Housing shortage, of course, accounts for most of these plans, but a number of them can be laid to the desire to be busy.

Senator Calder's Senate committee on reconstruction has recommended that congressional action be taken by easing building credits, by allowing tax exemption where money is to be used in home construction and by similar provisions. New York State is debating on a bill to promote easier building credits, and New York City has exempted all new domestic building to be undertaken within a year from paying taxes for ten years; one of the largest real estate mortgage houses in the country has reduced its minimum on building loans from $500,000,000 to $200,000,000.

Wages in the building trades are being reduced here and there. Materials prices are very much lower; in fact, in some cases, it is said, the prices have gone to the low limit.

Germans Active in Regaining Foreign Trade

THE great advantage possessed by the Germans in their export market now is said to be the extremely low production costs under which they manufacture. Consequently price basis is the main basis on which they are seeking trade and, indeed, getting it. With this price basis is a liberal system of credits backed up by national banking institutions. German companies are also investing in the business of their foreign customers to enable them to regain their prewar trade.

That the whole country is working to regain its export trade is shown in its constantly increasing volume of exports in the last two years. The electrical industry is one of its main standbys in this respect, and it seems that Germany is endeavoring hardest to undersell Americans in the Latin and South American markets and to undersell the British in the Far East markets. In furthering this there has been effected a co-ordination of important lamp, electrical machinery and raw-material interests in Germany since the ending of hostilities. This has lessened internal competition between these companies but strengthened materially the national competition of all of them working for one common purpose—to obtain trade for Germany.

The Allgemeine Electricitäts Gesellschaft is still extending its sphere of industrial influence. The board of administration has just decided on the increase of the capital stock by another 50,000,000 marks, chiefly for the purpose of acquiring a large interest in the Linke-Hofmann Works of Breslau, builders of all kinds of railroad material and rolling stock. The Linke-Hoffman Works give at present employment to about 16,000 men. In order to reinforce the working capital, and particularly for the purpose of supporting the increasing export trade, the board has furthermore decided to issue preferential shares to the amount of 250,000,000 marks. On account of these transactions the capital stock of the A. E. G. has risen to 850,000,000 marks, of which 350,000,000 marks represents common and 500,000,000 marks preferred shares.

The company has taken over the Felton & Guillaume Karlswerk, and the incandescent-lamp works of the company have been combined with those of Siemens & Halske and the Auer Company, which are now being run under the name of Osram Company. This company practically has the control of the incandescent-lamp production and export. While in the first half of the business year the progress of work was frequently disturbed by strikes and by shortage of coal and electrical energy, in the second half a considerable improvement in this respect and an increased efficiency of the workmen has become noticeable. The Oberspree cable works, near Berlin, have resumed the manufacture of copper cable, and the turbine factory has been employed on the manufacture of several series of large ship engines, especially Diesel oil engines. In the export business an increasing demand for special machinery has become noticeable.

Labor conditions have been reported good by visitors returning from industrial tours of Germany, but press reports of the last few days show that the Communist agitators are fomenting a general industrial strike.

Honesty in Business Necessary to Avoid Depression

THAT every man should be a man of his word, that industry should get back to the condition where an order is an order, that every manufacturer, jobber and consumer should agree not to cancel an order—these were the answers Charles L. Eidlitz, president of R. B. Corey Company, gave to his question "How to Prevent Industrial Depression Again," at the Atlantic Division meeting of the Electrical Supply Jobbers' Association in New York on March 15. Business—and included in that term is the electrical industry—since the middle of last year has been on such a basis that an order was not an order till the seller received a check for his goods and then had it certified. Mr. Eidlitz's characterization was that a man's word in business could not be taken today.

A chart prepared by the speaker showed a business cycle in the following rotation—high prices, surplus of goods, falling prices, bad business, low prices, scarcity of goods, rising prces, good business, then high prices again, and it was in explanation of this business cycle that Mr. Eidlitz made his plea for honesty in business. Everybody now is waiting, even the bank. In many cases the cash-discount man is taking thirty days to pay, the thirty-day man is taking sixty days, and so on, and business is at a low ebb. And while everybody waits business continues to drag along at this level.

Favorable Outlook Seen in British Manufacture

"THE general outlook appears to indicate a time of great activity for electrical manufacturers, with a more satisfactory financial result than in the past, with the proviso that political and industrial stability is maintained and that the supply industry is left free to adapt itself to the new code of area unification." Such was the conclusion of a discussion of the industrial outlook in the electrical industry forming part of the inaugural address of Llewelyn B. Atkinson at London, England, last November on his accession to the presidency of the Institution of Electrical Engineers.

In covering the growth of electrical manufacturing during the past fifty years Mr. Atkinson laid stress on the unification of the cable industry, the only branch of electrical manufacture which was unified, showing its success not only in the home market but also in the world markets,

and he brought out in serious contrast the deplorable commercial and financial condition of the manufacture of machinery and accessories both in home and foreign markets.

"Apart from social, political and labor unrest the manufacturing situation now looks more favorable. There has been a movement of integration," said Mr. Atkinson, "of joining up under single control of sufficient firms to enable complete contracts to be undertaken in any part of the world. The close of the era of constructing small localized generating plants will permit and necessitate standardization, and the increasing size of units will limit the number of newcomers into the industry who, with experience lacking and having the necessity of forcing their way into the market, were a constantly depressing influence.

"The experience of the war production of standard designs, and the increased amount of automatic and semi-automatic machinery as a result of the war, will tend to specialization on the part of those making small machines and accessory apparatus, thus to a certain extent eliminating competition, but, as the result of the increased production of a limited range of standard articles, diminishing the cost below what the previous competitive cost would have been."

Jobbers' Purchaser Compiles Prices on Electrical Materials

AN INTERESTING card of price comparisons on various lines of electrical supplies and material has been made up and distributed by the Biddle Purchasing Company, 107 Chambers Street, New York City, to its clients—jobbers for whom it acts as purchasing agent. The chart shows jobbers' buying prices from 1914 to January, 1921, the high and the low figures being given for each year.

It is understood that only prices representative of all the manufacturers of any given line have been used. Where one manufacturer may have doubled lists and the majority of manufacturers have not done so, the figures of the majority have been taken.

Carbon Industry Needs Tariff Protection

ALTHOUGH the carbon section of the Associated Manufacturers of Electrical Supplies has been active in its endeavor to get greater tariff protection on the importation of foreign carbons and carbon products, the desired results have not yet been achieved. On Jan. 11 A. C. Morrison of the Union Carbide & Carbon Company, representing the carbon section, received a hearing before the committee on ways and means of the House of Representatives. At its conclusion he filed with the committee data relating to foreign wages in carbon manufacture, a schedule of the suggested rates of duty on electrial carbon products and a brief suggesting the change in wording which might be used in this matter as opposed to the wording in the present schedule.

Manufacturers of electrical carbons and carbon products have always been confronted with difficulties in their endeavor to obtain information on undervaluation of these materials when entering this country as imports. But in this respect the industry has made some progress in the gathering of such information.

The speaker showed some of the methods by which importers paid a relatively light duty on arc-light carbons, motion-picture carbons, searchlight carbons, furnace electrodes, brushes, miscellaneous carbons, turbine packing rings and telephone carbons because of Supreme Court interpretations placed on the wording of the tariff rules. Particular emphasis was placed on German goods and the returning market which that country was finding in the United States through low tariffs and through low production costs. German carbon workers were said to average $3.90 per week against $31 per week in the States.

Before the war there were imported principally from Germany, 17,000,000 motion-picture carbons per annum. During the war American industry filled these requirements, and now 20,000,000 are needed. Last October 1,100,000 came in from Germany, and an order was placed in Germany early in January, 1921, for $1,000,000 worth. On a cost basis this importation will continue and will supply the whole field unless proposed tariffs are enacted.

ARTICLE		1914		1915		1916		1917		1918		1919		1920		1921
		LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	JANUARY
Batteries Dry	EA	12¢	14¢	14¢	24¢	26¢	27½¢	24¢	24½¢	24½¢	27½¢	27½¢	27½¢	27½¢	30¢	30¢
Bells Electric	EA	15½¢	16½¢	16½¢	16½¢	22¢	27¢	14½¢	27¢	29¢	37¢	32¢	37¢	37¢	37¢	46¢
Blades Hack Saw	C/D	$2.30	2.30	2.30	2.30	3.47	3.53	3.53	5.15	5.07	5.07	5.07	5.07	5.07	5.07	5.07
Boxes Outlet		50% 10%	50% 10%	50% 10% 5%	50% 10% 5%	70%	64%	62%	45%	67%	45%	60 10%	55%	45%	40%	40%
Boxes Switch		50%	50%	50% 10% 5%	50% 10% 5%	64%	53%	64%	60%	60%	50 10%	65%	56%	52%	40%	40%
Bushings Socket	H	$1.00	1.05	1.05	1.05	.75¢	1.05	1.15	1.50	1.50	1.50	1.50	2.25	2.50	3.00	3.00
Cable Bx	M/F	$35.00	45.00	38.00	50.00	50.00	80.00	62.50	75.00	60.00	70.00	60.00	75.00	60.00	90.00	55.00
Conduit		71%	69%	69%	69%	57%	54%	52%	32%	20%	22%	30%	26%	28%	20%	31%
Copper Electrolytic	LB	.14¢	.41¢	13¢	23¢	23¢	36¢	19½¢	30¢	23¢	29¢	14.5¢	23½¢	12½¢	18½¢	12.34¢
Cutouts Electric		70% 10%	70% 10%	70% 10%	70%	60%	60%	55%	50%	50%	40%	40%	40%	40%	35%	45%
Drivers Screw		60%	60%	60%	60%	60%	50 10%	50%	40 10%	40 5%	40 5%	40 10%	40 10%	40 5%	30 5%	30 5%
Fuses Enclosed		80%	75% 10%	80%	75% 10%	75%	75%	75%	65%	75%	65%	75% 10%	75%	70%	70%	70%
Iron Pig Basic Valley	TON	$12.48	13.21	12.50	17.73	17.64	30.00	30.00	53.52	32.00	33.00	25.29	34.25	33.00	48.50	32.00
Knobs Porcelain		50% 10%	50% 10%	50% 10%	50% 10%	50% 10%	50% 10%	50% 10%	40%	40%	40%	40% 10%	30 10%	30 10%	20 10%	20 10 5%
Lead St Louis	CWT	$3.35	3.76	3.50	7.50	5.45	8.25	5.42½	12.00	5.70	7.75	4.60	7.50	4.45	9.50	4.75
Loom Circular		80% 5%	80% 5%	80% 5%	75% 10%	75%	66%	70%	50%	65%	50%	75%	55%	55%	50%	65%
Plugs Attachment	M	$75.00	82.00	80.00	90.00	80.00	90.00	82.50	90.00	95.00	95.00	95.00	113.00	110.00	113.00	110.00
Plugs Fuse	M	$31.00	51.00	47.00	84.00	34.75	35.00	32.00	36.00	32.00	40.00	33.00	40.00	38.00	42.00	35.00
Rubber Up River Fine	LB	1	1¢	20¢		18½¢		27¢		27¢		24¢	50¢	21	28¢	11¢ TO 12¢
Schedule Material		60%	60%	52%	60%	54%	47 5%	47 5%	40%	40%	30%	40%	30%	40%	24%	24%
Solder 40/60	CWT	$14.22	17.00	15.02	27.41	16.30	27.35	20.30	41.75	31.75	48.83	24.69	33.80	15.67	31.70	16.25
Spelter New York	LB	4.5¢	4.5¢	5¼¢	21½¢	8¼¢	21½¢	7¼¢	11¢	7½¢	9½¢	6¢	9¢	5.2¢	9.2¢	5.3¢
Switches Snap		70%	60%	62%	60%	54%	47 5%	47 10%	40%	40%	30%	40%	30%	30%	24%	24%
Tape Friction	LB	60¢	70¢	64¢	77¢	64¢	77¢	24¢	24¢	24¢	38¢	32¢	35¢	40¢	50¢	50¢
Tin Straits New York	LB	31¢	32¢	32¢	57¢	37½¢	50¢	42½¢	80¢	70¢	110	52.5¢	72.5¢	33½¢	62¼¢	33¼¢
Tubes Porcelain		85% 10%	85% 10%	85% 10%	85% 10%	80% 10%	80% 10%	80% 10%	80%	80 10%	80%	40%	60%	60%	50 10%	50 10%
Wire Annunciator	LB	14¢	14¢	14¢	21¢	25¢	54½¢	17¢	54½¢	27¢	54¢	20.5¢	36¼¢	26½¢	42¢	26¢
Wire Copper Bare		14¢	15¢	14¼¢	23½¢	23.5¢	36¼¢	26¼¢	54½¢	23¼¢	42¢	17¢	20¾¢	18¢	23¢	15¾¢
Wire Rubber Covered	M/F	$.00	.00	575	570	865	340	910	1035	861	1025	825	1075	800	1075	775
Wire Weather proof	LB	13.2¢	14¼¢	14.4¢	21¢	23¢	36¾¢	26¾¢	54¢	27¢	30½¢	15½¢	27¢	10½¢	15¾¢	17¢
Wrenches Pipe Steel		80 5%	80 5%	80 5%	80 5%	80 5%	75%	70 10%	70 10%	70 5%	70 5%	70%	60 5%	60 5%	47½ 25%	55 25%

WHAT JOBBERS HAVE HAD TO PAY FOR ELECTRICAL SUPPLIES IN LAST SEVEN YEARS

Low Cotton Price Holds Back Southern Industry

A NUMBER of interesting facts were disclosed at the meeting of the Georgia Bankers' Association held in Macon on the twenty-third of March. This meeting developed the fact that 50 per cent of last year's cotton crop was still in the hands of the farmers who are holding it, with no definite price or date of selling in view. It also appears that the reduction in acreage will be 33 per cent and that only 38 per cent of the fertilizer used last year will be used this year. Banks will curtail their farm loans very sharply and will loan only where the money will be used for the production of food crops and where reasonable collateral is forthcoming.

A review of these facts makes it evident that an increase in the price of the staple will inevitably mean increasing activity, but that until the farmers dispose of some of their holdings from last year business will continue to be slow in the rural districts throughout the section. The fact, however, that a great deal of the agricultural wealth is still held indicates that even though the revival may be slow, conditions are, nevertheless, on a sounder basis than was heretofore supposed.

Present cotton prices in Augusta, Ga., are quoted at 11.25 cents a pound. During the war, when cotton was selling for 40 cents, the planters couldn't grow enough. Even with cotton at 20 cents it is felt that there would be considerable activity in that commodity, with resulting activity in all industry in the cotton belt. With money flowing in that region there is a nice volume of extension of electric service projected, but as conditions now stand it hardly seems that much reawakening of industry can be expected at present cotton prices.

Manufacturers of electrical apparatus and supplies are still carrying many Southern jobbers, who in turn are carrying their trade. The money just isn't liquid, and each branch of the industry in turn is bearing its share of the burden until such time as the market again opens up. This practice is saving liquidations.

Exchange Market for Used Washers and Cleaners

IN VIEW of the slowing up of the appliance market it is interesting to note that many dealers in the Middle West are increasing their sales of new washers and cleaners by making allowances on used machines. In some cases customers are approaching the dealer with the proposition that they will buy provided an allowance is made them on their old machine. In a far greater number of cases solicitation at the house discloses the same condition. In virtually every instance the dealer is making a profit on both machines, the profit on the whole transaction being considerably larger than it would have been on the sale of the new machine or cleaner only.

So far this factor probably does not greatly affect the industry, but there is approaching a time when the demand curve for washers and cleaners will tend to flatten out, and at that time the question of the acceptance and disposal of used machines will have to be considered seriously. At present the average dealer finds no difficulty in repairing and disposing of machines taken in trade. The services of one repairman and the occasional use of newspaper space suffice to keep this end of the business going at a pretty fair rate.

As the market approaches the point of saturation a more complicated system of merchandising will have to be used. In the used-automobile business, it is understood, standards of value are set by a bureau which tabulates from week to week the supply of the various makes of cars and the relative values of certain models, depending on condition. These values are bulletined to the members of the bureau, and nearly all of their transactions are based on the bulletins. Some procedure of this kind may have to be organized by washing-machine dealers. Co-operation of manufacturers, it seems, will be a necessity also if the consumer market for new machines is to be kept healthy, inasmuch as the average dealer does not possess the facilities to repair and dispose of a large number of used machines. There is another parallel in the automobile industry, several Detroit manufacturers maintaining salesrooms to dispose of used cars of other makes taken in by their dealers.

How Should Washing Machines Be Rated?

EFFORTS are being made by the educational department of the American Washing Machine Manufacturers' Association to have the rating of washing machines expressed in pounds of clothes, dry weight, instead of in number of sheets as at present. It is the contention of this department of the association that the present method of rating is misleading, inasmuch as sheets do not form a particularly large percentage of the average washing and the user gets only a very vague notion of the true capacity of the machine from the term "number of sheets."

Another point made by the department is that rating as expressed in pounds of clothes will enable the housewife to determine the exact amount of water to use with the amount of clothes to be washed. This would insure proper cleansing of the clothes and would eliminate poor washings resulting from too much water in proportion to clothes and the damage to clothes and washer due to overcrowding. Economies in the use of soap and washing powders also would result. Whatever can be done to make it easier to use the washing machine will of course redound to the benefit of the industry.

The Metal Market Situation

STEPS leading to a further drastic cut in copper production have now been taken, and as a result several large mines have closed down entirely. This factor in the market, together with the firm price stand that has all along been taken by large producers, has brought about a decidedly firmer tone. Prices have advanced about ¼ cent since last week's report, and the minimum quotation for prompt delivery is now 12.50 cents. Large producers are still holding to prices of 12.75 to 13 cents per pound for copper delivered over the next two to three months and are reported to have made sales at these figures. Consumers have apparently decided that nothing is to be gained by holding off longer from covering their needs, and as a result domestic buying interest is decidedly greater. Whether this is but a temporary condition it is, of course, yet too early to say. The Anaconda Copper Mining Company is the latest one to announce temporary suspension.

Following the expectation the prevailing low "official" price of lead was advanced to 4.10 cents, inasmuch as a 4-cent price has been below the effect of foreign competition and the outside New York market is about 4.45 cents per pound. Zinc is also regarded as a good buy at its present level, but money stringency has prevented consumers from taking advantage of this price extensively.

NEW YORK METAL MARKET PRICE

	March 22, 1921	March 29, 1921
Copper	£ s d	£ s d
London, standard spot	68 0 0	69 12 6
	Cents per Pound	Cents per Pound
Prime Lake	12 37 12 62	12 75 13 00
Electrolytic	12 00—12 50	12.50—12 75
Casting	11 75	12 00
Wire base	15 00	15 00
Lead, trust price	4 00	4 10
Antimony	5 37	5 12
Nickel, ingot	41 00	41.00
Sheet zinc, f o b smelter	11 00	11.00
Zinc, spot	5 20	5.15
Tin	28 50	29.25
Aluminum, 98 to 99 per cent.	28 00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.00	9.50—10.00
Brass, heavy	5.75— 6.00	5.50— 5.75
Brass, light	4 00— 4.25	4 00— 4.25
Lead, heavy	3.12— 3.62	3.12— 3.62
Zinc, old scrap	2 78½- 3 00	2 78½- 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

SEVERAL districts report a little better tone this week. New York, Chicago, Boston and San Francisco appear to be leading in new construction projected and in some cases let. Most of this is for residential work, however. In the other territories there is no evidence of any less activity, but conditions seem to indicate a waiting policy.

Except here and there locally, prices have shown no change this week. Stocks in general are ample to fill present needs, and all the trade is doing is to keep these stocks in a balanced condition. There is quite a movement of supply items, however, because contractors have a fair amount of replacement and repair work on hand. The feeling of optimism is a little bit more noticeable as the warm weather puts in an appearance.

While there is no evidence that money is any easier to collect, it is no harder. Constant application on this question is keeping most payments from going below the level of the last few months.

NEW YORK

A slightly better tone to trade can be reported this week, and in some instances a little improvement in demand is noted too. There is nothing big under way and total sales would probably not show much increase over the past few months, but spring is here, bringing a certain amount of seasonal buying, and an increasing number of plans for new buildings helps to brighten the horizon.

There is a fairly consistent volume of goods moving, but not in large quantities, and the source of buying differs among various jobbers.

Stocks are fairly low on standard items, yet jobbers are still endeavoring to lighten inventories further. As a consequence buying from the manufacturer is only such as sales are thought actually to warrant. Prices have remained unchanged the past week, and collections, while fairly satisfactory, are pushed closely.

Non-Metallic Flexible Conduit.—On 1,000 ft. of the $\frac{7}{32}$-in. size the market ranges from $22 to $23.10, and for $\frac{1}{2}$-in. from $24 to $25.15, though as high as about $6 per 1,000 ft. above these prices is held in some quarters. Demand is not large.

Rubber-Covered Wire.—No. 14 single-braid holds at $7.75 to $8.25 per 1,000 ft., but more jobbers are now quoting the bottom price. Stocks up to half a million feet are reported this week. A few jobbers are making fairly good sales, but general demand is not brisk.

Flexible Armored Conductor.—Several jobbers report that demand has picked up and is fairly good, but this condition is not yet general. Good stocks are on hand, with No. 14, two-wire, double-strip sold at $63 to $65 per 1,000 ft.

Conduit.—Competition among jobbers has had the effect of lowering the market as several houses are this week well under the mark of $70 per 1,000 ft. on $\frac{1}{2}$-in. black. On that size quotations range from $63.60 to $70 in 2,500-ft. lots, and on $\frac{3}{4}$-in. black in the same quantity from $83.75 to $93.50.

Tape.—Standard grades of friction tape bring from 42 to 47 cents per pound in 100-lb. lots, and rubber tape from 40 to 48 cents. The average market is about 45 cents per lb. on both friction and rubber. Demand, though not great in general, is spotty among different jobbers as some are selling considerable to industrials and to contractors for small repair jobs. Stocks are fairly large.

Schedule Material.—Stocks are well filled on standard items, and jobbers for the most part are ordering only as they need the material. The view that prices must ultimately come down persists. Sales are only fair.

Fans.—An early spell of warm weather has started supplies moving very slightly, but early orders placed with jobbers are small. Indications are that the fan business in this territory will be on a conservative basis all through the trade, especially as stocks carried over are large.

Vacuum Cleaners. — Demand is spotty. Some jobbing houses and retailers state that spring demand has increased sales to good proportions, while others report a poor market. Buying from the manufacturer is cautious; in fact, several jobbers have such large stocks they expect to order no more cleaners this season.

Lamp Cord.—No. 18 cotton parallel in 1,000-ft. lots sells for $18.75 to $24.55, and No. 18 cotton twisted from $16.50 to $20.70, though in both instances the higher quotation is considerably above the average market price.

CHICAGO

The steady stream of building permits keeps up, $1,426,000 being the figure for the past week. A large proportion of this is going into cottages and small apartments, and the total for March and February is so great that much activity in contractors' supplies is assured. While no actual boom is under way, the total of new construction so far this year exceeds the average for the past ten years and bids fair to keep up this pace for some time.

The Illinois State Legislature has initiated an inquiry into the construction situation in Chicago, it having been stated that conditions similar to those uncovered in the New York investigation are existent here and that building is thereby being greatly retarded.

Electrical trade remains in the same quiet stage that has been reported for some weeks. No price changes are noted and purchases are limited to actual requirements in all cases. Construction work is not yet far enough advanced to cause any pressure of buying, and general retail lines remain quiet on account of widespread non-employment. The employment situation, however, is gradually improving as the automobile interests are increasing their forces, and, in general, manufacturing activity seems to be upward.

Bare Copper Wire. — Slightly increased demand is in evidence, and sellers show less willingness to shade quoted prices, probably because it is now about as low as it can get. Thousand-pound lots of No. 8 are quoted at 16 cents. Supply is ample, but no reports of overstocks are heard.

Insulated Wire.—With a cessation in the tendency of prices to slide lower every day demand has stiffened up somewhat. With the volume of construction that is in sight it is evident that quantities of insulated wire will be needed this summer, and buyers who figure that the bottom has been reached are coming into the market. No change in quotation has been made, No. 14 rubber-covered still being $7.75 per 1,000 ft. and No. 6 triple-braid weatherproof 19 cents per pound in 1,000-lb. lots.

Conduit.—Continued speculation as to the future of steel prices makes a poor market on pipe, prospective buyers apparently being willing to gamble on lower prices coming. In 5,000-lb. lots, $64 per 1,000 ft. is the quoted price on $\frac{1}{2}$-in. black.

Flexible Armored Conductor.—Lack of orders is not inducing any appreciable amount of price cutting, No. 14, two-wire holding around $62 per 1,000 ft. in 5,000-ft. lots.

Fans.—Purchases of fans are so far very conservative. Prices hold no promise of a further reduction, and interested parties are content to stock just enough to meet current requirements and await developments.

Motors.—There has been some increase in inquiries in the past week. It is not felt that any very active demand will develop as, in this territory at least, there will have to be a considerable improvement in general business before present installations are kept busy.

Lamp Cord.—Sufficient stocks and fair business is the report from all factors. No. 18 twisted-cotton-covered is quoted at $15 per 1,000 ft.

BOSTON

A gradual improvement in jobbing trade is apparent, despite the continued handicap of the local building strike. One of the larger houses reports that its total billing for the first quarter of 1921 will be within 94 per cent of last year's billing for the same period. Building and engineering contracts in New England for the week ended March 22 are published as $4,097,300, exceeding all but one corresponding week since 1912. The unsatisfactory labor situation is the chief obstacle to an early return to prosperous trade conditions as far as the local construction field goes. Announcements of new industrial-plant construction are beginning to be played up in the press. Jobbers' stocks are running low and in many cases orders are being passed along to the manufacturer in the form of calls for replacing existing stores. Collections are poor this week, prices steady and deliveries generally satisfactory.

Wire.—Rubber-covered No. 14 sells at $8 per 1,000 ft. in 5,000-ft. lots and at $7.75 in 25,000-ft. consignments. Weatherproof base is 17 cents and bare base 16½ cents except in very large quantities, when about 15½ cents is figured. Little wire is moving compared with normal.

Fuses.—Stocks are easy, plugs up to 30 amp. at 110 volts bringing 5.1 cents in standard-package lots.

Motors.—Stocks are well filled and deliveries easy. A few motors are being sold and some inquiry work is being handled. Betterment work in industrial plants is absorbing some machinery of the motor-driven type, and rearrangements of old drives are receiving more attention.

Flexible Armored Conductor.—Good supplies are in hand and current sales are moderate, No. 14 double-strip bringing $87 per 1,000 ft. in 1,000-ft. lots.

Knobs and Tubes.—Moderate sales are taking place on a hand-to-mouth basis. No trouble is encountered in meeting current needs. "Nail-it" knobs are selling at $27 per 1,000 in barrel lots and 3-in. tubes at $9.50 per 1,000, same lots.

Appliances.—Local stocks of vacuum cleaners, radiators, flatirons and washers appear equal to anticipated spring demands. Energetic sales work in the retail field is proceeding, and washers and cleaners are moving fairly well. Considerable radiator business is anticipated shortly with the stopping of domestic heating plants. Competition among cleaners is keen at present.

Lamps.—Lengthening days have affected trade adversely but stocks are diversified and portable units are moving slowly.

Non-Metallic Flexible Conduit.—Prices are steady and stocks are not being drawn down sufficiently to lengthen deliveries much. The ⅜-in. size sells at $22 per 1,000 ft. in 5,000-ft. lots, and the ½-in. size at $24.

Storage Batteries.—Starting and lighting batteries are moving fairly well, the mild winter having kept many more cars in service than ordinarily. No complaints as to deliveries are heard. Tractor and truck batteries are relatively inactive, although inquiries are promising. From two to three weeks' deliveries are quoted.

Starting and Lighting Sets.—The improved conditions in the automobile industry are reflected in a better demand for this equipment. One New England manufacturer received an order for about 30,000 sets recently, and improved manufacturing plant will probably result in completion of the order in not far from four weeks.

ATLANTA

A canvass of jobbers disclosed a slight improvement in their business as a whole. Spring weather seems to have set in in earnest and is causing a general feeling of optimism which is reflected in the receipt of more inquiries than for some time. The constant demand for housing facilities is stimulating business activities, and building permits in the larger cities are showing a healthy increase over prior months. This has served to stimulate the production of lumber and many lumber mills which have been shut down are planning for early reopening.

Vacuum Cleaners.—The usual spring demand for this specialty has caused considerable increase in sales, and at the present rate stocks will be shortly depleted and jobbers forced to place reorders with manufacturers. Shipments are reported very good.

Rectifiers.—A slight improvement in the automobile trade has served to stimulate the interest in battery rectifiers, particularly in the 6-amp. size. Stocks are in good shape and prices on the 6-amp. size are steady at $130.

Interphones.—The completion of a number of office buildings and apartment houses in Atlanta and neighboring cities has caused a brisk movement in interphones. Jobbers' stocks are reported in excellent shape, with no immediate price reductions is prospect.

Non-Metallic Flexible Conduit.—While the movement in this line is still very sluggish, a slow increase in buying is to be noted, despite the rumor of another decline in price. All jobbers have heavy stocks on hand. Prices, lots of 1,000 ft. to 2,500 ft., ⅜-in., $2.75; ½-in., $3 per 100 ft.

Bell-Ringing Transformers.—Educational advertising and the revival of residential building are credited with increasing sales of this item. Local stocks are reported in good shape in all sizes. Price, list, 3, 3-in. gong size, $2.50; 12, 4-in. gong sizes, $6.50.

Conduit.—Galvanized pipe is showing an awakening activity and enameled is reported as quite steady. Jobbers are not buying heavily, expecting a further reduction in price, and as a result stocks of the popular sizes have become quite spotty. Prices per 100 ft., galvanized, ½-in., $9.17; 1-in., $18.00; 2-in., $39.18. Black, ½-in., $8.66; 1-in., $16.98; 2-in., $36.96.

Lightning Arresters.—The approaching summer season has brought with it a brisk movement of arresters—particularly of the 2,300-volt type. This movement, it is felt, will continue until well into the middle summer. Stocks are in good shape and shipments satisfactory.

Street-Lighting Equipment.—Dormant for a considerable period, this line is now showing considerable activity, most of the inquiries coming from municipalities for both the standard and ornamental type.

ST. LOUIS

The situation this week is unchanged, there being a steady and gradually improving demand. Of the recent inquiries for pole-line materials one has developed into the actual placing of orders for materials to erect a 22-mile transmission line, and it is felt that this is but the beginning of a fair amount of pole-line construction work which will be done this spring and summer. Stocks remain generally in good condition except that they are heavy in porcelain and schedule material and slightly short in safety switches and high-tension insulators. No price changes are noted for the week. Collections are perhaps slightly better, ranging as a rule from forty-five to sixty days. One jobber reports collections on a seventy-five-day basis, though with signs of betterment.

An interesting sidelight on the general business condition here is that the output of central-station energy this year has at no time been less than the output of the corresponding month last year. In comparison with reported reductions elsewhere this would seem to indicate that St. Louis is suffering less from the industrial depression than are many other sections of the country.

New construction work, however, is at a very low ebb. Building permits are few and for small amounts. There are reported to be a number of buildings, both residential and industrial, under contemplation and awaiting chiefly a reduction in labor costs. The dispute between the contractors and the building trades unions is still far from settlement.

Wire.—No marked change in either the demand or the supply of wire has occurred this week. Fair movement is maintained and stocks are in good condition. No. 14 rubber-covered is the best seller and is priced from $7.90 to $8.10 per 1,000 ft. in 5,000-ft. lots. It is quoted as low as $7.50 in 100,000-ft. lots. Weatherproof is being sold in some instances on a 16-cent base and bare copper from 15½-cent to 16⅝-cent base.

Safety Switches.—As a result of the recent ruling on in-

closing of switches and of its strict enforcement, there has been a good demand for safety switches and local stocks are becoming in some instances depleted. Jobbers are buying conservatively, however, and stocks will probably be maintained at a low figure for some time but with frequent turnover. No changes in prices have been reported.

Sockets.—Generally heavy stocks obtain and the demand is exceptionally low, this being largely attributable to lack of residential building. Pulls are quoted at $51, keys at $28 and keyless at $25.50 per 100.

Poles and Cross-Arms.—Demand is just beginning to appear in these items, the first sale of consequence for some time being reported this week. A good demand for pole-line materials this spring and summer is expected by the jobbers as inquiries are numerous and for large quantities. Cross-arms are approximately 25 per cent lower than on Jan. 1, and pole-line hardware is about 10 per cent lower. Stocks of these items are in good shape.

Porcelain Insulators.—There is a shortage of porcelain insulators for high-tension work, due to slow deliveries by the manufacturers, sixty-day deliveries now being offered.

Rigid Conduit.— While the city's ruling against open wiring is tending to stimulate sale of conduit, this has not yet been made an ordinance, so that it may be a month yet before demand will increase materially. Stocks are in good shape, ½-in. black being quoted from $65 to $71 per 1,000 ft.

SAN FRANCISCO

A great deal of building is reported in the residential section. Large building, however, is mainly restricted to jobs well under way and few permits are being issued for this class of construction. Appliance buying is well nigh at a standstill, all classes of materials from the small socket appliances up to washing machines and ironers being affected. This seems to be the result of the determination of individual housewives to await lower prices, which they deem certain. In this opinion they are confirmed by the reduction in price of a number of low-grade machines.

Rubber-Covered Wire.—Prices are still on the decline, the latest level reached being $8.95 for No. 14 single-braid solid in coil lots, with a price 90 cents per 1,000 ft. lower in 5,000-ft. lots. Assortment with other sizes is permitted. Local stocks are good, and the buying is in rather large quantities. Several dealers have assorted their purchases so as to bring out carload lots from the East, placing their orders directly with the manufacturers.

Conduit.—Pipe is now selling in 10,000-lb. assorted quantities at a price approximately 12 per cent below previous figures. A new price schedule eliminates the smaller quantities such as the 2,500-lb. and 5,000-lb. quantities and provides for just three prices—less than 10,000 lb., 10,000 lb., carload lots. Jobbers' stocks are good in all sizes and finishes. They are not heavy despite the decreased demand because they have been reduced proportionately by the cancellation of certain pre-scheduled shipments.

Non-Metallic Flexible Conduit. — A startling slash in prices is just published, the price of $\frac{3}{32}$-in. dropping from about $40 per 1,000 ft. in crate lots to $26. A new 5,000-ft. price averaging about $1.50 per 1,000 ft. lower is being quoted. This wiring staple was short nearly all last year, but when the factories caught up to their quotas they did it so rapidly that rather heavy jobbers' stocks are reported.

Lamps.—This is the quiet season for lamp sales, but keen competition for outstanding contracts is the rule. Quite a few electrical businesses are reported as changing hands, and this has occasioned many cancellations of lamp contracts and their consequent replacement from other sources. The illuminating educational campaign is being vigorously followed, but so far the results have not made themselves greatly felt commercially.

Ranges.—A drop in price of approximately 30 per cent has just been wired to the Coast, and new prices have not yet been exactly figured. From present indications it looks, however, as though the standard household range will retail for about $150. An immediate result of the drop was the stimulation of orders from power companies.

SEATTLE—PORTLAND

Unmistakable signs of business revival predominate, but actual business is not materializing; consequently the electrical trade is marking time awaiting the improvement predicted and anticipated. There is quite a general feeling that if labor would voluntarily grant a wage reduction it would have a greater effect than any other one thing in reviving business conditions. The wage earner is not buying because he is expecting a wage cut or the loss of his position.

Sales in Seattle and Puget Sound cities are very light, the principal movement, such as it is, being on certain domestic appliances and wiring devices. There have been no recent price changes of consequence and none is expected. Stocks are topheavy and virtually every line is easily obtainable. Collections are from fair to medium, and no new credits of moment are being asked for or extended. Employment conditions in Seattle and Sound cities are showing improvement, but wage cutting is an every-day occurrence. In an effort to stimulate building the Tacoma master builders' association and the Everett association announced wage cuts approximating 20 per cent effective May 1 and April 1 respectively. Seattle's wage cut of 20 per cent is in effect, and Portland builders will follow suit at once, it is understood. Manufacturers in the Portland district report business very spotty. Jobbers say that business in general is very slack, the principal activity being in copper wire and wiring devices. A few minor price reductions are reported for the week, but porcelain continues to show an upward tendency. Collections and credits remain virtually unchanged, the average of collections for Portland being about fifty days.

Motors.—For the first time in nearly two years stocks of fractional-size motors are in excess of demand and replenishments are very easy to obtain. The movement of larger sizes is negligible, as many lumber mills and manufacturing plants which contemplate electric installations have postponed work.

Knobs, Tubes, Cleats.—Stocks on hand are comparatively heavy, and demand is not showing the increase anticipated. Prices are holding.

Lamps.—All dealers report stocks ample and deliveries easily obtainable. Demand is showing little improvement.

SALT LAKE CITY—DENVER

As the time approaches when building activities should normally begin there are few big jobs scheduled for immediate work. Co-operative efforts on the part of all who contribute to building either in materials, skill or rough labor are being put forth in the hope that some sort of building campaign may be launched. Realtors on their part are also spending huge sums to spread the idea that this is the logical time to erect homes. That substantial results will accrue from this concerted drive on the prospective home builder and others no one doubts. Lumber is advertised as being back to a pre-war basis, hardware shows substantial reductions, and plumbing and heating costs are cut from 25 to 30 per cent from the level that was maintained for several years past. The financial situation continues conservative. The banks report the demand for money to be strong as ever, with little to be had. Country banks are reported cutting down their loans to absolute necessities, notifying city banks that there can be no lasting relief until farmers are able to market their products. High price of labor is one of the factors that stands as a hindrance to building. High wage schedules are maintained, despite the fact that thousands of men are now unemployed.

Wire can be had in plentiful supply from jobbers. The chaotic condition of the metal market holds the prices down to a low level.

Conduit is also affected seriously by the condition of the metal market. Orders can be filled for immediate delivery. Porcelain stocks are ample to meet present needs. Most back orders are now taken care of by manufacturers. The price shows no tendency to come down, quotations being about what they were a year ago. The status of sockets is about the same as that of porcelain, while the outstanding feature is the persistence of the high price level.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Richmond Picked for Credit Association Meeting

The twenty-second annual meeting of the National Electrical Credit Association will be held in Richmond, Va., on May 19 and 20, according to a recent advice from headquarters in Chicago. The name of the meeting place has not been decided upon to date, and this along with the program will be announced later. This meeting city, it seems, should permit of a large attendance from the states in the South.

Washing-Machine Makers Issue Laundering Data

Six bulletins dealing with the subject of home laundering have been issued by the American Washing Machine Manufacturers' Association for the use of domestic science courses in colleges, women's clubs and extension courses. The bulletins deal respectively with removal of stains, supplies for the home laundry, washing cottons, linens, woolens and silks, machine washing, ironing and the layout for the equipped home laundry.

Supply Jobber Adds Residential Fixture Studio

The F. Bissell Company, Toledo, Ohio, jobber of electrical supplies, will open an electric lighting fixture studio in the Locke residence at Madison and Thirteenth Streets. The residence will adapt itself readily to the display of fixtures actually seen and hung in a room corresponding in general with that in which they are to be used. E. R. Gillett, manager of the lighting-fixture department, will be manager in charge.

McKenney & Waterbury Embark in Jobbing Business

The McKenney & Waterbury Company, Inc., which was recently organized through the acquisition of the old McKenney & Waterbury Company, Boston, by Murvyn W. Vye and Alfred J. Paine, has extended its activities into the general field of electrical supply jobbing.

Arrangements are being made to represent various manufacturers of electrical household and industrial equipment. Among the lines which will be carried at once are National metal molding, H. T. Paiste taplets and other material, Hart & Hegeman wiring devices, Square D switches, and pole-line hardware, insulators, crossarms, etc. Various changes in the offices of the company have been made to render the executives and sales staff more accessible to visitors and customers, and a wiring device stock department has been established on the first floor.

Holt Power Equipment Enters Construction Field

The Holt Power Equipment Company, Milwaukee, Wis., which has been specializing in the purchase, sale and reconstruction of generators and motors, will hereafter and in addition to its present activities engage in electrical engineering, construction and maintenance work, particularly in connection with industrial light and power installations. Ottomar H. Henschel has become financially and actively associated with Dean S. Holt of this company.

Northwestern Electrical Equipment Changes Location

The building at 379-383 Washington Street, New York City, has been leased by the Northwestern Electrical Equipment Company, at present at 35 Vesey Street. The old location is only 25 ft. x 90 ft., six floors and basement, while the new building will be 60 ft. x 60 ft., five floors and basement. The company expects to have better shipping facilities from now on and to be able to provide better service in the supply jobbing field. The change must be made by May 1 as the present building has been sold.

Michigan Stamping Purchases Toledo Metal Products

The Michigan Stamping Company, Detroit, has recently purchased the business of the Toledo Metal Products Company, 1627-33 Dorr Street, Toledo, Ohio, and will continue the manufacture and sale of the "BG" line of outlet boxes, covers and switch boxes formerly made by that company. The Michigan Stamping Company business history covers a period of over twenty years until it has reached a capitalization of $4,000,000.

The present plant of the Michigan company in Detroit covers 6½ acres on a 36½-acre site. The work of moving the newly acquired electrical department equipment from Toledo to Detroit is well under way, and it is expected that permanent production in Detroit will be commenced early in May. A new floor, 480 ft. x 60 ft., is now under construction to care for part of this new manufacturing. Meanwhile some production is going on at 1631 Dorr Street in Toledo. John H. French is president, H. P. Cope is vice-president, W. F. Tant is secretary and treasurer, and A. B. Hoffman will be in charge of the newly acquired electrical department.

Westinghouse Lamp's Bloomfield Plant About Ready

The new Bloomfield (N. J.) plant of the Westinghouse Lamp Company is about completed. Started last spring, the work has progressed steadily. The expansion consists of 230,014 sq.ft, part of which is an extension and the remainder an entirely new building of four stories. Ground measurements on the extension are 164 ft. x 100 ft. and 94 ft. x 80 ft. On the new building they are also irregular, 550 ft. x 100 ft. and 466 ft. x 100 ft. New quarters will be provided for the commercial and general engineering departments, for finished stock, for a special lamp manufacturing division equipped to put out 5,000 special lamps a day, and for shops, etc. On the roof of the new building is a long-range wireless telephone outfit.

Progressive Electric Products Company Changes Name

Because of the similarity of the name The Progressive Electric Products Company to that of other companies, this company recently changed its name to The Electric Heat Control Company. It is located at 2711 Church Avenue, Cleveland. There has been no change in directors, officers or in manufacturing. The "King" bell-ringing transformers are being made by this company.

Sherman Law Upheld in Phonograph Record Suit

An action under the Sherman law was won by R. H. Macy & Company, New York City, this past week in which that company's claim that the Victor Talking Machine Company had refused to sell it phonograph records was upheld by Judge Mack in the federal court. This, it is alleged, caused the plaintiff financial loss from 1914 to 1917. The verdict returned grants the Macy company $49,698, which under the Sherman anti-trust law will be trebled. An appeal will be taken, it is reported.

Refractories Association Re-elects Former Officers

When the Refractories Manufacturers' Association held its annual meeting in New York, on March 16 to 18, these officers were re-elected: J. D. Ramsey, Elk Fire Brick Company, St. Marys, Pa., president; J. L. Green Laclede-Christy Clay Products Company, St. Louis, Mo., vice-president; C. C. Edmunds, McLain Fire Brick Company, Pittsburgh, treasurer; F. W. Donahoe, 840 Oliver Building, Pittsburgh, the association's executive

offices, secretary; E. M. Durant of the Pacific Clay Products Company, Los Angeles; Frank J. Helwig of the Standard Fire Brick Company, Pueblo, Col., and C. E. Kapitzky of the Federal Refractories Company, Cleveland, were elected to the executive committee.

Since its formation eight years ago the association has had for its aim in the serving of its client industries the closest co-operation possible in order to standardize as far as possible on existing molds, sizes and types. This has resulted in the elimination of many proposed special types of refractories for so-called special purposes, with consequently lower production costs.

St. Louis as an Electrical Manufacturing City

That advertising of the electrical industry is reacting up to a still higher plane is evidenced by the efforts of the St. Louis Electrical Board of Trade and the St. Louis Chamber of Commerce in working up a two-page article on "St. Louis—the Electrical Center" in the March issue of *Greater St. Louis*.

Estimates show that this city gives employment to between 8,000 and 10,000 persons in the electrical industry, while there is $50,000,000 invested in the various electrical factories. There is hardly an important line of electrical apparatus or supplies that is not made in St. Louis, according to the report.

Master Electric's Capital Trebled in First Year

Since its formation a year ago with a capitalization of $50,000, the Master Electric Company, 460 Beacon Street, Dayton, Ohio, has increased its capitalization from $100,000 to $150,000 by a recent addition. This new money is being used as increased working capital and to take care of the company's rapidly growing business, according to recent advices. Much of this business is with appliance manufacturers. E. P. Larsch is president; S. A. Brown is treasurer; R. S. Shonk is treasurer. On March 1 F. O. Kirkpatrick came to the company as vice-president and sales manager.

Canadian G. E.'s New Officers and 1920 Report

At the annual meeting of the Canadian General Electric Company, Ltd., held in Toronto on March 21, Frederic Nicholls, in retiring as president and general manager to assume the chairmanship of the board of directors, said that the outlook for the electrical industry was most promising as the demand for hydro-electric energy was greatly in excess of the supply. A survey of Canada's water power shows nearly 20,000,000 hp. available, of which only 2,000,000 hp. had been utilized. A. E. Dyment was elected president and J. J. Ashworth was promoted to be general manager, John A. Bremner, heretofore controller, was promoted to be assistant general manager, and Stephen Haas was appointed vice-president in place of Mr. Dyment.

From the annual report net profits for 1920 amounted to $1,356,689, an increase over the amount submitted for the year 1919. The original capital of the company was $10,000 when Senator Nicholls originated the syndicate thirty-three years ago; the assets have since grown to $31,000,000.

Fire Will Not Handicap Austin Machinery Corporation

The fire in the Winthrop Harbor (Ill.) plant of the Austin Machinery Corporation on March 22, while extensive at this plant, will not, according to officials of the corporation, in any way interfere with production and prompt delivery of Austin construction machines, as practically all lines of Austin machinery are also being built at the plants at Muskegon, Mich., as well as at the former plant of the Toledo Bridge & Crane Company at Toledo, Ohio. President B. A. Linderman immediately arranged for the plants at Toledo and Muskegon to increase their stock production orders to take care of the shortage which would otherwise occur through the loss of the Winthrop Harbor plant.

Insulators to Be Manufactured in France

The Compagnie Générale d'Electro-Ceramique, which is one of the largest manufacturers of electrical porcelain in France, has completed arrangements with the Jeffery-Dewitt Insulator Company covering the manufacture of the J-D high-tension insulator in France.

The insulators manufactured by the French company will be sold in France, Spain, Portugal, Italy and Belgium. A new factory for the manufacture of these insulators will be erected at Tarbes, where the same type and quality of insulator will be made as are made in the home factory at Kenova, W. Va.

A Dressler tunnel kiln is being erected, and it is stated that large orders have already been placed by some of the French railway companies, which have started an extensive program of electrification. A. L. McLeod, vice-president of the Jeffery-Dewitt Insulator Company, has just returned from Europe, where he signed the contract mentioned above. He returned very enthusiastic over the prospects of business to be done.

Westinghouse Expands Service in California

The Westinghouse Electric & Manufacturing Company has recently purchased at Emeryville, across the bay from San Francisco, a twelve-acre tract of ground upon which it expects shortly to erect buildings that will give increased advantages and space to its San Francisco service shop and warehouse. Additional buildings to provide facilities for assembling and testing electrical machinery for use on the coast will be erected also, it is announced. Plans for the first group of buildings will comprise about 120,000 sq.ft. of floor space. This move to increase the company's service on the Coast is the outcome of a recent visit of officials of the company to review conditions there in the electrical industry and prospects for the future.

The Habirshaw Electric Cable Company, 10 East Forty-third Street, New York City, has filed notice of increase in capital stock from $31,500,000 to $33,000,000.

The Downing Electrical Company, Des Moines, Iowa, has made arrangements with the Emerson Electric Manufacturing Company, St. Louis, whereby it will distribute the Emerson fans in the central Iowa territory.

D. B. Wilson announces that he is with Wilson & Ensign, 1405 Real Estate Trust Building, Philadelphia, and has no connection with Harris & Evans, as was stated in these columns on March 5. Wilson & Ensign, district managers, represents the Wellman-Seaver-Morgan Company, Benjamin Engineering Company, Irwin Manufacturing Company, Superior Die Castings Company and the Cleveland Electric Motor Company.

The Page Steel & Wire Company has transferred its general sales offices from the Union Arcade Building, Pittsburgh, to 1054 Grand Central Terminal, New York City. District sales offices will be maintained in the cities where they are now located; in Pittsburgh, 644 Union Arcade Building: Cleveland, 817 Guardian Building; Chicago, 208 South La Salle Street, and in Adrian, Mich., at the company's plant.

The Baraboo Manufacturing Company, Baraboo, Wis., manufacturer of electrically operated refrigerating units, has increased its capital stock by a new issue of $50,000 of preferred stock.

The Hugro Manufacturing Company, Warsaw, Ind., manufacturer of vacuum cleaners and washing machines, has appointed the George McKeever Company, 189 East Long Street, Columbus, Ohio, district managers for central Ohio for its "Airplane" cleaners and washing machines.

Laughlin & Barney, dealers in machine tools and agents in the Pittsburgh district for the Champion Engineering Company, Kenton, Ohio, manufacturer ol electric traveling cranes, will remove from their present quarters in the Wabash Building April 1 to rooms 481-487 Union Arcade, Pittsburgh.

J. E. Haetten & Company, Inc., 299 Broadway, New York City, have recently been organized by J. E. Haetten and J. V. Schmidt, formerly of the sales department of F. H. Niles & Company, New York City, to conduct a new and second-hand machinery business. The company will specialize in machine tools and power equipment.

The Valley Electric Company, 3157 South Kingshighway, St. Louis, manufacturer of alternating-current motors and battery chargers, has opened a sales office in the Bush Terminal Sales Building, 130 West Forty-Second Street, New York City, in charge of C. A. Sticht, district manager.

The Blaw-Knox Company, Blawnox (Pittsburgh), Pa, has recently established a district sales office in Birmingham, Ala., and on April 1 will open a new sales territory in the Southwest, with headquarters in Kansas City, Mo. The Kansas City office, which is in the Interstate Building, is in charge of R. B. Randall, formerly connected with the company's Chicago office, who will be known as the manager of the Southwestern territory.

The Crane Company, 836 South Michigan Avenue, Chicago, has recently established offices in the following places: Scott Building, Erie, Pa., in charge of Earl Colton; 16 Carroll Street, Madison, Wis., in charge of W. J. Pick; 57 Eddy Street, Providence, R. I., in charge of Arthur L. Hinman, and Miners Bank Building, Wilkes-Barre, Pa., in charge of C. H. Bossard.

The Duplex Electric Company, 258 Broadway, New York City, has filed notice of increase in capital stock from $100,000 to $125,000.

Foreign Trade Notes

THE AUTOMATIC & ELECTRIC FURNACES, LTD., 281 Gray's Inn Road, London, W. C. 1, England, announces that the Wild-Barfield patent rights for Germany, Poland and the former Austria-Hungary have been purchased by the C. Lorenz Aktiengesellschaft, and that the latter company has placed an order for various parts to complete about 100 furnaces.

THE CRANE COMPANY, 836 South Michigan Avenue, Chicago, has recently established an office in the Oliver Building, Sherbrooke, Quebec, in charge of Charles La Prairie. The company has also opened an office in the Central Building, Victoria, B. C., Canada, in charge of R. W. Murdoch.

INTERNATIONAL INDUSTRIAL FAIR IN HOLLAND.—The managers of the International Industries Fair to be held at Utrecht, Holland, from Sept. 6 to 16, 1921, have issued a booklet giving details regarding same. Further information may be obtained from L. Wittert van Hoogland, secretary the Netherlands Chamber of Commerce, 44 Beaver Street, New York City.

ELECTRIC EQUIPMENT FOR STEEL MILL IN SOUTH AFRICA.—The South Africa Iron & Steel Corporation, Ltd., has announced plans for the erection of a new steel plant, to include electrically driven steel rolling mills, steel furnaces and coke ovens, with equipment for the recovery of tar, sulphate of ammonia and benzol, and probably with electric furnaces. The cost is estimated at £2,200,000.

EXTENSION OF ELECTRICAL SERVICE IN BOHEMIA.—The electric generating capacity of the East Bohemian electric power house at Trutnov (Trautenau), according to Trade Commissioner Geringer of Prague, is being increased from 4,500 kw. to 10,000 kw. At present the plant is furnishing electricity to six towns, about ninety communities and a hundred factories of northeastern Bohemia, and the proposed extension will provide for supplying energy within a radius of more than 30 km. from Trutnov. Hydro-electric plants will supply part of the additional energy. The cost of the proposed undertaking is estimated at 35,000,000 crowns. Government aid is being given to the project.

T. H. WATSON & COMPANY, Ltd., Sheffield, England, and the ELECTRIC FURNACE CONSTRUCTION COMPANY, Philadelphia, announce that arrangements have been made with the General Combustion Company of Canada, Ltd., New Birks Building, Montreal, to handle, build and sell their various electric smelting, melting and refining furnaces in Canada. The Canadian rights of the Greaves-Etchells type of furnace are also included in the arrangements made. The American company will also co-operate with the Canadian company on the supply and installation of the various types of electrically heated core and mold drying ovens, annealing and heat-treating furnaces, and on electric furnace problems in general.

VICTORIA, AUSTRALIA, ASKS TENDERS ON STEEL POLES AND COPPER CABLE.—Tenders are invited by the State Electricity Commission of Victoria, Australia, for 600 steel poles for carrying three three-phase, 22,000-volt feeder cables and two metallic return telephone circuits, and for 250 miles of hard-drawn copper cable for the Morwell power scheme. Copies of specification No. 47, covering the steel poles, and specifications No. 66, covering the copper cable, have been forwarded by A. W. Ferrin, trade commissioner, and have been placed on sale at the Bureau of Foreign and Domestic Commerce, district offices, 734 Custom House, New York City, and 1424 First National Bank Building, Chicago. Tenders must be received at the office of the Electricity Commission, Melbourne, Australia, on May 31, 1921.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An American commercial agent who has sales and office connections in France (No. 34,592) is in the United States and desires to be placed in communication with firms with a view to securing an agency for the sale of electrical supplies, lamps, cables, etc.

An inquiry has been received by a consul in Rumania (No. 34,562) for descriptive literature and catalogs for orders on a commission basis of light switches, light brackets, etc., suitable for large apartment houses.

An inquirer in Rumania (No. 34,573) desires to purchase hot-air engines for small water plants or lighting for houses.

A mercantile firm in England (No. 34,588) desires to purchase and secure an agency for electric vehicles, particularly 1,500-lb., 1-ton-type delivery vans, and electric battery charging equipment.

A firm of commission agents dealing in machinery in Canada (No. 34,598) desires to obtain an agency for the sale of electric lighting plants for farms, milling and elevating machinery, etc.

New Apparatus and Publications

RIVET HEATER.—The General Electric Company, Schenectady, N. Y., has recently developed a new type of rivet heater, suitable for work in shipyards, building construction, structural steel work, etc.

METAL STATISTICS.—The fourteenth annual edition of the Metal Statistics, 1921, has been published by the American Metal Market and Daily Iron and Steel Report, 81 Fulton Street, New York City.

BRUSH HOLDERS.—D. B. Flower, 1217 Spring Garden Street, Philadelphia, is distributing two leaflets covering different types of Flower brush holders for industrial motors.

SERIES LIGHTING CUT-OUT. — The General Electric Company, Schenectady, N. Y., has recently developed a new automatic cut-out in series incandescent street lighting.

DAMPER REGULATOR.—A new hydraulically operated damper regulator for boiler pressure up to 250 lb. has recently been developed by the Atlas Valve Company, 282 South Street, Newark, N. J.

CONVEYOR.—Publication 2,000 issued by the Cutler-Hammer Manufacturing Company, Milwaukee, describes the "C-H" dispatch conveyor, which is designed particularly for newspaper and magazine publishing plants.

HEATING DEVICES. — The Electric Heating & Manufacturing Company, Seattle, Wash., is distributing a booklet describing the Apfel's "Heet-feet" heating apparatus and other electrical heating devices.

CONNECTORS AND TESTING CLIPS. —The Frankel Connector Company, Inc., 177-179 Hudson Street, New York City, is distributing a catalog covering its solderless electrical connectors, testing clips, etc.

STORAGE BATTERY PARTS.—The W. F. Battery Supply Company, 1618 North Broad Street, Philadelphia, has issued a new catalog covering its products, entitled "Everything in 'Storage Battery Parts and Shop Equipment' for Manufacturers and Service Stations."

AUTOMATIC STARTERS.—Leaflet 1660-A, distributed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes its type F automatic starters for squirrel-cage induction motors.

REGENERATIVE COMPRESSOR.—Bulletin No. 350 issued by the Griscom-Russell Company, 90 West Street, New York City, describes the G-R regenerative compressor.

CIRCUIT BREAKER. — The Automatic Reclosing Circuit Breaker Company, Columbus, Ohio, is distributing bulletin No. 312, covering its automatic reclosing breaker.

GENERATORS, MOTOR-GENERATORS AND DYNAMOTORS.—The Electric Specialty Company, Stamford, Conn., has issued bulletin No. 231, covering its high-voltage generators, motor-generators and dynamotors, designed especially for radio work ranging in capacity from 20 to 1,500 watts, and from 350 to 2,200 volts.

PULVERIZED COAL. — The Fuller-Lehigh Company, Fullerton, Pa., is distributing bulletin No. 600, entitled "Pulverized Coal for Boilers."

New Companies

THE SANFORD ELECTRIC CORPORATION, Belleville, N. J., has been incorporated by George C. Sturdy, J. Blake Kellogg and Lester C. Burdett, 71 Rutgers Street. The company is capitalized at $250,000 and proposes to manufacture electrical appliances and equipment.

THE IVAR-LITE COMPANY, INC., Boston, has been incorporated with a capital stock of $250,000 to manufacture electric lighting equipment and other electrical apparatus. The incorporators are G. Ivar Johnson, Robert G. E. Willson and Herbert E. Pheeney, 8 Brewster Terrace, Brookline, Mass.

THE WASHERETTE CORPORATION, Rochester, N. Y., has been incorporated by J. J. and T. R. Finucane and H. P. Sickels, Rochester. The company is capitalized at $200,000 and proposes to manufacture electrically operated washing machines and parts.

THE UNIVERSITY BATTERY & ELECTRIC COMPANY, Enid, Okla., has been incorporated by G. E. Darland, C. P. Harris and I. F. Conkling, Enid. The company is capitalized at $100,000 and proposes to manufacture electric storage batteries and other electrical equipment.

THE GENERAL INDUSTRIAL X-RAY COMPANY, Milwaukee, Wis., has been incorporated by E. H. Karrer, 246 West Water Street, William Guilliaume and Otto Herman. The company is capitalized at $100,000 and proposes to manufacture medical equipment.

GREENWICH ELECTRIC COMPANY, Hamburg, Pa., has been organized with a capital stock of $5,000 to operate a light and power system in Hamburg. H. H. Shollenberger is treasurer.

THE EVANSPORT LIGHT & POWER COMPANY, Evansport, Ohio, has been organized to furnish light and power service in Evansport and Stryker.

THE LAMBERT LIGHT & POWER COMPANY, Grundy, Va., has been incorporated with a capital stock of $10,000 by J. W. Lambert, president, and J. E. Lambert, secretary.

THE ROMNEY POWER COMPANY, Romney, W. Va., has been incorporated with a capital stock of $25,000 by James O. and E. H. Blue and J. W. Shull.

Record of Electrical Patents

Notes on United States Patents

(Issued March 8, 1921)

1,370,971. LIGHT PROJECTOR; Lyman C. Josephs, Jr., United States Army. App. filed June 6, 1919. Military and naval searchlight.

1,370,987. APPARATUS FOR ELECTRICALLY WELDING PLATES; Thomas E. Murray, Jr., Brooklyn, N. Y. Spot-welding plates of large area.

1,370,989. ELECTRIC FURNACE; Ralph D. Nye, Canton, Ohio. App. filed July 9, 1920. Means for disconnecting the current conductor.

1,370,992. TYPEWRITER; Alfred B. Parker, Monroe, La. App. filed Nov. 28, 1919. Automatic carriage return.

1,371,000. PUFF IRON; Benjamin Schindler and Jacob G. Viertle, Freeport, N. Y. App. filed April 24, 1919. Heads of different sizes and shapes readily substituted.

1,371,010. X-RAY SYSTEM; Harry F. Waite, New York, N. Y. App. filed Jan. 17, 1920. Single transformer used for either of two X-ray generating tubes.

1,371,023. IMPULSE STARTER; James McC. Edwards, Cedar Heights, Ia. App. filed Jan. 21, 1920. For automobile magnete.

1,371,049. ADJUSTABLE RESISTANCE UNIT; Benjamin F. Oler, Woodbury Heights, N. J. App. filed Sept. 28, 1918. Sliding contact inside coil.

1,371,061. CONDENSER; Clarence D. Tuska, Hartford, Conn. App. filed March 29, 1919. Variable, for wireless work.

1,371,092. BATTERY-SEALING MEANS; Walter E. Holland and James M. Skinner, Philadelphia, Pa. App. filed July 8, 1919. Threaded rubber sleeve around terminal post.

1,371,093. BATTERY CONNECTION; Walter E. Holland and James M. Skinner, Philadelphia, Pa. App. filed July 8, 1919. An insulated conductor and terminal connection.

1,371,094. MEANS FOR ELECTRIC ARC WELDING, CUTTING AND THE LIKE; Claud J. Holslag, South Orange, N. J. App. filed Nov. 16, 1920. Two or more series-connected arcs.

1,371,111. SPARK INTENSIFIER; Ralph L. Proesch, Beaver Dam, Wis. App. filed Feb. 9, 1920. Auxillary gap.

1,371,164. SELF-WINDING CLOCK; Fritz Guye, Neuchatel, Switzerland. App. filed April 25, 1919. Wound by electric motor.

1,371,192. RHEOSTAT; Edward M. Bentley, Lawrence, N. J. App. filed Aug. 7, 1919. Flexible metallic ribbon bending over a curved contact surface.

(Issued March 15, 1921)

1,371,225. REDUCTION OF STATIC INTERFERENCE IN RADIO RECEIVING STATIONS; Austen M. Curtis, Brooklyn, N. Y. App. filed Oct. 8, 1917. Wave filter.

1,371,233. ROTOR FOR SQUIRREL-CAGE INDUCTION MOTORS AND METHOD OF SECURING THE WINDING THERETO; Joens E. Fries, Birmingham, Ala. App. filed Aug. 21, 1918. No screws or other mechanical joints. End rings formed by spot-welding several duplicates of punchings of rotor.

1,371,287. RHEOSTAT AND PROCESS OF MAKING THE SAME; Charles Wirt, Philadelphia, Pa. App. filed March 23, 1918. Extremely compact.

1,371,298. TELEPHONE AND CALL SIGNAL SYSTEM; Alva B. Clark, Brooklyn, N. Y. App. filed Sept. 20, 1918. Circuit efficient for transmitting currents of ringing or talking frequency.

1,371,299. APPARATUS FOR EFFECTING ELECTROLYTIC CHEMICAL SYNTHESES AT HIGH TEMPERATURE AND PRESSURE; Georges Claude, Paris, France. App. filed Feb. 2, 1920.

1,371,301. COMBINED FEEDER AND MAGNETIC SEPARATOR; Henry Converse, Winona, Miss. App. filed Aug. 21, 1920. For use with cottonseed, grain or similar material.

1,371,310. TRAILING-CABLE FUSE AND HANDLE; Joseph F. Joy, Pittsburgh, Pa. App. filed June 19, 1920. For mining machinery.

1,371,367. WINDING MACHINE; William Grunow, New York, N. Y. App. filed Feb. 23, 1918. For forming wire coils.

1,371,378. OIL-TESTING APPARATUS; Laurence M. Klauber, San Diego, Cal. App. filed July 25, 1919. To test oil without removing it from case of transformer, oil switch, etc.

1,371,404. HIGH-POTENTIAL ELECTRIC MACHINE; Reinhold H. Wappler, Yonkers, N. Y. App. filed June 26, 1918. Composite type.

1,371,414. NICKEL PLATING; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed June 17, 1919.

1,371,420. PORTABLE ELECTRIC ARC LIGHT; Edward Hirt, Weymouth, Mass. App. filed Jan. 2, 1917. Carried in one hand.

1,371,466. ELECTROLYTE; Alvin A. Breitenwischer and George A. Howland, Detroit, Mich. App. filed April 30, 1920. Capable of hardening when allowed to set.

1,371,471. METHOD AND APPARATUS FOR DUPLEX CABLE SIGNALING; Louis Cohen, Washington, D. C. App. filed May 27, 1919. Overland lines or cables.

1,371,507. X-RAY STAND AND TABLE; William Meyer, Chicago, Ill. App. filed April 12, 1918.

1,371,523. CIRCUIT INTERRUPTER; Joseph Slepian, Pittsburgh, Pa. App. filed Sept. 7, 1917. For quickly de-energizing holding electromagnet.

1,371,558. SYSTEM OF CONTROL; Arthur J. Hall, Wilkinsburg, Pa. App. filed March 13, 1916. Electric railway motors.

1,371,559. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed July 5, 1917. For preventing slippage of wheels of locomotive during accelerating or regenerative period.

1,371,560. RELAY; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 28, 1917. Low-voltage tripping devices for polyphase motor circuits.

1,371,561. CIRCUIT-INTERRUPTING DEVICE; Henry D. James, Edgewood Park, Pa. App. filed Sept. 1, 1917. Low-voltage tripping device.

1,371,566. CONTROL SYSTEM; Paul L. Mardis and Lynn G. Riley, Wilkinsburg, Pa. App. filed July 12, 1917. Electric railway vehicles.

1,371,567. RADIO RECEIVING SYSTEM; Robert H. Marriott, Bremerton, Wash. App. filed Dec. 26, 1916. Means for treating distributing electric forces.

1,371,603. SYSTEM OF CONTROL; John A. Clarke, Jr., and Samuel B. Schenck, Wilkinsburg, Pa. App. filed Nov. 5, 1915. Electric railway vehicle.

1,371,620. COMMUTATING MEANS FOR DYNAMO-ELECTRIC MACHINES; Floyd T. Hague, Pittsburgh, Pa. App. filed Aug. 7, 1916.

1,371,647. ARMATURE-WINDING DEVICE; Henry K. Sandell, Chicago, Ill. App. filed March 18, 1920. For holding and revolving armature.

1,371,661. STORAGE-BATTERY GRID; Edward F. Andreae, Newark, N. J. App. filed May 29, 1918. Pasted-type plate.

1,371,698. PROCESS OF AND APPARATUS FOR ELECTROLYSIS; Oscar Linder, Chicago, Ill. App. filed Jan. 11, 1918. For completely eliminating salts and other ionized chemicals.

1,371,699. PROCESS FOR THE PURIFICATION OF POROUS OR GELATINOUS MATERIALS; Oscar Linder, Chicago, Ill. App. filed Jan. 11, 1918. Eliminating and recovering metallic salts, acids and other chemicals.

1,371,717. TELEPHONE SYSTEM; Ray S. Wilbur, Lyndhurst, N. J. App. filed Dec. 28, 1918. Transmission of frequencies outside the designed range.

1,371,728. SUBMARINE SOUND DETECTOR; Theodore Bodde, Lynn, Mass. App. filed Sept. 2, 1916. For detecting sounds emitted under water.

1,371,737. TELEPHONE EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 11, 1919. Alternating current for operating switch.

1,371,746. ELECTRIC STORAGE BATTERY; Charles J. V. Fery, Paris, France. App. filed March 24, 1919. Capable of replacing dry batteries.

1,371,747. TELEPHONE STAND; Charles Fischer, New York, N. Y. App. filed May 20, 1919. For holding receiver to ear.

1,371,748. HIGH-CAPACITY SELECTIVE SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed June 24, 1911. Step-by-step selective devices.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MIDDLEBURY, VT. — The Hortonia Power Company, Brandon, contemplates rebuilding its power plant at Middlebury, which was recently destroyed by fire, causing a loss of about $40,000.

FRAMINGHAM, MASS. — Considerable electrical equipment will be installed in the four-story extension to be built at the plant of the Dennison Manufacturing Company, manufacturer of paper products.

HOLYOKE, MASS.—The Lyman Mills have awarded a contract to the Swan Rigging Company, 145 State Street, Springfield, for the installation of a 2,500-kw. turbo-generator and auxiliary operating equipment in the power plant at their local cotton mills.

NATICK, MASS.—Electrical equipment will be installed in the three-story shoe manufacturing plant to be constructed by C. W. Dean & Company, North Main Street, at an estimated cost of $100,000.

SPRINGFIELD, MASS. — The United Electric Light Company has awarded a contract to the Adams & Buxton Construction Company for the installation of underground conduits in Liberty and Carew Streets, Page Boulevard and neighboring thoroughfares, about 300,000 duct feet.

PROVIDENCE, R. I.—Application will soon be made by the Penal and Charitable Commission to the General Assembly for an appropriation of $80,000 for the installation of electric light and power equipment at the state prison.

NEW HAVEN, CONN.—Plans have been filed by the United Electric Illuminating Company, 84 Temple Street, for the construction of a 70-ft. x 90-ft. addition to its steam power plant on Grand Avenue, to cost about $40,000.

Middle Atlantic States

BUFFALO, N. Y.—The Standard Milling Company 49 Wall Street, New York City, plans to erect a flour mill at the foot of Louisiana Street, Buffalo, to cost about $9,000,000. The installation as proposed will require about 16,000 hp. and will be furnished by one of the local electric companies. A. E. Baxter Engineering Company, Ellicott Square, is engineer.

ILION, N. Y.—Plans are under way for the installation of an ornamental street-lighting system in the business district.

JAMESTOWN, N. Y. — The Board of Water and Lighting Commissioners, it is reported, has received bids for the construction of an addition to the municipal electric power plant on Steele Street.

NEW YORK, N. Y.—Electrically operated hoisting and conveying machinery, loading and unloading equipment, etc., will be installed in the new seven-story freight terminal to be erected by the Pouch Terminal Company, 17 State Street, New York City, at Clifton, S. I. A similar building will also be built by the American Dry Dock Company, 17 State Street, New York City, an affiliated organization, at Tompkinsville, S. I. The structures will be 120 ft. x 160 ft. Contracts for the construction of the buildings have been awarded to the Turner Construction Company, 242 Madison Avenue, New York City.

BUTLER, N. J. — Arrangements have been made by the City Council for the installation of a switchboard and accessory equipment at the municipal electric power plant.

NEWARK, N. J.—Plans are under way for a number of improvements and extensions to the street-lighting system in different parts of the city. It is proposed to remove the arc lamps now used on Broad Street and substitute modern fixtures. Market Street will also be provided with new fixtures. Harry R. Jackson, electrical engineer has been engaged to make a survey and estimate of cost.

PERTH AMBOY, N. J.—The Board of Aldermen has authorized City Purchasing Agent Martin Olsen to award contracts for equipment for the ornamental lighting system on Madison Avenue.

ROOSEVELT, N. J. — Negotiations are under way between the Borough Council and the Public Service Company for a new lighting contract providing for a number of improvements to its system as well as a new commercial service to the East Rahway district.

ALTOONA, PA. — The Penn Central Light & Power Company has applied to the Public Service Commission for permission to issue $625,000 in bonds for proposed extension, improvements, etc.

HARRISBURG, PA. — The Harrisburg Light & Power Company has applied to the Public Service Commission for permission to issue $33,000 in bonds for extensions and betterments to its system

HARRISBURG, PA. — The Harrisburg Pipe Bending Company plans to install new equipment at its power house, including stokers, boilers and auxiliary apparatus.

BALTIMORE, MD. — The Public Improvement Commission is planning extensions to the municipal electrical conduit system to cost about $1,000,000.

GLENBURNIE, MD.—The Public Service Commission has approved a franchise granted to Grover C. Morgan for the installation and operation of a light and power system in Glenburnie.

NORFOLK, VA.—Extensions and improvements are contemplated to the municipal waterworks system, to cost about $700,000. Considerable electrical equipment will be required.

PORTSMOUTH, VA.—Plans are under way for the construction of additions to the electric pumping plant connected with the waterworks system. George J. Jervey, Municipal Building, is city manager.

WASHINGTON, D. C.—Bids will be received at the office f the District Commissioners, room 509, District Building, Washington, D. C., until April 8 for electric lighting, power nd telephone conduits and wiring in the psychopathic branch of the Gallinger Municipal Hospital, on Reservation No. 13, Massachusetts Avenue and Twenty-first Street, Southeast. Proposal blanks, plans and specifications may be obtained from the Chief Clerk, Engineer Department, room 427, District Building.

North Central States

GRAND RAPIDS, MICH.—The Creston Improvement Association has appointed a committee to make investigations relative to installing a boulevard lighting system in Creston from the east end of the Leonard Street bridge to Plainfield Avenue, then north on Plainfield Avenue to the Plainfield School. Ole. Henderson is chairman.

DAYTON, OHIO.—The Dayton Power & Light Company, it is reported, will furnish power for the operation of the Dayton & Western Traction Company, Dayton, after July 1. To provide for the change in service, a substation will be constructed at West Alexandria and units will be installed for the conversion of the 33,000 volts, 60-cycle, to 660 volts direct current. Changes will be made at Stop 8, 6 miles from the city, including the installation of new equipment.

GIRARD, OHIO.—Improvements to the street-lighting system are under consideration. John L. Gleason is village clerk.

HARRODSBURG, KY.—The City Council will receive bids shortly for the construction of a municipal electric power plant to be operated in connection with the waterworks system, to cost about $100,000. Pearce Greeley, 36 West Adams Street, Chicago, Ill., is engineer.

FORT WAYNE, IND.—The installation of a central fire-alarm system, to cost about $40,000, is contemplated. For further information address the Board of Safety.

HAMMOND, IND. — Plans have been prepared by W. F. Bridge, engineer, for a boulevard lighting system. A. J. Swanson is chairman.

ARENZVILLE, ILL.—Petition has been filed by the Arenzville Light & Power Company for permission to erect and maintain an electric transmission line from the city limits of Jacksonville to Concord, Arenzville and Chapin.

JOHNSTON, ILL.—The Central Illinois Public Service Company, Mattoon, has closed a contract to supply power to a mine near Johnston City.

WISCONSIN RAPIDS, WIS.—The Electric Light and Water Commission is considering the erection of a substation in the eastern part of the city.

DES MOINES, IOWA.—Plans are being prepared for the construction of a new electrically operated pumping plant, to cost about $150,000. Bids, it is understood, will be asked for in about sixty days. Alvord & Burdick, 1418-20 South Dearborn Street, Chicago, are engineers.

JOPLIN, MO.—The Union Iron Works, 623 Kentucky Avenue, contemplates improvements to its plant, including the installation of new machinery and the construction of a power house, 20 ft. x 40 ft.

KANSAS CITY, MO. — The Western Tablet Company contemplates the erection of a new power house, 40 ft. x 100 ft., at its factory at Eleventh and Mitchell Streets, to cost about $35,000.

SPRINGFIELD, MO.—The erection of an electric line from the city limits to Sunshine School is planned by the Springfield Gas & Electric Company.

Southern States

WINSTON-SALEM, N. C.—The question of issuing $750,000 in bonds to enlarge the lighting and water systems and provide for service to the schools is under consideration.

ATLANTA, GA.—Electrical and mechanical equipment will be installed in connection with extensions and improvements to the waterworks system, for which $2,250,000 in bonds have been approved.



KERN RIVER NO. 3 NEARING COMPLETION
This 32,000-kw. plant of the Southern California Edison Company will use the highest head turbines built and operate on either 50 or 60 cycles.

APALACHICOLA, FLA.—The City Council contemplates taking over the electric plant of the Apalachicola Electric Light & Telephone Company and rebuilding it in connection with the waterworks plant, for which $50,000 in bonds have been voted. H. B. Adcock is superintendent of the electric plant. J. H. Cook is Mayor.

BARTOW, FLA.—The Board of Trade is considering the installation of an ornamental lighting system on the principal business streets of the city.

FORT PIERCE, FLA. — Bonds to the amount of $60,000 have been voted for improvements to the electric light and power plant.

PALMETTO, FLA.—The Palmetto Crate Company, recently organized with a capital of $100,000, plans to establish a steam-driven power plant in connection with its new factory. Considerable transmission machinery will be installed at the works. C. E. Gibbens is secretary and treasurer.

DOTHAN, ALA.—Bonds to the amount of $750,000 have been voted for a hydro-electric plant on the Choctawatchee River to develop about 20,000 hp. R. W. Lisenby is city clerk.

BRISTOW, OKLA.—The Oklahoma Gas & Electric Company, it is reported, plans to make improvements to the lighting system to cost about $30,000.

MANITOU, OKLA.—Bonds to the amount of $10,000 have been voted for the construction of an electric light plant.

Pacific and Mountain States

TACOMA, WASH.—Surveys have been completed for the proposed Lake Cushman-Tacoma transmission line from this city to the Mason County line near Allyn. Plans provide for a high-tension line, 6,000 ft. long, to span the Narrows; that across Henderson Bay will be in two cables, 1,200 ft. long, with a central tower to be erected at Wauna, and the line across North Bay will be 2,800 ft. long.

IRWINDALE, CAL.—The construction of a substation in Irwindale is being contemplated by the Southern California Edison Company.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation has applied for permission to erect a transformer station at 420 West Tenth Street.

LOS ANGELES, CAL. — Marcus Pluth, 424 Wilcox Building, has applied to the Federal Power Commission to build two diversion dams in the north and south forks of the Whitewater river, a power house, 9 miles of transmission line, etc.

MERCED, CAL.—The installation of an ornamental street-lighting system in the business district is under consideration. The plans call for forty electroliers.

ORLAND, CAL.—Plans and specifications for street paving, conduits for electrolier wires, etc., were adopted by the Town Trustees.

PUENTE, CAL.—The Southern California Edison Company plans to erect a 60,000-volt transmission line from the Puente substation through Covina Valley.

RED BLUFF, CAL.—A preliminary report has been submitted to the City Trustee by W. F. Lunning, city engineer, regarding the cost of establishing a municipal electric light plant, which is estimated at about $169,000.

RICHMOND, CAL.—The City Council has entered into a five-year contract with the Western States Gas & Electric Company providing for the installation of an electrolier lighting system on MacDonald, Washington, Richmond and Standard Avenues.

SAN FRANCISCO, CAL.—The California Oregon Power Company, recently reorganized, has taken over the properties of the California-Oregon Power Company and has been authorized by the Railroad Commission to issue $1,849,000 in certificates later to be exchanged for bonds. Of the proceeds $932,650 will be used for construction purposes.

SAN FRANCISCO, CAL.—The El Dorado Power Company, care of Chickering & Gregory, Merchants' Exchange Building, has applied to the Federal Power Commission for preliminary permit to erect a power house, transmission line, enlarge three reservoirs, construct two reservoirs, etc., in the counties of El Dorado, Alpine and Amador.

VALLEJO, CAL.—Plans are being prepared by T. D. Kilkenny, city engineer, for the construction of the proposed Gordon Valley Dam, including an electrically operated pumping plant of a 3,000,000-gal. daily capacity, etc.

PROVO, UTAH—The Salt Lake & Utah Railroad Company, 222 South West Temple Street, Salt Lake City, contemplates the construction of a new substation at Curtis, 5 miles from Provo, to cost about $50,000.

TWIN FALLS, IDAHO. — The Idaho Power Company has applied to the Federal Power Commission for permission to develop a hydro-electric power project at Twin Falls on the Snake River.

PRESCOTT, ARIZ.—The City Council is considering the installation of an ornamental street-lighting system in the paving district.

Canada

PARRY SOUND, ONT. — The municipal power plant and the wing dam has been damaged by recent floods. George Murray is superintendent.

PETERBORO, ONT.—The Canadian General Electric Company, 212 King Street, West, Toronto, it is reported, is receiving bids for the construction of a power house in Peterboro.

CALGARY, ALTA.—The provincial government is having plans prepared for the construction of a power plant to cost about $150,000.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, L. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 9-11.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, Bethlehem, Pa. Annual meeting, Atlantic City, N. J., April 21-23.

AMERICAN ENGINEERING STANDARDS COMMITTEE. Secretary, P. G. Agnew, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio. Annual convention, Washington, April 23.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, S. E. Dillon, Hot Springs, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto. Annual convention, Toronto, June 28.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Co., Montreal, Canada.

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National Work Done in a National Way

DURING the past few weeks the National Electric Light Association has accomplished three things which stand out pre-eminently to its credit. Its water-power committee after weeks of labor in Washington has had the Federal Power Commission rules and regulations reopened and will probably succeed in having them made workable; the public policy committee has made more flexible the structure for financing in the standard system of accounting adopted by the National Association of Railway and Public Utility Commissioners, and a special committee has reached an understanding with a committee representing national telephone interests whereby inductive-interference difficulties will hereafter be amicably adjudicated. Thus in a remarkably short time conditions which have vexed the electric light and power companies of the country for very many years have been adjusted and the road cleared for speedy and satisfactory solution. This is national work performed in a really big and national way.

Yap and Modern Methods of Communication

WITHOUT going into the merits of the Yap controversy, it looks as if the United States had been rather successfully buncoed. The ethics of the situation is not the thing to which we want to call vigorous attention, however, but the necessity of the United States carrying out so complete a system of radio communication as to make it quite a matter of indifference whether sandbanks and coral islands do or do not fall within the sphere of the Volstead act. The time has now come when Great Britain has a pretty complete scheme for wireless communication over the world, and there is every possible reason why the United States should follow suit, since it is much easier, as experience has already shown, to cut a cable than it would be to jam successfully a modern wireless system. A cable once cut is out of business for a considerable time, while no amount of jamming is anything more than a temporary annoyance to a wireless plant. We have already made an admirable beginning with our several high-power stations, and if Congress takes a serious interest in the possession of Yap as a cable landing it certainly should take equally great interest in the construction of wireless stations such as would make that interesting island little better than a flyspeck on the map of the Pacific. So much splendid work has been done in the wireless line by American engineers that it is merely paying them a proper compliment for the government to push their work to the limit and make the United States both for military and commercial purposes quite independent of the conductors stretched on the bed of the ocean. These cables have done admirable service for the world's communication over a long period and probably will still continue in use for another long period, but there is not the least reason for worrying over their control or possession by foreign powers if we make the most of the radio systems already developed.

The Illuminating Engineers Should Not Move

WHEN in the winter of 1903 the late Andrew Carnegie made his generous contribution for the erection of the Engineering Societies Building and the Engineers' Club in New York City, the assumption was that the former edifice would be a temple of engineering to which all engineers might come. This it has been, to the gratification and convenience of the engineering profession. Now, however, for some reason by no means impossible to overcome, the Illuminating Engineering Society, small in numbers but not in accomplishments, is faced with the necessity of finding quarters elsewhere. This it can doubtless do without great sacrifice or cost, but this it ought not to be permitted to do. The building on West Thirty-ninth Street was erected for just such national technical societies, and certainly what little room the Illuminating Engineering Society requires can yet be found in it. Nor should the illuminating engineers be stuck in an out-of-the-way corner. They are the exponents of light, not darkness; and while they possess the skill to turn darkness into light, we presume they prefer natural illumination. If the United Engineering Society and the illuminating engineers will reason this thing out together, we are sure there will be no occasion for parting.

An Opportunity for Government Help

IF, AS has been intimated, the government desires to aid and not hinder business, it will find opportunity to gratify its wish legitimately. We have in this country at least one national body needing and deserving government support—the American Engineering Standards Committee. It is not unlike the British Engineering Standards Association, which has done so much in developing British industry, and similar standardizing bodies existing in a dozen other countries. They are not governmental bureaus, but are composite bodies made up of representatives of national engineering and industrial associations. The function of the American Engineering Standards Committee, as indeed of all the standards committees of the various nations, is to systematize methods of co-operation between the different national bodies in order to correlate the work of standardization, devise codes and standards, prevent duplication and

conflict of effort, and thus increase greatly the efficiency and economy of production and utilization in industry. The American Engineering Standards Committee is working in close co-operation with six national engineering societies, five government departments and thirteen national industrial associations. Since its organization a little more than two years ago it has done very creditable work in this country and has promoted in foreign countries the knowledge of recognized American standards and aided in international engineering standardization.

Ventilating Open Rotating Equipment a Design Problem

THE provision of an air supply to rotating machines that will insure adequate ventilation is as much a part of good station design as is the care exercised by the designer in providing internal means for machine ventilation. This point is frequently lost sight of in plant design except in the case of totally inclosed machines, where special means of providing for ventilating air must of necessity be adopted. Open rotating equipment is ordinarily so installed that there is no provision for air supply beyond the leaving of sufficient wall openings or the placing of fan equipment to force the air estimated to be required into the room. So long as machines are not crowded or seriously overloaded no ill effects are observed, but when developments necessitate placing them in close proximity or in such positions that air from one machine is carried by the natural room currents past other machines serious heating effects due to the recirculation of warm air are observed. Observation of plant conditions leads to the belief that this situation is a much larger factor in operating troubles than is realized. In the last two or three years a number of cases of rather serious effects from air recirculation have been observed. No reasonable increase of air in the room's supply appears to help matters materially, and it has been generally found by test that air is being recirculated by each indvidual machine or that the air from one or more machines is being carried by room currents to other machines and recirculated. Experimental work with various schemes designed to break up recirculation is being carried out on existing installations with varying degrees of success, but the problem, if it is to be satisfactorily solved, must be met by proper provision for ventilation in the original design. It is a design problem and cannot, in general, be handled efficiently on any other basis.

Intensive Relay Inspection Fully Justified

HUMAN vigilance and supervision over control apparatus will make it operate with what almost seems uncanny intelligence, while lack of supervision will render it absolutely useless. The more nearly perfect a piece of apparatus is, however, the more it requires the attention of its master. There is no better example of the truth of this statement than in the matter of relay systems. Under proper supervision relay systems will perform duties with astounding accuracy, while the least defect in the smallest part may result in complete disorganization of the entire system. While all believe and know that successful relay operation depends on adequate inspection, tests and constant attention, many fail to apply these requisites of operation to their system. It is therefore interesting and of educational value to read Raymond Bailey's paper in this issue on "Relay Tests and Inspection" and to study his recommendations. Mr. Bailey inspects relays before installation and carries on tests not only for electric soundness but also for sensitiveness of operation. The information thus obtained is used in finding the best place for each relay in the system. After the relays are installed other tests are applied to make certain that their operation will be dependable. When a relay has been once put in a system and is being depended upon to perform its duties it is inspected at regular intervals and tested at other intervals less frequent.

Recommendation is made by Mr. Bailey to create a department with the specific duty of taking care of relays. Although some may feel that his methods are too intensive, it is only necessary first to realize the very purpose of relays and secondly to analyze some of the large failures in big systems in the last few years to realize that any effort to improve operation of relays will be well justified by saving of apparatus and improvement of service.

Experience and Study Go Hand in Hand

FROM one viewpoint engineers can be grouped into three classes. There are a few shrewd and competent practical engineers who pay little attention to the published experiences of others and seldom consult books and magazines devoted to their line of work. Their entire store of knowledge, experience and judgment is carried in their heads or is contained in whatever card catalogs, curve sheets, drawings and similar records they have in their offices. On the other hand, there are engineers with the instincts of compilation who are fond of collecting and consulting all kinds of printed information. An engineer of this class may not be able to decide on the best solution in a given case, but he can readily tell what various authorities have advised in similar instances. Both these types are extremes, and neither can be trusted in an important engineering problem involving new features. The third type of engineer, seldom found among the job hunters, is the one who is active in his professional society, who reads at least one leading technical paper regularly and who co-ordinates his practical work with what he reads in new books and periodicals. In other words, a progressive engineer accumulates his own practical experience and judgment on a background of the much more extensive published experience of the leading men engaged in his line of work. In this way he is not apt to generalize from miscellaneous data or be misled by rule-of-thumb methods found useful in his own narrow field, but is more liable to preserve the correct perspective. On the other hand, when his data are confirmed by printed information he feels doubly assured in following the results of his own experience.

Unfortunately, many engineers think that they can find reliable printed information on short notice, without previous training in library search. This is a delusion which sometimes leads to serious disappointment. Only he who follows the current engineering literature more or less regularly can find what he needs with ease and assurance, can assign the proper relative weight to contradictory statements and can be reasonably sure of not having omitted any important reference or clue. Offhand statements on engineering topics

are sometimes made on the floor of a convention or in private discussions that are based on old information. They may be the half-baked conclusion of a young enthusiast, they may be the result of honest experience but experience under special, narrow conditions, or they may be an insidious attempt at advertising a piece of apparatus or some other commodity. It takes long experience to place such statements where they belong, and the only way to gain this experience is to read at least one periodical regularly, so as to be able to analyze every contribution about as quickly and as surely as an editor of long experience and training does. The same consideration, of course, applies to new books.

The critical period in an engineer's career comes soon after he leaves college when he has to shift for himself so far as his mental food is concerned. Then is the time to develop the habit of reading at least one technical magazine regularly, of cutting out and filing useful articles or notes, of following up references to other magazines, of reading book reviews and glancing at publicity pages and advertisements, personnel changes and so forth. Such a practice not only becomes easy later on, but becomes as indispensable a part of one's life as the reading of a daily newspaper. And it may be said without exaggeration that for many a young engineer this choice between reading and not reading a professional journal means in the end the difference between settling down to a narrow routine, with a blind alley at the end, and pursuing a steadily broadening path to varied and satisfying activities.

Suspension Insulators and Unequal Spans

WITH transmission-line spans of different lengths it is a well-known fact that suspension insulators will hang in a vertical position at only one given temperature. In other words, if a line as a whole is strung for one particular condition, the insulators will swing one way or the other from the tower for all other conditions. Further, in stringing a transmission line the ideal would be so to build a line that uniform stress would result in insulators hanging vertically at the maximum loading. Over rough country with spans of different lengths it will be necessary, in order to obtain these conditions, to string each span at the proper tension based on the maximum load planned and then to let the suspension insulator find its position after the clamp is fastened. This would be an expensive and difficult process.

In this issue Murray J. Idail points out in a short article on "Stringing Suspension Insulator Lines in Rough Country," that advantage can well be taken of the fact that suspension insulators, while swinging one way or another from the tower, will make up for uneven stresses in the spans. Saving and simplicity will result from pulling the wire between two dead-end strains over uneven span lengths at some definite tension determined by the temperature at the time of stringing and the maximum conditions for which the design is made. The wire between the spans will find its proper position if allowed to roll freely over blocks. Further, Mr. Idail shows that in general it is preferable to determine this stringing tension by means of the equivalent span as defined by him rather than by the average span, this resulting in less severe stressing conditions in the longest span under consideration. However, it is well to check up under extreme conditions of varying span lengths what the tension on the longest span will be before stringing the wire. The article also indicates how this should be done and brings out clearly that satisfactory results are obtained in most cases by the simple method of pulling the wire from one end, at some determined tension between two dead-end points.

Is Not Greater Accuracy Practicable in Sphere-Gap Measurements?

THE distribution of electric field or voltage gradient between spherical electrodes obviously varies from point to point, being a maximum along the line joining their centers. It is interesting, therefore, that for given spheres under constant conditions the sparking difference of potential has a definite and remarkably constant value. The explanation doubtless lies in the fact that the extended surface of the spheres acts as an electrostatic screen to the central region on the line between centers, just as the outer portions of two parallel planes act as guard rings to the central section. We find, therefore, that with increasing distance between spheres the spark-over voltage becomes less constant, that is, more subject to electrostatic influences of surrounding objects. There is also a limiting minimum value of space separation, about 1 mm., below which the sparking voltage is not constant. In this region the distance of separation is comparable with the mean free path of the gaseous ions which cause breakdowns. If this mean free path is limited, breakdown does not occur.

The computation of the maximum electric stress between two spheres has attracted the attention of many investigators. Owing to the dissymmetry of the arrangement the problem is not simple. One of the most persistent workers in this field is Dr. Alexander Russell, who presented some interesting new data in a paper in the *Journal* of the (British) Institution of Electrical Engineers not long ago. He offers a greatly simplified formula for the maximum electric stress in terms of the potentials of the equal spheres, their radii and the distance between them. The simplification consists in an approximation to the extremely complicated function of the radii and distance of separation which appears in the exact solution. Applying the formula to some of the most careful experimental values of sparking distances, the agreement between the computed and actual values is found to be remarkably close when both spheres are insulated. Moreover, it is shown that for any one value of the radius of the spheres the maximum stress corresponding to breakdowns is a constant, the law being almost the same as that given in the "Standardization Rules" of the American Institute of Electrical Engineers.

A matter of great moment to American engineers, however, is the fact that Dr. Russell claims that there are errors in the values of sparking voltages, as given in the "Standardization Rules" of the Institute, for the case of one sphere connected to earth. In fact, it is suggested that in the observations on which the "Standardization Rules" are based the grounded sphere was not actually at zero potential. The value of this criticism lies in the excellent agreement of Dr. Russell's formula with other experimental results. While, therefore, it cannot be stated that his conclusion is definitely proved, nevertheless a doubt is thrown on the accuracy of one of the Institute's important standards which cannot be lightly passed over.



Bernard Edward Sunny

One of the ablest executives of the electrical industry, whose organizing and administrative powers have had a real influence in the development of the telephone, central-station and electrical manufacturing industries

PROMINENCE in the development of two more or less unrelated phases of the electrical industry is an achievement that seldom falls to the lot of one man. Such is the accomplishment of B. E. Sunny, who belongs to the unusual type of corporation executive in whom are combined the ability to pilot a huge commercial undertaking and the acquirements of a technical expert. The telegraph field claimed him at the age of sixteen. In the employ of the Atlantic & Pacific Telegraph Company he became an operator and was transferred from Brooklyn, N. Y., where he was born in 1856, to Chicago, where while still in his "teens" his ability won for him promotion to the position of night manager of his office, of which he soon became manager.

Bell's invention of the telephone, which was then attracting widespread interest, led Mr. Sunny to apply himself to a study of this instrument with such [illegible] effect that in 1879 he became superintendent of the Bell Telephone Company in Chicago. Then only twenty-three years old, he foresaw the future development of the telephone business and entered into his new duties with enthusiasm. During this period the old Bell and Edison Telephone companies were merged and the Chicago Telephone Company was formed.

Before very long Mr. Sunny's administrative ability attracted attention outside of the telephone field, and in 1888 he was called upon to take the presidency of the Chicago Arc Light & Power Company, at that time one of the largest central-station companies in the country. Two years later he became Western manager of the Thomson-Houston Electric Company, and such was his success that on the merger of the Thomson-Houston, Brush and Edison General Electric companies he was placed in charge of the Western interests of the new organization. He later became a vice-president of the General Electric Company and also of the American Telephone & Telegraph Company. He returned to the telephone industry in 1908, when a man who could combine executive ability with technical knowledge and a thorough appreciation of the problems of public utility service was needed. He became president of the Chicago Telephone Company and chairman of the board of directors of the Central Union Telephone Company, both now succeeded by the Illinois Bell Telephone Company.

Mr. Sunny believes that the only problem involved in the relations of corporations with the public is that of arriving at a mutual understanding. He has the courage of his convictions and has always expressed them with the utmost frankness. A recent example of this trait is the announcement made by him that so far as the Illinois Bell Company is concerned the war emergency is over and no further operating troubles can be charged to that cause.

Relay Tests and Inspection

Reliable Operation Demands that Utmost Attention Be Given to Routine Tests, Adjustment and Inspection Before and After Installation—Advantage of Making One Man Responsible for All the Relay Installations

By RAYMOND BAILEY
The Philadelphia Electric Company

SINCE the failure of a single relay contact to function properly may result in the complete shutdown of a part or all of an electric system, it is highly important that the utmost attention be devoted to routine tests, adjustments and inspection of relays and relay systems. Some of the methods of the Philadelphia Electric Company are herewith presented with the thought that they may be of interest and stimulate discussion. Only those types of relays which are more or less standard in their application will be considered.

The first step in the procedure should be thoroughly to inspect all the working parts of the relay to make sure that it is in good condition before being placed in service. All contacts should be carefully gone over to insure that they are properly lined up and making good contact. Potential should be applied to the contact system and to the coils of the relay to make sure that the insulation is satisfactory. The exact voltage used for this test may vary according to conditions, but in most cases it will be in the neighborhood of 1,000 volts. Excess-current time-limit relays should be checked for the minimum operating current at the different points, and it is also well to check the time required for the relays to function upon various currents. After this has been done, the relays may be set for desired current and time, if desired, and sent out for installation.

Directional relays usually have excess-current time-limit relays installed in conjunction with them. In some cases the excess-current relay is inclosed in the same case with the directional relay, while in other cases it is a separate unit. The following statements made concerning the testing of directional relays will apply, however, in either case:

In addition to making the general inspection and potential test which should be made on all relays, the directional relay should be adjusted so that it will operate satisfactorily on very low power factor and voltage (in most cases 1 volt). The current used during this adjustment should be in the neighborhood of 35 amp. or 40 amp. if a current as great as this will exist in the current transformer secondary under short-circuit conditions. If the directional relay is not adjusted properly, it may require more time to operate under a severe short circuit than the excess-current relay, resulting possibly in the loss of selective action. Energy should be passed through the directional relay in order to check its action to make sure that the contact will remain open when the power is in the normal direction and closed when power reversal occurs. A check should be made of the minimum operating current of the excess-current element and the time required for it to function. After the relays have been adjusted for the desired current and time they are ready to be sent to the station.

Double-winding differential relays, in addition to the general inspection, should be checked for operating current. The ratio of turns on the two coils of each relay can be checked very easily by means of the special test core, the use of which was described in detail in the issue of the ELECTRICAL WORLD for Feb. 21, 1920.

During this test it is well to read the voltage induced in the test coil when one of the relay windings alone is carrying the current that will exist under normal load conditions; the other coil on the same relay should carry no current at all. The same test should then be repeated, using the second coil. Another reading of induced voltage in the test coil should be taken when both coils are carrying the current they will carry under load conditions and connected so that they tend to produce zero resultant flux in the relay core. These voltage readings indicate whether or not the relay has been wound with the correct ratio of turns and which coil leads should have the same instantaneous polarity to give the desired balance.

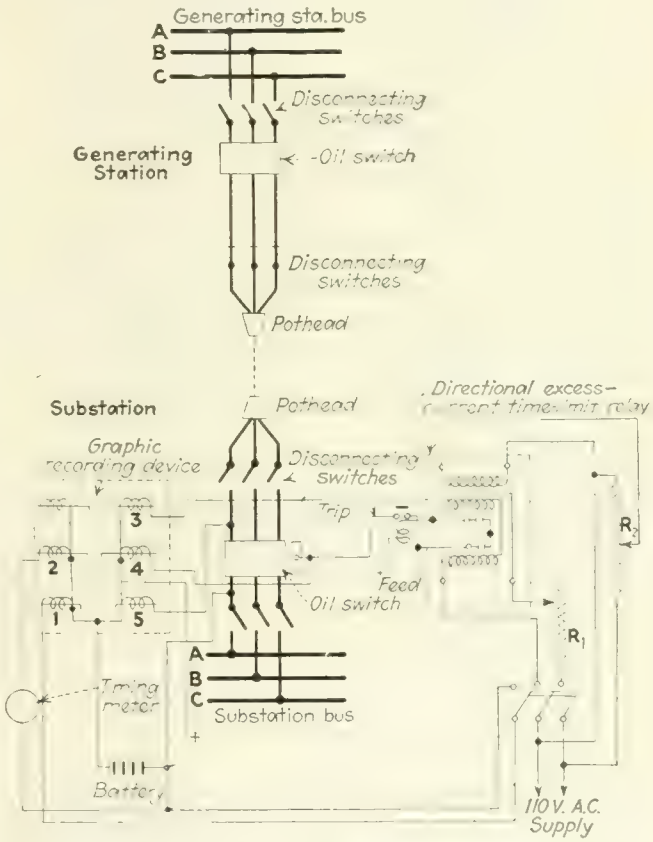
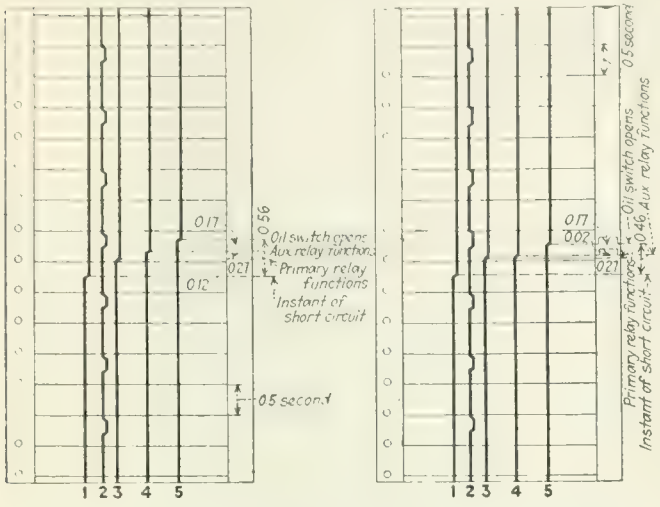


FIG. 1 — CONNECTIONS BETWEEN FEEDER RELAY AND ELECTRICALLY OPERATED GRAPHIC RECORDING DEVICE USED TO CHECK SELECTIVE ACTION OF RELAYS

There is very little that can be done in the laboratory in the way of preparing single-winding differential relays for installation further than the general inspection, adjustment and check of operating current.

The test on under-voltage relays should include a



FIGS. 2 AND 3—TIME IN SECONDS REQUIRED FOR THE PRIMARY RELAY, THE AUXILIARY RELAY AND THE OIL CIRCUIT BREAKER TO FUNCTION WITH A SLOW-ACTING AND QUICK-ACTING AUXILIARY RELAY

check of the voltages at which the contacts open and close.

When testing the types of relays in which the direct-current tripping current is carried through springs or flexible leads to a movable contact, it is well to pass a current somewhat larger than this tripping current through the contact system for a short length of time to make sure that the soldering, circuit connections, etc., are all right.

Most relays are equipped with internal contactor switches caring for the tripping current of one oil circuit-breaker. However, if it is desired to make tripping connections with two circuit breakers and to operate an audible alarm it is necessary to make use of auxiliary relays. A type may be used in many instances which will make it unnecessary to use the internal contactor in the relay. If such is the case, the internal contactor can be disconnected and the relay contacts connected directly in the circuit to the auxiliary relay.

When certain types of relays are under consideration it is advisable to make special tests on them, in addition to those outlined above, in order to determine their adaptability for the intended service. Tests which should be included in a case of this sort will in many instances suggest themselves, depending upon the conditions to be met. The following tests, however, are mentioned because results obtained from them will in most cases be found to be of value.

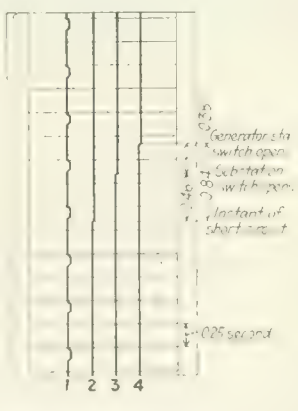


FIG. 4 — INTERVALS BETWEEN SHORT CIRCUIT AND OPENING OF SUBSTATION AND GENERATING STATION BREAKERS

Usually it is desirable to make a series of tests to determine the accuracy of the relay. By operating the relay a number of times the variation in operating current, time and so forth can readily be determined. The results obtained from a test of this sort will have considerable bearing upon the settings given to the relays when they are installed.

When the relay settings are being determined the characteristic curves should be studied, as the various types of relays have differently shaped curves with the result that even though there may be sufficient time difference between relays at the two ends of a feeder when operating on the test current, this time difference may disappear altogether on a current of the magnitude produced by a short circuit.

Excess-current relays should have passed through them a number of times a current as large as that which will result under the most severe short-circuit conditions. If there are any weak or defective points in a relay, they will no doubt become evident at this time. The performance tests of the relay should always be made under conditions which approach as nearly as possible those which will exist when the relay is required to function after it is installed.

Potential tests using 1,000 volts will indicate where insufficient or defective insulation exists.

The disk of an induction-type excess-current relay will not return immediately to its initial position after an excess current has passed through it unless the current in the relay is reduced to zero instantly. If the excess current has not opened the circuit, the relay disk will return slowly so that if another swing occurs very soon the relay will function in less time than desired. It is a good plan to find out just how the relay under consideration will act in this respect.

The ability of a relay to carry the tripping current of an oil circuit breaker satisfactorily is of considerable importance. In most cases the relay contacts are not required to open the trip circuit, this being usually opened at the oil circuit breaker.

The volt-amperes required by and the power factors of different relays under normal conditions should be compared. Excessive volt-ampere requirements at low power factor will increase the error of the current transformers.

The sturdiness and simplicity of construction and ease of adjustment of the relays under consideration are important factors and should not be overlooked. A relay which is so arranged that the adjustment can easily be changed by an unauthorized person or so that the contacts could be closed accidentally is very undesirable. It is important that the relay be absolutely dust-tight since the presence of dust may prevent the relay from doing its work.

Tests Prior to Placing in Service

After relays have been installed they should be gone over very carefully to make sure that they have not been damaged during the process of installation, that all connections are correctly made and that all contacts are lined up properly. It is particularly necessary to check the current and time settings of excess-current time-limit relays.

The connections of directional relays should be carefully checked as inaccurate connections may cause serious trouble. This test can be very readily made without removing any of the relay connections by means of a special test device described in the issue of the Electrical World for Feb. 5, 1921.

Whether or not all connections to double-winding

differential relays are correctly made can be determined by means of the test core referred to above.

The correctness of the connections to single-winding differential relays can be checked under load by putting an ammeter in the relay circuit. This instrument should, of course, indicate zero current, if all connections are correct and current transformers of the proper ratio have been installed.

Special Tests on Completed Installations

Even though the individual relays at the two ends of the feeder have been checked separately, it is advisable in some cases to make a check of the complete relay installation to determine whether or not the desired selective action will be obtained. Fig. 1 shows apparatus

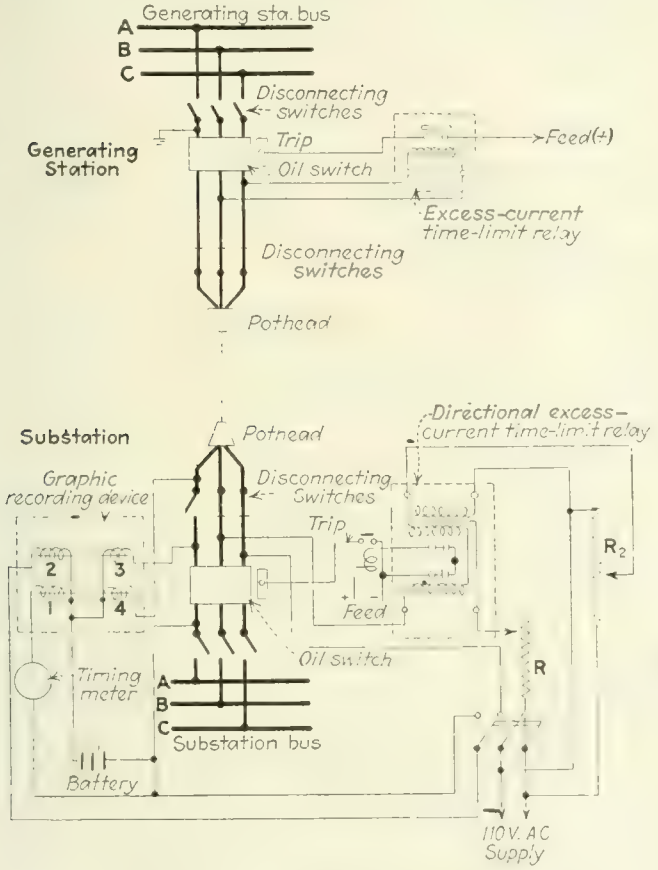


FIG. 5 — CONNECTIONS TO DETERMINE THE TIME REQUIRED FOR THE VARIOUS PIECES OF EQUIPMENT TO FUNCTION

and connections which may be used for a test of this sort.

From the illustration mentioned it may be seen that the relays at both ends of the feeder are energized simultaneously with a current of any desired value, which may be, if desired, equal to the calculated short-circuit current.

Resistor R_1 is used to limit the current in the relays to the desired value. Resistor R_2 is employed to give reduced voltage on the potential coil of the directional relay in order to study its performance under conditions very much the same as exist during a short circuit. The time required for the oil-circuit-breaker contacts to part is recorded on a chart by means of electrically operated pens. One of the pens is operated every half second by means of a timing meter. The second pen deflects when the short-circuit current is applied to the relays, the third and fourth when the breaker at the substation and generating station ends of the feeder open.

A typical chart taken during a test of this sort is represented in Fig. 4. This chart shows very clearly the time from the instant of short circuit to the points when the contacts of the substation and generating station breakers start to open, and the time between the breakers at both ends of the feeder.

In some instances it will be found necessary to make an analysis of the time for the various pieces of equipment at one end of the feeder to function. Connections shown by Fig. 5 should be employed in this case. The chart obtained from a test of this sort will give the time from the instant of short circuit to the closing of the primary relay contact, to the closing of the auxiliary relay contact and to the opening of the breaker. Fig. 2 shows a chart taken on the feeder, which was

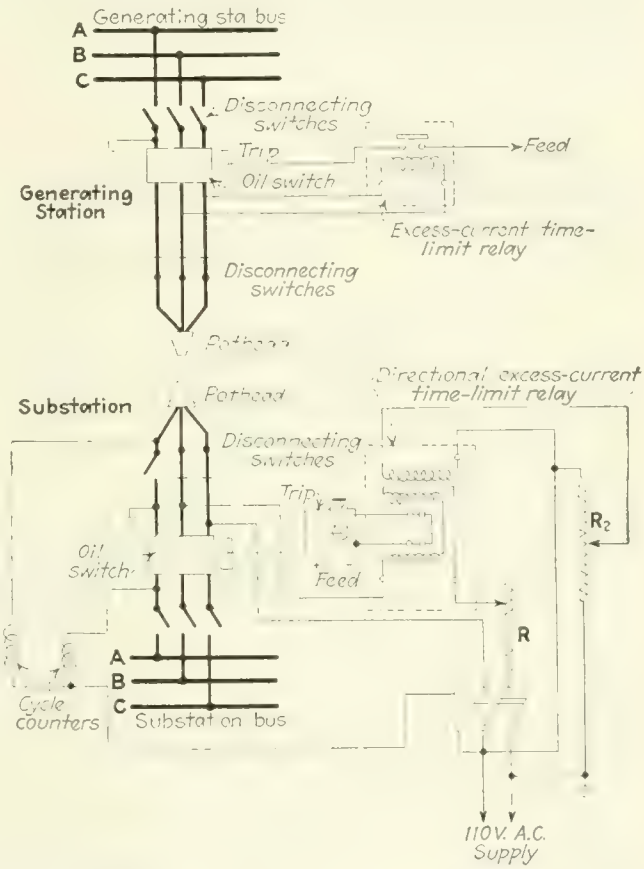


FIG. 6—CONNECTIONS BETWEEN FEEDER RELAY EQUIPMENT AND CYCLE COUNTERS FOR CHECKING SELECTIVE ACTION

equipped with an auxiliary relay requiring an excessive amount of time to function. Fig. 3 is a chart taken on the same feeder after a quick-acting auxiliary relay had been substituted. A comparison of these two charts will show how easily a slow-acting auxiliary relay may destroy selective action.

In addition to impressing reduced voltage on the directional relay, low power factor is employed in these tests in order to determine whether or not the relay will function satisfactorily on both low voltage and low power factor.

A slight modification of the connections of Fig. 5 makes it possible to determine whether the directional relay contact closes in less time under all conditions than the excess-current relay contact.

Cycle counters are very useful in making various tests and can be utilized for checking selective action between switches on a feeder by employing connections similar to those shown in Fig. 6.

In order to obtain desired results from relay protective systems it is advisable to follow a definite schedule of inspection and tests. Every two weeks an electrical test should be made to reveal the operating condition of the relays. For this test it will be found convenient to operate the relays by means of a bell-ringing transformer which can be mounted complete with connections in a carrying case. This test is easily made and enables one to determine whether or not the relays will operate when current is applied to them and whether or not they will trip the oil circuit breakers.

A thorough inspection should then be made to see whether the relay element has returned to the normal position, whether the contacts have opened properly and whether they show signs of burning, or if they are in need of cleaning. The presence of metal particles or other foreign material should be looked for and guarded against.

The current and time adjustments of excess-current time-limit relays and the performance of directional relays on low voltage should be checked at intervals of not more than one year.

Complete records should be kept of all of these tests and inspections as to the condition of the relays both "as found" and "as left."

It is a good plan to make one man of the proper training and experience responsible for all of the relay installations throughout the system. The routine inspections made every two weeks could be taken care of by the operating force, but all uncertain operations, defects, etc., should be reported at once to the relay engineer. If this man realizes the importance of the relay protective systems and the necessity of making rigorous routine tests and inspections and sees to it that his instructions are carried out most satisfactory results should be obtained.

Stringing Suspension-Insulator Lines in Rough Country

All Spans Between Dead-End Towers Are Pulled to the Same Tension, One Such that Elastic Limit Is Not Exceeded Under Maximum Loading Conditions—Rational Basis for Investigations

By MURRAY J. IDAIL
Electrical Engineer with F. R. Weller, Washington, D. C.

THE construction of a high-voltage (66,000 and above) transmission line through rough and mountainous country involves a problem in methods of stringing that is not encountered in construction through flat and regular country. In flat country a standard length of span can be adopted and adhered to more or less closely. In rough country, however, it is often necessary to span across valleys and to place structures on ridges and knolls in order to keep adequate ground clearance. This construction, of course, renders it impossible to adopt any standard span length. Adjacent spans may differ in length by several hundred per cent. This particular characteristic of mountainous construction must be taken into account in stringing wires and conductors. The problem is further complicated by the use of strings of insulator disks in suspension position, since different tensions cannot exist in adjacent spans except at dead-end towers.

Rather than to blindly string the sections of line to the tension proper to the average of all the span lengths in the section (which naturally first suggests itself as the most fitting tension) an investigation was undertaken to determine upon a more exact and justifiable basis for the stringing tension. Based upon the consideration of the unstressed length of conductor between strain towers, a formula was determined for a common stringing tension for all spans in the section. This formula, though empirical, is sufficiently accurate for all practical purposes and holds for both steel-covered aluminum and copper conductors.

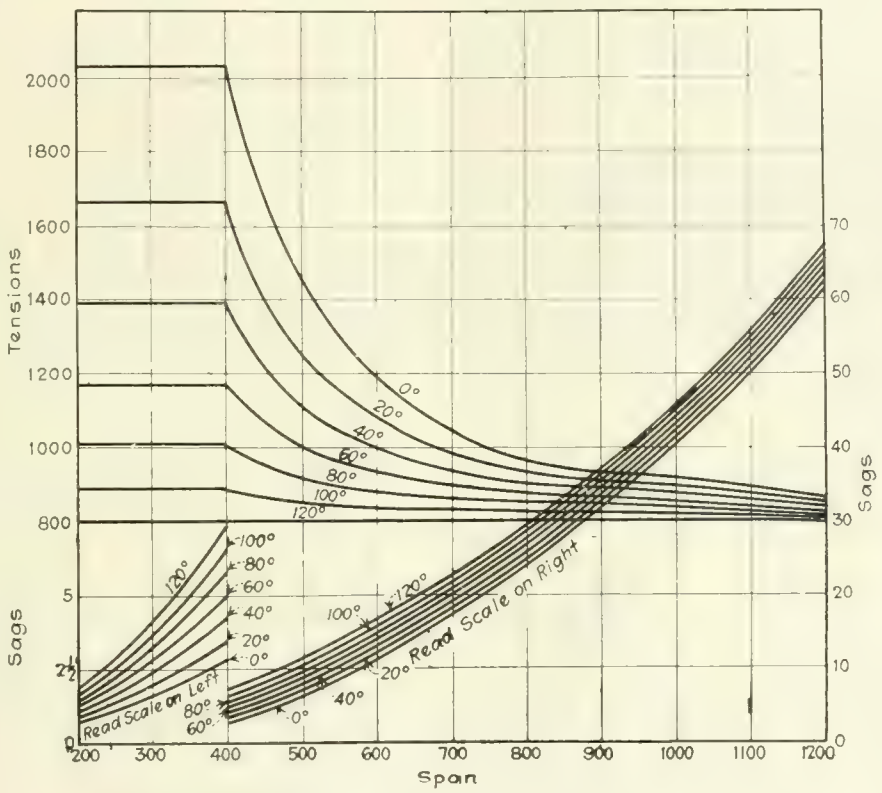
The curves for use in stringing the conductor are usually plotted tensions in pounds and sags in feet against span length in feet, curves being given for each of a number of atmospheric temperatures. The stringing tensions given by these curves are such that when the line is subjected to its maximum load—½ in. (1.27 cm.) ice and 8 lb. per foot (39 kg. per sq.m.) wind pressure at 0 deg. Fahr. (—18 deg. C.) for example—a certain definite maximum tension exists in all spans. This maximum tension is usually the elastic limit of the wire or slightly less than this value. Such a basis for the stringing curves assures the strength of the wire being used to the best advantage—*i.e.*, all spans are given just enough sag in stringing to prevent them from being overstressed at maximum load. These values of sags and tensions given by these curves will be referred to as the theoretically correct stringing values. The curves show that the longer spans require a lesser stringing tension than do the shorter spans. This means that, while the stringing tension curve for a conductor at ordinary atmospheric temperature is a curve resembling somewhat a section of equilateral hyperbola, the tensions existing in all spans under the conditions of maximum loading would be the same.

Basis for Rational Method of Stringing

Consider a line containing spans of greatly varying length. If in the construction of the line the insulators at each end of every span could be placed in the strain position and the conductors dead-ended thereto, the proper stringing tension for each span could be read directly from the curves and the conductors strung accordingly, the sag and tension in every span being entirely unaffected by adjacent spans. However, there are several reasons which render it inadvisable to dead-end each span. In fact, dead-end (*i.e.*, strain) structures are usually avoided as much as possible, sus-

pension structures being preferred. In mountainous country, however, on account of the great difference in length of many of the spans adjacent, it is necessary to provide a greater number of strain structures than is otherwise desirable. This is especially true when the line is being constructed at right angles to the general run and range of mountains. Under these conditions sections of more than four or five spans between dead-end points are rarely found.

Take, then, the case of a section of line comprising three suspension structures (*i.e.*, four spans) between dead-end points. As noted above, the spans on either side of a strain structure are unaffected by one another; that is, any tension can exist in the wires of one span without reference to the tensions existing in the other. Inherently, however, a suspension structure is incapable of maintaining a difference in conductor stress in the spans on either side of it. Any tendency for a greater stress to be set up in one span is immediately compensated by the insulator string swinging toward the greater stress, thus maintaining an equality of tension throughout all spans of the section. It is evident that with the insulator strings on the suspension structures kept in their proper positions—vertical or nearly so—the longest span in a section must at all times have exactly the same tension as the shorter span. As above noted, however, the stringing curves show that the proper tension for a comparatively long span is considerably less than that for a shorter span. The problem, then, is this: What stringing tension used for all spans of a section of line (*i. e.*, the section as a whole) will cause all spans in the section to be stressed to the maximum safe value under the conditions of maximum loading?



STRINGING CURVES FOR NO. 4/0 STEEL-CORE ALUMINUM CONDUCTOR

Curves are based upon equal sags at 0 deg. Fahr. with ⅜-in. Siemans-Martin steel ground wire. This sag is safe for conductor at 0 deg. Fahr. with ½-in. ice and 8-lb. wind and allows sufficient clearance at 32 deg. Fahr. with ground wire loaded and conductor unloaded.

Composite modulus of elasticity = 12,000,000.
Composite coefficient of expansion = 0.0000105 per deg. Fahr.
Weight of wire = 29 lb. per foot.

A satisfactory solution of this problem has been worked out, based on a comparison of unstressed length of conductor. By unstressed length of wire is meant the length of wire under the condition of no external stress acting on it. Stated another way, unstressed length of wire in a span is the actual length measured along the curve taken by the wire when in place, less the elongation due to the stress in the wire. It will be noted that unstressed length varies with the temperature. The basis for a formula for a tension suitable to the conditions outlined before is as follows: The stringing tension for any section of line between dead ends should be such that the total unstressed length of conductor in the section is equal to the length that would be the sum of the unstressed lengths in the component spans if each of these could be strung independently to the theoretical tension.

Procedure in Determining Stringing Tension

Once a section of line has been strung, there is for that section, at any one temperature, a fixed and invariable unstressed length of wire which depends upon the unstressed length at stringing temperature, the temperature coefficient of expansion of the wire and the change in temperature from the stringing condition to the one in point. The unstressed length taken in conjunction with the loading determines the deflection and tension. That this is true is shown very clearly by the method of sag-tension calculation given by Lyndon in his "Hydroelectric Practice." Having given a span at a temperature and loading different from the stringing conditions, the unstressed length at the new temperature is found as just outlined. A value for the unknown stress in the wire under the new conditions is then assumed. The elongation, total stressed length of wire and consequent deflection in the wire are then computed. The stress corresponding to this deflection must be the same as that assumed, or the computation must be repeated with a new assumed stress. Coming back to our problem, it is evident that in the case of any given section of line it is the unstressed length of wire in the section, together with the characteristics of the wire itself, that determines the tension and deflection under any given set of conditions. Hence it is necessary only to determine what unstressed length at stringing temperature gives the desired tension on maximum load and to string the section as a whole to that unstressed length.

Short Cut by Using Equivalent Span

It is evident that the stringing tension for a given section will have a value between the curve tensions for the longest and shortest spans in the section. By

means of a cut-and-try method the following simple formula was determined upon: The stringing stress for a given section of line between dead-ends shall be the stress given by the stringing curve for an "equivalent span" the length of which is equal to the average of all spans in the section plus two-thirds of the difference between the length of the longest span and the average span length. Thus:

$$L_{equiv} = L_{av} + \tfrac{2}{3}(L_{max} - L_{av}), \text{ where}$$

$$L_{av} = \frac{l_1 + l_2 + l_3 \cdots + l_n}{n}$$

This empirical formula gives results correct within the degree of accuracy obtainable in the actual stringing of the wire, as shown in the following example:

Assume a section of line as follows: Three suspension structures between a pair of dead-end structures; span lengths, three of 300 ft. (90 m.), and one span of 700 ft. length; conductor No. 4/0 steel-reinforced aluminum; maximum loading, Class B, *i.e.*, 8 lb. (39 kg. per sq.m.) wind and ½ in. (1.27 cm.) ice at 0 deg. F. (—18 deg. C.); maximum safe stress in the conductor, 4,000 lb. (280 kg. per sq.m.)

The tabulation gives for each span the stringing stress at 80 deg. Fahr. (27 deg. C.), and the unstressed length of wire in each span at 80 deg. Fahr. for three different methods or conditions of stringing:

STRINGING STRESSES, ETC., AT 80 DEG. FAHR.

Method	Span Length, Feet	Stringing Tension, Lb.	Stringing Sag, Feet	Stressed Length, Feet	Unstressed Length, Feet
a	300	1,220	2.67	300.063	299.941
b	300	880	3.72	300.125	300.035
c	300	1,010	3.23	300.093	299.990
a	700	863	20 50	701.600	701.398
b	700	880	20 20	701.550	701.344
c	700	1,010	17.60	701.180	700.944

TOTAL UNSTRESSED LENGTHS IN WHOLE SECTION

Method	Unstressed Length, Feet
a	1601.221
b	1601 449
c	1600.914

In method (a) each span is considered as isolated from the others and strung with theoretical correctness, as outlined in the first part of the paper.

In method (b) the section as a whole is strung to the tension for the "equivalent span"; *i.e.*, 600 ft. (180 m.) in this case.

In method (c) the section is strung as a whole to the tension for the average span; *i.e.*, 400 ft. (120 m.) in this case.

Since the formula for the tension for the "equivalent span" is an empirical one, it is not to be expected that in all cases the total unstressed length, and therefore the stress under maximum loading, given by method (b) will check the correct and exact values given by the theoretical computation (a) as closely as in the example given. It will be seen that the stringing tension for the average span is only slightly greater than the tension for the equivalent span. In fact, the dynamometer in stringing might easily introduce a greater inaccuracy than would enter by stringing by method (c). Hence in many cases it is immaterial whether method (b) or method (c) is used; that is, the more obvious method of stringing the section to the tension for the average span may in many cases be safely used. Just what stress would exist in the above section if strung by method (c) does not admit of easy determination, it being very difficult to arrive at the adjustments in unstressed length that take place in the several spans as the temperature decreases and the wire becomes loaded.

It will be noted, however, from the stringing curve shown that there is a greater difference between the stringing tensions for two given span lengths at the lower temperature than there is at the higher temperatures. In stringing at the lower temperatures, therefore, and in other cases where there is considerable difference between the tensions for the average and "equivalent" spans, it is well to use the tension for the equivalent span. It is advisable for the office engineer, in preparing his table of stringing tensions and sags for his foreman, to investigate unusual sections of line with a view of determining whether or not the tension for the "equivalent span" can be used to good advantage.

The study of this problem established a correct and rational basis for stringing a number of spans of varying length in the same section. It also established the fact that while the usual method of stringing to the tension for the average length of span results in slightly overstressing the conductor, this latter method may in the majority of cases be used. It is just as easy, however, for the office engineer to give the construction foreman a table based on tensions for the equivalent span, and under some unusual conditions, such as a combination of up-hill work and varying span lengths, the tension for the equivalent span may give somewhat better results.

It might be well to add a word of explanation concerning the stringing curve shown. All spans strung according to this curve, or any section strung to the tension given by the curve for the equivalent span, reach a maximum stress of 4,000 lb. (280 kg. per sq.cm.) at class B loading. The curves are flattened at the 400-ft. (120-m.) point because it was not considered advisable or necessary to stress an isolated span to a tension greater than that given for 400 ft. It is merely a matter of chance that the curve at 120 deg. Fahr. (49 deg. C.) is parallel to the axis of span length.

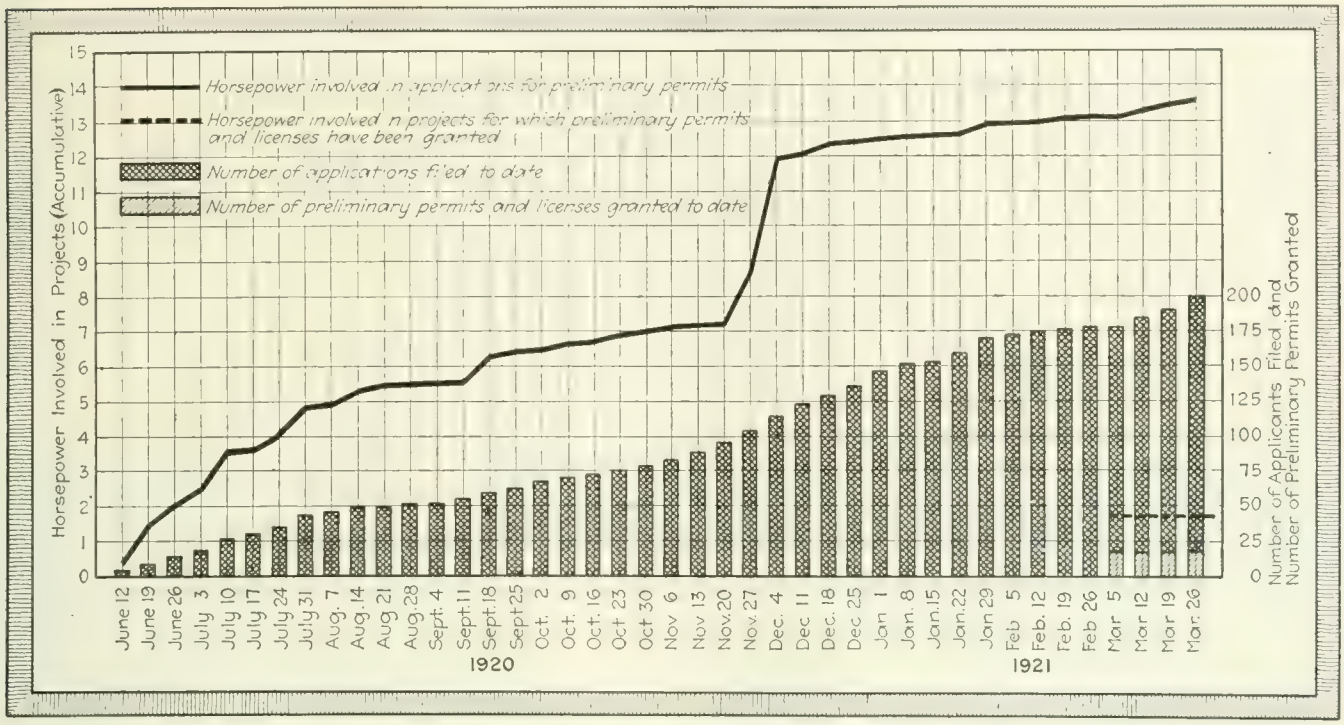
These methods of fixing upon the suitable tension for stringing a section of line containing widely varying span lengths were investigated as above outlined by the engineers of Francis R. Weller, Washington, D. C., in connection with the design and construction of an 88,000-volt tie line between the Logan and Sprigg plants of the Kentucky & West Virginia Power Company.

New "Stop-Water" for Joints in Concrete Dams

A RECENTLY designed "stop-water" for sealing joints in dams and other concrete structures has the novel feature of providing for renewal of the seal in case it is broken by settlement of the structure or other cause. The seal is made by asphalt in the form of blocks placed in a vertical groove during construction. Upon completion this asphalt is melted by passing steam through a pipe embedded in the blocks, thus allowing the hot asphalt to flow into and fill the joint. Should renewal of the seal become desirable at a later time, the asphalt is again melted, and if necessary more is added at the top of the column to replace that which, at the time of the second melting, may flow into the joint. The method has been patented by F. B. Smith of San Francisco.

Water-Power Applications Reach 200 Mark

Federal Power Commission Reports the Receipt of 200 Applications for Preliminary Permits Up to and Including March 26—Twenty-two Applications Were Filed with the Commission During March



PROJECTS INCLUDED IN APPLICATIONS FILED WITH THE FEDERAL POWER COMMISSION NOW TOTAL 13,536,431 HP.

MORE applications for preliminary power permits were filed with the Federal Power Commission during March than during any average month since the passage of the federal water-power act. Applications involving twenty-two projects were filed in March, involving a total of 386,085 hp. The latest data issued by the commission indicate that the net capacity of the 200 projects now on file totals 13,536,431 hp. The discrepancy between these figures and those previously published arises from the revision of figures where conflicts between certain large projects had occurred.

Of the applications filed during March, thirteen were for projects in California, three in Montana, and one each in Kentucky, Oklahoma, Utah, Missouri, South Carolina and Alaska. The largest project recorded during March was that of J. S. Wallace, involving three dams on the Cumberland River in McCreary, Pulaski and Whitley Counties, Ky., and totaling 160,000 hp. This was the only project involving more than 100,000 hp.

Table I gives a list of the applications for preliminary permits filed with the Federal Power Commission from Feb. 26 to and through March 26. Lists of applications filed prior to Feb. 26 appeared in the ELECTRICAL WORLD of Jan. 1, Jan. 15, Feb. 12 and March 12.

The work of the Federal Power Commission has now reached the stage of granting preliminary permits and licenses. During March sixteen preliminary permits or licenses were granted, one of which involved two applications. Six of these permits were for transmission lines, leaving ten hydro-electric projects which may be considered as almost certain of construction in the near future. These ten projects involve a total of 1,702,036 hp., and it is estimated that they will require an expenditure of about $1,975,000,000 for generating plant, transmission and service equipment. The largest of these projects is that of the Southern California Edison Company, involving five dams, four reservoirs and two power houses in the headwaters of the South Fork of San Joaquin River, California, with a possible waterwheel installation of 425,000 hp. Table II gives a list of the preliminary permits and licenses which have been granted by the Federal Power Commission.

At the sixteenth meeting of the Federal Power Commission, held on Feb. 28, the following applications for preliminary permits or licenses involving the use of the waters of the Niagara River were rejected: Project No. 6, Niagara Power & Development Company; project No. 14, Western New York Utilities Company; project No. 25, Niagara, Lockport & Ontario Power Company; project No. 26, city of Buffalo; project No. 37, J. K. Thomson et al.; project No. 39, M. F. Bowen; project No. 45, Niagara Gorge Power Company.

GROWTH IN APPLICATIONS FILED

The accompanying diagram shows the growth in the number and horsepower of applications for preliminary permits and licenses filed with the Federal Power Com-

TABLE I—LOCATION AND SIZE OF WATER POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM FEB. 26, 1921, TO AND THROUGH MARCH 26, 1921

Name of Company	Location of Project	Capacity, Hp.
CALIFORNIA		
Pacific Gas & Electric Co., 445 Sutter St., San Francisco	Transmission Line, Green Valley	.....
Pacific Gas & Electric Co., 445 Sutter St., San Francisco	Transmission line, Tahoe National Forest	.....
El Dorado Power Co., care Chickering & Gregory, Merchants Exchange Bldg., San Francisco	South Fork American River	39,735
Southern Sierras Power Co., care W. L. Huber, First National Bank Bldg., San Francisco	Willow, Vivian, Falls, Alder and Lost Creeks	800
Provident Irrigation Co., Willows, Cal.	Deer Creek, Tehama County	11,500
Little Rock Power & Water Co., Room 307, Delta Bldg., Los Angeles	Little Rock Creek, Los Angeles County	4,830
C. B. Johnson, care V. G. Preston, Bishop, Cal.	Transmission line, Ingo County	.....
City of Los Angeles, Dept. of Public Service, 603 Knickerbocker Bldg., Los Angeles	Big Pine and Baker Creeks, Ingo County	8,000
Same	Rock Creek Lake and Rock Creek, Inyo and Mono Counties	6,000
Same	Sawmill and Division Creeks, Inyo County	1,300
Same	Cottonwood Creek, Kern County	4,950
Rich Point Mining Co., 57 Tevis St., San Francisco	Bear Creek, Plumas County	360
CALIFORNIA:		
Yuba Development Co., 1213 Hobart Bldg., San Francisco	No. Fork of Yuba River, Sierra and Nevada Counties	76,500
KENTUCKY:		
J. S. Wallace, care Chas. H. Gunter, The Annex Hotel, New York City	Cumberland River in Kentucky	160,000
MISSOURI:		
H. S. Shaner, Eminence, Mo.	Current River	5,000
MONTANA:		
R. T. Ringling, White Sulphur Springs, Mont.	Willow Creek, 6 miles from White Sulphur Springs	400
Fred Mielde, Livingston, Mont.	Republic Creek, Park County	220
Boston & Montana Milling & Power Co., Butte, Mont.	Transmission Line, Lewis and Clark National Forest	.....
OKLAHOMA:		
Sand Springs Home, Sand Springs, Okla	Grand River, Rayes County	55,000
UTAH:		
United Power & Light Co., care Charles Demoisey, Vernal, Utah	Pole Creek and United River Duchesne County	6,500
SOUTH CAROLINA:		
Columbia Railway & Navigation Co., Columbia, S. C.	Santee and Cooper Rivers	5,000
ALASKA:		
Cooper-Harbor Pulp & Paper Co., care T. A. Kelley, Bank of Nova Scotia Bldg., Vancouver, B. C.	Reynolds Creek, Prince of Wales Island	5,000

mission since the passage of the water power act. The number of applications filed has far exceeded the expectation of those who are interested in the work of the commission.

It is estimated that with the present force of engineers on the staff of the commission it will take some four or five years to investigate and report on all these projects in an efficient manner. During the first ten months of the commission's existence 200 applications were received, and only seventeen applications for preliminary permits and licenses have been granted, and six of these were for transmission lines.

Commission Engineers Have Gigantic Task Ahead of Them

The field investigation and making of reports will move along much faster now that the regulations and schedules have been fully worked out, but the task before the commission is a gigantic one. During the month of February it looked as though the filing of applications had about ceased, or at least would continue at the rate of only two or three per week, but during March the new filings were again increased to an average of about six a week.

How long the filing of applications will continue remains to be seen.

Winter Power Stations in Switzerland

PROMINENT among the winter power stations which large Swiss electric light and power corporations have been led by the unusually dry winter of 1920-1921 to consider erecting is one in the Wäggi Valley in the Canton of Zurich. This project is attracting great attention in all parts of Switzerland. At a recent meeting of the Zurich Chamber of Commerce the president of the Northeastern Swiss Power Works said that on account of the steadily increasing demand for electrical energy the lack of winter power had been intensively felt and that for the Northeastern Power Works alone the deficiency during the winter months in the next four or five years will reach at least 50,000,000 kw.-hr. The Wäggi Valley power house, which the company intends building with the financial support of the city of Zurich, will supply 110,000,000 kw.-hr. A concession for this station has already been granted. The cost of its construction, including all necessary electrical machinery, etc., will amount to 94,000,000 francs; that is to say, 1 kw.-hr. will cost 7.6 centimes. This price is considered a little high at present, but the market price for winter energy is still higher. Work on the new plant will be started early in the spring of this year, and it is expected that by the end of 1924 the station will be in operation.

TABLE II—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH PRELIMINARY PERMITS OR LICENSES HAVE BEEN GRANTED BY THE FEDERAL POWER COMMISSION

Name of Company	Location of Project	Capacity, Hp.
ARKANSAS:		
Dixie Power Company, Title Guaranty Bldg., St. Louis, Mo.	White River	100,000
CALIFORNIA		
Southern California Edison Co., Edison Bldg., Los Angeles	Big Creek, Fresno County	120,000
Southern California Edison Co., Edison Bldg., Los Angeles	South Fork San Joaquin River, Fresno County	425,000
Luther Hill, Independence, Cal.	Sam Mill Creek	386
Pitt River Power Co., care Harr and Bates, Westory Bldg., Washington, D. C.	Pitt River	,000
Coast Valleys Gas & Electric Co., care Chickering & Gregory, Merchants' Exchange Bldg., San Francisco	Transmission Line, San Benito	.....
Southern California Edison Co., Edison Bldg., Los Angeles	Transmission Line, Sequoia National Forest	.....
MONTANA:		
Amazon Dixie Mining Co., Walkerville	Transmission line, Lolo National Forest	.....
MONTANA:		
Butte-Jardine Metals Mining Co., care C. R. Leonard, Butte, Mont.	Transmission line, Deer Lodge National Forest	.....
NEVADA:		
Spanish Belt Silver Mining Co., 629 Nicholas Bldg., Toledo, Ohio	Transmission line, Nye County	.....
NEW YORK:		
Hydraulic Race Co., Lockport, N. Y.	Niagara River	5,000
Niagara Falls Power Co., Niagara Falls, N. Y.	Niagara River	400,000
Lower Niagara River Power & Water Supply Co., care H. L. Cooper, 101 Park Ave., N. Y. C.	Niagara River	250,000
Ford Motor Co., Dearborn, Mich.	Green Island, Hudson River	8,250
NORTH CAROLINA:		
United Mills Co., Hickory, N. C.	Harper's Creek, Caldwell Co.	1,400
SOUTH DAKOTA:		
Paving Granite Quarry Co., Rapid City, S. D.	Transmission line, Black Hills National Forest Reserve	.....
WASHINGTON:		
Washington Irrigation & Development Co., care Electric Bond & Share Co., 71 Broadway, N. Y. C.	Columbia River	300,000

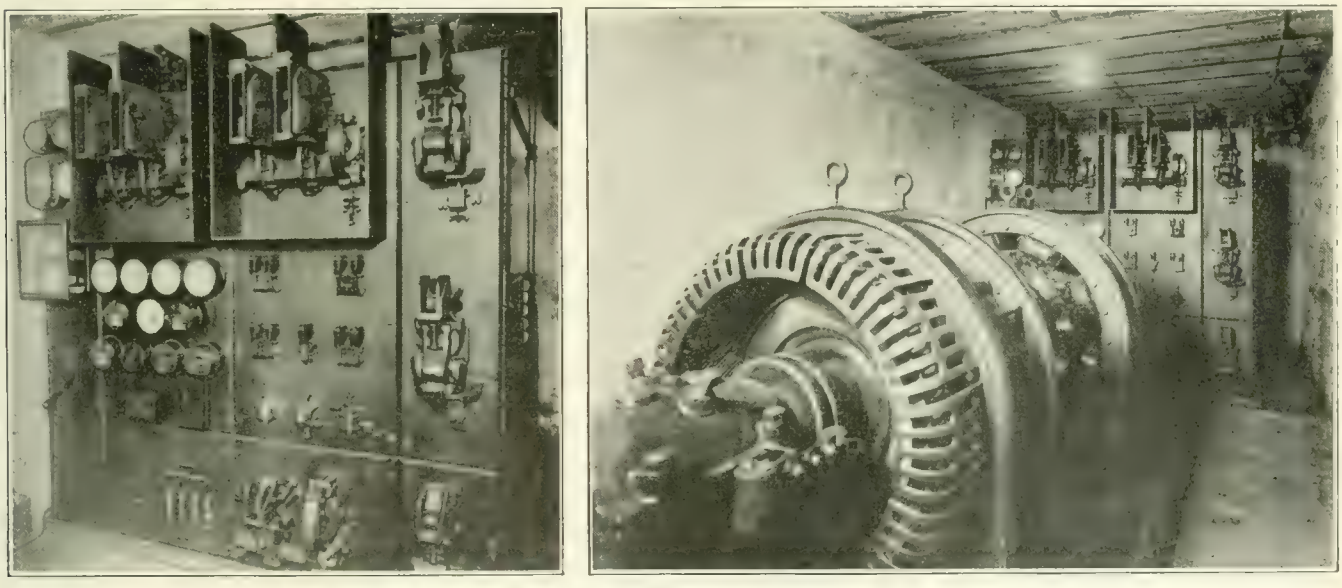
Mine Substation Operates Automatically

Underground Substation Automatically Aids Steam Generating Station at the Mouth of Mine in Maintaining Voltage Regulation—System Adopted May Be Used for Rotaries or for Motor Generator Sets

By GRAHAM BRIGHT
General Engineer Westinghouse Electric & Manufacturing Company

AUTOMATIC substations offer interesting possibilities as a solution for the distribution problem connected with the electric haulage system in mining work, particularly in those cases where feeder capacity is not sufficient to give good voltage regulation. Owing to the low operating cost as compared with manually operated stations, the automatic substation appears to deserve the study of every mining electrical engineer confronted with this problem.

So far as is known, the installation recently placed in operation by the Lincoln Coal Company of Nanty Glo, Pa., is the first of its kind. This mine is of the drift type with a main-line haul of more than 2 miles (3.2 km.). Power is generated by a 250-volt direct-current generator belted to steam engines at the drift mouth. The grade is against the loaded trip for the entire length of the main haul, so that even with a fair amount of feeder capacity the voltage near the working places was, before the substation installation, very low when the trip was being made.



AN APPLICATION OF THE AUTOMATIC SUBSTATION TO MINING WORK
On the left is shown the control equipment and on the right a general view of the substation recently installed by the Lincoln Coal Company at Nanty Glo, Pa.

As the Penn Central Power Company has a power line running over the property, it was decided to install a substation in the mine near the working places. Charles Stuart of Stuart, James & Cook acted as consulting engineer for the coal company and decided to install an automatic substation to provide the needed relief at a minimum operating cost. The converting set installed is a 200-kw. synchronous motor-generator set, and the entire substation equipment has been operating successfully since its installation. Before the substation was placed in service the operating conditions were very unsatisfactory. It required forty-five minutes to bring out a loaded trip of thirty cars, and during this time the voltage was very low for the other electric equipment operating in the mines. Since placing the substation in operation a round trip with the same number of cars is made in eighteen minutes and good voltage regulation is obtained at all time in various parts of the mines with a consequent speeding up of all operations.

The output of the mine has been increased 200 tons per day, which represents a fairly high percentage for a mine whose yearly production has been 150,000 tons. The good voltage regulation inside of the mine should greatly decrease the upkeep and repairs on all electrical equipment, since one of the most prolific causes of high upkeep and repair expense is poor voltage.

The substation is installed 2 miles from the drift mouth, and the room consists of a dry, well-ventilated and well-lighted underground chamber about 10 ft. x 30 ft. (3 m. x 9 m.) in size. The walls are built of heavy masonry with concrete reinforced with steel beams for the ceiling. The inside walls are cement-plastered. The 2,200-volt cable comes down from the surface through a bore hole just outside of the substation. The entire substation is built and the equipment is mounted in a most substantial manner which will insure long life and low maintenance.

One illustration shows the automatic control equipment. The main oil switch, resistance grids and some of the relays are installed back of the switchboard panel. The three large switches to the right are the resistance

contactors to cut in resistance when the load becomes too great, while the contactor at the bottom in the center is the main direct-current switch and is controlled by an alternating-current magnet. The large high-voltage contactors at the top are for starting the motor-generator set, the one on the right being the starting switch and the other the running switch. The main oil circuit breaker, auto-transformer and resistor are located back of the panel. In the center are the various relays and meters. To the left is an incoming alternating-current panel with graphic, indicating and integrating meters as well as overload relays.

Automatic substation equipment is designed to operate with either rotary converters or motor-generator sets. About the only difference between the two is that the rotary requires a brush-lifting device, if of the commutating-pole type, and a polarized relay to take care of the rotary coming into step with the direct-current voltage reversed.

At present the substation is started and stopped by a small control switch operated by the first man to enter the mine in the morning and the last man out in the afternoon. However, the substation can easily be made entirely automatic by throwing the double-throw control switch in the other direction, or it can be started and stopped from a push-button station in the power plant. Under automatic operation the substation will start up when the trolley voltage goes below a predetermined value for a period longer than five seconds. The set is started up and placed on the line in about twenty-five seconds, and it stays on the line until the direct-current load is reduced below a certain predetermined value for a period of time ranging from three to thirty minutes. Heavy direct-current overloads are taken care of by automatically inserting resistance in the direct-current feeder circuit. This lowers the substation voltage and shifts some of the load to the steam plant. As soon as the overload is reduced the resistance grids are cut out. If the overload persists long enough to heat up the grids to a dangerous temperature, a thermostat will shut down the substation. As soon as the grids have cooled down, the station will start up again if voltage conditions require it. If necessary, this scheme can be changed and an automatic reclosing breaker can be substituted. This may prove more satisfactory in mines where frequent short circuits occur. A continued overload on the generator or rotary will cause the substation to shut down until the set has cooled, when it will automatically start up again if required.

Machine Will Shut Down if a Hot Bearing Develops

As the bearings of the motor-generator set or rotary are equipped with thermostat relays, the set will be shut down if a hot bearing develops and will not start up again until the thermostat is reset by hand, thus insuring that attention will be given the bearing before operation again begins.

Automatic control might be elaborated on, but only the simple and necessary features are recommended for mine service. Such characteristics as the following have made the new substation equipment popular and a practical success: First, the equipment duplicates in every way the manual operation of substation apparatus. Second, each switching operation is a direct function of the electrical condition of the converting apparatus at that particular moment. Third, each succeeding switching operation is dependent upon the proper functioning of the preceding operation. Fourth, at no time is any switching operation dependent upon any mechanical time element or mechanical sequence of operation. Fifth, none of the time elements used with various relays are of the oil dash-pot type, but they are especially designed to be unaffected by wide variations in temperature. Ordinarily, a substation without an operator would not be heated, and at extremely low temperatures oil dash pots may become inoperative. Sixth, the entire equipment consists of an assembly of proved apparatus. The majority of the magnet switches and relays have demonstrated their quality in steel-mill control work.

Scheme of Operation

Substations without attendants may be made to start automatically in a number of ways depending upon conditions to be met, but for the most part they function through the agency of some form of remote control, or automatically by means of a voltage relay which closes its contacts at some predetermined value of reduced trolley voltage. In starting a synchronous converter, circuits thus set up cause other control relays to function in such a way as to close the oil circuit breaker, the normal field switch and the alternating-current starting switch.

Synchronism and polarity are indicated by a polarized relay which, in case of reverse polarity, causes the polarity of the machine to be corrected by field reversal accomplished by normal and reverse field switches opening and closing automatically. The control for the field switches consists of a small direct-current magnet switch energized from the direct-current end of the converter through contacts made on a small drum switch driven in a counter-clockwise direction by the polarized motor. Just here it must be explained that the field of the polarized-motor relay is fixed by means of a permanent magnet, while the polarity of the relay armature becomes that of the machine for the reason that during starting it is directly connected across the direct-current terminals of the converter. It is thus obvious that the relay armature will not rotate until the machine has pulled into step since prior to synchronism it is receiving alternating current of a diminishing frequency, the value of which becomes zero at the instant the converter armature reaches synchronous speed. The supply to the relay armature thus becomes direct current, causing it to rotate in a direction dependent upon the polarity of the machine. It must also be understood that when the field of a synchronous converter is reversed the voltage at its commutator falls to zero. So it may now be understood that the reverse field switch remains closed only for the instant required for voltage to fall to zero and release the control relay. Immediately normal field is re-established by the closing of the normal field switch; the machine has slipped a pole, thus correcting the polarity. The polarized relay now runs in a clockwise direction, setting up circuits on the drum switch in such a way as to cause the alternating-current starting contactor to open and the alternating-current running contactor to close. Then through interlocks, which are closed in proper sequence, the brushes are lowered to the commutator by a motor-driven device and the direct-current switches close. This connects the machine to load through current-limiting resistance, which is then shunted in steps by switching closed through the functioning of accelerating relays. The machine remains in operation until cut out of service by the light-load control.

Protection is provided by induction-type single and polyphase relays which prevent the station from starting under any abnormal conditions of alternating-current line voltage, such as low voltage, open phase or reverse phase. This same type of relay causes the station to shut down on unbalanced phase conditions. If the trouble is inside of the station, a lockout relay prevents restarting, while if the unbalanced phase condition is outside of the substation, the automatic equipment will function to bring the apparatus into service as soon as the line is restored to normal.

Bearings are equipped with thermostats which in the case of a hot bearing lock the machine out of service until the contacts of the thermostat device have been reset by hand.

A thermal relay protects the machine from overheating on overload.

A direct-current reverse-current relay, an overspeed device, induction-type alternating-current overload relays, a thermostat to prevent overheating of the direct-current current-limiting resistance and a look-out relay which locks the equipment out of service in case of failure of any part of the apparatus are other protective features.

The protection furnished by the equipment is complete, and it responds immediately in case of trouble, thus eliminating the losses which often occur in manually operated substations owing to the inability or impossibility of an operator to handle an emergency.

Substations with Two or More Units

The control for stations equipped with two or more units is so designed that after a load exceeding a given value has been maintained for a predetermined period of time another machine is automatically connected to the load. In case of failure of one machine another machine starts and picks up its share of the load. If in starting the first unit fails to take load within two minutes after the control receives the starting impulse, the second machine starts and the first is locked out of service. A signal connected with the lockout relay gives notice of the failure. This signal may be by pilot wires to some distant point, or it may be a signal which is visible to the motormen on trips passing the station.

To obtain a clear conception of the operation of an automatic substation let us assume a fairly large mine the workings of which have developed to such an extent that satisfactory voltage regulation cannot be obtained by a reasonable installation of feeders. It is decided to install an automatic substation inside of the mine containing two rotary converters.

The substation lies idle during Sundays, holidays, and in fact all the time that there is no demand for power. At about 7 a.m. the men start coming into the mine, and in a short time a main-haulage locomotive picks up a loaded trip and starts for the drift mouth. The ordinary night load caused by cutting machines, pumps and one or two gathering locomotives does not cause a sufficient drop in voltage to start the substation. The main-haulage locomotive will, however, cause a decided drop in voltage. This fact is immediately telegraphed to the substation, where a low-voltage direct-current relay receives the message. If the call for power is only momentary, lasting but two or three seconds, the rotary will not begin operation. If, however, the heavy call for power persists for five seconds or more, then the rotary is started up, correction for wrong building up of voltage is made if necessary, the brushes are let down on the commutator at the proper time, and in less than thirty seconds the rotary is helping to its full capacity.

If the load is of short duration, the low-current relay will operate and shut the rotary down. The same thing is repeated when a second trip starts to the drift mouth. As soon as rotary No. 1 starts up rotary No. 2 stands ready to help out with the load. If the load becomes too heavy for rotary No. 1, a load relay causes rotary No. 2 to get ready, and if the heavy load persists, rotary No. 2 starts up and operates as long as the heavy load lasts.

Resistance Inserted in Line in Case of Overload

Sometimes a combination of circumstances arises which makes the load too heavy for both rotaries. This may be due to a motorman trying the destructive scheme of starting a very heavy trip with sand on the track and his brakes screwed up. In this case a load relay causes resistance to be inserted in the circuit, which reduces the voltage and shifts some of the load to the power plant or other substations. This is done in one, two or three steps, depending upon the severity of the overload. If this does not produce results, the resistance will stay in the circuit until it becomes as hot as is safe and then a thermal relay operates and opens up the circuit and shuts down the substation. As soon as the grids have cooled to a definite temperature the substation will start up again with one or two rotaries as the load conditions may require.

One or both rotaries will operate until the lunch hour, when both will shut down until the afternoon work begins. Some of the feeders may be equipped with automatic reclosing circuit breakers. Where frequent short circuits occur this is a better scheme than the resistance relay, as explained above. With the automatic reclosing breaker a very heavy load or short on a feeder will cause the breaker to open, and it will remain open until the short or overload is removed.

Thermostat Protects Bearings

If a rotary develops a hot bearing, the bearing thermostat—there is one on each bearing—does not wait until any real damage is done but promptly shuts down the machine and the other rotary takes over the load. The thermal relay also can be arranged to bring a maintenance crew by operating lamp or bell signals installed at some point whence help can be summoned by telephone. In a short time the bearing receives attention and the substation is once more in normal condition. At quitting time the station shuts down, and it remains in this condition until called upon the next working day by the load condition in the mine.

If the alternating-current voltage drops below a certain value at any time or if one phase of the power system is opened, the substation will shut down until normal conditions are re-established. The substation equipment is always awake when power is available and always does the right thing at the right time, instantly making the proper decision and affording full protection to the equipment at all times.

The automatic substation should not require an inspection more often than once every two weeks and the saving in substation attendants will in most cases pay for the increase in first cost and more than compensate for the additional capital investment.

How 3,000 Southern Homes Were Wired--II

Method of Making the Preliminary Sales Canvass—Results Derived from the Campaign Estimated by Months—Cost of Obtaining Contracts—Essentials of a Successful House-Wiring Campaign

By L. J. WILHOITE
Lighting Contract Agent Chattanooga Railway & Light Company

DETAILED description of laying out the sales plan, preparing advertising material and selecting and training salesmen, leading up to the preliminary survey, was given in the first section of this article on page 645 of the ELECTRICAL WORLD for March 19. In this concluding portion of the article the results of the campaign, cost per contract and interesting points connected with the house-wiring business are related.

In starting the sales canvass the following instructions were given: "We are now ready for the preliminary survey. Take no contracts for two weeks and as long thereafter as it requires you to complete a canvass of your respective districts. Take everything that looks like a 'prospect,' and if in doubt give the person living there the benefit. Don't waste any time—you can't afford it for you are on starvation wages until you finish this preliminary job. Get the information and get away. Leave a house-wiring booklet and a return post card in your wake. Let the booklet do the talking and save your voice for more strenuous business later on. The sooner you finish this preliminary canvass job the sooner you will get in the money-making class, and the more thoroughly you do it the bigger the income will be when you get there. Remember, the first man fooling away his time signing a wiring contract is fired—that's all."

The way those men swamped the follow-up clerk during the next two weeks was good to see. In two weeks 1,982 prospective customers had been reported, but only two salesmen declared their districts finished. These two men were then put into unfinished districts, and the canvass started into the third week. At this point we said: "If you fellows don't get this job through, you are going to starve to death; so get a move on you, ring some door-bells." By Saturday night 1,242 reports were in, making a total for three weeks of 3,224. The following Monday morning each man stood up and declared that he had counted every nose in his district. We had our doubts because we were short 842, since our original calculation called for about 4,066 availables. However, we had all the information that any direct-by-mail expert could work on—3,224 good "prospects."

As a result of the canvass, supplemented by the newspaper advertising that we had been carrying, a few contracts had been taken at our office and at the contractor's office. Further, several post cards that the salesmen had left while making their canvass had begun to come in, all of which we had discreetly kept under cover during the preliminary canvass. The crediting of these contracts to the men from whose districts they had come, and the passing out of the inquiries received, acted as a good stimulant the first day of real selling effort. The first month's start was good, and on April 30 we had a total of 303 contracts. At the end of that period two of the men gave up the work, while a third begged for more time. We slowed up slightly and started the second month with a crew of five, splitting up the vacant districts among those remaining. The men who finished their house-wiring career so quickly were the very ones who went through the preliminary canvass most smoothly, easily and dashingly.

RESULTS OF CAMPAIGN BY MONTHS

About the second half of the second month the number of contracts started to slump. The independent contractors began knocking the props from under our predetermined price schedule. They were poking fun at the Edison plan by advertising it, and "wildcat" wiremen were combing the town for business. It looked as if every wiring contractor in town had suddenly come to the conclusion that his only salvation lay in increasing the volume of his old-house-wiring business, and as usual the only way he could figure out to increase the volume was to cut the price. In a very short while the prices we were quoting were considerably above the current level. What with independent contractors, the "wildcat" wiremen and the "prospect's" determination not to wire his house now, it looked pretty gloomy for the Edison plan. On May 31 we wound up with a total of 138 contracts for the month. On June 1 things looked blue, and we were debating what to do with our sales force. We believed that it was not altogether the fault of the men and made a modification of our plan. This included an offer to give two months' energy to anybody signing a contract for wiring an old house before June 30. We made it plain that 300 house-wiring contracts must be taken during that month or the house-wiring sales department would terminate from that time on. The way those salesmen passed out free energy must have made the "prospects" forget the conditions, for they frequently called us up to thank us. The contractor doing the work for us was snowed under with orders, and we wound up on June 30 with 319 old-house-wiring contracts.

The morning after we issued the following notice: "Fellows, your jobs are safe and we have a picnic coming. Everybody is tired and has a right to be. So we are off duty until the tenth—no daily report and no regular time to get up in the morning." We had the picnic and the ten days without reports, and that's where we made a mistake. The picnic and ten days with no alarm clock, coupled with good commissions the month before, were too much prosperity for a couple of salesmen and they slumped in July. But we are glad to add that they succeeded in coming back the following month.

The total for July with two men out was 269, one man securing 137 contracts, which is the best one-man house-wiring record that we have ever had the pleasure of marking up. In August, with no special inducements, the record was 258. One of the salesmen fell down that

Return Post Cards and Free Premium Coupons Used to Stimulate the "Edison Home Wiring Plan"




The Easiest Way to Pay for a Lifetime of Joy

Gentlemen:

Our home is not wired for Electric Lights. You may send your representative to give prices for wiring and to explain the new

Edison Easy Payment Home-Wiring Plan

It is understood that this request places me under no obligations whatever and is made merely to ascertain the details of your wiring plan and the cost of wiring our home.

Sincerely,

Name _____

Address _____

Remarks _____

PLEASE MAIL THIS CARD NOW WHILE YOU THINK OF IT — "LEST YOU FORGET"

4

What Has Your Landlord Given You IN RETURN FOR YOUR RENT MONEY?

Has he given you full value for your money in the form of a convenient, comfortable, modern home, or has he given you just a house? Answer this question frankly. Ask yourself if your rent money doesn't entitle you and your family to a real, comfortable, modern place to live in. You know that no home can be called modern or convenient that isn't wired for electric light.

Landlords know that an unwired home isn't modern. They know that the most desirable tenants won't rent a home without electric light. That's why hundreds of them are wiring their properties.

Have you asked your landlord to wire your home? He can no longer dodge the issue on the plea that he can't afford it. Our special home wiring plan enables him to wire your home without one penny in advance and on easy monthly payments without interest.

You and your family deserve this convenience—so let's get it. Send us your landlord's name on the attached postal, and we'll explain our plan to him. Do this TODAY.

——LET US HELP YOU WIRE THAT HOME——

Chattanooga, Tenn. .....191. ....

Gentlemen:—

I would like to have electric light in my home, but I am renting, and the house is not wired. Without obligating me in any way, you may explain your wiring plan to my landlord.

His name is

His address is

The agent is

My name is

My address is

I have lived here about .... Years Months

Remarks

2

Reply Card

PLACE ONE CENT STAMP HERE

Chattanooga Railway & Light Company

Chattanooga,

Tennessee

EDISON
Home Wiring
Department

3

THIS COUPON VOID

UNLESS PRESENTED ON OR BEFORE WEDNESDAY OCTOBER 15TH, 1919. AND IS FOUND TO COMPLY WITH THE FOLLOWING REQUIREMENTS:—

*COUPON MUST BE COMPLETELY FILLED OUT AND ENDORSED BY DISTRICT AGENT AT TIME OF PRESENTATION TO PARTY NAMED ON OTHER SIDE.

*WIRING CONTRACT MUST COVER THE WIRING OF AN ALREADY BUILT HOUSE LOCATED ON THE COMPANY'S EXISTING LINES.

*LIGHTING CONTRACT MUST COVER PREMISES DESCRIBED IN THE WIRING CONTRACT.

*WIRING MUST BE COMPLETED AND SERVICE CONNECTED, UNLESS COMPANY IS UNABLE TO COMPLETE CONNECTION ON OR BEFORE OCTOBER 15TH, IN WHICH EVENT COUPON MUST BE PRESENTED FOR APPROVAL IMMEDIATELY UPON COMPLETION.

*COUPON IS VOID IF PARTY TO WHOM ISSUED HAS PREVIOUSLY PRESENTED A LIKE COUPON FOR APPROVAL OR IS A PERSON OTHER THAN THE ONE DESIGNATED AS SIGNATORY TO EITHER THE LIGHTING OR THE WIRING CONTRACT.

*COUPON MUST BE APPROVED BY COMPLETION OF ENTRIES BELOW AT TIME OF PRESENTATION AT OFFICE.

WIRING CONTRACT NO. ..... SERVICE COMPLETE W.O. No. .....

APPROVED ..... L. C. AGT. PREMIUM RECD. .....191...

5

THE EDISON HOME WIRING PLAN PREMIUM COUPON

GOOD FOR
ONE STANDARD SIX POUND IRON
IF PRESENTED
ON OR BEFORE WEDNESDAY OCTOBER 15TH, 1919
AT OUR OFFICE, 620 MARKET STREET, IN COMPLIANCE WITH THE REGULATIONS PRINTED ON THE REVERSE SIDE AND APPROVED AS STIPULATED.

ISSUED TO _____ ADDRESS _____

ACCOUNT OF WIRING CONTRACT FOR NO. _____

WIRING CONTRACT SIGNED BY _____

ACCOUNT OF LIGHTING CONTRACT FOR NO _____ STREET

LIGHTING CONTRACT SIGNED BY _____

SIGNED _____ DISTRICT AGENT _____ 191_

CHATTANOOGA RAILWAY & LIGHT CO.

6

FREE PREMIUM CARD

Chattanooga Railway & Light Co. Date _____191_

Gentlemen: I am going to try to get the landlord to wire our home, with the understanding that if I succeed I am to receive one $4.50 ELECTRIC IRON FREE as soon as the electricity is turned on.

Name _____ Address _____

Landlord's Name _____ Address _____

Remarks _____

NOTE: Please keep the enclosed Free Premium Coupon till your home has been wired and the current turned on, then present it at our office and the $4.50 Electric Iron will be given you absolutely free. This offer limited to 30 days from date.

FILL OUT AND MAIL OR SEND THIS CARD TODAY

7

1. Doorknob reminder left by meter man when he removed the meter from a vacated house.

2 and 3. Return post card sent to tenants of unwired houses. This provided an effective entering wedge for the salesman when he interviewed the landlord.

4. Return post card addressed to owners of unwired houses.

5 and 6. Form of premium coupon and conditions under which it was good for an electric iron. This was offered to property owners for a limited period as an added inducement to sign the wiring contract then and there.

7. Premium card sent to tenants to enlist their assistance in persuading landlords to wire old houses.

month and we put him in our appliance department, where he made good immediately. He has since become district manager for a large company, and it was with considerable regret that we released him.

In September we used a couple of hundred flatirons that we had bought at a bargain and which, like most bargains, did not turn out well as a selling proposition. These we turned over to the four salesmen left to use as an added inducement to close house-wiring business. In dividing them up and turning them over to the men we cautioned them not to give everybody one of the irons, because the supply was limited and what they ought to do was to use them as an inducement with those inclined to hang back. They proceeded in such instances to make the flatiron a sort of personal token of appreciation for signing a contract then and there. The four salesmen and the 200 irons brought in 305 contracts for the month of September—one man winding up with 107 to his credit, the second highest record for one man in one month.

We opened October with only three men left and continued with these three up to Dec. 31. During the three months these three men took a total of 339 contracts, making a total for nine months ended Dec. 31 of 1,936 contracts. No advertising was done, nor was any special inducement of any kind offered during that time. This was on account of an unfortunate curtailment order that came along about Oct. 1. Most central-station business men can appreciate what we mean by a curtailment order and an enlargement on this point is not necessary.

As stated in the beginning, our goal for the first twelve months' campaign was set at 2,416 contracts. On Dec. 31, 1919, we had obtained 1,936 of these contracts after nine months' effort, leaving 480 to be taken in January, February and March, 1920, to complete the record. We fell down, however, as only 269 contracts were taken during these three months, leaving us short of our goal by 211 contracts. We should have made the quota had it not been for the fact that one of the salesmen had made so much money during 1919 that he felt impelled to get into business for himself and severed his connection with us on the first day of February. We were unable to replace him in time to reach the goal.

Cost of the Campaign

"But what did it cost?" It cost us just $7,124.48 less than we had originally figured it might possibly cost us to get 1,936 old-house-wiring contracts. We had figured it out that if necessary we could afford to spend $10.25 per contract. The actual cost was $6.57 per contract, making the total cost of the work from March 15 to Dec. 31 $12,756.40. As previously mentioned, $5 per contract went straight into the pocket of the salesman who secured the contract, while $1.57 per contract went to take care of clerical expense, advertising, etc.

"What is the business worth?" is the next question a central-station man is likely to ask. Pick out a straight road, line up on it 1,936 cottages, each on a 50-ft. lot, allow a cross street at the end of each city square, and you have a string of houses stretching about 17½ miles from end to end. We know of a man who owns a central station with less than half this number of consumers on its line and is making a very good living out of it. Anyhow, a string of homes like this ought to earn an average income of . . . , but that all depends upon the respectability of your rates and habits of the people in your town.

As a by-product of our efforts during the twelve months from April, 1919, to April, 1920, we had ascertained definitely the exact number of persons not using electric service in their houses. The number of white families living in houses near an existing line in our service districts and still continuing to deny themselves this privilege is 4,375, while the number of colored families is 4,981, making a total of 9,356. Of these however, 1,500 are so situated as to make it at present impossible to serve them, leaving 7,856 families accessible to our lines. Of course, a large part of this business is practically unavailable, and if it were available, would perhaps not be desirable. However, what constitutes desirable or undesirable residence business is a matter of which a discussion cannot be attempted in this paper. We felt safe in assuming that there were at least 4,000 persons in our districts still living in unwired homes that we must get wired up during the next two years at the longest. In view of this situation it was decided on April 1, 1920, to continue our house-wiring efforts as a permanent feature until we should reach as near 100 per cent saturation as possible.

Owing to the necessity of giving attention to commercial activities other than house wiring during part of 1920 and owing to the scarcity of competent salesmen only one man was regularly employed in house wiring, with a second man a part of the time. The number of house-wiring contracts secured from April 1 to Dec. 31, 1920, was 712. This, added to the total secured previous to that period, namely, 2,205, gives a total for the entire campaign of one year and nine months ended Dec. 31, 1920, of 2,917. Adding to these the contracts secured by independent wiremen places the total contracts over 3,000.

Roughly, our campaign efforts in old-house wiring during the nine months we were actively engaged during 1919 can be divided into three periods, characterized by the principal activities carried on during each one.

Cost per Contract Under Three Different Plans

The first period extended from April 1 to July 31 and may be referred to as the publicity period, inasmuch as during this time we engaged in much newspaper and direct-by-mail advertising. The total number of contracts taken during that period was 1,031; the average number per month was 258, and the average cost per contract was $8.03.

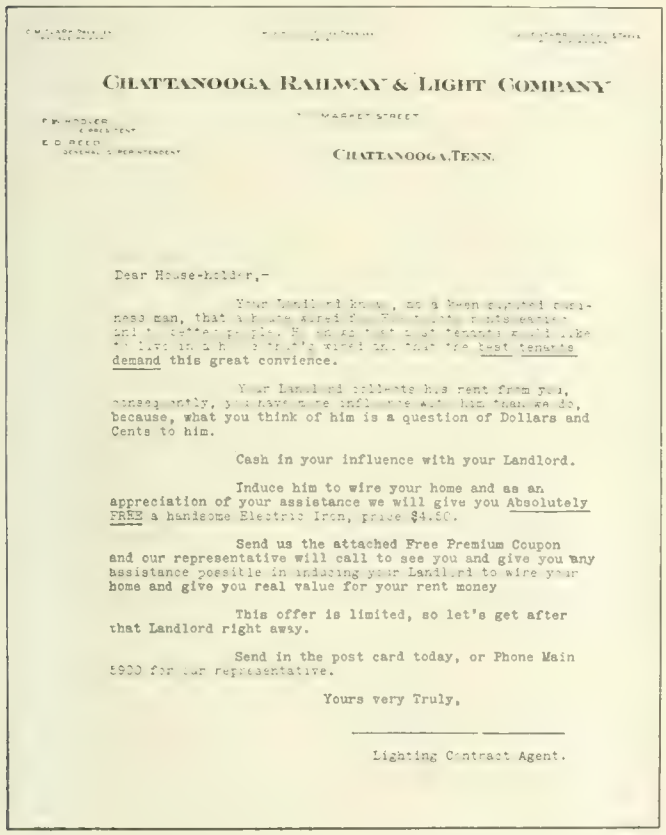
The second period extended from Aug. 1 to Sept. 30 and may be referred to as the free-premium period, inasmuch as during this time the only assistance given the salesmen was in the form of free electricity, as previously mentioned, and the giving away of a limited number of electric irons as premiums. All newspaper and other advertising was discontinued. The total number of contracts taken was 566; the average number per month was 283, and the cost per contract was $5.45.

The third period, extending from Oct. 1 to Dec. 31, may be styled the personal solicitation period, inasmuch as during this time no advertising was done nor were any special inducements offered. Dependence was placed solely upon the unaided efforts of the salesmen. The total number of contracts taken during this period was 339; the average number per month was 113, and the average cost per contract was $6.13.

From a study of results obtained during these three periods it is evident to us that if we had continued our advertising uninterruptedly until Dec. 31 we would have

secured 400 more contracts at an additional cost of approximately $3,200, or about $8 per contract. That is, an expenditure of $3,200 over and above what we actually spent—$1,200 for advertising and $2,000 commission to salesmen—would have added approximately 400 customers, producing an annual income of around $8,000. Of course, we hope to get this additional business some day; but we must confess that hope is not nearly so refreshing as the realization—all of which has proved to us—and we shall remain convinced until such time as somebody produces convincing arguments to the contrary—that it is downright hard-headed good business to advertise and keep everlastingly advertising.

Moreover, it might be interesting to note that contracts come cheaper and faster with a flatiron thrown in than they do without; that is, of course, if the flatiron is bought at a bargain price. Persistent advertising,



CHATTANOOGA RAILWAY & LIGHT COMPANY

CHATTANOOGA, TENN.

Dear House-holder,-

Your Landlord knows, as a keen business man, that a home against fire, burglar proofs makes better property. He also knows that desirable tenants would like to live in a home where they can feel sure that the best tenants demand this great convience.

Your Landlord collects his rent from you, personally, but how more influence has he than we do, because, what you think of him is a question of Dollars and Cents to him.

Cash in your influence with your Landlord.

Induce him to wire your home and as an appreciation of your assistance we will give you Absolutely FREE a handsome Electric Iron, price $4.50.

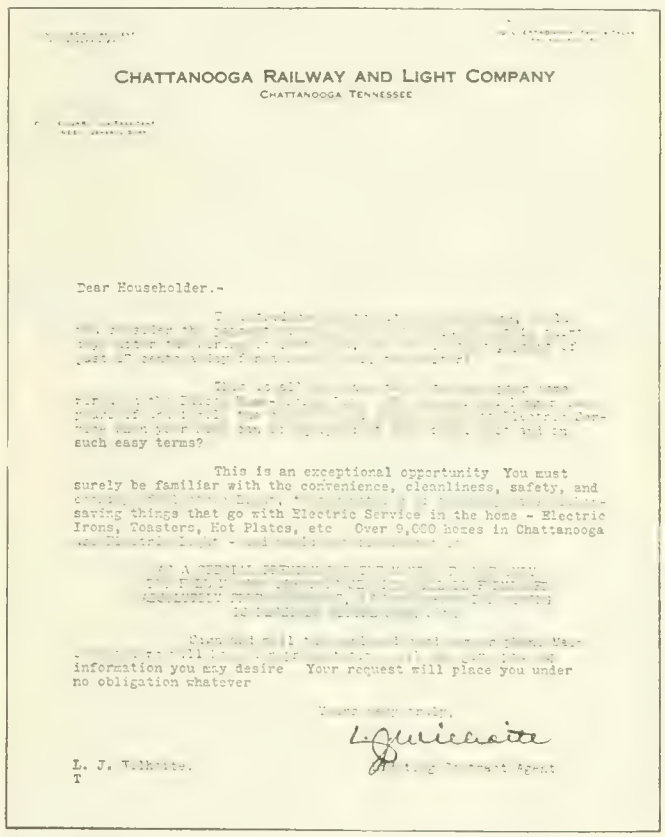
Send us the attached Free Premium Coupon and our representative will call to see you and give you any assistance possible in inducing your Landlord to wire your home and give you real value for your rent money

This offer is limited, so let's get after that Landlord right away.

Send in the post card today, or Phone Main 5900 for our representative.

Yours very Truly,

Lighting Contract Agent.



CHATTANOOGA RAILWAY AND LIGHT COMPANY

CHATTANOOGA TENNESSEE

Dear Householder.-

such easy terms?

This is an exceptional opportunity You must surely be familiar with the convenience, cleanliness, safety, and saving things that go with Electric Service in the home - Electric Irons, Toasters, Hot Plates, etc Over 9,000 homes in Chattanooga

information you may desire Your request will place you under no obligation whatever

L. J. Talbott.

TWO LETTERS OFFERING EXTRA INDUCEMENTS TO TENANTS AND PROPERTY OWNERS TO HAVE THEIR HOMES WIRED

together with special premium offers, particularly electric flatirons to house-wiring "prospects," serves as a wonderful nerve steadier to the house-wiring salesmen in the front line trenches.

Essentials of a Successful House-Wiring Campaign

"But what have we learned from our efforts of the last year?" Here is what we have been able to put down as the A B C of the house-wiring business in so far, of course, as house wiring applies to Chattanooga, Tenn.:

First—Don't try to make wiring salesmen out of boys. Selling house wiring to gas and oil users is not a child's job—it is a man's job and requires the highest type of specialty salesmanship that you can buy. Pick out full-grown men of the age of thirty and upward and pass up the young fellows.

Second—Advertise in the newspapers, on street cars, on the billboards, through the mail and in any other way that will get attention to your wiring campaign.

Third—Make up your mind that the house-wiring business is going to be a permanent feature with you until you have cleaned up all available contracts and leave the question as to whether or not the business is desirable or undesirable to some one with plenty of time to sit down and figure it out.

Fourth—Give your men a new argument every now and then in the form of a special inducement to close, such as a free premium for a limited time. Anything that you can buy cheaply will do, ranging from an 85-cent portable lamp to free energy for two months. The best premium is an electric flatiron.

Fifth—Forget all the electrical contractors in town except one real live one and hitch up with this one in real earnest. Give him the best that you have, work with him, appreciate his difficulties, and don't worry what the others may think of you and your company.

Sixth—Give your wiring efforts a name. We called ours the "Edison home-wiring plan" simply because the word Edison has a peculiar attraction to a lot of people.

Seventh—Bear down hard on the easy terms and forget to worry about the "price per outlet."

Eighth—Get your credit department to see the campaign in the right light. Persuade the credit man that the deposit requirement may be all right in the ordinary run of business, but that the use of that kind of language is entirely too rough when carrying on diplomatic negotiations with a house-wiring "prospect."

Ninth—Don't start off by thinking that you are going to stop in a month or two months or six months and thus give your salesmen the idea that they are merely temporary employees just hanging around waiting for something to turn up.

Tenth—Decide what you are going to spend per contract before you start and then try to save some money—it puts interest into the work. Our men watch our so-called surplus fund as closely as they do their own income.

Eleventh—Don't become alarmed when a wiring salesman starts making more money than the general superintendent. He's worth more, maybe, especially in this particular business.

The essentials of a really successful house-wiring campaign have always been just about as follows:

First—A concise, neatly printed application for wiring, detailing specifications and prices and illustrating a neat lot of sample fixtures good enough for the average home; that is, a predetermined schedule of prices all fixed up in an attractive application ready for the prospective customer to sign.

Second — A super-easy payment plan, preferably one allowing the consumer to pay for the wiring in monthly installments of not more than $5 each. A definite payment per month regardless of the amount of the wiring contract is much better than a monthly payment based on the amount of the contract spread over a number of months. The definite monthly payment is susceptible of more effective advertising than the ordinary installment plan.

Third — An ultra-liberal credit policy. A stingy credit department can wreck a good house-wiring campaign in less time than it takes the proverbial snowball in the lower regions to disappear.

Fourth—Some well-coached, quick-witted, clean-cut, backbone-carrying salesmen, none of whom have ever heard of the profession of electrical engineering and all of whose past experience in sales engineering has been strictly limited to the business of getting prospective customers to take advantage of the opportunity to use the fountain pen on the dotted line—that is, fellows whose long acquaintance with doorbells has made them eager ringers.

Fifth—Honest electrical work installed as promptly as present-day abnormal conditions will permit.

With these essentials firmly incorporated into a house-wiring campaign, such details as price per outlet, newspaper advertising, card-index follow-up, "ginger" talks and "get-together" schemes can be made to pay dividends. Otherwise they cannot.

Economist Urges that Utilities Be Allowed to Earn 9 or 10 per Cent

RATES that will enable public utilities to earn 9 or 10 per cent on their capital are urged by Dr. David Friday, professor of political economy at the University of Michigan, in his new book, "Profits, Wages and Prices." Such rates, he asserts, are essential if utilities are to make a showing that will attract the additional funds necessary to meet the requirements of the public. He points out that while wholesale prices were rising from 100 per cent in 1913 to an average of 212 per cent in 1919, the rates paid railroads and public utilities increased not more than 30 per cent.

"When we consider," comments Dr. Friday, who gained practical utility experience during the war as statistical adviser to the United States Telephone and Telegraph Administration, "that these companies have never earned a rate on their investment which compared favorably with even so conservative a business as banking, it becomes clear that before we can hope for any adequate facilities in these lines we must have a drastic revision of rates."

Referring to the increased value of utility service to businesses which made enormous profits in recent years, the economist says: "There is no reason why those who utilize these services for the purpose of making such profits should not pay a rate for them which yields an adequate return on the investment employed. The prices they receive for their products have doubled, and they can justly be asked to pay double the utility rates, if that be necessary to give an adequate return upon public utility investments."

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Economic Value of Interconnecting Isolated and Central Stations Questionable

To the Editor of the ELECTRICAL WORLD:

SIR: In the Jan. 1 issue of the ELECTRICAL WORLD there appeared an article discussing the advantages of "Co-operation for the Central Station and Isolated Plant" in which is advocated the idea of electrical interconnection between the central station and small plants whose purpose is primarily the production of steam heat. There are, no doubt, many cases where the production of electrical energy as a by-product of steam heat and the sale of the surplus of such energy to the central station might result in advantage to both parties. As a general proposition, however, it is believed that the economy of such a practice is not self-evident. The idea should be approached with caution and all influencing elements carefully considered.

From the point of view of the small plant it is simply a question of whether the electrical energy needed at that plant can be produced locally at a cheaper cost than the price charged by the central station for supplying the same energy. The cost must include annual charges on the generating equipment and additional apparatus necessary to utilize the steam, also the additional cost of coal (to produce the extra pressure) and other operating expenses if any. In case the cost is greater than the central-station rate, the further consideration is necessary of whether additional surplus energy can be produced and sold to the central station at a profit which will make the whole installation economical. The deciding factor in such a case is the price which the central station can afford to pay for such energy.

On the other hand, from the central station's point of view, the question is whether the energy which can be bought from the private plant can be resold, and if so whether the cost will be less than the cost of the same energy produced at the central plant and transmitted to that point. If such energy may be obtained at time of peak load and is dependable, the advantage may be considerable. If, however, there is no demand for such energy at nearby points at the time it is available, or if the supply is more or less intermittent, it may be worth very little. If the central station must maintain generating capacity, transmission and distribution line capacity, etc., to supply the full amount of such load at certain times of the day or year when the local supply is not available, the demand cost will not be reduced and only the kilowatt-hour cost will be saved on the energy purchased. Since this may be less than one-half the total cost of such energy, it may well be conceived that, with a less efficient plant, the smaller station could not afford to sell such energy at less than this cost.

If, in addition to this, the central station is called upon to supply the energy requirements of the local

plant at such times as the heating plant is not required, the demand cost on such energy must be charged, which would make the cost per kilowatt-hour used considerably more than it would be for full-time consumption. This would reduce the apparent economy of the small power installation.

All these points should be carefully considered when such an installation is contemplated. That scheme which will give the best over-all economy for both parties combined will be most advantageous for each.

Detroit Edison Company, HOWARD P. SEELYE,
Detroit, Mich. Distribution Engineering Dept.

Cause of Fires Not Accurately Reported

To the Editor of the ELECTRICAL WORLD:

SIR: Supplementing "A Reader's" statement in your issue of Feb. 19—that causes of fires are not accurately reported—I would add that this has been my experience also. For several years I was employed by a public utility corporation. Part of my work was to inspect and reinstall metering and service equipment. Previous to the inspection and as soon after a fire as possible a report of the cause was made by a police officer, and in probably 50 per cent of the reports this was necessarily guesswork. In many fires of doubtful origin the electric wiring was reported as the cause, although frequently an electric conduit or distributing system was still in operation.

It is surprising how an unqualified person reporting causes of fires may be influenced by the defective-wiring theory. Here is an instance: A fire occurred in the woodbin of the cellar of a tenement house. Strung from the floor joists and stapled to the under side were the bell wires, about 5 or 6 in. apart. These were of the usual No. 16 annunciator wire, and connected to them were two dry cells. At no point did they come near lighting wires, yet a fire that started in the bin owing to a tenant dropping a lighted match was attributed to defective wiring because the joists had been charred by the flames, and this regardless of the fact that even these wires at the time of inspection were not and could not be in contact.

In another case coming under the writer's observation, in a new dwelling, a plumber accidentally cut through a gas pipe with a hacksaw. The accumulated gas from the leak finally caused an explosion, but the reported cause was defective electric wiring, although the wires were not yet connected to the service mains!

MATHEW KING,
Electrical Engineer.

The Standard Textile Products Company,
Passaic, N. J.

Effect of Ground Wires on Inductive Interference

To the Editor of the ELECTRICAL WORLD:

SIR: On page 544 of the ELECTRICAL WORLD for March 5, 1921, the writer has noticed an article entitled "Telephone Noises Reduced by Double Overhead Ground Wire." The California Joint Committee on Inductive Interference made a study of the effect of ground wires on the inductive interference from a power circuit in a case very closely resembling the one described in this article, with this difference, that the telephone line considered was placed at horizontal separations of 65 ft. and 1,040 ft. instead of being immediately beneath the power circuit. The results of the study were published in "Inductive Interference," issued by the California Railroad Commission in 1919, on page 1088 f.f.

The results of that study indicated that the most striking effect of the ground wires is to reduce greatly the inequalities among the capacitances of the line wires to ground, thus reducing the unbalanced voltage to ground (the residual voltage) to about one-third of its value without ground wires. The shielding effect of the ground wires for both electric and magnetic induction was shown. It was found that the effect of the ground wires upon the magnetic induction arising from the balanced currents would be either to increase or to decrease the induction, depending upon the direction of phase rotation of the balanced currents. The complete discussion may be found in the publication to which reference has just been made. D. I. CONE.

Pacific Telephone & Telegraph Company,
San Francisco, Cal.

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the letter from the undersigned which was published in your issue of Jan. 29, the attached table may be of interest as additional information. This table shows the book value of the property referred to and the additions and depreciation reserve illustrating how it can be carried along from year to year.

The table which was presented with my letter already referred to showed only the amount deducted for depreciation. This information, together with that already published, shows not simply depreciation but the balance of the property as carried upon the books after depreciation had been deducted.

C. W. KOINER,
General Manager.

Municipal Lighting Department,
Pasadena, Cal.

SCHEDULE OF PROPERTY AND DEPRECIATION

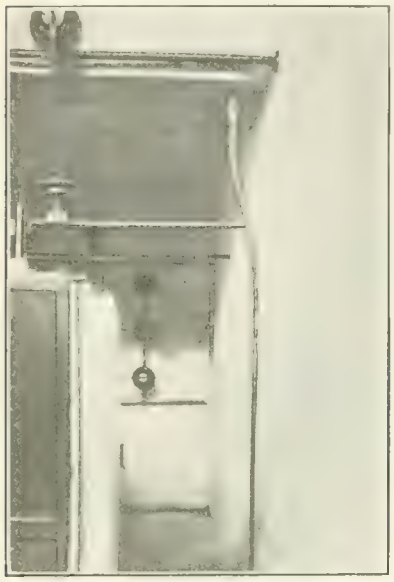
	Book Value			Depreciation Reserve			Replacements from Depreciation Reserve	Present Depreciated Value
	Balance July 1, 1919	Additions During Year	Total July 1, 1920	Total July 1, 1919	Additions During Year	Total July 1, 1920		June 30, 1920
Real estate and buildings	$32,792.36	$2,138 26	$34,930.62	$7,805 88	$997.39	$8,803 27	.....	$26,127.35
Station equipment, boilers, generators, etc	307,257.60	32,731.32	339,988.92	101,147.65	18,749.09	119,996.74	.....	220,097.57
Overhead lines for commercial service, including electric services, poles, cross-arms, wires, etc	265,199.12	29,618 06	294,817.18	65,588 41	11,126.65	76,715 06	$980.92	219,077.65
Underground lines for commercial service conduits, cables, wires, etc	17,610.26	5,925 33	23,535.59	1,593.07	424.98	2,018 05	.....	21,517.54
Transformers and devices	69,969 01	5,946 59	75,915.60	17,362.76	3,109.45	20,472.21	472.32	55,915.71
Meters	109,636 48	10,466 56	120,103 04	32,994.98	4,632.03	37,627 01	584.17	83,060.20
Municipal street-lighting system	162,209 51	2,194.47	164,403 98	79,382.05	7,494 27	86,876 32	966.03	78,493.69
General equipment	28,340.19	3,360 08	31,700.27	18,091.17	3,811.19	21,902 36	1,962.85	11,760.76
Telephone lines	65.32		65 32	12.20	3.27	15.47	.....	49.85
Total	*$993,079.85	$92,380 67	$1,085,460 52	$323,978.17	$50,348.32	$374,326.49	$4,966.29	$716,100.32

* Does not include inventory, cash or government bonds.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Protecting Oil Switches from Dampness



IRON DRIP PAN CATCHES CONDENSATION FROM OVERHEAD BEAM

TROUBLE due to condensation of moisture above a 33,000-volt oil-switch compartment was eliminated by installing a galvanized-iron drip pan beneath the reinforced-concrete beams forming the interior framing on the hollow dam at the Ellsworth (Me.) hydro-electric plant of the Bar Harbor & Union River Power Company. A funnel and a 1-in. pipe are provided to drain the trough, as illustrated in the accompanying halftone. The trough has proved very satisfactory for its purpose. A. P. Royal is chief engineer of the Ellsworth plant.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Good Fireman as Necessary as Boiler Instruments

IT MAY be said that the most important man in a power plant is the fireman. He handles large quantities of an expensive raw material and has a splendid opportunity to waste as much as he likes. The boiler may be equipped with all kinds of instruments, but they represent money thrown away unless the fireman can understand them. Given a high-class fireman, then the more instruments he has the better. These should consist of a flow meter and draft gages for indicating the draft at several points. It is impossible to work any of the modern types of forced-draft stokers without them. All instruments should be indicating as they are for the use of the fireman and not to fill a filing cabinet.

Control stations for fan speeds or stoker motors should be so placed that the firemen can make the necessary adjustments while he is looking at the instruments. CO_2 machines are useful, but do not tell the whole story, as a man can easily get a high CO_2 and still be wasting coal.

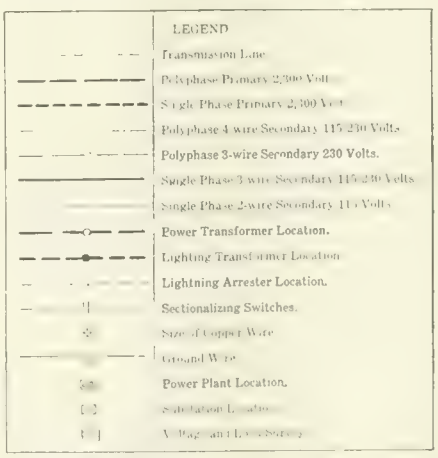
A useful instrument is a flow meter of the indicating type so that the fireman can see which boilers are carrying the load and whether he is working too many boilers or too few. Of course, there are many instruments that are useful, such as thermometers showing the temperature of the gases leaving the boiler or economizer, but a good fireman can get all there is out of a boiler by means of draft gages and flow meters and by observing the fire.

Every boiler should be checked up regularly by test instruments to locate and correct defects. The important thing to look for is air leakage in the boiler setting. It is not unusual to raise the efficiency of a boiler 5 per cent by reducing the air leakage even in plants which were considered to be run economically. To get good results there are two main points to observe —train the fireman and keep boilers in good condition.

Sargent & Lundy, Chicago, Ill. A. B. CLARK, Engineer.

Map of Distribution System Should Be Easy to Revise

A MAP showing a company's distribution system should have two prime advantages—(1) the legend used should be such as to be very easily understood by the average workman; (2) the legend should be so arranged that on the progressive stages of line construction it will be necessary to erase only a minimum number of the present lines to illustrate the changes. That is, on changing a single-phase primary circuit to a polyphase circuit, or changing a two-wire to a three-wire secondary, it should be necessary only to rule a heavier line over the present circuit. Such a legend is shown in the accompanying drawings. By indicating transformers, lightning arresters and switches on the reverse side of the tracing these can be changed without marring the present layout.



LEGEND FOR MAP OF DISTRIBUTION SYSTEM

A copy of the map embodying the different circuits should be in the hands of every man having to work on or refer to any part of the distribution system. Some method should be followed to keep the map up to date after a survey of the distribution system has been made. Corrections can be made in the original tracing from the regular work orders. The map should be on a scale which will not crowd the circuits excessively. The circuits should be easily distinguishable to the average workman. In larger cities it may be an excellent plan to have sectional maps,

while in towns of 30,000 to 40,000 one map on a scale of 500 ft. to 1 in. would probably be more adaptable. The scale to be used depends on the density of distribution circuits.

THEODORE H. RICE,
Operating Department.
Henry L. Doherty & Co.,
New York, N. Y.

Barrel Rheostat Handles 1,600 Amp. at 125 Volts

A VERY convenient form of water-cooled resistor for loading exciters on test, built for one of the Eastern power companies, is shown in the accompanying illustration. It is large enough to load a 200-kw., 125-volt exciter to full load from a minimum load of 10 kw. at 125 volts and increasing in steps of 10 kw. The resistor is so constructed that it will fit into a standard-size lubricating-oil barrel and is cooled by running fresh water into the barrel through a rubber hose and either allowing it to run over the top or drawing it off with another hose. The resistor costs about $150 and weighs approximately 150 lb. exclusive of the barrel.

BILL OF MATERIAL FOR RHEOSTAT WHICH HANDLES 200 KW. AT 125 VOLTS

Twenty resistance units, General Electric Company, size Z, form R, symbol 1.9Z.
Three switches, S.P.S.T., back connection, 200 amp.
Five switches, S.P.S.T., back connection, 60 amp.
43 lb. of strap iron, ¼ in. x 1¼ in., cut into eight 33¾-in. pieces, sixteen 6½-in. pieces, two 16-in. pieces, two 12-in. pieces, four 4-in. pieces.
Eight machine bolts, ½ in. x 9½ in., with nuts.
Ten machine bolts, ¼ in. x 1½ in., with nuts.
Twenty-eight machine bolts, ¼ in. x ⅞ in., with nuts.
Eight machine bolts, ¼ in. x 1¼ in., with nuts.
Forty brass machine bolts, ¼ in. x ¾ in., with nuts.
18 in. of copper, ⅛ in. x 2 in.
4 ft. of copper, ⅛ in. x ½ in.
5 ft. of copper, ¼ in. x 1½ in.
18 in. of fiber, ⅛ in. x 1 in.
45 ft. of copper wire, No. 6 B. & S., rubber-covered.
15 lb. of ½-in. round iron washers.
One slate or fiber top, 12 in. x 18 in.
Tape, red lead and insulating paint and one standard-size oil barrel.

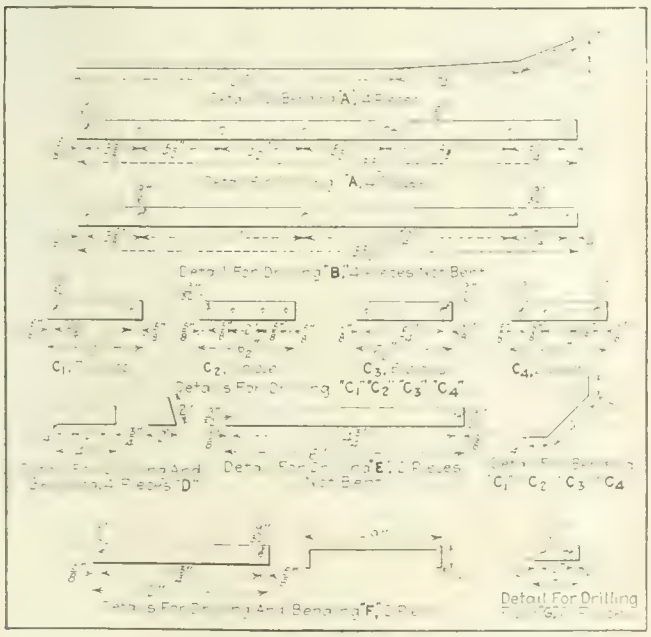


FIG. 1—DETAILS OF PARTS USED IN WATER-COOLED RHEOSTAT

The strap-iron pieces for the frame are cut, drilled and bent as shown in Fig. 1. The resistor is then assembled, using the washers on the long bolts as separators for the resistor units. The end units are placed directly alongside of the upright cornerpieces and the intermediate units are equally spaced. Copper strap, ¼ in. x 1¼ in., forms the common lead for each set of resistors. This is supported at one corner of the frame by six fiber pieces *G*.

The switches are placed on the slate or fiber top so that the hinged parts come in a straight line. A 14-in. x 2-in. piece of copper forms the common terminal and has several free inches on the end for connection to a cable. After the switches are mounted on the top the common terminal is wired with No. 6 rubber-covered wire as shown in the diagram, ⅛-in. by ½-in. copper being used as the common connection on each row of units. The wires are taped together and painted with insulating paint. The ends of all the bolts are cut off and filed smooth, and to all the metal parts a coat of red lead and insulating paint is given. To prevent fusing of the switches a circuit breaker should be inserted in the circuit between the machine under test and the loading resistance.

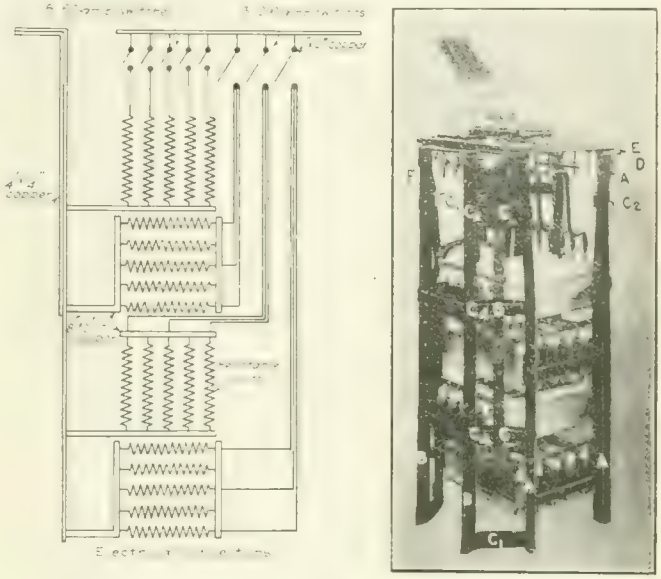


FIG. 2—WATER-COOLED RHEOSTAT TO BE MOUNTED IN OIL BARREL WILL HANDLE 200 KW. AT 125 VOLTS

FRANK H. BROOME.
Jersey City, N. J.

Maintenance Schedule for 35,000-Kva. Generating Plant

INSPECTIONS necessary to keep a plant in efficient operating condition may be divided into two classes—(1) periodic examination which does not require taking equipment out of service, and (2) thorough and less frequent inspection involving more or less dismantling of equipment. In the following paragraphs a schedule followed by the maintenance organization in a 35,000-kva. plant is given. (See ELECTRICAL WORLD, March 26, page 713, for a description of the organization.)

A continuous check on the boiler-plant efficiency should be possible by means of fuel and steam tests and from the records of permanent measuring devices. These will serve as a guide on both operation and maintenance of the boilers. In these inspections during operation lies the field for co-operation between the two departments which will result in suspected troubles being reported to the supervisor of maintenance. Flue-gas temperature should be noted at least weekly, and at the same time baffles should be inspected for leaks. Note should also be taken of the conditions of the ex-

ternal heating surface, in so far as this is possible during operation, to obviate undue accumulations of ash, slag or soot. Similar frequent inspection of furnace brickwork will permit repairs being made before the deterioration has become too serious. Safety valves should be tested at least biweekly. Once in three months, or oftener if operating conditions require, boilers should be opened and inspection made of external and internal surfaces. At this time the condition of soot-blower elements can be carefully noted.

Stoker defects are usually noticed during operation and should be reported by the operators. When boilers are taken out of service for inspection opportunity is afforded for careful examination of stoker conditions and replacements of any parts showing serious deterioration. Systems for handling coal and ashes will likewise frequently reveal their weak points during operation. In addition, a careful general inspection should be made monthly, and any seriously worn parts should be replaced without waiting for them to break.

Feed pumps should be opened and inspected once every six months, and oftener if conditions require. Overspeed devices should be tried once a week. Cleaning of feed-water heaters may not be required frequently unless water conditions are bad, but the heaters should be inspected internally at least every six months, or whenever opened for cleaning, for evidences of corrosion or other deterioration and for difficulties with float-valve mechanisms and other movable parts.

The inspections of prime movers and auxiliaries should include a continuous test of turbines by permanently installed meters to detect decrease in efficiency and weekly inspection to determine the position of rotor following any wear or displacement of thrust-bearing parts. It is good practice to check the overspeed devices by employing them instead of the throttle to shut the machine down. The automatic stop valve is the most important safety device on the turbine, and by this practice its maintenance in operating condition is assured.

Opening and careful inspection of turbines and generators is necessary once a year to determine wear of important parts, such as nozzles, blading and bearings, and to find any fouling conditions of turbines or generators.

Semi-annual or annual overvoltage tests of turbo-generator armature windings, preferably using some form of variable-ratio potential transformer of ample size, are desirable. The magnitude of overvoltage should depend upon the character and general condition of insulation, the age of the machine and other conditions. In general the over-voltage should range from 125 to 200 per cent.

Test should be made for condenser-water leakage by chemical or electrical (resistance) means at least weekly, and daily if circulating water is bad. Monthly tests by means of an air bell will detect condenser-air leakage. Thorough inspections of internal condenser surfaces are justified monthly, unless required oftener by operating conditions. Inspection should be made semi-annually of circulating-pump runners and other internal wearing parts and of wearing parts of air and condensate pumps as well as driving turbines, if any, with tests of overspeed devices.

Plant motors should be observed daily and should also have a careful inspection monthly, particular attention being given to cleanliness, proper cooling of bearings, clearance between rotor and stator, etc. Overload and underload automatic devices should also be tested monthly.

The switchboard should be looked over frequently, and semi-annually there should be a careful inspection, including a test of meters. Special attention should be given to cleanliness.

Oil switches require occasional inspection, and semi-annually they should be opened up for replacement of oil, removal of dirt or carbonization and to make sure that the mechanism is working properly. Every three months all relays should be tested.

Rotaries and motor-generator sets require frequent observation and careful semi-annual inspection, with special attention to cleanliness, proper cooling of bearings, adjustment of brushes, smoothness of commutator and other important details.

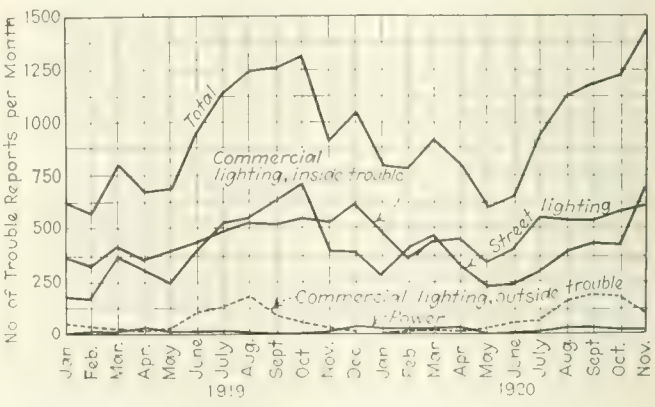
S. B. FLAGG,
Electric Bond & Share Company, Engineer.
New York City.

Graphic Reports Aid Company in Removing Causes of Trouble

GRAPHIC reports have proved very valuable to the management of the Worcester (Mass.) Electric Light Company in making scientific analyses of its distribution department problems. One report of this kind is shown herewith which gives the number of troubles in different classes of service from month to month. These curves are kept up to date from the monthly records.

A curve which rises abnormally fast indicates that troubles in this type of service are becoming too frequent and that the causes of the troubles should be discovered and removed in order to forestall further trouble. In this diagram are shown the number of troubles reported per month in four classes of service —commercial lighting, inside trouble; commercial lighting, outside trouble; street lighting, and service to power customers. A fifth curve shows the total number of troubles on all these classes of service.

This company finds it very advantageous to show



GRAPHIC REPRESENTATION OF REPORTS INDICATES WHEN TROUBLE IS BECOMING FREQUENT ON DISTRIBUTION SERVICE

many conditions of operation by means of graphs. In subsequent issues several other forms will be shown, including those used for meter reading, testing and installation, labor cost, pole setting, arc-lamp information, etc.

GEORGE M. HARDY,
Worcester Electric Light Company, Superintendent.
Worcester, Mass.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Job Order Records Check Costs

TO KEEP a continuous check on the installation and operating costs of the electrical equipment of the Southwestern Shipbuilding Company, East San Pedro, Cal., the electrical department has for some time made use of the cards shown in the illustration. These are standard 4-in. x 6-in. cards. Every job order is

J O No. 642 — ELECTRICAL DEPARTMENT JOB ORDER RECORD — Period No.

DATE	EMP. NO.	HRS.	AMOUNT	DATE	EMP. NO.	HRS.	AMOUNT	DATE	EMP. NO.	HRS.	AMOUNT
3-16-21	100	8	8 00	FWD			72 00	FWD			
"	1010	8	5 60	3-19-21	100	2½	2 50				
"	1032	8	5 60	"	1010	5	3 50				
"	1925	8	4 80	"	1925	5	3 00				
"	1122	8	4 80								
3-17-21	100	8	8 00								
"	1010	8	5 60								
"	1032	8	5 60								
"	1925	8	4 80								
"	1122	8	4 80								
3-18-21	100	4	4 00					FWD			
"	1010	8	5 60					PERIOD TOTAL			80 00
"	1925	8	4 80					PREV. TOTAL			
FWD			72 00	FWD			80 00	JOB TOTAL			80 00

COST OF A JOB IS KEPT UP TO DATE BY DAILY ENTRIES ON THIS CARD

entered on a separate card, and every day on which work chargeable to a particular job is done, the date, the employee's number, the hours worked and the total amount charged are entered. This permits the electrical engineer to watch the costs on each job carefully and keep them within the appropriation.

A. G. HUMPHREY,
Electrical Engineer.
Southwestern Shipbuilding Company,
East San Pedro, Cal.

Refilling Inclosed Fuses

TO REFILL inclosed fuses is a practice generally condemned because the wrong size of fuse wire can be used in a fuse marked for a certain current. However, this method of reclaiming fuses is sometimes practiced, and in such cases safety should be insured by careful and proper refilling. In the first place, all fuses should be sorted for size and then tested with a lamp for good or bad circuit. In handling be sure that each size is kept by itself. For the smaller sizes with cylindrical contact surfaces bore a $\frac{1}{16}$-in. hole through one ventilation hole at each end of the fuse tube and run a stiff iron wire all the way through to open a path for the fuse wire. Next, insert a piece of fuse wire of the proper amperage, leaving $\frac{1}{2}$ in. outside each end, which is bent over flat. After cleaning the end of each ferrule and the fuse wire, solder the latter down securely. Care must be taken not to melt the wire except at its ends and thus open the circuit. Too much solder should not be used as the fuse would be made too long to fit the cut-out block. These operations apply to all sizes up to and including 60-amp. fuses. Above this size fuses are of the knife-blade type, which must be disassembled and fused more carefully for exact length.

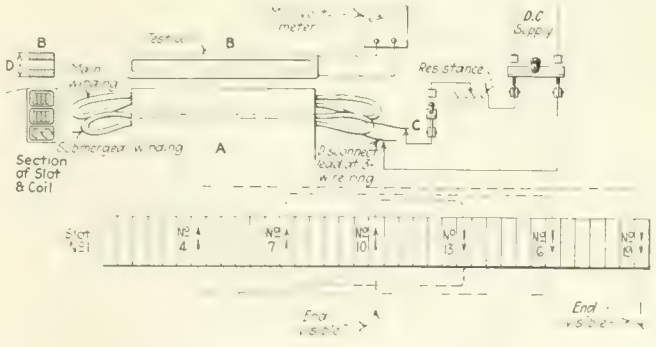
The first one or two fuses of each size should be tested with an ammeter and a rheostat consisting of a wooden pail of water containing a little salt or soda. If the fuse carries more than its proper rating, the wire should thereafter be filled down thin for part of its length and again tested.

After refilling and testing, the ferrule should be polished clean of all solder and dirt, so as to make perfect contact in the cut-outs. If any of the labels and other size markings are missing, write on the size plainly with pen and ink.

H. S. RICH.
East Berlin, Conn.

Kick Method of Locating Submerged Conductors in Armatures

A NUMBER of cases have come to the writer's attention where it has been desirable to locate the direction of winding and the position of turns in a submerged winding, such, for instance, as a reversed coil or turn in a Burke three-wire generator, where the balancing windings are placed under the main winding. To do this a current is passed through one of the submerged windings in the armature (*A* in the accompanying sketch) and a long narrow coil *B* is placed lengthwise along the armature and directly above the slot



HOW POSITION AND DIRECTION OF SUBMERGED WINDING IS DETERMINED

which it is desired to explore. The current in the three-wire winding is broken by means of the switch *C*, and a kick is observed on the millivolt meter *M*. The magnitude of the kick in the meter will indicate whether the slot under the coil *B* contains two active conductors or one active conductor, and its direction will tell the direction in which the current is flowing. The dimension *D* of the coil *B* should be small, as this coil will

measure not only the leakage flux from the slot under observation but also the leakage flux from the complete armature. If the dimension D is small, the value of the leakage flux crossing the slot which is being investigated through the coil B is so much greater than the leakage through the coil B from the total armature that the armature leakage has no large effect on the meter. Of course, the coil B must be close to the slot and, if possible, should just enter the top of the slot. All slots in the armature are investigated, and when this is done a developed diagram of the armature is laid out, as shown at the bottom of the drawing, indicating the direction of the current (meter kick) by arrows. The start and finish of the winding can generally be seen, and it is then possible to connect together on the diagram the ends of the slots by dotted lines, and as the entire submerged winding is symmetrical, it can be at once laid out without having to turn to a drawing. If a drawing is available, the layout of the winding can then be checked against the drawing.

Coil B may be wound on a $\frac{1}{2}$-in. board 2 in. x 12 in. in size. A $\frac{1}{4}$-in. notch $\frac{3}{8}$ in. deep is made in each end of the board and the notches are wound full of No. 28 magnet wire. The notches are cut along the end of the board so that the coil measures inside 2 in. x 12 in. A screw eye or nail is put near each end of the board and a strand of a lamp cord is tied to each screw eye. The leads of the coil are then soldered to the lamp cord.

Newark, N. J. F. W. Gay.

End Welded on Motor Shaft Without Removing Winding

Instead of replacing a badly damaged armature shaft, one large industrial establishment welds a new end to the shaft without removing the winding. Although it may take four men to make the best weld, it is much cheaper than to remove the windings and press the commutator and core off the old shaft and onto a new one, A saving of something like $50 per shaft may be realized by the method. It has been used for more than three years, and as many as four or five have been thus repaired in a day. In this method the shaft is heated in an ordinary forge. It may sometimes be necessary to place a shield between the armature and the fire.

The armature is handled by means of a sling from a small jib crane which can swing it from the forge to the steam hammer, and a hand wheel is fixed to the commutator end of the shaft so that the desired turning may be readily accomplished. When the shaft is hot enough the tapered portion is cut off and the shaft is split back far enough to make a good weld. The piece to be welded on is prepared in a like manner. Both parts are brought to a welding heat and the weld is made under the hammer. The armature is rotated and the shaft is shaped and drawn out ready for turning in a lathe.

Of course, if the shaft is only slightly damaged it is easily repaired. It sometimes happens that the keyway in an armature shaft becomes enlarged or tears out so that the pinion becomes loosened. If the shaft is not badly damaged, the keyway may be filled up with a metallic-arc weld and a new keyway cut in another location. But if the second keyway tears out, or if the tapered portion of the shaft becomes so badly damaged that a new one seems to be required, then it will pay to consider another method of repairing the shaft instead of replacing it by a new one.

In this plant it is also customary to straighten bent shafts without removing the windings or commutator. If there is not much of a twist in a shaft it may be straightened in an ordinary shaft straightener such as may be found in the machine shop of most large industrial works.

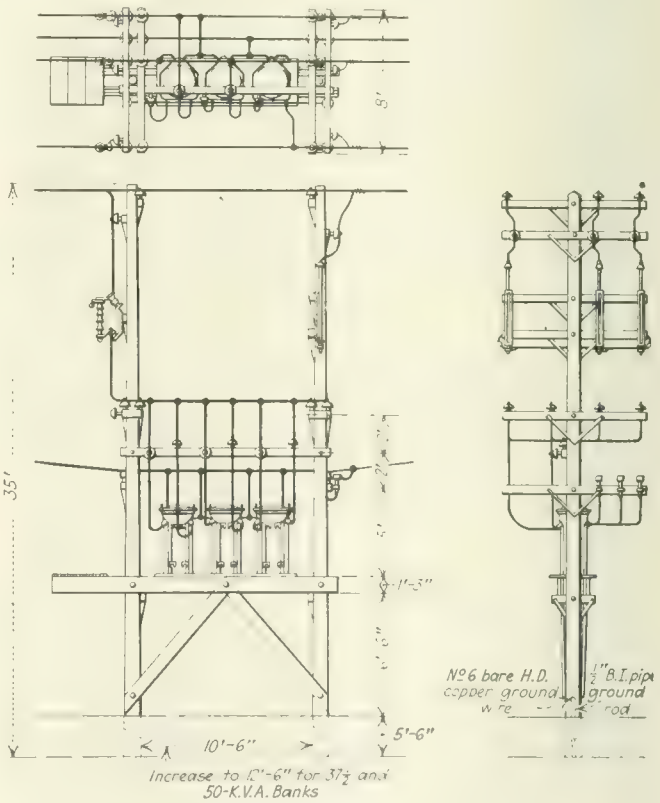
The saving which is obtained by straightening a shaft with the armature assembled complete is, of course, even greater than that in the welding repair described.

D. W. Blakeslee.

Pittsburgh, Pa.

Standard 11-Kv. Substations for Kansas Oil Fields

The standard 11,000/440-volt substation used in the Eldorado oil fields to provide electric service for pumping oil is shown in the accompanying illustration. The distribution is 11,000-volt, three-phase, and the transformer banks are connected in Y, allowing the use of standard 6,600-volt transformers. The neutral point of the transformer Y is grounded for each bank. A



SUBSTATION RATED AT 11,000/440 VOLTS FOR OIL-FIELD DISTRIBUTION

No. 6 hard-drawn bare copper wire connected to a $\frac{1}{2}$-in. driven pipe is used for grounding. The fuses protecting the primary side of the transformers are 25-amp. (General Electric T.D. 227). They are for protection against short circuit and not for overload. The 440-volt sides of the transformers are connected in delta. Lightning arresters for both high and low sides are installed on crossarms mounted on the poles.

Empire Gas & Fuel Company, S. B. Severson,
Eldorado, Kan. Assistant Chief Engineer.

Routing Storage Batteries Through a Repair Shop

WITH the widespread use of storage batteries for automobile lighting and starting and for electric haulage by means of mine locomotives and industrial trucks and tractors the problem of handling battery repairs has become an important part of the work carried on in repair shops. In some cases it has been necessary to put this work on a production basis, while in others it may be handled in a more simple manner as a side line to motor winding and for other classes of work.

The battery repair work of the Electric Motor & Repair Company, Newark, N. J., on account of the number of automobile starting and lighting batteries received, has been placed virtually on a production basis, and it is thought that some of the methods of handling repairs will be of interest to repair shops.

Batteries are received at a central point on the first floor of the shop, where they are submitted to an examining test in which the following points are noted: Specific gravity, voltage on open circuit and at highest discharge rate, test applied for location of any low or dead cells, loose connections, and the general condition of the box, sealing, handles and terminals, and identifying marks are carefully noted. In commercial work the identifying marks such as make, voltage, capacity, battery number and type, whether special or standard, are very important for record and tracing purposes.

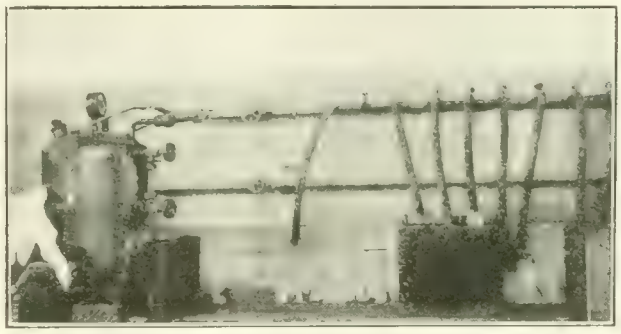
At the time the battery is received the accompanying card form is filled out. In the case of commercial work this is possibly more important than would be the case in an industrial repair shop. It is also important in this case to determine as near as possible what work is to be done, whether it is simply a recharge or repair or whether new parts for the battery are required. These points can almost always be determined by the tests which are applied on receipt of the battery.

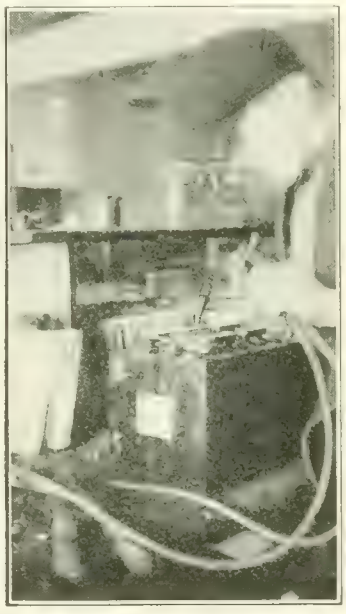
A work order is then made out, and the battery is taken to the battery room on drop platform trucks. The batteries are segregated as to the type of work to be done, those requiring only recharging being taken to the charging benches, while all those requiring opening are left at the steaming table.

The batteries are placed in a definite order in respect to capacity and voltage on the charging table shown in the accompanying illustration. Those batteries that have nearly the same capacity are placed together and connected in series, or according to the charging system used.

Battery benches are an important part of the repair shop equipment, and they should be carefully designed for the work and properly maintained. The benches shown are designed so that the tops slope toward the center and any acid or water is carried into an insulated lead trough sloping from both ends of the bench toward the center, where a lead drainpipe carries the acid or water to an earthenware or rubber jar. Benches should be painted weekly in order to preserve them from the effects of acids. Each bench is equipped with hydrometer rack and a conduit outlet for the charging leads. Pure water for filling the batteries is piped throughout the shop and is taken from a float tank maintaining a constant level. At each charging bench there is a water outlet to which a ¼-in. rubber hose, long enough to reach to any part of the bench, is attached.







BATTERY REPAIRS ARE FACILITATED BY PROPERLY EQUIPPING A SHOP FOR THE WORK

On the left is shown a charging bench equipped with a rubber-hose water connection for filling the batteries, hydrometers conveniently located and flexible leads with clips to attach the battery to the line. Several batteries may be placed on the steaming table (center view) and left until the compound has softened sufficiently to permit withdrawing the covers with the groups. The connections to the steam line are lengths of hose. Terminals and connectors are burned on with an oxyacetylene torch.

The leads for connecting up the batteries for charge should be flexible-conductor, rubber-covered wire, and not smaller than No. 10 gage. The type of snap clips which are used for making the connection is very important, especially when the charging is done at night without supervision. Several types of clips, which are made of two pieces and use a spring to hold the contact on the battery terminal, have given trouble due to corrosion insulating the two halves from each other, causing the charging current to flow through the spring. The consequent heating of the spring takes out the temper and results in the clip becoming loose and falling off. This breaking of the charging circuit and consequent arcing may result in local cell explosions or, in the case of lines charged through a mercury-arc rectifier, means an increased current in the other lines, or the shutting down of the rectifier because of "fluttering" of the arc at the time of the interruption. One-piece clips have eliminated trouble of this kind.

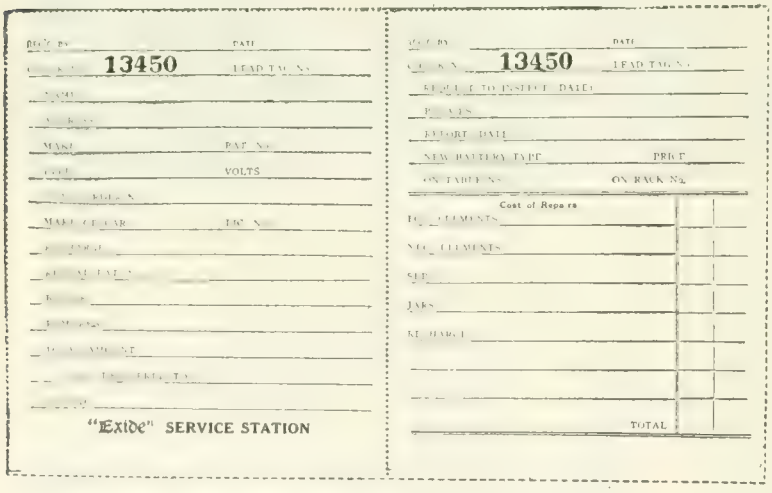
The first operation in repairing a battery is to drill off the cell connectors and terminals. This is done by drilling through the terminal or strap connecter down

to a level with the terminal post, which frees the connector. These straps and terminals, if not in bad condition, are used again.

When a dead cell is found, or for any reason a battery requires opening and inspection or repair, the instrument is delivered to the steaming table, where the cover is steamed off. When steam is accessible from the heating system the work is done by using this source of heating. In the summer months, however, when no steam is available from this source, a small boiler is used, which gives a pressure of 5 lb. for the work. As shown in the illustration, the steam is taken from the main steam line through lengths of rubber hose which are inserted in the opening of each cell. In five or ten minutes the compound is sufficiently soft and the covers with the groups may be drawn out with a pair of pliers. After the cells are opened the remaining acid is emptied out and the cells are sprayed with water, the cell being in an inverted position. The force of the water is generally sufficient to remove any sediment.

After this spraying the plates are set, tipped into the jars for draining and then taken to the repair bench, where new separators or plates are fitted according to the nature of the work to be done. The cells are then reassembled, straps and terminals being burned on with an oxyacetylene torch. Sealing and compound flowing is then done and the battery box receives a coat of black acid-resisting paint.

One of the important points in routing a battery through the repair shop, particularly in the case of commercial work, is to facilitate the prompt location of a battery when wanted. In the case of this repair shop there are five places where a battery might be found —first, in the opening or steaming department; second, the waiting rack; third, the repair benches; fourth, the charging benches, and fifth, the "ready" rack. Each



FORM USED FOR RECORDING BATTERY REPAIR WORK

job received has a serial number. This serial number corresponds to the one stamped on a paraffine-coated, acid-proof, lead-wired manila tag which is attached to the battery. When the battery reaches the repair shop a small card form is found which bears the same serial number as the original record. On this card are entered the various locations of the battery as it proceeds through the shop. If charging only is required, the number of the charging table is entered on the card, while if it is necessary to repair the battery, the different locations are entered until the battery finally gets to the ready rack. To find a battery all that is necessary is for the office to call the serial number by means of a loud-speaking telephone and the repairman ascertains the location by reference to the card file. Although several hundred batteries may be on hand, it is usually possible to locate the one wanted and deliver it in about forty seconds. Loud-speaking telephones are a valuable adjunct to the repair shop as they permit communication of the office and the receiving and delivery stations with the repair shop without taking the repairmen from their work. It is possible to talk from any part of the shop to the office without unduly raising the voice.

H. C. HEIDRICH,
Electric Motor & Repair Company, President.
Newark, N. J.

Repairing Squirrel-Cage Rotors

OCCASIONALLY poor contacts develop in the squirrel-cage windings of induction-motor rotors. Such trouble usually makes its presence known by the rotor having a very low starting or running torque or a dead point from which it will not start at all. Poor contacts are frequently caused by loose bearings permitting the rotor to rub the stator core. The heat generated by this rubbing overheats the joints between the rotor bars and rings. If these joints are soldered, as a great many are, the solder is thrown out, leaving a high-resistance contact. With the screw type of joint, when the contact becomes poor the surfaces are darkened. Even rotors with the rings cast around the bars once in a great while give trouble by a bar breaking at the point of contact with the ring.

When resoldering a ring, dismantling it for cleaning is both difficult and unnecessary. A very efficient way in which to handle a resoldering job is as follows: Remove as much of the paint and dirt as possible with a scraper and a wire brush. Then apply a strong soldering acid and a hot flame. Use plenty of acid and make sure the parts are well heated so that the solder will run freely. This will remove any excess paint and other substances. Burning the slot insulation can do no harm as it makes no difference whether insulation is present or not. After soldering remove all traces of the soldering acid by washing the rotor thoroughly with a hot solution of caustic soda and then wash again in hot water to remove the soda. The rotor is then placed in an oven and baked until all moisture is driven out, after which it is ready for painting. The paint should be thin so that it will run freely into the spaces in the slots and thus tighten the bars in the core.

In the repair of rotors with laminated end rings welding is often resorted to with success. When welding copper to copper a soft copper wire should be used as a flux, and not a brass wire as is often done.

When a rotor with screw-connected joints is to be repaired it is frequently best to remove all the bars and thoroughly clean them and the rings. Removing the screws is often quite difficult as they are usually burred with a center punch. To overcome this the writer uses an electric drill to cut out the burred portion of the screw and bar. The reassembling is easy, but particular care should be paid to see that all the screws are drawn quite tight.

A. HERVEY.
New York, N. Y.

Detachable Lighting Fixture Reduces Cleaning Expense

THE cost and difficulty of maintaining lighting equipment in certain locations is greatly reduced by use of a fixture which may be easily detached. Such a fixture made of standard parts is shown in the accompanying photograph. The fixture can be detached and replaced by a similar one, complete with clean lamp, in a few seconds by simply pulling apart the connector, unhooking the fixture and substituting a new one. Two men on a crane can change a great many fixtures within a half hour, say, during noon hour when the crane is not in use. The dirty fixtures can be lowered to the floor and conveyed to a central point to be cleaned and inspected and made ready to be installed at another point where cleaning is needed. Thus by the use of a few extra fixtures a cleaning system can be worked out which will insure efficient and economical illumination.



WHEN DIRTY THIS FIXTURE IS REPLACED BY A CLEAN ONE

These fixtures are applicable to many locations. In a great many cases the dirt and dust is of such a nature that the reflectors and lamps need to be taken down and put into a bath of cleaning solution. In industrial plants many lighting fixtures are mounted comparatively high, and in some cases they are above crane runways. They are not accessible from the floor, and the cranes cannot be stopped while a cleaner uses one of them to pass from one fixture to another, cleaning each one as he goes. Under such conditions a detachable unit like that described is particularly valuable.

J. C. RITCHEY,
Electrical Engineer.

Pressed Steel Car Company,
Pittsburgh, Pa.

Careful Handling of Furnace Electrodes Cuts Production Costs

SPECIAL care in handling and storage of electric furnace electrodes is an important step in reducing production costs to the lowest point. In unloading from the car and placing in storage, or in preparing for installation in the furnace, the electrode should not be pinched around with a bar. Nor should a bar be placed in the threaded ends in attempting to lift or move it. The use of a bar usually results in surface abrasions, making it impossible to obtain the necessary electrical contact between the holder and the electrode, and if the threads are broken it will be impossible to produce a satisfactory electrode joint. Serious local heating results from either surface abrasions or imperfect joints.

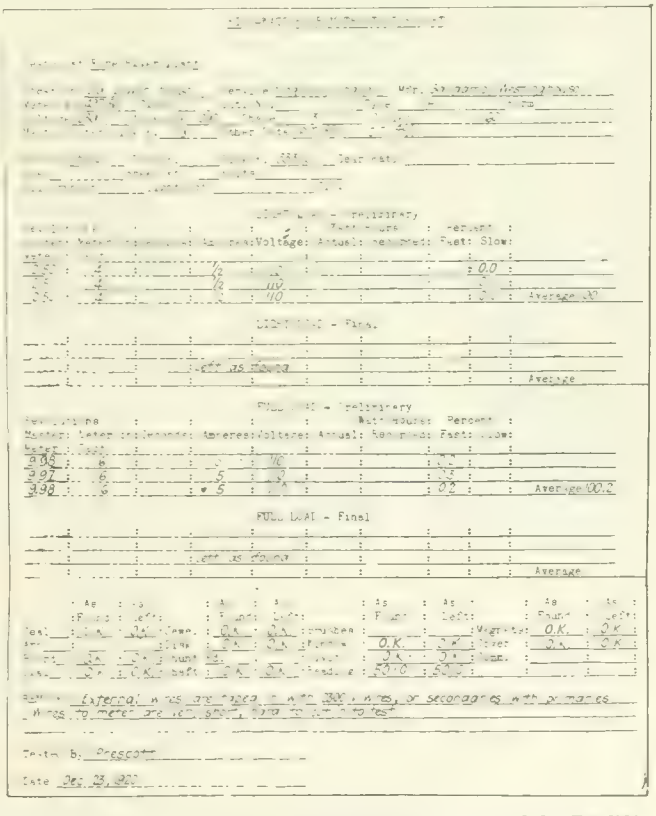
In moving electrodes from cars a roller should be used. An electrode should not be slid or rolled on the car floor, as the rough surface or protruding nails will cut the electrode. After removal from the car it is advisable to handle the electrode in a rope sling with a crane. If this is not possible, it should be rolled on clean planks to avoid contamination and abrasions. Electrodes should be stored in a dry room, built to receive them and preferably located immediately adjacent to the furnace.

Tiering has been found a very satisfactory storage method. The first tier should be laid on 2-in. x 4-in. timbers placed on a clean dry floor. The additional tiers should also be placed on 2-in. x 4-in. timbers, which should properly distribute the weight and avoid unnecessary strains on the threaded ends of electrodes. Blocks should be nailed to the ends of the timbers between the tiers so that the electrodes cannot possibly roll off the pile. It is always desirable to have a crane or set of chain blocks to handle the electrodes to and from the storage pile.

This information was furnished by the National Carbon Company, Inc.

Comprehensive Meter-Test Form for Industrial Plant

A CONVENIENT meter-test form is used at the Fore River (Mass.) Works of the Bethlehem Shipbuilding Corporation, Ltd. Data are recorded on this form, which is about 8 in. x 10⅜ in. in size, showing the full nomenclature applying to each meter, spaces for preliminary and final light-load and heavy-load test readings



THIS FORM WILL RECORD INFORMATION FOUND ON TESTING WATT-HOUR METERS

with percentages fast or slow, and a set of checking or "O.K." spaces for recording the condition of all important parts, such as seal, jewel, cover, etc., upon beginning and ending inspection. Below are spaces for comments on unusual conditions.
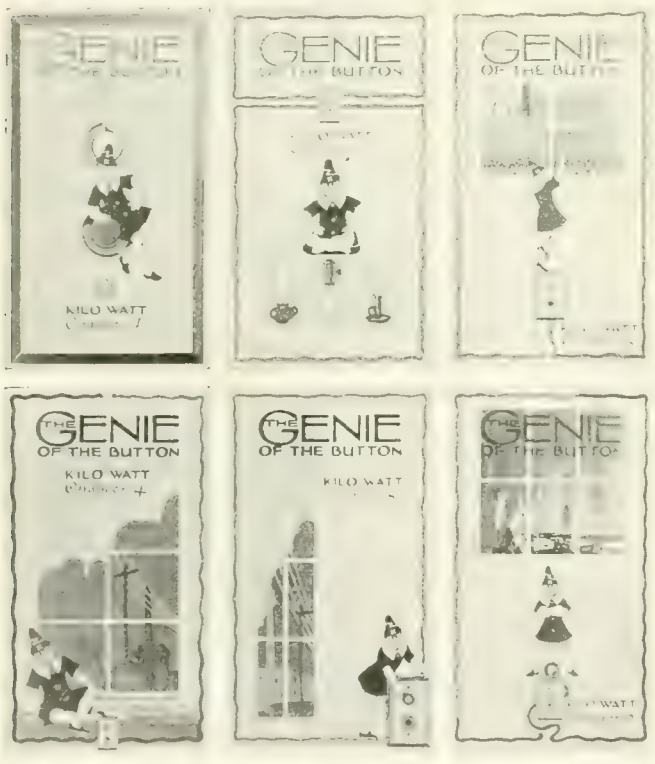
Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Second Series of "Kilo Watt" Pamphlets Carries Good-Will Message

ENCOURAGED by the reception accorded to the first "Kilo Watt" series and by the manner in which the idea was accepted by the public, a second series has been prepared by the Public Relations Section of the National Electric Light Association. "The Genie of the Button" is the interesting title of the new series, which consists of six pamphlets as shown in the accompanying illustration. In the second series the good-will message on financing, regulation, taxation and self-interest is



SECOND SERIES OF SIX "KILO WATT" PAMPHLETS

carried out broadly on the foundation built up in the first "Kilo Watt" pamphlets. It follows closely the national campaign for public utility good will, thus affording the electric light and power companies an effective means of tying their local advertising in with the national publicity.

The first series of "Kilo Watt" pamphlets achieved a success far beyond expectations, the extent of which may best be judged from the fact that nearly 7,000,000 of them were distributed, reaching more than 1,100,000 electric light and power customers, or more than 5 per cent of the homes throughout the country.

Already orders have been received for the second series, some from companies which ordered and others from companies which did not order the first series but desired the second. Like the first "Kilo Watt" pamphlets, these are designed for distribution with customers' bills or through counter distribution and with appliances sold.

Newspaper Warns Against Home Repairing of Electrical Appliances

ELECTRICAL appliances which receive only ordinarily careful treatment as they perform their duties about the household get out of order at remarkably infrequent intervals. When something does go wrong a competent repairman can, as a rule, correct the trouble in a few minutes. Sometimes, however, he finds that the appliance has developed troubles which have not been caused by ordinary use, wear and tear or even accident. Such cases usually can be traced to a complication of the original difficulty by the tinkering of that handy man about the house—the "home mechanic."

Warning owners of electrical devices against attempting to make repairs on appliances about which their knowledge is limited at best, the Cleveland *Plain Dealer*, under the heading "'Home Mechanic' Courting Trouble," recently printed the following pertinent comments:

"If something goes wrong with your electric cleaner, don't pry open the motor with a chisel and hammer or try to adjust the commutator with a kitchen fork.

"An electrical man warns against the danger of ruining appliances by tampering with motor, contacts and gears. The amateur home electrician frequently does a great deal of harm in this way, he declares.

"'Moreover,' he says, 'the owner of the electric appliance should take note that such tampering in most cases cancels the manufacturer's guarantee. Electrical devices are usually protected by the promise of the maker to replace or repair any parts which give out within a specified period of time—unless such defects are caused by accident or misuse.

"'If the machine happens to stop for any trivial reason, it is usually a simple matter for an expert to adjust it unless some one, acting in ignorance, has made matters far worse by tinkering. Hence this misuse of the appliance forfeits the right of the owner to the protection of the manufacturer's guarantee.'

"The delicately adjusted fan of the electric cleaner may easily be thrown out of line by the home mechanic. To tamper with the motor commutator also is disastrous because nicks made in its surface are likely to cause short circuits or ruin the connection. People frequently take off the gear case of an electric washer, not realizing that the alignment of the gears is easily disturbed and that they cannot as a rule be replaced by an amateur or by one lacking proper tools.

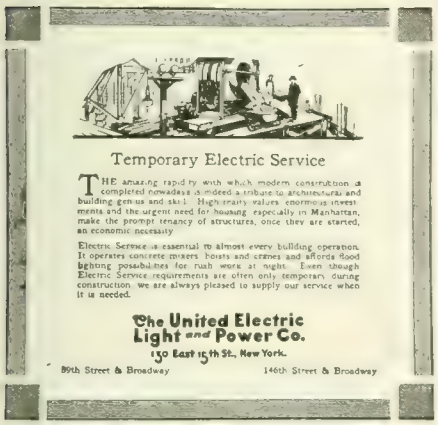
"'It reminds me of the backwoods days when the only remedy for the toothache was to have mother pull the tooth,' said the electrical man. 'Such an attitude toward the delicate human mechanism is uncalled for of course,

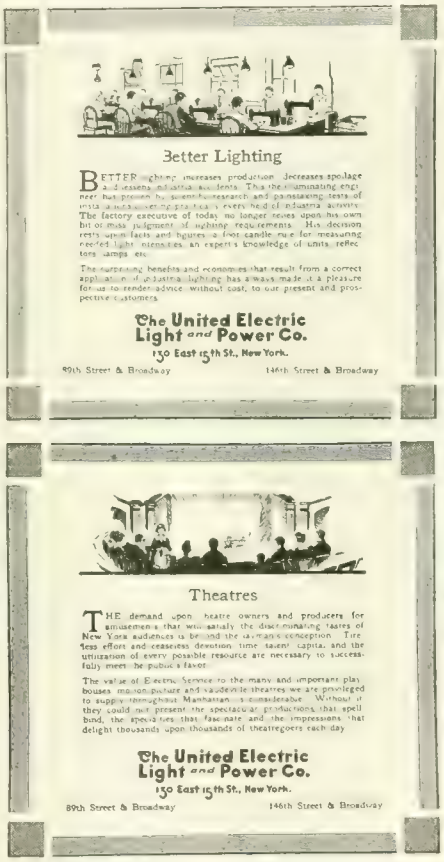
and it is just as unjustifiable in handling electrical equipment. Electrical appliances seldom go wrong, but when this happens, it is far better to call the dealer from whom purchase was made or to refer to the manufacturer than to attempt any home-made remedies.'"

New York Company's Publicity Promotes Good Will of Public and Consumers

TO SHOW the vital connection and importance of central-station service to many of New York's industries and indirectly to the public which these industries serve, the United Electric Light & Power Company has used a series of fifteen advertisements in the New York newspapers during the past month. Four advertisements typical of the series are shown here.

An effective good-will appeal has been carried through the advertisements by directing the public's attention to the importance of the service rendered by various industries and trades and showing how the United company's electric service enables these industries to maintain a high degree of operating efficiency and service to the public. This type of publicity in addition to advertising the company's service advertises that of its customers as well, regarding which Ralph Neumuller, advertising manager of the United Electric Light & Power Company, said:





TWOFOLD GOOD-WILL PUBLICITY



"We have found that advertising of this nature creates a considerable amount of good will. It establishes a human bond between the public and ourselves and promotes friendly relations with our largest consumers, who are, of course, appreciative of desirable reference to the importance and faithful operation of their business."

The eleven other advertisements of the series dealt with the following subjects: Shops and stores, woodworking, laundries, electric signs, paper boxes and containers, dyeing and cleaning, confectioners and bakers, smelting and refining, machine shops, electric cooking appliances and electric household appliances.

Another series of twenty-five advertisements covering all phases of house wiring essential to the most complete use of electric service has been prepared by the United company and will appear in the daily newspapers during the next ten weeks.

Merchandising by a Small Central Station

POSSIBILITIES and results obtained from merchandising by a small central station serving a community of 28,000 people, and through transmission lines about a dozen small towns, were given in a paper, "Merchandise Service and Its Possibilities," by D. W. Snyder, general manager of the Bloomington & Normal (Ill.) Railway & Light Company, before the joint convention of the gas, electric and railways associations of Illinois held in Chicago March 15 and 16. In describing how the merchandising department was conducted Mr. Snyder said:

"The operating plan of the central station referred to provides for a local manager in each town or group of towns. The maintenance of adequate service demanded a local man. These men, in order to perform their varied duties, must be versatile, and necessarily earn good wages. Their work incident to the operation of the electric utility requires only a portion of their time, and the rest is available for other duties. In many of the small towns there is no other agency available to handle electrical merchandise work as the total business in a community of approximately 1,000 people cannot support an independent electrical shop. The electrical energy sales cannot provide sufficient revenue for a living wage for the local manager and leave a return to the company. The natural outcome of the situation was the utilization of the spare time of the local managers in electrical merchandising. The company doing a merchandising business in a dozen small towns naturally must maintain a central stock at its central establishment, and there also would engage in an electrical merchandising business.

"The merchandise business of the company was conducted jointly under the office and electric distribution departments without any well-defined lines of authority between the departments and without any aggressive merchandising policy. The result under that arrangement was that the merchandising business aided in reducing operation costs in the small towns but earned little profit.

"Early in 1919 the rising costs incident to the war, coupled with the inability to raise rates, caused the management to turn to the one department of the

business that was not regulated as to rates and did not require a great deal of new capital to develop. It was decided to establish a merchandise department in charge of a commercial manager, who would rank with the other department heads. This department handled all merchandising and new business except certain types of industrial motor business which are still under the jurisdiction of the electric distribution department.

"The merchandise department based its policy on the following principles: (1) Not to do house wiring in the large towns where there were electrical dealers to handle this class of work; (2) to sell only those appliances which were meritorious and would stay sold; (3) to co-operate with local electrical dealers and maintain fair prices; (4) so to conduct the merchandise department that electrical energy sales would be increased, the use of electricity popularized and the service bettered.

High Rate of Stock Turnover

"The results in 1919 were highly satisfactory. New records for sales volume, net profits and meter customers were made. The fiscal year 1920 showed still better records than the previous year. The daily sales averaged about $500 per day and the net revenue earned was $36,244.50, from which should be deducted $9,153.85, covering advertising and new business development expense, which is charged to the merchandise department to offset office rents and other items of general overhead. In addition to the above earnings the merchandise department made possible many savings in operating expense. The average merchandise stocks amounted to $28,000, which include small stocks in each town. This stock was turned over five and a quarter times in 1920. In addition, approximately $25,000 was tied up in accounts receivable, some being on time payments on which interest is charged. This is partially offset by accounts payable. The accounts receivable on time-payment plans could have been discounted through the Morris Bank plan or a similar arrangement. The company carried them itself, and it takes a surprisingly short time to create a revolving fund sufficient to carry these accounts.

"The following results, attained last year in a small town of 1,300 population, indicate the value of a merchandise department to the central station:

Article	No. Sold	Receipts
Vacuum cleaners	24	$1,563.25
Washing machines	11	1,544.00
Heating appliances	56	902.20
Fans	3	84.00
Motors	6	390.00
Lamps, wiring, etc.	..	3,499.41
Total		$7,982.86
Expense		5,437.60
Gross profit		$2,545.26
Less:		
Advertising (local)	$208.00	
Part commercial manager's wages	155.00	
Miscellaneous expense	120.00	483.00
Net profit		$2,062.26
Local merchandise stock (average)		950.00

"This statement is somewhat misleading as to capital invested in merchandise stock as the local stock was kept small compared with the volume of sales owing to the fact that the central stock was called upon when needed.

"The method of handling the merchandise department is comparatively simple. The commercial manager, by means of sales talks, educational letters and tabulated reports of business done in each town, keeps up enthusiasm and a spirit of friendly rivalry. All members of his staff are paid regular monthly salaries except vaccum-cleaner salesmen, who operate under the "Hoover plan" and are paid commissions only. Nearly each month a campaign in some leader is put on, but rarely, if ever, is a cut price the feature of the campaign.

"Advertising, backing up personal solicitation, is the most important part of the sales promotion work. Approximately 4 per cent of the gross sales is spent in advertising, the major portion going to the newspapers.

"Certain contractor-dealers thought the program of advertising was aimed at them and voiced their complaint to the manager of the central station. His explanation was that the advertising was not directed against them, but to draw the buying power of the public into the electrical trade. They were urged to increase their advertising, not in the spirit of competing against one another, but of the electrical trade competing against the field. The combined sales of the contractor-dealers also showed a healthy increase in 1920, which we believe proves the truth of the theory. This same advertising, some being quite general in its nature, was reflected in the demand for new services. No special inducements were held out to new customers as the company did not wish to increase its capital account. Connection rules and charges were rigidly enforced. In spite of these conditions more meters were installed than in any previous year, the gain in meters being 1,138, or 14 per cent on the entire property.

"The merchandising department is a fertile place for complaint, but is just as fertile a place to make friends for the central station. It is our belief that a central station owes it to its customers to maintain a properly organized merchandising department, not as a competitor of the contractor-dealer but to co-operate with him to serve properly the existing electrical needs and to develop the almost untouched field before us."

Steady Growth of Business Reported by Byllesby Subsidiaries

THE standard Gas & Electric Company's annual report, to be issued shortly, will show that the company's utility subsidiaries are now serving nearly 500,000 customers, having connected approximately 1,000,000 hp. in lighting, heating and power devices. It is estimated that during the year 1921 these customers will consume more than 1,000,000,000 kw.-hr.

A tabulated record of the subsidiaries' connected load growth from 1914 to date in two-year periods follows:

Year Ended Dec. 31	1914	1916	1918	1920
Electric customers	169,412	211,071	256,454	317,452
Gas customers	120,629	130,204	144,690	157,572
Lighting and power business served (in hp.)	465,653	596,632	771,261	962,891
Kilowatt-hour output	380,212,118	488,982,265	691,097,366	874,306,424
Miles electric pole lines	4,789	5,590	7,041	7,983

In this six-year period the number of electric customers nearly doubled, the horsepower equivalent of the customers' installations more than doubled and the kilowatt-hour output increased 130 per cent. To serve this business the company increased its distributing facilities (electric pole lines) only 66 per cent, indicating the greater extent to which customers on established lines are utilizing electric service for their daily needs.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Delta-Star Motors for Agricultural Use.—H. ROTH.—It is customary to use a 15-kw. to 20-kw., three-phase motor dimensioned for driving threshing machines and for small farm machinery, as this requires comparatively little power, and investment in a second, smaller motor is infrequent. This means a lower efficiency and a poor power factor. The author suggests winding such motors in open delta and operating them for full power in closed delta and for small power requirement in star. For example, a three-phase motor, delta-connected, will give 15 kw., and the same motor star-connected about 5 kw., operating in both cases with about 89 per cent efficiency and at 0.9 power factor. The same 15-kw. motor loaded with only 5 kw. with delta winding would operate with only 81 per cent efficiency and at 0.75 power factor. A tabulation of segregated losses, derived by means of the Heyland circular diagram method, is given.—*Elektrotechnische Zeitschrift,* Jan. 13, 1921.

Standardized Electric Motor Manufacture.—A discussion of the standardization in motor manufacture as established by one British firm.—London *Electrician,* Feb. 25, 1921.

Generation, Transmission and Distribution

Applications of Electric Power on Modern Gas Undertakings.—H. C. WIDLAKE.—The modern gas works, with their many power-using units scattered over a wide area, offer a peculiarly suitable field for the application of electric power. Until recently single-cylinder non-condensing steam engines were in common use, fed by a network of pipe throughout the works. At present, however, the gas-works plant convertible to electric drive includes charging and discharging machines, conveyors, telphers, elevators, cranes, hoists, exhausters, compressors, blowing and gas-boosting fans, pumps, washers, disintegrators, agitators, hydro-extractors, electro-tinning plant, machine tools and wood-working tools. The distribution of the total output of electricity among the various classes of apparatus in the cases discussed in the article was as follows: Coal-handling plant, 30.9 per cent; coke-handling plant, 19.1 per cent; purification plant, 24.1 per cent; water-gas plant, 17.6 per cent, and machine tools, lighting, etc., 8.3 per cent.—London *Electrician,* Jan. 14, 1921.

Inductive Grounding in Systems with Unsymmetrical Capacity Distribution. — JONAS. — When a flashover occurs on an insulator a power arc is often started, which may keep going until the insulator is seriously injured. The tendency to devolop such power arcs is greater in systems with larger capacity. Professor Petersen, in Darmstadt, Germany, recently has shown that if the transformer neutral is grounded through a choke coil of such inductance as to give resonance with the line capacity at the working frequency then the arc will be almost immediately extinguished, since the current discharged from the line and the inductive current in the neutral-point grounding coil will almost exactly cancel, leaving a very small current in the arc. The inductive grounding coil is patented and is marketed by the A. E. G. The present author, however, questions the usefulness of Petersen coils in many practical cases where the capacity to ground of the different phases is never exactly alike, and shows that in unsymmetrical systems the grounding coil may give rise to very large voltages from neutral to ground when the system is in normal operation. The conclusion is that, contrary to the Petersen proposal, the inductive grounding coil should be decidedly out of tune with the line capacities in order to avoid such complications. Definite suggestions are made as to the most advantageous amount of inductance in different cases, and the author also discusses the effectiveness of a non-resonant grounding coil. It turns out that the coil will very effectively stop the arcing even when enough out of tune to prevent voltage rises during operation. — *Elektrotechnik und Maschinenbau,* Vol. XXXVIII, page 453.

Optimum Conditions of Transmission Economy.—BATICLE.—One difficulty encountered when attempting to apply the Kelvin economical rule to practical problems of transmission is the necessity to determine beforehand a price for the energy lost in the transmission line. This price corresponds neither to the self-cost at the generating plant nor to the sales price, nor can it be considered independent of the economy of transmission. The author, therefore, in attempting to derive some rational economical rules, puts as a fundamental requirement that the self-cost per kilowatt-hour at the receiving station shall be a minimum. On this basis he derives the following rules for a given percentage loss of transmission: (1) For a given efficiency of transmission the voltage should be such that the cost of the conductors is equal to the cost of the insulation multiplied by $n/2$, where the insulator cost is assumed to be proportional to the nth power of the transmission voltage; (2) if the voltage is given the transmission efficiency should be such that the cost of the conductors is to the total cost in the same proportion as is the average loss to the average received power; (3) assuming cost of insulation to be simply proportional to the transmission voltage rather simple expressions are derived wherein voltage as well as efficiency are variables. The rules are applied to practical transmission cases and appeared to lead to quite reasonable results.—*Revue Générale de l'Electricité,* Vol. VIII, page 595.

Traction

Renewal of the Catenary Construction in the Hoosac Tunnel.—L. C. WINSHIP.—Nine years of exposure to gas, moisture and corrosive solutions from the tunnel roof have been sufficient to destroy the copper messenger which was installed in the Hoosac Tunnel at the time of electrification in 1911. The construction of the new

messenger is shown to give promise of even longer life.—*Electric Journal*, March, 1921.

Economical and Constructive Viewpoints for Large Electric Locomotives.—Alb. Laternser.—The author compares the following recently built electric locomotives: (1) General Electric freight type for Chicago, Milwaukee & St. Paul, direct current; (2) General Electric express type for Chicago, Milwaukee & St. Paul, direct current; (3) Westinghouse freight type, Pennsylvania Railway, alternating current; (4) Westinghouse express type, Chicago, Milwaukee & St. Paul, direct current; (5) Oerlikon freight type, Swiss Federal Railways, alternating current; (6) Oerlikon express type, Italian State Railways, three-phase. The comparisons are made entirely from the European standpoint, the author being a Swiss. Comparing the geared and the gearless type, the low center of gravity of the latter and the decreasing gear efficiency with increasing speed of the former are disapproved. The high amount of unsprung load of the types Nos. 1, 3 and 4 is mentioned, resulting in undue wear of rails. Attention is called to the disagreement of the two leading American firms as to the construction best suited to both the express and the freight types of heavy locomotives. The two European types, Nos. 5 and 6, represent the most powerful locomotives used abroad, and are both equipped for regenerative braking. The American direct-current regenerative system is considered very complicated and not fully reliable. The whole electrical equipment of the American types is held to be complicated, and the number of economic controller positions is thought inferior to the corresponding feature of the Swiss federal locomotive type.—*Schweizerische Bauzeitung*, Jan. 29, 1921.

Installations, Systems and Appliances

Swedish Electric Pig-Iron Furnace.—Jonas Herlenius.—A brief description of the constructional details, methods of starting and operation of these electric furnaces. The following table gives results during the first seven months of 1920 from the operation of a large plant of several units having a transformer capacity each of 3,000 kva. to 4,000 kva.:

	Furnace 3	Furnace 5
Total amount of ore used, tons	5,733 20	6,310.41
Total amount of lime used, tons	568 74	742 80
Total amount of ore and lime used, tons	6,301 94	7,053.21
Total amount of charcoal, lb.	2,957,440	3,112,640
Total amount of current, kw.-hr.	9,576,200	9,001,700
Operating time, hours and minutes	3,736 05	2,989 35
Idle time, hours and minutes	167 45	97 25
Total time, hours and minutes	3,903 50	3,087 00
Produced pig iron:		
Open-hearth, tons	365,670	3,483,275
Bessemer, tons	3,307,585	
Total tons	3,673 255	3,483,275
Relative figures:		
Electrode, lb. per ton pig	17 6	19 3
Charcoal, lb. per ton pig	20 1	22 3
Electric current, kw.-hr. per ton pig	2,605	2,580
Average load in kw	2,565	3,020
Pig iron per day in tons	22 5	27 1
Per cent pig of ore charged	64 2	55 25
Per cent pig of total charge	58 3	49 40
Lime in per cent of ore	9 95	11 75
Idle time in per cent of operating time	4 47	3.23

("Ton" means metric ton of 1,000 kg., equal to 2,205 lb., approximately 1 long ton.)

The total present cost in the United States of a complete electric pig-iron plant with one furnace of 4,000-kva. transformer capacity is estimated at about $150,000.—*Chemical & Metallurgical Engineering*, Vol. XXIV, page 108.

Electric Welding Progress.—Neuberger.—The author discusses recent developments in electric machine welding and deals in detail with the method of seam welding in machines with rolling electrodes. It was found at an early date in the history of electric welding that rolling electrodes with a continuous rolling motion will burn the plates to be welded. In recent seam-welding machines the plates are carried forward stepwise between the rolling electrodes, while at the same time the current is interrupted by an automatic device so that no current is flowing when the motion takes place. The author describes different types of seam-welding machines operating upon this principle and states that thin white sheet iron may be welded by this method without even the tin covering being burned, while on the other hand reliable joints may be welded with rolling electrodes when the thickness of the plates to be welded amounts to as much as 8 mm. or 10 mm. ($\frac{3}{8}$ in.). Another development in electric welding with stepwise rolling electrodes is the automatic tube-welding machine built for welding tubes up to 10 m. (33 ft.) long, of plate up to 10 mm. ($\frac{3}{8}$ in.) thick. There are also smaller types of tube-welding machine which turn long ribbons of plate into welded tubes of indefinite length. The capacity of these machines is from 300 m. to 600 m. (1,000 ft. to 2,000 ft.) of tube a day.—*Elektrotechnik und Maschinenbau*, Vol. XXXVIII, page 571.

Electrophysics and Magnetism

Electrical Resistance of Metals.—P. W. Bridgman.—The paper contains a brief summary of an extensive series of measurements, which are to be published later, made to determine the effect of pressure up to 12,000 kg. per square centimeter and of temperatures from 0 deg. to 275 deg. C. on the resistance of lithium, sodium, potassium, gallium, bismuth, mercury, calcium, strontium, magnesium, titanium, zirconium, arsenic, tungsten, lanthanum, neodymium, carbon (amorphous and graphitic), silicon and black phosphorus. The data for tungsten and magnesium are said to be improvements over data previously published, and the data for the other substances are new. The first six of the elements mentioned were studied in both the liquid and the solid states. A previous theoretical discussion concerning measurements of the effect of pressure on resistance suggested most strongly that in metallic conduction the electrons pass through the substance of the atoms and that the mechanism by which resistance is produced is intimately connected with the amplitude of atomic vibration. This view is here given quantitative form.—*Physical Review*, February, 1921.

Einstein's Principle of Relativity and Its Bearing Upon Physics.—Joseph S. Ames.—The author says that experience of more than 100 years has confirmed the general belief in the accuracy of Newton's laws. There is, however, one feature of universal gravitation about which there was no knowledge in Newton's day, or even in our own till very recently. This is the question as to whether the law of gravitation differs as between bodies moving slowly and those moving rapidly. The greatest velocity known is that of light, about 186,000 miles per second, and in comparison with this the velocities of the planets may in general be called small. Thus it is perfectly possible that Newton's law is a statement of fact for bodies moving slowly but requires modification in case they are moving rapidly. This now appears to be the case, since there is knowledge of the action of gravitation in the case of great velocities and Newton's law does not express the facts. Moreover, Einstein has

proposed a law which does correspond in a wonderful manner with these and all known facts. The article asserts that Einstein has not disproved Newton's law but has simply described the limitations within which it holds. Some of the consequences of this theory are discussed by the author.—*Journal Franklin Institute*, January, 1921.

Electrochemistry and Batteries

The Electrodeposition of Metals.—W. E. HUGHES.—This is the third article of a series and deals particularly with the preparation of the work. Methods of cleaning are classified and taken up as follows: (1) Mechanical, (2) chemical and (3) electrochemical. It is said that usually two of these methods must be employed in any case—the mechanical and either of the other two. Detailed methods of cleaning iron, brass and other metals for electroplating are considered in detail.—*Beama (British Electrical and Allied Manufacturers' Association)*, February, 1921.

Units, Measurements and Instruments

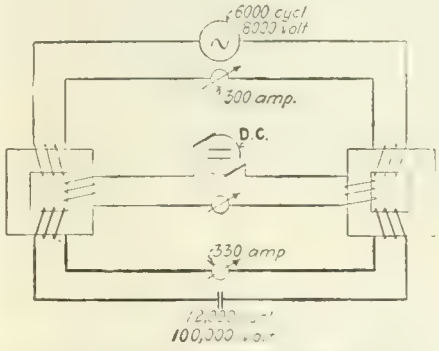
Errors of Direction Finders.—Dr. E. BELLINI.—The discovery of the amplifier is held to have enormously extended the range of direction finders, and the adoption of undamped waves of very great length also helped to change their working conditions completely. The extension of the ranges to enormous values, however, has developed new sources of errors which can be attributed neither to the conditions of the earth's surface nor to the influence of neighboring bodies. The characteristics of the new errors are especially their magnitude and their variability. Minimum in the daytime, they become larger at sunset and reach their maximum at night, becoming sometimes enormous, as much as 50, 60 and even 90 deg. Their rate of change may reach several degrees per minute. The author undertakes to demonstrate that these errors are due both to the reflection of waves from the Heaviside layer, considered as homogeneous and continuous, and to the influence of the horizontal parts of the sending antennas uppon the horizontal parts of the receiving loops.—London *Electrician*, Feb. 18, 1921.

The Whitened Cube as a Precision Integrating Photometer.—H. BUCKLEY.—The paper indicates how a whitened cube can be made to give accurate results when used in the determination of the average candlepowers of lamps having different polar distributions. As a preliminary the relative effects of different portions of the interior of the cube in producing illumination on the window are determined and the results are used to calculate the illuminations produced by different types of light distribution. The ratios of these illuminations to that furnished by a uniform point source of unit intensity give apparent average candlepowers in the cube. It is then shown by experiment that candlepowers obtained by the usual methods of integrating photometry agree with these calculated values. Thus it is possible to determine by how much these apparent candlepowers differ from true candlepowers deduced by point-to-point methods, and hence to obtain true candlepowers from experimentally determined apparent values. In the special case where a comparison is made between lamps having identical polar distributions it is shown that the usual method gives accurate results.—*Journal Institution of Electrical Engineers*, London, January, 1921.

Telegraphy, Telephony and Signals

Morse Printing of Wireless Signals.—B. S. T. WALLACE.—The writer deals with apparatus that can be applied to the printing of signals received by wireless in such a way that the operation is automatic.—*Wireless World*, Feb. 5, 1921.

The High-Power Wireless Station at Nauen.—FELIX LINKE.—A very elaborate and profusely illustrated article on the development and present equipment of the famous Nauen station. The history of the station is at the same time the history of the art of wireless telegraphy and telephony. All systems invented and developed in the past fifteen years have been tried out on a large scale in this station, which now covers an area a hundred times greater than the original one. Four distinct periods have been gone through in this station: 1906-1909, open-spark system (Knallfunken) with 10-kw. antenna energy; 1909-1911, quenched spark (tonende Loschfunken), with 25-kw. and 35-kw. antenna energy; 1911-1916 (a) same as before with 80-kw. and 100-kw., (b) high-frequency machines of 100-kw. antenna energy; 1916 to present day, high-frequency machines of 400-kw. and 150-kw. antenna energy. The height of the original tower, 100 m., was increased to 200 m., but the tower was blown down by a heavy storm. A new tower of 260 m. was then erected. The Telefunken company, operating the Nauen station, built in 1913 the Sayville plant and opened regular commercial communications between America and Germany, thus antedating the efforts of the Marconi company to establish communication between England and the United States. The high-frequency current is generated by the Arco system, first suggested by Jolly for the doubling of 50 cycles alternating current (see sketch).



PRINCIPLE OF MULTIPLYING-FREQUENCY SYSTEM JOLLY ARCO

The main generator is rated at 6,000 cycles, 1,500 r.p.m. It has 240 teeth and 480 slots. By means of a cascade arrangement of direct-current-influenced static transformers a final frequency of 24,000 cycles is obtained. This generator and transformer set have been used continuously for the last four years without any trouble of any kind. It is claimed that such a record cannot be achieved by any other known system. Electric data for the transformers, such as efficiencies, losses and heating, are given. The transformers are oil-cooled.—*Zeitschrift des Vereines Deutscher Ingenieure*, Vol. LXIV, page 973.

Miscellaneous

The Question of Current Rates for Inductive Loads.—F. SCOUMANNE.—Six different methods for determining satisfactory rates for inductive loads are given and criticised. By means of analytical investigations along purely mathematical lines the author arrives at a formula which permits of a very exact and just kilowatt-hour rate.—*Revue Générale de l'Electricité*, Jan. 1, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Utilities Asked to Report on Coal Stocks

ELECTRIC power plants and other large consumers throughout the country have been asked by the United States Geological Survey to report the stock of coal on hand as of Jan. 1 and as of March 31. In addition, these plants are asked to answer the question, "What should be your normal stock as of March 31?" The survey, which issues a weekly report on coal production and movement and on operating conditions at the mines, has long felt that the report is not complete without information as to the state of consumers' stocks.

In addition to electric power plants, similar information is being requested of coal-gas plants, industrial plants, retail coal dealers, steel plants and byproduct coke plants.

Agreement on Water-Power Regulations Expected Soon

AN AGREEMENT probably will be reached this week between the representatives of the National Electric Light Association and Federal Power Commission officials in the matter of regulations. Objections to the regulations as promulgated have been many and the questions involved are intricate. As a result the conferences have extended over more than two weeks. No announcement will be made of the changes which already have been agreed upon until a final decision is reached in regard to all matters at issue.

Foundation Laid for American Engineering Standardization

ORGANIZED for active work somewhat more than a year ago, the American Engineering Standards Committee has already assumed an important rôle in co-ordinating the work of more than a hundred organizations already engaged in the development of engineering standards. Of especial significance to electrical engineers is the work in progress on "rating of electrical machinery," sponsored by the American Institute of Electrical Engineers, and "terminal markings for electrical apparatus," sponsored by the Electric Power Club, as well as the "Electrical Fire Code" and the "Electrical Safety Code." These matters are discussed in the annual report of the American Engineering Standards Committee, which will soon be published. A. A. Stevenson is chairman and P. G. Agnew is secretary of the committee.

The "main committee" is made up of forty-seven members, representing seventeen bodies, including six national societies, five government departments and thirteen national industrial associations. Its purpose as emphasized in the report is not to dominate but to serve. Thus the "main committee" occupies itself with policy matters and co-ordination work, leaving to the "sectional committees" the actual technical problems. The sectional committees are organized by one or more of the principal bodies interested in any particular work, with the approval of the main committee, such "sponsor bodies" assuming leadership in the actual development of standards.

President Harding Indorses Electrical Expositions

ON TUESDAY, April 19, and the four following days the Duluth (Minn.) Society for Electrical Development will hold an exposition in the city's armory, at which an attendance of 25,000 persons is expected. Besides the manufacturers' displays there will be electrical spectacles and other attractions. President Harding has written to the promoters of the show as follows:

"On the occasion of the electrical exposition which the Society for Electrical Development is to hold in Duluth will you please extend my greetings and good wishes to the organization and my hopes that the exposition may be fully successful. America has always been a leader in electrical science, and such expositions as you are holding are sure to prove valuable contributions toward maintaining our national position."

Rating of Machinery Discussed by Standards Sub-committee

FIVE subjects of considerable importance to motor users as well as manufacturers were discussed at the two days' meeting in New York on March 31 and April 1 of the sectional committee of the American Engineering Standards Committee on rating of electrical machinery. The subjects were (1) single-temperature versus double-temperature basis of rating all classes of electrical machinery, (2) safe temperature limits for class A insulation, (3) ambient temperature, (4) temperature gradient, and (5) methods of temperature measurement.

While the discussion, which was informal, did not result in any agreement, it appears more likely than ever that supporters of opposite views will be brought together on a mutually agreeable basis. It was quite generally held that the hot-spot temperature at the hottest spot in machinery with class A insulation should never exceed 105 deg. C., although no definite agreement was reached.

The sectional committee which discussed the foregoing subjects is composed of delegates from the American Institute of Electrical Engineers, the National Electric Light Association, the Association of Edison Illuminating Companies, the Electric Power Club, the American Mining Congress and the American Institute of Consulting Engineers. The opportunity to have representation on the committee has been given to other

national associations, but they have not yet taken advantage of the invitation.

Another meeting has been called for May 5 and 6, at which each member of the sectional committee will be expected to present specific data and facts on which decisions can be based. Prof. Dugald C. Jackson is chairman of the sectional committee, L. L. Elden is vice-chairman, and Dr. A. S. McAllister is acting as secretary.

General Electric's 1920 Billings $275,000,000

SALES billed amounting to $275,758,487 in 1920 are shown in the twenty-ninth annual report of the General Electric Company just issued—an increase of $45,778,504 over those for 1919. The net value of orders received was $318,470,438 as against $237,623,932 for 1919. At the end of the year the amount of orders unfilled, after eliminating all cancellations, was $111,778,000, compared with $98,880,000 at the close of 1919. Reduction of inventories to market values of Dec. 31, 1920, amounted to $17,803,985.

The unprecedented volume of orders received during the first seven months of the year, plus unfilled orders at the beginning of the year, resulted in more urgent efforts, in a difficult situation, to add to manufacturing facilities, and during the year the company added 2,052,000 sq.ft. of owned factory floor-space and 1,768,000 sq.ft. leased with option to purchase. Present manufac turing space amounts to 24,501,000 sq.ft.

At the close of 1920 inventories at factories amounted to $93,574,114 and at warehouses, in transit, on consignment, etc., amounted to $24,535,059, a total of $118,109,174, as against $83,978,463 at the close of 1919. The item of customers' accounts and notes receivable, carried at $64,962,682, which is an increase of $19,077,154 over the balance shown on Dec. 31, 1919, is an indication of the way bills are being paid. Total outstanding capital stock at that date was $139,026,900.

National Electrical Safety Code Now Available

THE third edition of the National Electrical Safety Code, prepared by the Bureau of Standards, Washington, D. C., and known as Handbook No. 3, has just been issued.

The greatest changes made in this edition are in part 2, which deals with the installation and maintenance of overhead and underground service and signal lines. The loading specification, upon which are based the requirements for strength of construction, has been simplified and has been applied to signal lines crossing railways, for which arbitrary rules were formerly used. The rules have been rearranged in more convenient order, and an index has been added. The sag tables have been extended to cover iron and steel conductors.

The new edition of these rules is in pocket size and has been entirely separated from the discussion of the rules which accompanied them in the second edition. This discussion has been considerably amplified and will be published separately as Handbook No. 4, which is now in press.

Copies of Handbook No. 3 may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 40 cents per copy, bound in buckram.

Propounder of Relativity Theory Visits United States



Prof. Albert Einstein, whose theories regarding space and time have made such an impression recently upon the scientific world, photographed as he arrived in this country last Saturday on the Holland-America liner Rotterdam.

Little Hope for Texas Utility Act Until Next Legislative Session

MUNICIPAL home-rule representatives in the lower house of the Texas Legislature have by incorporating in the proposed utility act many amendments injurious to utilities forced proponents of the bill to kill it by striking out the enacting clause. This development leaves little hope for state utility relief until the next biennial session of the Legislature.

The bill was drafted by a committee appointed by the Governor and consisting of an equal number of representatives of municipalities, utilities, state commercial bodies, the State House of Representatives and the Senate. The original draft of the bill, as prepared by the representatives of the municipalities, was drastic as regarded the treatment of utilities. Many open hearings were held by the committee, however, and a greatly amended final draft was passed by a large majority referring it to both chambers of the Legislature. The bill was passed by the Senate, but in the House it ran into the snags mentioned.

Five Miles of Spectacular Mountain Highway Lighting Proposed

NEGOTIATIONS are under way between the Jefferson County Power & Light Company of Golden, Col., and the city and county of Denver for the illumination of the Williams Highway from the city limits of Golden to the summit of Lookout Mountain, a distance of approximately 5 miles. This road is part of the Denver Mountain Parks system, and if the lighting is installed it will form one of the most spectacular stretches of highway illumination in the country.

The proposed system would consist of 150 600-cp. series lamps mounted on 20-ft. posts, light centers being 18 ft. from the ground.

Hundred Thousand People to Help Finance 900,000-Hp. Project



R. H. BALLARD

TWO hundred million dollars will be needed by the Southern California Edison Company to develop and distribute power from the San Joaquin River, for which authorization has been given by the Federal Power Commission. According to R. H. Ballard, vice-president and general manager of the company, who is now in the East in connection with the financing of this project, work will start this spring on this development, which will yield eventually close to 900,000 hp. Financing, Mr. Ballard told an ELECTRICAL WORLD representative, will probably be 60 per cent in the form of bonds and the remaining 40 per cent common stock which will be sold locally.

"Common stock sold locally," said Mr. Ballard, "will be the foundation on which this immense development will rest. Up to the end of January we had sold in excess of $3,250,000 of common stock to more than 3,500 subscribers in anticipation of this work. To date we have on our books eleven thousand stockholders, and we expect eventually to have a hundred thousand locally. On the average a subscriber takes eight shares of stock."

Mr. Ballard was then asked to explain the engineering principles of this development, and he said:

"First and foremost we shall have recourse to immense storage reservoirs. Water in California is becoming more and more valuable, not only for power purposes but for irrigation as well, so that it is the part of wisdom to store all of it we can. Time was when in seasons of flood water went tearing through the canyons in its mad rush to the sea, inundating and destroying as it went. Such happenings may be impressive as scenery, but the scars left are anything but attractive. Besides, the periods of drought are far longer than the periods of flood. Now we plan to save the water and curtail the damage; hence the reservoirs.

"Under the permits that have been issued to us we shall shortly begin construction of reservoirs at Vermilion Valley on Mono Creek, a tributary of the South fork of the San Joaquin River; at Blaney Meadows and Florence Lake, on the south fork of the San Joaquin, and at Shaver Lake, on Stephenson Creek.

"These, together with the Big Creek chain, will complete the development of this diversion of the San Joaquin. There are a number of tributaries feeding into the San Joaquin divided into two sections. This development takes into consideration the upper river only. At the highest altitude, between 7,000 ft. and 8,000 ft. from Mono Creek, these waters are to be stored in Vermilion Reservoir, which has a capacity of 30,000 acre-ft. Below the dam enters Bear Creek, and its waters and the spill from Vermilion reservoir combine with waters from the south fork, after filling the 17,000-acre-ft. Blaney Meadow reservoir, to fill Florence Lake to a capacity of 50,000 acre-ft. These reservoirs will thus catch the spring floods, and the spill which otherwise would be lost is saved. Big Creek and Pitman Creek combine with the spill from Florence Lake to be stored in Huntington Lake, which has a capacity of 89,000 acre-ft. Before this, however, the Pitman Creek waters will be regulated by a 30,000-acre-ft. reservoir and Shaver Lake storing 146,000 acre-ft.

"All of this will be storage before a single drop of water passes through a wheel. It will then drop through a chain of power houses a distance of about 6,000 ft., when all of it will be available for irrigation purposes. From Huntington Lake water now goes through power house No. 1, where 32,000 kw. out of an eventual 64,000 kw. is operating under a 2,130-ft. head. Below is power house No. 2, which will eventually have 134,000 kw. capacity, with 48,000 kw. now in operation.

"With the creation of the reservoirs in the upper altitudes Huntington Lake will be able to accommodate considerably more than the present No. 1 and No. 2, so part of the water will be shunted through tunnels to Shaver Lake and power house No. 5.

"This plant, work on which will be started as soon as satisfactory financial provisions have been made, will have an ultimate capacity of 108,000 hp. and operate under a head of 1,480 ft. Its tailrace will lead into Shaver Lake, which will store also the waters from Stephenson Creek. It will have a capacity of 146,000 acre-ft. This reservoir will also feed into No. 2, or what is virtually the same, a power plant adjacent to No. 2. From No. 2 the tailrace drops 717 ft., feeding No. 8. This plant, which will ultimately be rated at 120,000 hp., will also be started this summer with 30,000 hp. From this point the water will be used as it drops in other power houses to be developed as needed.

"We believe that with this system of water control we have solved the problem of the power supply of southern California for some years to come."

Public Utilities to Exhibit at Chicago Pageant of Progress

THE education of the public on the subject of recent electrical inventions will be one of the objects of the public utility exhibit to be held at the Chicago Municipal Pier during that city's "Pageant of Progress" in July. Among some of the inventions exhibited will be the directional wireless and the wireless telephone. Demonstrations will include steering a boat by wireless, controlling pilotless aëroplanes by wireless, communicating with aviators by wireless telephone and transmission of music by wireless telephone. Manufacturers of electric appliances also will be represented.

A definite plan for an exhibit to show how the public utilities have aided the progress of the city has not been worked out yet, according to George Foster of the Commonwealth Edison Company, and W. C. Keith, city commissioner of gas and electricity, who are in charge of the exhibit, but it is understood that the utilities' part in making Chicago the second largest city in the country will be strikingly portrayed.

The section apportioned to the utilities has space for approximately forty individual exhibitors, about half of this space having been taken on April 1. Reservations are being made in such numbers, according to Mr. Foster, that there is little doubt that the whole section will be filled far in advance.

Inspectors Favor Separation of Electrical and Safety Codes

ABOUT a hundred members and guests of the Western New England Association of Electrical Inspectors convened at Springfield, Mass., March 30, Thomas H. Day presiding, to discuss wiring questions associated with the 1920 edition of the National Electrical Code. By a vote of about three to one the meeting declared itself in favor of retaining the present separation between the National Electrical Code and the National Safety Code. Following a short business meeting, the use of metal conduit in installations subjected to the fumes of animal waste, steam vapors, packing-plant drips, salt spray, etc., was discussed in person or by letter by President Day; G. E. Bruen, superintendent electrical department, Suburban Fire Insurance Exchange, New York; C. R. Hodgdon, chief electrical inspector Allegheny County Board of Fire Underwriters, Pittsburgh, and A. E. Braddell, Sprague Electric Works, New York.

The growing favor with which modern designs of safety switches and fuses are being received and some of the problems involved in protection were discussed by A. A. Packard, superintendent Connecticut Power Company, Middletown, Conn.; F. T. Wheeler, vice-president Trumbull Electric Manufacturing Company, Plainville, Conn.; B. H. Glover, associate electrical engineer Underwriters' Laboratories, Chicago, and Dr. M. G. Lloyd of the United States Bureau of Standards. An exhaustive interpretation of the grounding rules of the 1920 Electrical Code occupied the afternoon session, President Day, a member of the committee on rules for grounding, being the chief speaker.

Central-Station Service from Different Points of View

A SYMPOSIUM on central-station power service from different points of view is scheduled for the April 15 meeting of the Western Geographic Section of the Pennsylvania Electric Association at the William Penn Hotel, Pittsburgh.

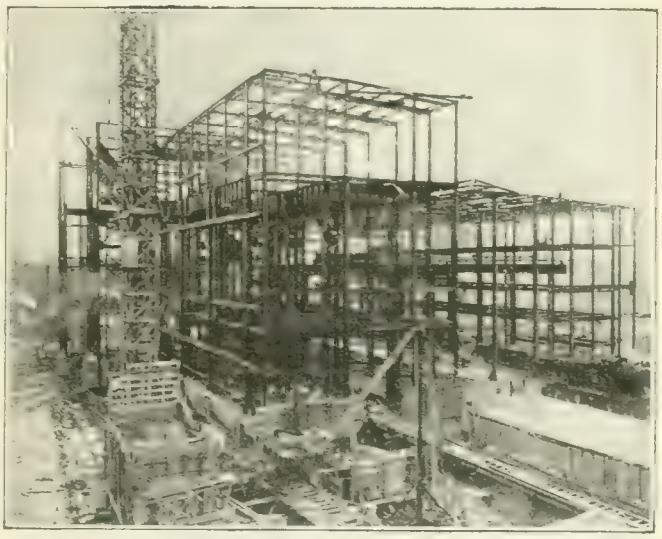
The following papers are to be presented: "The Ideal Power Customer for the Central Station," from the commercial standpoint, by G. M. Gadsby, vice-president West Penn Power Company; from the technical standpoint by E. C. Stone, assistant to the general manager of the Duquesne Light Company; "The Ideal Central-Station Power Service," by J. A. Coyle, general manager of the Universal Steel Company, from the standpoint of the steel plant, and by W. L. Affelder, assistant to the president Hillman Coal & Coke Company, from the point of view of the coal mine.

Bethlehem Steel Company Interchanges Power with Lehigh Valley Company

ALTHOUGH no interconnection contract is in existence, the generating station of the Bethlehem Steel Company, Bethlehem, Pa., has frequently carried a part of the load of the Lehigh Valley Light & Power Company, D. M. Petty, electrical superintendent of the Bethlehem Steel Company, asserted in his paper, "Generation of Power in Steel Mills," read before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers on April 2. During the month of November, 1920, the steel mill supplied the power company with three times as much power as was purchased from the power company. The power purchased, observed Mr. Petty, cost the steel company between two and three times the price obtained for the power sold to the power company. However, the power bought was worth more because it was peak-load power, while that sold to the power company was simply a by-product of the steel company.

A study of steel-mill plants has shown that for the economic operation of gas-engine plants the load factor should be between 65 and 100 per cent. Below that range the steam-turbine plant shows higher economies. The logical development would, Mr. Petty continued, be a combination steam and gas station. However, as the central station would be able to handle the steam turbine at a higher continuous load factor, the most efficient arrangement which could be made would be to buy that part of the load from the power company. For this reason interconnection offers a very interesting possibility.

Hartford Plant Construction Speeded Up to Relieve Employment Situation



ACTING upon advices from S. G. Dunham, president of the Hartford (Conn.) Electric Light Company, construction work at the new "Meadows" generating plant of this organization is being pushed toward completion at the normal rate by Stone & Webster, Inc., builders of the station. In a recent letter to Stone & Webster, President Dunham said that the very great curtailment in local industrial development and consequent lesser demand for power make it unnecessary to push the new plant to completion during the present year, but in view of the amount of local nonemployment, which it is for the company's interest to relieve as far as possible, and because of the greater economy to be obtained from the new plant if it should be in operation during the coming winter, the Hartford company was willing to release the hold-up orders placed last fall and allow the construction to proceed at once, provided that the work can be done economically and at a reasonable reduction from the very high wage scale prevalent last year. Accordingly the working force has been approximately doubled and the job is now proceeding on the basis of a wage reduction of about 20 per cent. Contrary to impressions prevailing outside Hartford, work on the station was not suspended during the winter but was slowed down to meet the prevailing business situation. The steel structure of the plant is now virtually finished, and two 20,000-kva. generating units are to be installed as initial equipment.

A. S. M. E. Power Test Codes Being Revised and Enlarged

REVISION and enlargement of the power test codes of the American Society of Mechanical Engineers, issued in 1915, are under way by separate code committees. In all there will be nineteen codes, by means of which all power apparatus may be tested. A main committee of twenty-eight, of which Fred R. Low, editor of *Power*, is chairman, is supervising the work of the nineteen committees.

Three of the nineteen codes will be presented to the A. S. M. E. for consideration and adoption at the spring meeting, to be held in Chicago, May 23-26. One is in the nature of a preliminary set of rules and is entitled "General Instructions," the second relates to reciprocating steam engines and the third to evaporators.

Study of Elimination of Waste Going Forward Rapidly

ALL FIELD WORK of the American Federation of Engineering Societies' committee on elimination of waste in industry will be completed by April 15, according to a statement this week by Secretary L. W. Wallace, when the publication of the final report of the committee will be undertaken immediately. It is anticipated that the final report will be published some time in June. The findings of the committee, Mr. Wallace states, thus far are very significant, and there is every reason to believe that the publication of this report will create a great deal of interest.

The next meeting of the executive board is to be held in Philadelphia on April 16 at the Engineers' Club. A dinner at the Bellevue-Stratford is scheduled for the evening of April 16, which is to be addressed by the president, Herbert Hoover. It is expected that this will be one of the most important meetings that the board has ever held.

Electrical Home Arouses Interest in Chicago

MORE interest was created by the electrical home built for display at the Chicago "Own-Your-Home Exposition," according to the management, than by any other single exhibit. The exposition was open to the public from March 28 to April 2 inclusive, and during those six days it is estimated that more than 30,000 persons inspected the home and its furnishings. The home was sponsored by the Electrical Contractors' Association of Chicago, and electric appliances and furnishings were supplied by the Commonwealth Edison Company, Western Electric Company, Electric Appliance Company, American Electric Supply Company, Metropolitan Electric Company, Illinois Electric Company, Inland Electric Company and Marshall Field & Company.

The home consisted of living room, dining room, kitchen, two bedrooms and bath and was built from the prize-winning design in the architects' national small-house competition. The living room and dining room were lighted by wall brackets and floor lamps, with numerous wall outlets for the floor lamps and for toasters, percolators and other appliances. The kitchen was furnished with electric dishwasher, ironer, washing machine, refrigerator, vacuum cleaner, cooker, exhaust fan and intercommunicating telephone. In the bedrooms were found ceiling lights, several conveniently arranged wall brackets, wall outlets for appliances and bed lamps and intercommunicating telephones. It is understood that, encouraged by the impression made on the public by this temporary exhibit, various Chicago electrical interests are considering the construction of a permanent electrical home.

In addition to this exhibit a lighting exhibit was arranged by the Chicago Lighting Fixture Council and by C. G. Everson & Company, Chicago. It was attempted by means of these exhibits to educate the public to buy fixtures on a style and not a price basis. Other exhibits were arranged by manufacturers of electric household appliances.

Vermont Association Elects Officers

AT THE annual meeting of the Vermont Electrical Association held in Burlington recently the following officers were elected for the ensuing year: President, J. A. Prouty, Newport; vice-presidents, I. M. Frost, Rutland, and R. P. Osgood, Windsor; secretary-treasurer, C. E. Warsaw, Burlington; executive committee, Wilfred Smith of Woodstock, F. S. Nicholson of Rutland, D. W. Jardine of Burlington, C. J. Cookson of Montpelier, C. C. Wells of Middlebury and E. E. Gage of St. Johnsbury.

California Legislative Investigators Back Up Commission

FRANKLY admitting that some preconceived ideas entertained by them had undergone a complete change as the result of their investigation into the workings of the California Railroad Commission, the members of the joint legislative committee appointed to hold hearings in this matter have recommended to the Legislature of California that the public utilities act be strengthened rather than weakened, to the end that the commission shall continue to be a buffer between the people and the utilities and that capital shall be encouraged to seek investment in the development of the state's resources. The committee indorses the abrogation of contracts where this is necessary to prevent discrimination and insure a fair return; declares that in the absence of public ownership of utilities—which it neither indorses nor opposes—regulated monopoly is the only solution of the problem of public service, competition being neither necessary nor desirable; opposes granting to municipalities the right to withdraw from the commission's jurisdiction; sanctions the raising of rates to meet increased cost of operation, but suggests that a fixed term might be set during which a further increase should not be sought; denies that the commission has based rates on the "cost plus" theory or allowed dividends on watered stock; makes recommendations regarding certain promotion abuses which the commission has no power to prevent; finds that on the whole the work of the commission has been performed without avoidable delays or postponements, and urges that this work be brought closer to the people by having a representative of the commission in each community, which could be done by consolidating with the commission the State Department of Weights and Measures.

Increased appropriations to enable the commission to see that the consumers are amply represented at its hearings are suggested by the investigating committee

to the Legislature. It also recommends a standard form of contract for service, the use of which should be compulsory upon the utilities and which should contain a provision in plain type showing that the rates therein set forth are subject to change by the commission at any time, anything in the contract to the contrary notwithstanding. Another recommendation is that all literature relating to the sale and advertising of the securities of any public service corporation be supervised by the commission and that nothing in that literature be permitted which can be construed by the public as an indorsement of such securities or of the rate of the return thereon by the commission. The committee also holds that the commission should more strictly enforce the penalties provided by the public utilities act for violations of the act and of the rules and regulations of the commission, more particularly with regard to overcharges for extensions and service.

Co-operative Instruction in Industrial Heating Planned

UNDER the auspices of the power sales committee of the New England Division of the National Electric Light Association, it is expected that experts from the factories and sales offices of the Westinghouse Electric & Manufacturing Company, Cutler-Hammer Manufacturing Company and General Electric Company will participate in giving a three days' industrial-heating lecture course at Boston during the week beginning May 8. It is planned to set forth the history, development and applications of modern industrial electric heating apparatus by illustrated talks designed to appeal to central-station power engineers, industrial-plant engineers and executives and others interested in concentrated and efficient applications of controlled heat. A large attendance is looked for.

Minneapolis Street Lighting Under Fire

THAT the street-lighting system of Minneapolis fails in efficiency and causes a strain on the eyesight of its citizens is the reported conclusion of a committee of the Civic and Commerce Association of that city. The five-light cluster standards on the ornamental system installed less than five years ago are admitted to fall short of the standards of good illuminating engineering, and there is room also for improvement in the magnetite system.

A committee of the association having the co-operation of the Engineers' Club made the report. It is asserted that the cost per mile per year for arc-lighted streets is $374, for ornamental lights $2,407 and for gas lights $1,073. Two ideas have developed from the discussion, one being to throw away every part of the present ornamental system and start afresh. The cost of this plan is estimated at $3,000,000 to $4,000,000, which would necessarily be covered by a bond issue. The other idea contemplates the changing of the present equipment in the ornamental standards so as to direct the light rays toward the street and kill the glare. This, it is asserted, can be done at a nominal cost per standard.

Rerouting of car lines in the downtown districts has created a demand for extensions of the ornamental system, and some single-light 500-watt units are about to be installed. No final plans have yet been made.

Department of Commerce to Have Closer Relations with Business

ANNOUNCEMENT was made on Monday of this week by the Chamber of Commerce of the United States of the appointment of a committee of five, with five alternates, to co-operate with Secretary Hoover in working out a plan for closer relationship between business and the Department of Commerce. The committee, which was named at Mr. Hoover's request, met with the Secretary on Tuesday. Members of the committee are: A. C. Bedford, New York, chairman of the board of directors of the Standard Oil Company of New Jersey; George E. Smith, New York, president of the Royal Typewriter Company; John H. Fahey, Boston, publisher; Homer L. Ferguson, Newport News, Va., president of the Newport News Shipbuilding & Drydock Company; Philip H. Gadsden, Philadelphia, president of the American Electric Railway Association. The five alternates are: Lewis B. Stillwell, New York, electrical and consulting engineer; Howard Elliott, New York, chairman Northern Pacific Railway Company; R. Goodwyn Rhett, Charleston, S. C., president People's National Bank; Henry M. Victor, Charlotte, N. C., cotton manufacturer and president Union National Bank; A. L. Humphrey, Pittsburgh, president Westinghouse Air Brake Company.

To Confer on International Standardization



Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, sails for England on April 12 to attend a conference of secretaries of national standardizing bodies to be held in London this month.

Wasteful Competition Between Utilities Now Barred in Washington State

HENCEFORTH before any public utility company in the State of Washington can enter the field in competition with an established utility it must first appear before the Public Service Commission of the state and show the necessity for the duplication of service. This has been made law through the passage by the Legislature of the "act to prevent waste in duplication of public utilities" recommended to the Governor by the commission. The bill had a large majority. It applies also to proposed municipal plants.

A. I. E. E. to Award Prizes for Original Papers by Members

ONE hundred dollars in cash and a suitable certificate are to be offered by the American Institute of Electrical Engineers every year for the most worthy original paper presented during the year at a meeting of any section of the Institute by a member who has never before presented a paper at an Institute or section meeting. Two similar prizes—one for enrolled students of the A. I. E. E. and the other open to all members—have been approved by the directors for future award, but will not be offered this year.

The board has also accepted an offer from the Jeffery-Dewitt Company to donate to the Institute each year a prize of $100 for the best paper on a subject within the field of high-tension transmission and distribution. The details have not yet been announced, but it is understood that all papers presented before the Institute during the calendar year 1921 within the field of high-tension transmission and distribution are eligible for this award. The procedure to be followed in connection with the award of both the prizes will be announced later.

Inter-Scandinavian Power Exchange Planned

SOME very definite plans are now receiving consideration for an inter-Scandinavian power exchange. This, according to the ELECTRICAL WORLD'S correspondent in Sweden, is to be based on a power agreement between Sweden, Norway and Denmark on an official basis. Already the Swedish Foreign Office has been approached by Norway, but when this was written no reply had been given.

For some time Norwegian engineers, realizing that Norway has about ten times as much water power as Norwegian industry will be able to use in the next hundred years, have been considering the possibility of exporting power to Denmark. The line, as it was first proposed, would run through Sweden and in cable under the sound and would cost around 90,000,000 kronen ($20,000,000).

The latest idea, however, is to join the Norwegian power system to the Trollhättan system in Sweden and run a line south to the private power system in southern Sweden, and thence into Denmark.

From 100,000 kw. to 200,000 kw. is involved at a transmission pressure of either 100,000 volts or 200,000 volts.

Prize Essay Contest on Courtesy and Good Will at Boston

PRESIDENT C. L. EDGAR of the Edison Electric Illuminating Company of Boston has authorized a prize essay contest among employees upon one or more phases of the "courtesy and good-will" campaign which has been running in the company for more than a year past. The company now has about 2,000 employees, and the award will be announced at the annual field day, June 25. The following board of judges has been named: Chairman, L. D. Gibbs, superintendent of advertising Boston Edison company; W. E. Holmes, general manager Cambridge Electric Light Company; F. J. Whiting, editor *Stone & Webster Journal;* H. W. Moses, superintendent employment bureau, Boston Edison company; H. S. Knowlton, New England editor ELECTRICAL WORLD.

New York Electrical Show to Be Held in Armory Sept. 28 to Oct. 8

THE Grand Central Palace, in which previous exhibitions have been held, being no longer available for exposition purposes, the management of the New York Electrical Exposition has selected the Seventy-first Regiment Armory, Park Avenue and Thirty-fourth Street, New York, as the place for the 1921 show, which will begin Sept. 28 and last ten days. The armory is said to combine suitable floor arrangements, facilities for handling the exhibits and accommodations for spectators. As in former years, the 1921 show will feature electrical equipment for the home, motor-driven machinery for industrial purposes, electrically operated material-handling machinery and electric vehicles.

Electrical Equipment on Newest Superdreadnought





At the left is shown one of the 20,000 hp. Westinghouse generators of the U. S. S. *Tennessee*, the newest of Uncle Sam's superdreadnoughts. The entire control of the ship is centered in the room shown at the right.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Municipal Electric Plant Voted Down at Ogden. — An election was held at Ogden, Utah, on March 26 to determine, among other things, whether bonds for $500,000 should be issued to establish a municipal electric plant. This proposal was defeated by a close vote.

Another British Tidal-Power Scheme.—A report is now being prepared in Great Britain on a scheme to utilize the tides at Walney Island to supply electrical energy to the Barrow district of Lancashire, with its great industrial development. As with the similar project for the River Severn, even if all engineering difficulties were overcome, the cost of the enterprise would, conservative authorities think, be likely to prove prohibitive.

Hydro-Electrification in Spain.—Contracts have been signed for the use of hydro-electric motive power on an inclined section of the Norte railroad of Spain, this section lying between Gijón and León. It is thought that a proposed steam central station for use in this work can be dispensed with or at least simplified and used only as a reserve, there being enough power available from hydro-electric companies operating in the neighborhood to take care of normal operation on the grade.

Tax on Power Development in Ontario.—The Premier of Ontario has said publicly that there will probably be a tax on the development of hydro-electric power in that province, but he has given definite assurance to the secretary of the Ontario Municipal Electric Association that the tax will not be so much as the $2 per horsepower that was recommended by the special committee of the Legislature which recently reported on the subject. The Premier assured the assocation that the government does not intend to take any drastic action.

Exposition to Show Electrical Advertising Methods. — Plans are rapidly taking shape for an electrical advertising display which the New York Edison Company is to hold in its Irving Place showroom during the week of May 2-9. Many manufacturers of signs have accepted an invitation to take part. Roof signs will be shown with their flashers in actual operation; store-front signs will make up another part of the exhibit, and a third department will include the so-called directional signs. An effort is being made to have an exhibit of early sign material, and Major William J. Hammer, who as Edison's representative in London in 1881 built the first electric sign, has been invited to contribute material from his historical collection. As 1921 is the fortieth anniversary of the making of the first sign, it is thought a historic exhibit of this nature will be of great interest.

Hydro-Electricity in Western France.—The first important hydro-electric installation in the west of France is being pushed to completion on the River Vienne, where three falls, at Isle-Jourdain, Joussaud and Chardes, have made feasible the construction of power houses rated at 9,000 hp., 9,000 hp. and 5,000 hp. respectively. The first of these power houses, built upon the dam itself, is about ready and contains three Francis turbines each coupled to a three-phase alternator, with room for a fourth group. Energy generated at 5,000 volts and 50 cycles is to be raised to 60,000 volts for transmission. Work on the Chardes development also has begun. The combined installation will serve a rich agricultural region.

"Bell Loud Speaker" Carries Inaugural Address to Vast Crowd. — By means of the "Bell loud speaker" President Harding's voice was so amplified that it is estimated that quarter of a million persons heard him deliver his inaugural address at Washington on March 4. This was the first public exhibition of the perfected device, which has required years of research to develop and which, the Bell engineers say, will make it possible for the human voice to reach a million hearers clearly when no buildings on any side block its path. The crowd at the inauguration saw no equipment, the great horns being concealed in the roof of the rostrum erected for the President's use and the electrical apparatus being beneath this stand and under the portico. The system consisted essentially of three parts —a specially constructed, ultra-sensitive transmitter, shielded with copper to carry off interfering currents however minute, placed directly in front of the speaker; a series of vacuum-tube amplifiers in a control room, these providing eight stages of amplification for the current from the transmitter, and the loud-speaking telephone receivers attached to the large wooden horns already referred to. The apparatus was provided without cost to the government by the Chesapeake & Potomac Telephone Company, of which A. E. Berry is president.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Club of Chicago.—On Tuesday of this week L. E. Myers addressed this club on "Electricity in Its Infancy and the Problem of Today." Next Tuesday, April 12, is to be ladies' day.

Detroit Engineering Society.—C. F. Hirshfeld, chief of the Detroit Edison Company's research department, will speak before the Detroit Engineering Society on Thursday evening, April 14, his topic being "Industrial Electrical Heating."

Providence Section, A. S. M. E. — "The Effect of the Variable-Speed Motor on Heat Balance in Finishing Plants" will be discussed by Warren B. Lewis, president of the Providence (R. I.) Engineering Society, before the Textile Section of the A. S. M. E., meeting with the Providence Section on Tuesday next, April 12.

Electric Club Organized at Los Angeles.—Representative officials from every branch of the electrical industry met at Los Angeles recently and formed the Electric Club, with these officers: President, H. L. Harper, district manager Western Electric Company; first vice-president, A. W. Childs, sales manager Southern California Edison Company; second vice-president, J. C. Rendler, president Southern California Electric Company; third vice-president, N. R. Powley, commercial superintendent Southern California Telephone Company; secretary-treasurer, F. J. Airey, manager Pacific States Electric Company; executive secretary, E. F. Moss; sergeant-at-arms, J. G. Pomeroy. The club's objects are the promotion of hydro-electric development in southern California and the general use of electrical energy. Carl M. Heintz, advertising manager of the Westinghouse Electric & Manufacturing Company, is chairman of the publicity committee.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Cleveland Section, April 11; Pittsburgh Section, April 16.

Pennsylvania Electric Association, Western Section—Pittsburgh, April 15.

A. I. E. E. Section Meetings—Pittsburgh (joint session with A. I. and S. E. E.; for program see issue of March 19, page 672), April 16; New York (joint session with A. S. M. E.), April 22; New York, May 20.

American Welding Society — Metropolitan Section, New York, April 19.

Missouri Association of Public Utilities — Kansas City, April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society — Washington, April 23.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers — Houston, Tex., April 27.

American Association of Engineers—Buffalo, May 9-11.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

American Society of Mechanical Engineers —Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A.—Annual convention, Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Section — Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

The Coal "Rider" and the Minimum Charge.—The State Corporation of Virginia has ruled that the Virginia Railway & Power Company cannot add the surcharge for fuel to its minimum charge. When the energy charge plus the coal charge is less than the minimum charge the bill must be for the minimum amount only.

Income Tax Must Not Be Charged to Operating Expenses.—The federal income-tax law, declares the District of Columbia Public Utilities Commission, thus ranging itself with various state commissions which have made the same pronouncement, contemplates that the burden shall be imposed on the corporations and paid out of their net profits and not passed on to the public, and this tax is, therefore, not a proper charge to operating expenses.

Deficit in Water Department Must Not Be Recouped by Increase in Electric Rates.—The Wisconsin Railroad Commission has granted to the Richland Center municipal electric and water plant an increase in its water rates but has refused an increase in electric rates, finding the latter adequate under the present schedules and declaring that no adequate reason exists why a loss on fire protection and unmetered water service should be met by the users of electrical energy.

Reasonable Return from Extensions an Essential Element.—A complaint asking that the Duquesne Light Company be required to extend its lines to furnish electric light to complainants was dismissed by the Public Service Commission of Pennsylvania, where it appeared that the territory to be served was sparsely settled and offered no prospects for development in the near future and where the return on the necessary investment over and above the cost of producing the energy and maintaining the service would amount to little more than 2 per cent.

Distributing Company Cannot Shift Responsibility for Poor Service to Selling Company.—An electrical company purchasing energy from another company will be held responsible for inadequate service and cannot excuse itself on the plea of poor service rendered to it by the selling company. So holding, the Illinois Public Utilities Commission allowed to the McHenry County Light & Power Company a return of only 6 per cent upon the rate base until such time as it shall maintain service in accordance with the standards of the commission. In the case at issue the Illinois company purchased its supply of energy from the Southern Wisconsin Electric Company, which in turn purchased from the Wisconsin Gas & Electric Company, the selling companies being in another state and beyond the jurisdiction of the Illinois commission.

Period of Repose—Filing of Schedule.—Within the time designated by a commission order, the New York Public Service Commission for the Second District has found, the statute provides that the prices fixed shall be the minimum to be charged for a period to be fixed by the commission not exceeding three years and there can be no further increase in utility rates by way of a service charge or otherwise. A utility company must, the commission held in the same case, instead of filing a tariff, apply to the commission for permission to increase rates filed by order of the commission.

Company Cannot Advance Rates by Merely Filing Tariff with Commission.—Although applying to the Public Service Commission of New York, Second District, for an order granting increased electric rates, the Rockland Light & Power Company maintained that under the law approval of its schedules by the commission was not obligatory except where the rates previously in force had been found unjust, and further maintained that it had the right to charge the new rates after the filing of its tariff. The commission approved the tariff as filed, but denied the company's contention just stated, asserting that, although the period of the commission's last previous order had expired, that order remained in effect until the commission should issue a new order to take its place. A concurrent petition from the company for permission to increase its gas rates by adding a service charge to a fixed maximum charge was denied on the ground that the term of the commission's last previous order had not expired.

Refusal of Service Not Justified in "Saturated" Community. — The Idaho Power Company objecting to extend service in cases where the investment cost would exceed the probable return for one year unless the difference between investment cost and yearly return were advanced by the applicant, the Public Utilities Commission of Idaho overruled the contention, asserting: "With this contention the commission cannot agree. This service is required in the city of Caldwell, which for many years has been served by this utility and where a fair state of saturation of service has been reached. It is reasonable to assume that in this city there are many individual services where the disparity between investment and return would equal or exceed the one under discussion, and also many individual services where the amount of revenue will equal if not exceed the cost of extension required to furnish, and to draw the line as proposed by the power company in the instant case would appear to the commission to be an attempt to collect the cream and reject the milk."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Attempt to Cut Fallen Electric Wires Where No Emergency Existed Act of Intermeddler.—A man somewhat familiar with electricity who discovered near his home the fallen wires of a power company, from which flames were issuing, and who first kicked them apart and afterward was injured in attempting to cut them in two, was an intermeddler and could not recover damages. This was the finding of the Supreme Court of New Hampshire in Croteau vs. Twin State Gas & Electric Company. The plaintiff maintained that he was actuated by fear that his children might meet injury from the fallen wires, but the court held that no emergency justifying the risk he assumed existed. (112 At. 397.)*

Damages Recovered Because of Fright Caused by Meter Reader Entering Without Knocking.—In Mollman vs. Union Electric Light & Power Company the plaintiff, a nervous woman, recovered judgment in the sum of $500 because of severe fright and subsequent illness alleged to have been caused by defendant's meter reader entering her house without knocking or otherwise making his arrival known in advance. The electric company appealed, maintaining that its contract with plaintiff's husband gave its meter reader the right to enter the premises in performance of his duty at seasonable hours. The St. Louis Court of Appeals sustained the verdict found in the lower court, holding that the manner of entrance was an invasion of the sanctity of the home. (227 S. W. 264.)

Oklahoma Corporation Commission Restrained.—In granting a writ prohibiting certain acts on the part of the Corporation Commission of Oklahoma, on the petition of Oklahoma City, the Supreme Court of the state held that the commission had no authority to require consumers of gas to pay an additional rate for the benefit of a public service corporation furnishing gas to the local company owning a franchise, the said supplying corporation receiving as remuneration a certain percentage of what the local company collects. Nor had the commission authority to make an order requiring the consumers of gas to pay a sum over and above a fixed rate for the purpose of creating a special fund which might be used in the future by the corporation with the commission's consent to build additional lines and compressor stations. (195 Pac. 498.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

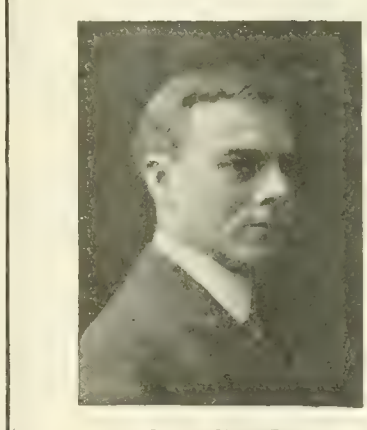
Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Dr. Ernest Fox Nichols, past-president of Dartmouth College and for the past year director of physical science at the Nela Park Research Laboratory of the National Electric Lamp Association, Cleveland, has been elected president of the Massachusetts Institute of Technology. He succeeds the late Dr. Richard C. Maclaurin. In the interim following the death of Dr. Maclaurin in January, 1920, Dr. Elihu Thomson of Swampscott, Mass., has served as acting president of the institute. Dr. Nichols has attained a brilliant reputation in the field of physics, and his broad experience as an educator and as a scientist is counted upon to give the institute an administration ranking with those of his distinguished predecessors. He was born at Leavenworth, Kan., June 1, 1869, and received the B.Sc. degree from the Kansas Agricultural College in 1888, M.Sc. from Cornell University in 1893 and Sc.D. from Cornell in 1897. From 1889 to 1892 he was a graduate student in physics at Cornell and from 1894-96 at the University of Berlin. He studied at Cambridge University in 1904-05. In 1903 he received the honorary degree of Sc.D. from Dartmouth College and later LL.D. degrees from Colgate, Clark, Wesleyan, Vermont, Pittsburgh and Denison universities and Dartmouth College. Dr. Nichols' early career includes professorial work in physics at Colgate University, Dartmouth College and Columbia University. From 1909 to 1916 he was president of Dartmouth College and from 1916 to 1920 professor of physics at Yale University. From 1907 to 1909 he served as research associate at the Carnegie Institution, Washington, D. C., and from 1917 to 1919 was attached to the Bureau of Ordnance, U. S. N. In 1905 he received the Rumford Medal of the American Academy of Arts and Sciences. He is a member of the National Academy of Sciences, American Philosophical Society, American Physical Society, American Astronomical Society and Washington Academy of Sciences and a fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science. He is a collaborator of the *Astrophysical Journal* and has contributed many papers to scientific journals in this country and abroad on radiation and other subjects. While working for the Bureau of Naval Ordnance during the war he developed certain valuable optical devices whose character has never been disclosed by the government. As a student in the physical laboratory of the University of Berlin he discovered the metallic reflection of quartz and its anomalous dispersion in the infra-red spectrum, which led at once to a new method of spectrum analysis by which the knowledge of the spectrum was increased to six times the previous limits.



E. F. NICHOLS

C. S. Ruffner, who has been associated in an executive engineering capacity with subsidiaries of the North American Company since 1911 and up to the present time has been vice-president and director of that company with headquarters in New York City, has resigned to become vice-president and general manager of the Adirondack Power & Light Corporation. Mr. Ruffner took up his new duties on April 1. The company with which Mr. Ruffner goes is an important factor in the development of the Mohawk and Hudson Valley sections of New York State. Mr. Ruffner's career as an engineer and executive was outlined in the ELECTRICAL WORLD for Feb. 19, 1921, page 447.



C. S. RUFFNER

P. S. Minner, the new district manager of the Southern California Edison Company at San Pedro, who was recently promoted from the Redlands district as announced in the ELECTRICAL WORLD, has a record of thirty years' experience in the electrical industry, having been connected with this business continuously since 1891. Following twelve years in the construction department of the Chicago Edison Company he took an active part in the organization and management of the Central Electric Company at Omaha, Neb. Because of ill health he moved to California and in 1912 entered the commercial department of the Southern California Edison Company, where he has successfully filled various positions in the district organization. In 1919 he was appointed assistant district manager at Redlands, a position he held up to the first of this year.



P. S. MINNER

Guido Semenza, a consulting engineer of Milan, Italy, who is the honorary secretary of the American Institute of Electrical Engineers in that country, will arrive in the United States on April 21 on a visit.

N. S. Franklin, superintendent of the New Britain district of the Connecticut Light & Power Company, Waterbury, Conn., has resigned. Albert S. Jourdan, formerly superintendent of the Waterbury district of the company, succeeds him in that capacity.

A. Becsey, chairman of the mechanical and electrical engineering section of the Hungarian Institute of Architects and Engineers of Budapest, is visiting this country for the purpose of re-establishing the friendly intercourse between Hungarian and American technical societies which formerly existed and was terminated by the great war. Mr. Becsey is making his headquarters at the Swedish Legation in Washington.

A. S. Gjolme, government engineer of Christiania, Norway, is making a tour of hydro-electric developments in this country for the purpose of studying the behavior of tunnels under pressure. Three Norwegian hydro-electric plants possessing tunnels operating under heavy pressures have developed leakage troubles.

Don N. Finlayson, who has recently succeeded W. J. Tideman as factory manager of the Tideman Electric Manufacturing Company, Cairo, Ill., was formerly general manager of the Detroit Pneumatic Chuck Company.



D. N. FINLAYSON

Prior to that he was associated with the Dodge Brothers Company of Detroit as efficiency engineer. During the war Mr. Finlayson was connected in an executive capacity with the United States Army's bureau of air-craft production. For more than twenty years he has served in responsible capacities in efficiency and production work.

James E. Watson, formerly sales manager of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been appointed general manager of that company. C. L. Brown succeeds Mr. Watson as sales manager.

D. H. Kelly has been appointed vice-president and assistant general manager of the U. S. Light & Heat Corporation, Niagara Falls, N. Y., to succeed C. L. Lane, who has resigned as vice-president and general manager of the company. For the past two years Mr. Kelly has been assistant sales manager of the Willys light division of the Electric Auto-Lite Corporation.

Frederick G. Simpson, formerly chief engineer and general manager of the Kilbourne & Clark Manufacturing Company and Ship Owner's Radio Service, Inc., Seattle, Wash., has established offices in the L. C. Smith Building, Seattle. He is prepared to undertake the design and to supervise the construction of electric plants, machinery and instruments, including lighting, power and communication systems.

R. F. Harrison, Cleveland representative of the Cleveland Electric Motor Company, has been transferred to Chicago as district manager, with headquarters at 1242 Monadnock Building.

T. F. Crawford, formerly St. Louis district sales manager of the Elliott Company, Jeannette, Pa., manufacturer of power accessories, has been transferred to the Philadelphia office in the same capacity.

E. N. Lightfoot has been appointed manager of the heating department of the New York works of the Cutler-Hammer Manufacturing Company, Milwaukee.

L. W. Hench has been appointed secretary and general manager of the International Oxygen Company, Newark, N. J., succeeding Eugene Schoen, who has resigned.

T. G. Whaling, general manager of the Westinghouse Lamp Company, accompanied by R. W. Murphy, Pacific Coast manager of the Westinghouse Lamp Company, is making an extended business trip through the Western States.

L. B. Timmerman has been placed in charge of the Cleveland office of the Cutler-Hammer Manufacturing Company, Milwaukee, to act in the capacity of assistant to A. G. Pierce, manager of the central district

G. S. Crane, formerly manager of the Cleveland office of the Cutler-Hammer Manufacturing Company, Milwaukee, has been appointed manager of controller sales at the main office in Milwaukee.

Stuart Bartram, formerly electric range specialist for the Edison Electric Appliance Company, Chicago, has been appointed general sales manager for the H. G. Weeks Manufacturing Company, Hamilton, Ohio, manufacturers of electric ranges and sterilizers.

M. F. P. Green has recently been appointed Southern sales manager of the Arrow Electric Company, Hartford, Conn., manufacturer of electric wiring devices. His headquarters will be at 804 Continental Building, Baltimore. Mr. Green will have charge of sales in all the South Atlantic States.

George J. Blanton, who for the past four years has been connected with the engineering sales department of the Chain Belt Company, Milwaukee, has been made New York district manager at 50 Church Street, New York City. Previous to 1917, Mr. Blanton was associated with the General Electric Company for eight years, three years of which were spent in Schenectady, N. Y., and the other five in the Milwaukee office. Since Mr. Blanton has been with the Chain Belt Company he has been prominently connected with the largest installation of traveling water screens yet on record as well as with various conveying installations all over the country. Mr. Blanton is a graduate of the University of Michigan department of mechanical and electrical engineering, class of 1909.

Robert C. Weller has been appointed general sales manager of the Lakewood Engineering Company, Cleveland.

Wallace B. Conant, proprietor of the Conant Machine Company, Concord Junction, Mass., manufacturer of power-driven loading equipment, has been elected chairman of the Concord municipal lighting board.

Gilbert E. Ryder has been appointed vice-president in charge of sales for the Locomotive Superheater Company, manufacturer of superheaters and boilers, with offices in New York. Mr.



G. E. RYDER

Ryder entered the employ of the Locomotive Superheater Company ten years ago as a member of the service department and later took charge of that department, which today is responsible for the operation of 30,000 superheaters on locomotives in this country. He also developed and had charge of the publicity department. Mr. Ryder was deputy smoke inspector for the city of Chicago in charge of locomotives.

Obituary

Willis H. Trenner, chief engineer and superintendent of power for the Idaho Power Company, Boise, Idaho, died in New York City on March 6 from pneumonia. He had been in New York since January on business for the company. Mr. Trenner was born in Glenwood, Wash., June 4, 1879, and was graduated from the Washington State College in 1903. He went to Idaho in 1908 to install an electric power plant at the De Lamar mines at Silver City, and in March of that year he was appointed general superintendent of the Idaho-Oregon Light & Power Company, holding the same position with the Idaho Railway, Light & Power Company until 1914. When the Idaho Power Company was formed in 1915 Mr. Trenner was made chief engineer and superintendent of power, a position he had held ever since.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Refractories Production Low with Light Steel Trade

WITH the general dependence of refractories manufacturers on the steel trade, it is no wonder that expressions of opinion from about forty-seven different manufacturers, represented at their annual meeting in New York on March 16 to 18, showed that business was dull and could hardly be expected to pick up to any great extent till fall by the earliest and possibly not before next spring. There were only two or three good business reports.

These manufacturers generally establish their plants near coal mines, to be near their source of fuel supply, and near steel mills, to be near their principal market. Consequently their wage scales are regulated largely by the wage scales paid by those two industries. Still, this year there have been two wage cuts, each following a price cut of about 10 per cent in the refractories industry. Further reductions in steel prices and wages, it is thought, would immediately result in general business activity on an increasing scale.

The electric furnace industry has called for materials of a higher refractory power than were previously used because of the greater heat generated. This business is continually growing, so the refractories companies have been expanding their services in this direction. There is no delay experienced in making shipments on any kind of order.

Improvement Shown in Market for Electric Ranges

SALES of electric ranges have started to show their usual spring increase, according to a survey of manufacturers in this field. The volume of business as yet is not large, but an increasing number of inquiries and the general slight improvement in orders that has been noted lends a basis for optimism that the year's business will be good.

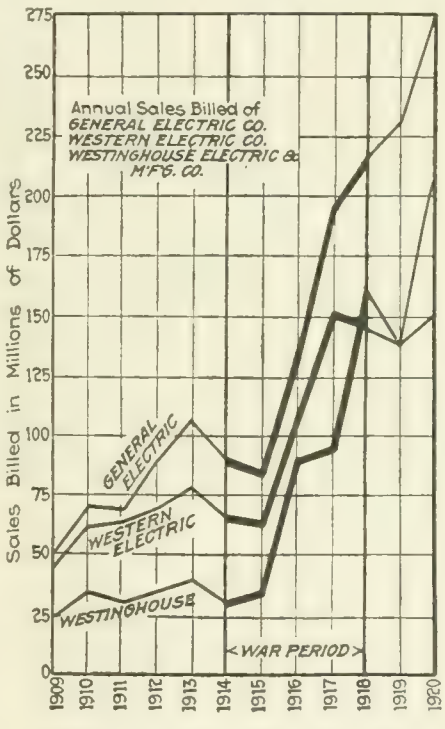
In the East manufacturers report a noticeable increase in demand within the past month. On the Pacific Coast business has been recently stimulated by price reductions, while in the Intermountain section of the West and also in Chicago territory prospects for good sales are seen and jobbers and central stations are stocking. In the South and in St. Louis territory, however, trade in this line has remained extremely dull.

An increasingly important aspect of the range market, it is reported, has been the demand for heavy-duty equipment used by hotels, bakeries, restaurants, etc. For one thing this load is generally favored by power companies because the installation is most often in a downtown city district where line equipment facilities are adequate, and the current load of this type of range is pretty evenly distributed over the day and night. Because the converse of these conditions is often true of domestic range installations, many central stations unfortunately are not inviting this class of business. As a result, not enough attention has been devoted to the question of special cooking rates, and in many communities such as New York City the prohibitive cost of operation materially holds down sales.

Reports from different parts of the country indicate that consumers have considered range prices too high, and even in those instances where price reductions have been made reluctance is very often displayed to make an investment such as the first cost represents. Some manufacturers since the first of the year have reduced prices 10 per cent and even more while others as yet have not lowered prices. In some of these latter cases stocks of high-priced material have been held, but despite this reductions will ultimately be made, it is expected. In line with the general declining market producers are not stocking heavily, but surplus supplies both at factory and with distributers are sufficient to insure immediate shipments for the present.

Three Producers' 1920 Sales Total $632,000,000

BILLINGS for the calendar year 1920 of the three largest electrical manufacturers again show an upward trend and the total amount reaches approximately $632,000,000. The reports of the General Electric Company and of the Western Electric Company have been made public, while the figures used for the Westinghouse Electric & Manufacturing Company are the result of an estimate, as the fiscal year of that company closes March 31. Sales billed of the Western and Westinghouse companies declined in 1919, but they are again on the up grade. The previous year's billings were about $500,000,000.



SECOND POST-WAR YEAR SEES SALES TENDING UPWARD AGAIN

Bookings of all the companies were at a high rate over the first half of 1920, much higher than the final figures show. At one time General Electric was receiving orders at a rate of a million dollars a day. But in the latter half of the year these orders receded to a great extent for all the companies. During the three months of this year General Electric's bookings have been running around $4,000,000 a week, or about $17,000,000 a month. Westinghouse has been receiving orders at the rate of about $7,300,000 a month for these three months.

At the end of December, 1920, unfilled orders on the books of General Electric amounted to $111,800,000; Western Electric had $83,000,000 unfilled. An estimate of Westinghouse unfilled orders at that time is $79,500,000.

From present indications it hardly seems possible that 1921 buying will resume in time on a buying basis sufficient to exceed the figures of 1920. The greatest drawback is stated to be the cost of money. Public utilities all over the States have extensive plans already drawn to push out their lines into new territory, to increase present capacity and to build entirely new stations. Foreign exchange depreciation is holding back much needed development in other countries. Although electrical apparatus of any class costs less today than it did last year, still money costs so much

that the utilities cannot afford to borrow it. At the same time the electrical manufacturing field never presented such possibilities for continued large business as at present.

February Exports Show Total of $13,632,478

ALTHOUGH the total electrical exports for the month of February, 1921, are nearly $2,000,000 less than those for January, they are nevertheless higher than any other month previously on record except those of last December. Last October the exports really took a decided jump of more than two millions and in November went over the ten-million mark; December was over thirteen millions, January, 1921, was over fifteen millions, and now February keeps up the record with $13,632,478.

Total exports to date this year amount to $28,965,433. The first four months of last year were just under this figure. The entire year 1913 was the first to approach this figure,

	February 1920	February 1921	Two Months Ended — February 1920	February 1921
Batteries	$526,972	$451,756	$901,702	$1,107,468
Carbons	76,586	62,337	216,226	133,160
Dynamos and generators	363,340	774,607	776,633	1,404,068
Fans	78,756	309,373	98,343	667,817
Heating and cooking apparatus	140,020	381,742	243,839	673,288
Insulated wire and cable	567,036	1,123,873	1,228,878	3,571,527
Interior wiring supplies	195,514	377,540	364,403	799,555
Arc lamp	172	1,234	262	2,664
Carbon-filament lamps	9,746	14,804	16,879	23,879
Metal-filament lamps	363,391	597,917	575,088	1,218,351
Magnetos, spark plugs, etc.	251,876	159,513	513,418	463,413
Meters and measuring instruments	219,454	375,705	407,577	774,583
Motors	828,727	2,426,433	1,563,963	4,490,857
Rheostats and controllers	86,482	114,235	105,040	275,488
Switches and accessories	381,203	663,566	675,239	1,460,812
Telegraph apparatus	16,750	56,069	200,154	155,742
Telephones	253,457	819,802	483,643	1,479,175
Transformers	295,185	1,320,481	645,549	2,245,853
All others	1,930,537	3,601,491	3,898,689	8,017,733
Total electricl mach'y	$6,585,204	$13,632,478	$12,915,525	$28,965,433

with $28,197,363. In the two years following the exports fell off, but in 1916 they rose again, this time to $40,244,075. And now in two months the business is bringing in nearly thirty millions.

Increases for February over January are not large on individual items, but are shown for dynamos and generators, heating and cooking apparatus, carbon-filament lamps, motors and telephones. If this average keeps up for the whole year, the total for 1921 will be more than $170,000,000.

The Bureau of Foreign and Domestic Commerce is responsible for the figures in the table.

Slight Break in Insulation Prices

ALTHOUGH prices of insulating material in general have for some time been about holding their own, further reductions on a few items have been announced recently. A standard grade of friction tape was reduced in price 6 cents per pound on April 1, a drop of 15 per cent. On the same date all varnished cloths were reduced about 7 to 8 per cent by the same company. On March 28 another manufacturer lowered the price of woven cotton tape, the cut on the 1-in. width being from $1.42 to $1.10 per gross yard.

The general view expressed by representative manufacturers is that prices in this line can hardly go lower. Cotton, rubber, shellac, etc., are all at unprecedently low figures, and the general average drop on all classes of finished insulating material has amounted to at least 33⅓ per cent, according to the estimate of a well-known manufacturer. Spot cotton at New York is quoted at 11.90 cents per pound at present. Consumers however, apparently are not yet satisfied that insulation prices have hit bottom as buying remains from hand to mouth for the most part.

Electric railways are making light repairs. Repair shops are buying such material as they need, but their present requirements are small. Manufacturers of finished products such as motors have greatly curtailed production. These outlets account for a considerable number of orders that are being received, but each order is usually small in size. There is a pretty good industrial market for motor repair work, especially steel mill, at present. There is little question that the existing market is quiet and will probably remain so for some time. Distinct optimism is manifest among manufacturers, however, as the expectation of better business persists. There has been, in fact, some slight trend toward improvement already noticed in some quarters in the number of inquiries received this month.

Stocks of finished material have been purposely kept rather low by producers, who have materially curtailed production under present market conditions. The supply is in virtually all cases quite adequate to cover present needs with immediate shipments, however.

Germans Again Undersell Electric Export Market

WORD comes from the ELECTRICAL WORLD'S correspondent in Sweden that all German business seems to be in one great muddle with no one very much concerned. Even so and with the high export fees, Germany continues to outsell everybody, thanks to the rate of exchange. The Swiss railroads, for instance, are offered Brown-Boveri electric locomotives for 1,000,000 francs apiece, while the A. E. G. offers the same thing, f.o.b. Switzerland, for 600,000 francs.

In one thing only does this correspondent find that the Germans are high, and that is insulators. One very large order for the Swedish Board of Waterfalls went to an American company at a price laid down in Sweden that was lower than the Germans could meet. A good many of the insulators of American make are seen in Europe.

The Metal Market Situation

THE copper market presents little change over a week ago, but encouragement is taken from the producer's standpoint that the recent gain in prices has been held. There is not a great deal of current buying, but now that radical cuts in production have been made to a point where it may be safely said that output is less than consumption, the market looks better. Producers are holding electrolytic for prompt shipment firmly at 12.75 cents delivered and 13 cents covering the second quarter. Foreign buying is light and may be expected to continue so in view of the coal strike in England, the Allies' advance into Germany and the recent doubling of ocean freight rates on copper affecting French Atlantic ports, Hamburg, Rotterdam and Antwerp.

The "official" price of lead, following the slight advance of last week, has again moved upward, and the market has a strong tone. Foreign competition in zinc has aided in unsettling the domestic market, which is quiet with production much curtailed. Scrap heavy lead has moved up with the parent metal but light brass is lower.

A discouraging feature to producers who have closed down their properties is the volume of copper imports which have been coming in at a rate of about 40,000,000 pounds in January and February and about 30,000,000 pounds in March.

NEW YORK METAL MARKET PRICE

	March 29, 1921	April 5, 1921
Copper	£ s d	£ s d
London, standard spot	69 12 6	68 7 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	12 75—13 00
Electrolytic	12 50—12 75	12 75
Casting	12 00	12 00
Wire bars	15 00	15 00
Lead, trust price	4 10	4 25
Antimony	5 12	5 12
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 15	5 15
Tin	29 25	28 75
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9 50—10 00	9 50—10 25
Brass, heavy	5 50— 5 75	5 50— 5 75
Brass, light	4 00— 4 25	3 75— 4 00
Lead, heavy	3 12— 3 62	3 50— 3 65
Zinc, old scrap	2 87½— 3 00	2 87½— 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WITHOUT any particular spurt in business, the trend of buying seems to be always upward—slowly upward. At the same time strikes in Boston and impending lockouts in Massachusetts, the state legislative investigation into building construction at Chicago and unsatisfactory negotiations between building contractors and the unions in St. Louis all tend to hold up construction in those territories. Building is better in the South, and farmers are planting. There the municipalities and utilities are the most active. The utilities on the West Coast are also very active in the pole and cross-arm market. Collections are improving in New England.

There have been few general price changes this week, although the safety switches and knife switches of one producer are off and insulation is quoted lower. Jobber buying is light, but one New York jobber reports a return to stock buying on the basis of low price levels. Stocks are good with jobbers and manufacturers and shipments quick.

NEW YORK

The tone of trade this week is decidedly more optimistic than has been the case for some time past. Jobbers report that general sales are improving, more inquiries are received and there is more strength and volume to demand. This condition is not noticeable in the form of any decided buying spurt, however, rather in a very slowly improving market whose pulse one must continuously feel to notice the change. Several supply jobbing houses report that total sales for March went ahead of January and February.

There is still a great deal of shopping around on the part of consumers, and prices are so shaky that on many items a buyer almost makes his own price. Safety and open knife switches were reduced in price by a leading manufacturer the first of the month.

For the most part jobbers are pursuing their previous policy of not stocking material this spring but of depending upon current supplies and replenishing them from other jobbers or manufacturers as needed. One representative house at least, stating that it expects no further radical price declines, has now started to lay in a sizable stock on all standard items, varying from a two to a three months' supply.

Conduit.—The market on ½-in. block this week ranges from $63.75 to $71.50 and for 1-in. black from $131.60 to $137 per 1,000 ft. in 2,500-ft. lots, though higher prices than this are held. Demand is spotty among different houses, with good stocks.

Flexible Armored Conductor.—Sales are not heavy, but seem to be on the increase, small repair jobs accounting for a considerable number of orders. No. 14 two-wire, double-strip, in 1,000-ft. lots, is quoted from $62 to $66.

Rubber-Covered Wire.—Plentiful supplies are moving, although slowly. No. 14 single-braid brings from $7.50 to $8.25 per 1,000 ft. in 10,000-ft. quantities.

Porcelain.—Demand is very slight with fair stocks on hand. Jobbers' prices are "all over the lot" since the reduction of last month.

Outlet Boxes.—Stocks are about normal, but demand is at a very low point. Discounts offered by jobbers cover an extremely wide range, in lots of 100, varying from 29 to 40 per cent on black boxes and from 21 to 35 per cent on galvanized.

Sockets.—On pulls listing at 60 cents each, keys at 33 cents and keyless at 30 cents jobbers allow from 18 to 20 per cent discount in standard packages. Stocks vary greatly in size but are being held down as much as possible as supplies are not moving very much.

Safety Switches.—Some jobbers report little demand, while others say it is picking up and is fairly good. Stocks are spotty. The Trumbull Electric Manufacturing Company on April 1 reduced the price of safety switches approximately 14 per cent and open knife switches about 10 per cent.

Dry Cells.—Demand is only fair with average stocks on hand. Some talk is heard of the need of lower prices, but quotations remain unchanged, with No. 6 in barrel lots worth 36 cents.

Bells and Buzzers.—Stocks of the small house types carried by jobbers are small and orders are few and far between. Manufacturers' stocks are large, but in several instances production is continuing on the expectation of a demand coming from new building work. Railway types and burglar alarms are moving slightly better than the small sizes. Prices remain unchanged.

CHICAGO

Expected stimulation in the electrical trade has thus far failed to make itself felt in spite of the volume of housing construction that has been put under way in the past few weeks. Building activity has been brought to an abrupt halt by the action of the State Legislature in appointing a committee to investigate all phases of the construction industry in Cook County. Prospective builders are marking time until they see the outcome.

The local situation depends largely on the action of the members of the Chicago Building Trades Council next week. The contractors have submitted a new wage scale based on $1 an hour for skilled labor, a cut of 20 per cent. The acceptance of this scale has been put up to a referendum of the membership, on which the vote is to be taken next Tuesday. An acceptance is anticipated and should be the forerunner of an immense amount of work.

Bare Copper Wire.—Quoted on an 18-cent base to contractors, No. 8 bare copper wire is 18½ to 19 cents per pound in 500-lb. lots and No. 10 is 20½ to 21 cents. Quoted prices are being adhered to by most jobbers, there being less willingness to shade prices in order to get business. A steady and slightly stronger New York market on electrolytic copper has tended to strengthen the local market in copper products.

Insulated Wire.—Rubber-covered wire has shared in the price stiffening process, $8 per 1,000 ft. now being the quoted price on No. 14 in 5,000-ft. quantities, with no price cutting reported. Weatherproof remains on an 18-cent base, with No. 6 triple braid priced at 19 cents in 1,000-lb. quantities. Business in insulated wire is light.

Magnet Wire.—Jobbers report fair business in the more popular sizes with stocks just about right to meet current demand. No. 14 double-cotton-covered is quoted at 29 cents per pound. Prices are firmly held and any variation in the near future should be upward.

Black Conduit.—Demand remains very light and stocks in all hands are approaching the high point. Less disposition is noted, however, to shade prices. The ½-in. size is priced at $64 per 1,000 ft. and 1-in. at $135 per 1,000 ft. in 5,000-lb. lots.

Flexible Armored Conductor.—Demand is very light. Prices are firm, No. 14 two-wire double-strip being priced at $62 to $62.50 per 1,000 ft.

Fuses.—Consumption of fuses has fallen off in proportion to the shrinkage in general manufacturing activity, and all hands hold ample stocks. No price reductions are found, and a rather stronger tendency is noted.

Knobs and Tubes.—Available supply now seems fairly plentiful and prices are considerably firmer, there being absolutely no variation from quoted prices. In barrels the No. 5½ split knob is $18.80 per 1,000. Porcelain tubes, 3 in. x ⅝ in., in barrels, are $8.30 per 1,000.

BOSTON

Business is marking time this week, disturbed labor conditions holding back buying of electrical supplies. Strikes in Boston are influencing interior conditions somewhat. In New England building and engineering contracts for the week ended March 29 totaled $2,770,600. A better feeling is noted in electrical manufacturing circles in this section with the advent of spring. Jobbers are buying lightly and deliveries are good in almost every line. Collections showed a slight improvement in the last week. Stocks are low among distributers and in many lines factory stocks have been accumulated to afford prompt shipment in case of demand arising. Part-time operation continues in not a few industrial plants. House-wiring campaigns in some cities are yielding excellent results.

Wire.—The market is sluggish, with steady prices. Rubber-covered No. 14 is settling at $8 per 1,000 ft. in 5,000-ft. lots; weatherproof is steady at 17 cents base, and demand is light for bare.

Ranges.—Awakening interest in this class of equipment is noted in retail sales departments, and early orders are anticipated for installations to be completed before summer. Distributers report that the outlook is better than for some time.

Motors.—Large stocks have been built up in the factories, and little trouble is experienced in obtaining prompt shipments of virtually all of the commonly used sizes and types including fractional-horsepower machines. Prices show little movement at present.

Flexible Armored Conductor.—A quiet market is evident with fair stocks and little prospect of increased demand until construction work develops better. No. 14 double-strip sells this week at $67 per M in 1,000-ft. lots.

Non-Metallic Flexible Conduit.—Slow sales are reported with steady prices and good stocks within easy reach. For ⅜-in. $22 per 1,000 ft. is being obtained, and the ½-in. size commands $24, both in 5,000-ft. lots.

Dry Cells.—A moderate trade is being handled with ample stocks and steady prices. In barrel lots the No. 6 cells bring $37.35 per 100 and the ignition type $38.35.

Flashlamps.—A fair renewal business is going across the counter and new sales are coming along well. Buying is, of course, light compared with business times, but the staple demand tends to increase.

Appliances.—Vacuum-cleaner sales are reported dull and domestic heating devices are moving very slowly at present. Hand-to-mouth buying is the rule. Popular interest is not abating, however, in washers and ironers. Radiant heaters are at present rather overstocked but good sales are expected in the near future when the fires are let out. Sewing-machine motors are being featured in sales efforts this month. Fans are not being stocked much, many having been carried over from last season. Interest in industrial electric heating equipment is being shown in the interior.

Street-Lighting Equipment.—New life is appearing in this market, owing to interest displayed in communities considering extensions of or improvements to old systems.

ATLANTA

Taken as a whole business shows a slow but nevertheless tangible improvement this week over prior weeks of this year. The spring season has ushered in activities in the farming section and planting is well under way in the southern portion of the state, while the ground is being prepared in the northern portion. Farm labor is reported plentiful and of improved efficiency. As nearly all of the cotton has been put up as collateral on loans, the slight improvement in the sale of it will not put any money in the hands of the sellers but is relieving bank conditions and will tend to make money slightly easier in the section affected. The retail trade in nearly all of the smaller towns is very slow and merchants are loathe to place heavy orders, as they are unable to collect their outstanding accounts.

Building activities are showing a healthy increase, especially in the larger cities. Permits for March in Atlanta number 350, valued at $1,094,000, a value greater than for the two prior months combined. Jobbers report conditions improved in Columbus, Savannah and Albany, though the rest of the section is somewhat quiet, most of the inquiries received at the present time coming from utilities and municipalities. Industrial plants have settled back into an inactive state after an apparent reawakening sixty days ago. A large number of the cotton mills in the section are still shut down or on a part-time basis.

Poles.—The market is very dull, few orders are being placed and even inquiries are scarce. Producers have large stocks on hand, but there is no immediate prospect of fresh activity.

Watt-Hour Meters.—Jobbers have succeeded in accumulating fair stocks of the more popular sizes, which continue to move satisfactorily, the demand being for the 5-amp. and 10-amp., two-wire and three-wire types. No price reductions are to be noted.

Washing Machines.—With heavy stocks on hand, the trade is welcoming a slight increase in the activity of this line. The agitation for a greater margin of profit continues to be the subject of much discussion among the retailers.

Lightning Arresters.—A price reduction of 15 per cent on the compression type, 2,300 volts, is reported this week. The approaching summer season is causing a brisk movement in this line, and stocks are reported in good condition.

Pole-Line Material.—Though poles are not moving, crossarms, hardware and insulators are reported fairly active. Jobbers' stocks are in excellent shape. Prices, standard fir arms, four-pin, 4-ft., 78 cents; braces, ⅜-in. x 24 in., $17.92 per 100; pins, ¼-in. x 8 in., $4 per 100; brackets, $4.28 per 100.

Switch and Outlet Boxes.—While the volume is small, steady orders are being received for this line. Local stocks are in good condition, with prices on switch boxes at 28 cents for the single-gang type, 50 cents for the double-gang.

Wire.—Rubber-covered continues to be the more active, though weatherproof is being moved in sizes Nos. 6, 8 and 10. Local stocks are in good shape, with prices for rubber-covered on a 16-cent base and weatherproof on a 15½-cent base.

Heating Devices.—No movement in this line is reported, while jobbers throughout the section are still found with very heavy stocks on hand. This is particularly true of flatirons, though this item should begin to show signs of life in the next thirty days.

ST. LOUIS

Construction work awaits only a reduction in labor costs to open up in substantial manner, but the wage situation, contrary to expectations, is becoming more difficult rather than better. The building contractors and the unions are not only getting nowhere in their negotiations but a lockout in the concrete trade is now reported because the men will not accept a reduction in wages. Sales of electrical goods will probably continue to show gradual improvement, but are not expected to be generally normal until the wage difficulty is settled.

Some apprehension was felt over the recent freezing weather, but it is reported that wheat and other crops were not injured and only the early fruit crop was affected. The effect on the electrical industry will probably be nil.

No changes in prices for the week are reported. Stocks where heavy are gradually being reduced. Slight increase in demand is noted, and while jobbers and dealers are by no means jubilant, they are fairly content with the situation and look to the future with confidence.

Wire.—No. 14 rubber-covered is selling satisfactorily, but the larger sizes are moving slowly. The price as a rule is from $7.50 to $8.10 per 1,000 ft., but one instance is reported where a large block was sold for $7. A fair demand for bare and weatherproof is found. Bare wire is selling on a 15½-cent to 16½-cent base, but one jobber has quoted on a 14-cent base. Weatherproof is selling on a 16-cent base. Stocks in these three kinds are in good condition.

Flexible Armored Conductor.—Stocks are rather heavy and the demand is slow; No. 14 is quoted from $65 to $80 per 1,000 ft.

Magnet Wire.—The market for magnet wire is virtually dead, manufacturers having enough on hand to take care of the requirements for some time. Jobbers' stocks are being kept down. Quotations are on an 18-cent base.

Lamp Cord.—This is selling fairly well in a very competitive market. No. 18 cotton twisted is selling at $17.50 per 1,000 ft. and No. 18 silk at $33.45 per 1,000 ft.

Schedule Material.—Stocks are spotty and selling is on a close basis. Movement is very slow in most items.

Insulators.—Demand for glass insulators is quite dull, stocks are in good shape and no change in price has been reported for some time. The demand for porcelain insulators is good and shows improvement. Stocks are practically exhausted and thirty-day to sixty-day deliveries are offered.

Fuses.—The demand for fuses is better than it has been for the last six months and they are selling well. Stocks are complete and in good condition.

Poles and Cross-Arms.—Pole-line construction shows more activity than any other line. Inquiries are on a normal basis and attractive orders are appearing. A number of municipalities within a 100-mile radius of Keokuk are interested in obtaining water power, and some bond issues are being promulgated. Ranier fir arms, 3¼ in. x 4¼ in., are quoted as follows: Two-pin, $46.73 per 100; four-pin, $62.30; six-pin, $93.46—all for quantities over 1,000 arms. In quantities less than 1,000 the two-pin arm is quoted at $52.57.

Ranges.—A 20 per cent increase in residential gas rates just announced may tend to stimulate local range sales, but the demand at present is extremely dull.

SEATTLE—PORTLAND

Prospects for 1921 crops of all kinds in the Northwest are reported as exceptionally favorable. Wheat has come through the winter satisfactorily, and there will be virtually no re-seeding. Opportune rains and warm weather have caused deciduous fruit trees to bud and blossom profusely, and if unseasonable frosts do not occur, their yields should be record ones. Lumber mills in this district continue gradually reopening, but production is still only about 42 per cent of normal period. Reductions announced in transcontinental freight rates to St. Paul, Omaha and Chicago, as well as charter rates to the Orient, are expected to benefit lumber manufacturing interests, and prospects for the remainder of the year are bright. The peak of non-employment has been passed, and resumption of operations in mills and logging camps and the Alaska mines, coupled with the beginning of agricultural activities, is gradually relieving the congestion in the cities.

Manufacturers in both the Seattle and Portland fields report conditions practically unchanged and prospects very poor for any material improvement before well along into the second quarter. Jobbers say that business is far from brisk. Short buying is still the rule, owing both to a continuation of the buyers' strike and a feeling by the dealer that prices have not reached the bottom. As if in response to this feeling, prices continue tending downward, although the decline is very gradual. During the past week reductions were noted in porcelain, fuses, conduit, telephones, bells, buzzers, etc.

Heaters.—Jobbers have full stocks, and it will probably be necessary to sacrifice them at less than cost to move them. Demand is negligible.

Ranges.—Demand has not shown the increase predicted; if anything, the movement has slowed up. Stocks of all standard lines are reported in good condition and replenishments are easily obtainable.

Vacuum Cleaners.—During the past week in Seattle both jobbers and dealers have reported a considerable increase in sales, and it is believed the long-anticipated movement has actually started. All types are in fine shape. Prices have shown no recent chance.

Schedule Material.—Demand is showing a slight increase from week to week; still the volume is not nearly as large as anticipated. Building gives every indication of beginning, but the major portion of new construction is confined to homes.

SAN FRANCISCO

In glancing around the larger California cities there is noted a surprising amount of large building which is now about ready for the electrical work. However, there is a shortage of jobs just now; for while a number of permits are being issued it appears that many of them are being held over. Counter business picked up considerably during the last two weeks of March and appliances are moving much better. Manufacturers, jobbers and dealers have combined to restore confidence in the market and to convince the public of the justice of prevailing prices, and a healthier tone is manifested.

Collections are good. Particular attention is being paid to a common-sense method of accounting to be used uniformly by electrical dealers. Several of the jobbers have supplemented the staffs of their credit departments by the addition of a sort of traveling accountant. It is predicted that the prosperity of districts dependent upon certain fruits, vegetables and nuts, will be seriously affected by the inability of packers and growers' associations to come to terms over standard prices. This has resulted in the carrying over of huge stores of unmarketed fruit into 1921. Packing and canning firms have curtailed their operations.

Poles.—One class of customer that is buying heavily at the present time is the power companies. Many carload orders of poles have been received for shipment to various companies. Local stocks are small and for emergency purposes only. The orders received are for direct shipment from the mills in the Pacific Northwest. About fourteen carloads of poles have been ordered during the last week or so.

Cross-Arms.—In this line, too, many good sales are reported. Deliveries are now good because of the gradual restoration of better labor conditions and normal business at the mills.

SALT LAKE CITY—DENVER

The industrial event of outstanding significance in the Intermountain section is the complete shutdown of the copper mines. Operations are at a standstill, and when activities will resume no one ventures to say. Electrical men, along with all other classes of merchants and jobbers, are going to be both directly and indirectly affected as the copper mines have been large users of energy. The cessation of mining work will thus create a surplus of energy that it will be difficult to divert without some radical readjustments. The copper companies have also been among the best and most regular customers of jobbers for electrical materials and equipment. This large demand will cease forthwith and leave merchants seeking new outlets.

The indirect effect will be an immediate and marked falling off in the demand for line materials and electrical supplies on the part of the central stations. It is felt that there will be months ahead of marking time and retrenching in building and construction work. In spite of the new discouragement, however, business men are determined to push ahead and to bring about the much-needed regeneration in trade and commerce. In late months they have acquired the habit of optimism and are not disposed to be downhearted over the calamity to the copper industry. A movement that is being watched with eager interest is the boring for oil in southeastern Utah by the National Oil Corporation. If oil is found in commercial quantities, electric companies will immediately construct lines to the bases of operation. This will mean electric service to hundreds of new homes and a boom in the electric industry generally. Collections are unimproved. Shipments are good and jobbers' and dealers' stocks generally satisfactory. Noticeable improvement has been made in the building situation, interest being especially shown in the construction of new homes and apartment houses in the larger cities.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Doubled Capacity of Colonial Chandelier Works

With its plant running full and even for a couple hours at night, the Colonial Chandelier Works, 122 Center Street, New York, is making alterations and adding machines which will about double the capacity. At the same time, the company is extending its distribution through electrical supply jobbers throughout the Eastern and Middle Wstern States.

Improved Stock Service for Piedmont Electric

The Piedmont Electric Company, Ashville, N. C., announces that it has been made direct factory representative in its territory of Duncan meters and transformers. This jobber has sold these products exclusively for fourteen years, but now it expects to be able to give better service under its new arrangements. It can make immediate warehouse shipments on transformers up to 10 kw. in standard voltages and alternating-current meters in single-phase and three-phase up to 50 amps.

Gregory Electric's Balance Sheet Favorable

The Gregory Electric Company, Sixteenth and Wood Streets, Chicago, dealer in used electrical machinery, shows a surplus as of March 1, 1921, of $258,-756, as against $204,413 on that date of 1920 and $203,542 in 1919. Total assets on those respective dates amounted to $790,681, $498,685 and $475,351. On March 1, 1921, materials, supplies and stock in process of manufacture were worth $267,864. The company's earnings were high in 1916 and 1917, but dropped off in 1918 and again in 1919. In 1920 they advanced again 33 per cent.

Another Citation on Alleged Unfair Competition

Upon application for the issuance of a complaint, the Federal Trade Commission has, as required by law, the public interest appearing, cited the Standard Electric Manufacturing Company, Chicago, in complaint for the use of tying contracts and unfair competitive methods in the manufacture and sale of electric appliances in interstate commerce.

The tying feature of the contract to which the complaint is directed provides that customers of the Standard Electric Manufacturing Company agree not to solicit orders for or to sell goods of any kind or character that will compete with the goods of the respondent. In consideration of this tying feature the complaint further shows that the Standard company allows a discount of 10 per cent to those of its customers who faithfully perform this contract and refrain from handling competing lines of goods. The complaint avers that this practice lessens competition.

The complaint is also directed to the company's system of fixing prices at which its appliances are sold upon condition that its customers will maintain such standard prices fixed by the company. Thirty days are allowed for filing answer, after which time the case will be heard on its merits on May 17, or as soon thereafter as it can be reached on the calendar.

Larger Space Bought by Bullock Manufacturing Company

When the Bullock Manufacturing Company moves into the building it has just purchased at 356-358 West Fortieth Street, New York, in July or August, it will have available for manufacturing lighting fixtures and equipment about 150 per cent more space than it has at present at its works at 408 West Thirteenth Street. Whether all this space will be used for this purpose will be determined by business conditions later in the summer. The company is working full time now and has a good volume booked ahead. The new building is six stories, 40 ft. x 50 ft.

Trumbull's February Billings Good

February of last year was supposed to be a pretty good month in the electrical business. February of this year couldn't have been so bad for the Trumbull Electric Manufacturing Company, Plainville, Conn., for, according to the March *Trumbull Cheer*, the company's factory output for February, 1921, was ahead of that of February, 1920. The company billed out more stuff this February than last.

Graton & Knight's 1920 Business High

In its annual report for the year ended Dec. 31, 1920, the Graton & Knight Manufacturing Company, Worcester, Mass., leather-belt manufacturers, states that it has rounded out the year with its sales by far the best in its history, with the single exception of the war contract period in 1918. The year ended with the company in a strong financial position. The loss sustained by shrinkage in value of inventories has been considerably offset by strenuous sales efforts and by reduction in the production costs and general overhead expenses. January of the present year shows considerable improvement in business over December, 1920—the company's low point—and February and March have shown still further improvement. The present financial position also shows a decided improvement over that of Dec. 31 by reason of a substantial reduction in the liabilities. Surplus, after allowing for plant values, amount to $3,929,-862.

Reorganization of Consulting Engineers' Business

Johnson & Benham, Inc., consulting engineers of New York and Kansas City, Mo., announce the reorganization of the business. All contracts and business of the New York office have been taken over by the George A. Johnson Company, Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are at 150 Nassau Street, New York. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren, a partnership consisting of Webster L. Benham and Arthur L. Mullergren, with offices in the Firestone Building, Kansas City.

New House Organ of Hygrade Lamp Company

The Hygrade Lamp Company, Salem, Mass., is issuing through its lamp distributers and jobbers a new house organ called the *Hygrade Triangle*. The sheet is for the purpose of giving news about lamps and lighting and also facts about Hygrade lamps.

Royal Electric Adds Air-Break Switch Line

The Royal Electric Manufacturing Company, Chicago, is adding to its products a line of pole-type, vertical-air-break switches, with remote mechanical control designed for rural service line use. The switches will be supplied in capacities up to 150 amp. and at voltages up to 16,500 and will be equipped with fuses, choke coils and series lightning arresters with series resistance.

Gray & Davis Looks for Good Operating Profits

In the annual report of Gray & Davis, Inc., Cambridge, Mass., for the year ended Dec. 31, 1920, sales for the seven months ended July 31 for both the Cambridge and Amesbury plants are stated to have been $2,806,190. Net loss on this operation amounted to $463,100. In this period, however, no depreciation charges were included. On Aug. 1, the company entered into a sales contract with the American Bosch Magneto Corporation under which contract the Bosch company became the selling agent for the product of the Gray &

Davis Cambridge plant. At this time the Bosch company assumed control of the manufacturing operations both at the Cambridge and Amesbury plants, and during the last five months of the year worked at revamping manufacturing processes and generally getting both plants in the best possible physical shape for economical operation. As of Dec. 31, unfilled orders on the books of Gray & Davis, Inc., amounted to $4,111,-124.

During the last five months of 1920 sales at the two plants amounted to $1,293,490, while net operating loss showed $4,998 after charging into production costs depreciations of $91,824. Shipments were curtailed almost entirely during the last three months of the year. With the inventories written at replacement value and with manufacturing processes revamped, the company feels that it is safe to assume that immediately business starts in any reasonable volume very satisfactory profits will be forthcoming.

Electric Box & Cover Company Organized from Metals Stamping Company

The new name of the Metals Stamping & Manufacturing Company, Inc., 29 Avenue C, Newark, N. J., is the Electric Box & Cover Company. In addition to manufacturing various metal parts the new company is making electric outlet boxes and covers. Albert J. Slap is at the head of sales.

Laundryette Publishes Sales Bulletin

The Laundryette Manufacturing Company, 1190 East One Hundred and Fifty-second Street, Cleveland, announces the recent publication of the first number of its new sales bulletin to be known as the "Dryer." This little bearer of advertising and selling ideas will be sent from time to time to each "Laun-Dry-Ette" dealer.

J. F. Buchanan's Jobbing Business Being Expanded

In line with plans to extend the wholesale end of its business and to keep pace with its development, the J. F. Buchanan Supply Company, 1719 Chestnut Street, Philadelphia, has appointed A. M. Little as its manager, as announced on page 792 of last week's ELECTRICAL WORLD. At present the company's wholesale stock is in buildings at the rear of its retail store at 1715 Chestnut Street, but it is planned under Mr. Little's supervision to secure a modern, well-appointed building in the wholsale district into which the wholesale stock, offices, etc., will be moved and the jobbing business carried on. At the present location the retail, contracting and repair business will be continued as a separate business under the name J. F. Buchanan Company, buying as such from the J. F. Buchanan Supply Company.

The Supply company believes that in its relations with dealers it will have the advantage of the experience of its own retail department to act as a guide in offering to other dealers advice and service.

Delta-Star Expands Sales Organization

The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has recently opened offices in the Interstate Building, Kansas City, Mo., and at 411 South Main Street, Los Angeles, Cal. The Rochester (N. Y.) office has been transferred from the E. & B. Building to larger quarters in the Chamber of Commerce Building.

Million-Dollar Order for Springfield Boilers

The order for the boilers for the new Hell Gate station of the United Electric Light & Power Company, New York, went to the Springfield Boiler Company, Springfield, Ill. This order, it was learned, ran in excess of $1,000,-000. These boilers, which will be among the largest in existence, will have a rating of 1,890 hp. So far but twelve boilers have been ordered, but provision has been made for twenty-four ultimately.

Holdings of International Combustion Engineering Corporation

What has been characterized as one of the biggest accomplishments in the development of stoker business and combustion business generally thus far is the organization of the International Combustion Engineering Corporation to control the Combustion Engineering Corporation of New York and the Underfeed Stoker Company, Ltd., of London, England. It owns almost all the stock of both these companies and of course controls also their subsidiary companies and representatives. The Underfeed company occupies in England a position similar to that of the Combustion company in this country, and the former company has agencies and representatives throughout the world.

Austin Machinery to Rebuild Burned Plant

Announcement is made by the Austin Machinery Corporation, 609 Railway Exchange Building, Chicago, that the plant recently destroyed by fire at Winthrop Harbor, Ill., will be rebuilt. This is deemed advisable as the location of this plant particularly facilitates production for the West and Northwest territory. The company has developed a group of subsidiary corporations and large agencies with extensive warehouses carrying stocks in order to overcome the delays incident to late spring and summer ordering. The plant of the Fairmont Mining Machinery Company, Fairmont, W. Va., where extensive improvements are planned, has recently become one of those comprised in this consolidated group.

The Runzel-Lenz Electric Manufacturing Company, 1751-55 North Western Avenue, Chicago, is reported to have awarded a contract for a two-story addition to its plant, to cost about $20,000. The company manufactures lamp cords and annunciator wire.

The Edward Valve & Manufacturing Company, 72 West Adams Street, Chicago, is reported to be making arrangements to rebuild the portion of its East Chicago (Ind.) plant recently destroyed by fire. Cost is estimated at $350,000.

The Wolke Lead Batteries Company, Louisville, Ky., successor to the Peerless Storage Battery Company, has filed notice of increase in capital stock from $500,000 to $1,250,000, the proceeds to be used for expansion purposes.

Daniel J. P. Jones, formerly connected with the Chicago office of the Economy Fuse & Manufacturing Company, has been appointed sales representative of the company in Michigan and will have his headquarters in Grand Rapids.

The Trammell Electric Lamp Company, 21 South Broad Street, Atlanta, Ga., has made arrangements with the Lux Manufacturing Company, Hoboken, N. J., manufacturer of tungsten and nitrogen lamps, to distribute its products in the Atlanta district.

The Sampson Manufacturing Company, 4244 West Lake Street, Chicago, manufacturer of electric and gas fixtures, has completed plans for the erection of a one-story plant, 40 ft. x 125 ft., on West Lake Street, to replace a building recently destroyed by fire.

The Michigan Stamping Company, 3171 Bellevue Avenue, Detroit, has awarded contract for construction of a one-story factory, 60 ft. x 480 ft., on Bellevue Avenue.

The Power Manufacturing Company, Marion, Ohio, manufacturer of Primm heavy-duty oil engines, has established an office at 114 Liberty Street, New York City, in charge of H. L. Dean.

The Morgan-Gardner Electric Company, Chicago, has removed its general offices to its plant at 2624 Shields Avenue.

The Binghamton Electric Truck Company, Binghamton, N. Y., has filed notice of increase in capital stock from $200,000 to $1,200,000.

The Tafel Electric Company, Louisville, Ky., has filed notice of increase in capital stock from $150,000 to $175,-000.

The Crocker-Wheeler Company, Ampere, N. J., has moved its Boston office to 171 High Street (Cornhill Square), where it has larger quarters. L. S. Howland continues as district manager.

The Buffalo Chandelier Corporation, Buffalo, N. Y., has filed notice of increase in capital stock from $50,000 to $125,000.

The Ames Iron Works, Oswego, N. Y., will early in April establish direct branch sales and service offices at 1033-1035 Commercial Trust Building, Philadelphia, under direction of E. A. Hahl and H. Schluter as district managers.

Foreign Trade Notes

ELECTRIFYING ROUMANIAN RAILROADS.—The Bukarest government is considering the electrification of a number of its railroads. Large orders have already been placed in Germany, the Orenstein-Koppel Works alone having received orders to the amount of 90,000,000 marks. It is reported that additional orders will be placed in the near future.

SWEDISH COMMISSION TO STUDY SWISS ELECTRIFICATION. — Advices from Switzerland state that during the next few weeks a commission of foreign engineers will visit Switzerland for the purpose of studying the electrification of the Swiss railroads. The commission will be composed of three American and three Swedish engineers. Mr. Oefverholmen, the Director General of the Swedish State Railways, heads the commission. The foreign engineers will inspect the Gotthard and Lotschberg lines and the large new power stations on both of these lines.

DEVELOPMENT OF WATER POWER IN FINLAND.—It is stated on advice from Switzerland that of all the States formerly belonging to the Russian Empire, none is making such efforts to improve its economic and industrial conditions as Finland. This country is extremely rich in water power, and the Finnish Diet has now passed a law according to which the great waterfalls at Imatra and Aujala will be exploited for industrial purposes. Large power stations will be erected at a cost of 300,000,000 Finnish marks, which amount has been appropriated by the Diet. It is expected that the electrification of the railroads will also be started in the near future.

NEW MUNICIPAL ELECTRIC PLANT PROPOSED FOR SYDNEY, AUSTRALIA. —According to the report of Forbes Mackay, city electrical engineer, to the City Council of Sydney, Australia, the present municipal electric plant will have reached its limits of supply by 1925, and as there is no room for further extension on the Pyrmont site, a complete new building and plant must be provided. The purchase of one of the coal mines south of Sydney and the locating of the proposed plant there has been recommended. The cost of the plant completed is estimated at between £4,000,000 and £5,000,000.

DEVELOPMENT OF CHILEAN WATER-POWER RESOURCES.—The water power resources in the central provinces of Chile, according to *Electrical Industries*, are to be utilized to generate electricity for Santiago, Valparaiso and neighboring cities and towns. A company, capitalized at $3,250,000, has been organized for the purpose, and work has been started on a hydro-electric plant on the Colorado River, near Santiago, where it is expected that 18,000 hp. can be developed. The project is backed largely by Chilean capital. Until recently no water-power concessions in Chile were granted by the President of the Republic for more than thirty-five years, but the latest concessions are said to be perpetual.

DEMAND FOR ELECTRICAL GOODS IN SIAM.—Owing to the fact that no electrical apparatus of any kind is manufactured in Siam there is a demand for all classes of electrical goods with the addition of specialties needed for a tropical country. Bangkok, according to Carl C. Hansen, vice-consul, is the only city furnished with electric light and power stations, of which there are two, the Siam Electricity Company, Ltd., and the Samsen Power station. The customs records show that the United States, with exports of nearly $90,000, was the heaviest contributor to the imports of electrical goods during the calendar year 1920. Electric lighting sets of various makes and sizes are advertised in the local press, but the demand seems to be moderate and limited to the provinces. The import duty on all electrical goods is 3 per cent ad valorem.

DEVELOPMENT OF WATER POWER IN QUEENSLAND RECOMMENDED. — A final report submitted by Mr. Crowley, a government expert, on the water-power possibilities of Queensland, Australia, according to *Engineering*, states that the northern hydro-electric scheme is capable of developing about 50,000 hp. He recommends that surveys be made at once of the Barron, Mount Spec and Mackay waters and advises that the first work should be done on the Barron River. If possible, surveys should be made simultaneously of the Mount Spec and Mackay waters. Then plans should be prepared and tenders called for the initial 10,000-hp. plant with provision for three others as soon as wanted. If the plants were built, the Barron and Tully Rivers would act as main feeders for the northern system.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A mercantile firm in India (No. 34,632) desires to purchase and secure an agency for everything electrical, electric passenger and freight elevators, etc.

A firm of commercial agents in Australia (No. 34,633) desires to secure the exclusive representation of manufacturers for the sale of electrical and ventilating machinery as well as motors and accessories.

A trading company in Australia (No. 34,645) desires to secure an agency for the sale of all classes of electrical goods, switches, holders, connections, lamps, motors and generators (large and small). The voltage principally used is 240.

New Apparatus and Publications

SOLDER.—The Union Smelting & Refining Company, Inc., St. Charles Street, Newark, N. J., is putting out a new handy-package "Usarco" solder in stick form for electrical use.

ELECTRIC VEHICLE WHEEL. — The Electric Wheel Company (Associates) has designed a new electric motor in the wheel drive for commercial and industrial trucks.

STEEL TOWERS.—Archbold-Brady Company, Syracuse, N. Y., has issued a pamphlet on the transmission lines of the Niagara Falls Power Company.

ACCEPTANCES. — "Acceptances, Trade and Bankers'" is the title of a new book just published by D. Appleton & Company, New York City, written by Park Mathewson, vice-president of the Business Bourse, New York.

OVERHEAD EXPENSES.—Chamber of Commerce of the United States of America, Mills Building, Washington, D. C., has just issued a pamphlet on "Overhead Expenses: How to Distribute Them in Good and Bad Times."

HIGH-TENSION SWITCHES. — The Royal Electric Manufacturing Company, Chicago, is issuing bulletins Nos. 20 and 25 inclusive, describing a new line of air-break switch, fuse and lightning arrester equipment for farm-service lines, high-tension air-break switch equipment and outdoor bus supports.

MILL-TYPE LAMP.—A new tipless mill-type lamp for rough service, 25-watt and 50-watt sizes, 110 volts and 220 volts, has been brought out by the Hygrade Lamp Company, Salem, Mass.

TRADEMARKS. — "The Work of the Trade-Mark Bureau" is the title of a booklet distributed by Mida's Trade-Mark Bureau, Ellsworth Building, Chicago.

SWITCHBOARDS.—The General Electric Company has issued bulletin No. 47,030A, superseding bulletin No. 47,030, entitled "Switchboards for Merchant Ships."

EVAPORATORS. — "Lillie Evaporators for Waste Waters and Solutions Generally" is the title of bulletin 11 distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J., describing the Lillie evaporator.

RADIO BATTERY.—The Ship Owners' Radio Service, Inc., 80 Washington Street, New York City, is distributing a four-page leaflet describing its "Sorsinc" new "B" battery, designed for tube transmission and reception purposes.

PLUGS AND RECEPTACLE HOUSINGS. —The Crouse-Hinds Company, Syracuse, N. Y., is distributing a four-page pamphlet covering its BRJ receptacle housings, MK series of condulets and MF switches.

POWER TRANSMISSION DEVICES.— "Link-Belt Silent Chain" is the title of data book No. 12, being distributed by the Link-Belt Company, Chicago. The company has also issued book No. 425 on textile machinery and bulletin No. 282 on the dye-making industry.

ELECTRIC SNOW MACHINE.—The B. L. Schmidt Company, Davenport, Iowa, has recently placed on the market its "Little Giant" No. 45 electric snow machine for soda fountains.

BATTERY HANDLES. — The Mueller Electric Company, 2135-45 Fairmount Road, Cleveland, is distributing circular No. 57, describing its No. 6-A battery handle. The company has also recently developed two battery handles of the wire type, known as No. 7-A and 9-A.

SWITCHBOARD.—A new type of dead front and rear switchboard has been brought out by the Krantz department of the Westinghouse Electric & Manufacturing Company, suitable for any capacity up to 600 amp., 250 volts, direct current, and up to 1,000 amp., 600 volts, alternating current.

INSTRUMENTS.—The Hickok Electrical Instrument Company, Cleveland, is distributing bulletin No. 20, describing the Hickok miniature ammeters, voltmeters and wattmeters.

BELL RINGER BATTERY. — The National Carbon Company, Cleveland, has recently placed on the market a dry-cell battery of two-cell power, known as the Columbia ringer battery.

SOCKETS.—The Gibson Electric Manufacturing Company, 118 South Forty-third Street, Philadelphia, is distributing a new catalog sheet covering its miniature and candelabra socket specialties.

VALVES.—The Rensselaer Valve Company, Troy, N. Y., is distributing book No. 12, describing its "Rensselaer" throttle and control valves.

INSULATING FABRIC. — A non-woven fabric sheet and tape for insulating purposes, "Voltape," has been developed by the Res-Pro Industries, Inc., 209 Washington Street, Boston.

New Companies

THE MINIATURE BREAKER COMPANY, New York, N. Y., has been organized by F. A. Cole and C. H. Aborn, 45 John Street, to manufacture circuit breakers and other electrical equipment.

THE NEWARK IGNITION COMPANY, N. J., has been incorporated by Joseph M. Maier, Jacob Lubetkin and Harry Landskroner, 32 William Street. The company is capitalized at $125,000 and proposes to manufacture magnetos and ignition equipment.

THE THREMO ELECTRIC, LTD., Brantford, Ont., has been incorporated by James Harley, Edmund Sweet, Archibald M. Harley and others. The company is capitalized at $60,000 and proposes to manufacture electric machinery, apparatus, etc.

MATSON & COMPANY, LTD., Aurora, Ont., has been incorporated by William H. Bushell, Reginald R. Matson, William G. Cole and others. The company is capitalized at $40,000 and proposes to manufacture electrical fixtures, machinery, motors, tools, etc.

THE ROMER MOTORS CORPORATION, Boston, Mass., has been incorporated by Albert J. Romer, Boston; J. Ellis Nightingale, Danvers, James L. Roope, Salem. The company is capitalized at $5,000,000 and proposes to manufacture motors, steam, gas and electric engines.

THE STORAGE BATTERY, PARTS & EQUIPMENT COMPANY, Poughkeepsie, N. Y., has been incorporated with a capital stock of $50,000 by H. Eggleston, J. W Bitts and W. S. Lent.

THE PARAMOUNT LIGHTING FIXTURES CORPORATION, New York, N. Y., has been incorporated with a capital stock of $30,000 by M. Geringer, H. A. Safion and J. J. Gans, 302 Broadway.

THE ELECTRO SERVICE COMPANY, INC., Hoboken, N. J., has been incorporated with a capital stock of $5,000 by Ernest and Albert J. Casper, 413 Jane Street, Hoboken. The company proposes to manufacture and deal in electrical equipment and supplies.

THE NEW JERSEY ELECTRIC LAUNDRY COMPANY, Keyport, N. J., has been chartered with a capital of $100,000 by Phillips and Earl H. Cherry and Leroy W. Bouton.

THE RIGSBEE ELECTRIC COMPANY, Dallas, Tex., has been incorporated with a capital stock of $35,000 by A. R. Rigsbee, W. A. Schnabel and T. L. Farmer.

Record of Electrical Patents

Notes on United States Patents

(Issued March 15, 1921)

1,371,749. TELEPHONE EXCHANGE SYSTEM; Clarence B. Fowler, New York, N. Y. App. filed Jan. 24, 1919. To improve signaling.

1,371,757. WIRELESS-TELEGRAPH RECEIVER; Ernest W. B. Gill, Oxford, England. App. filed Oct. 7, 1920. Audion.

1,371,782. ELECTRIC SWITCH; Frederic P. Gates, Hartford, Conn. App. filed Nov. 20, 1917. Socket pull switch.

1,371,789. METHOD OF PRODUCING NITRIC ACID; Yoshinao Kawakita, Kamoto-Gun, Kumamoto-Ken, Japan. App. filed April 2, 1918. Electric spark discharges through mixed gas of nitrogen and oxygen.

1,371,797. IGNITION SYSTEM FOR ENGINES; Alva C. McCandless and Daniel L. Harris, Wichita, Kan. App. filed April 12, 1920. Movement of piston of engine for causing a spark.

1,371,814. WATER-TREATING APPARATUS; John Roche and Raymond J. Parker, Buffalo, N. Y. App. filed Feb. 7, 1919. Purifying, softening or otherwise treating water.

1,371,825. MAGNETIC SEPARATOR; Franz Uhlig, Berlin, Germany. App. filed March 16, 1920. Material falls directly on or close to magnet.

1,371,826. METHOD OF ELECTROLYTICALLY PRECIPITATING METALS AND COMPOUNDS FROM SOLUTIONS; George D. Van Arsdale and Charles G. Maier, New York, N. Y. App. filed May 13, 1918. Depolarizers.

1,371,855. INSULATOR; Henry W. Buller, Fremont, Neb. App. filed April 5, 1918. No tie wire required.

1,371,874. TELEPHONE SWITCHING CABINET; John H. Ditch and William T. Burns, Altoona, Pa. App. filed Jan. 25, 1916. Railway block offices.

1,371,894. BATTERY-CELL CONSTRUCTION; Walter E. Holland, Philadelphia, Pa. App. filed Jan. 29, 1920. Simple, inexpensive and relatively flexible sealing joint.

1,371,895. BATTERY-CELL COVER; Walter E. Holland, Philadelphia, Pa. App. filed July 13, 1920. Readily molded to accurate dimensions.

1,371,907. ELECTRODE TERMINAL; Harry M. Koretzky, New York, N. Y. App. filed June 30, 1920. For dry cells.

1,371,935. TIME-CONTROLLED ELECTRIC SWITCH; Jacob Rubin, Charleston, W. Va. App. filed Feb. 6, 1919.

1,371,966. STARTING DEVICE FOR VAPOR CONVERTERS; Alfred L. Atherton, Edgewood Park, Pa. App. filed Nov. 29, 1915. Auxiliary anode and cathode in contact and in series with tilting magnet.

1,371,990. AUTOMATIC CUT-OUT APPARATUS; James K. Delano, New York, N. Y. App. filed Feb. 25, 1918. For automobile.

1,371,994. DIRECT-CURRENT TRANSFORMER; Arthur F. Nesbit, Wilkinsburg, Pa. App. filed April 25, 1917. Direct current of any voltage from alternating current.

1,371,997. MANUFACTURE OF SUGAR DIRECT FROM THE JUICE; Elie Delafond, Havana, Cuba. App. filed July 24, 1920. Cane juice purified by electric current.

1,371,998. ELECTRIC STORAGE BATTERY; Walter Lawrence Gill, San Bernardino, Cal. App. filed April 23, 1920. For starting, lighting and ignition systems.

(Issued March 22, 1921)

15,067 (reissue). BATTERY AND SEPARATOR THEREFOR; Frank T. Baird, Blue Island, Ill. App. filed Sept. 17, 1918. Highly permeable separator.

15,068 (reissue). AUTOMATIC TELEPHONE SWITCHING APPARATUS; John G. Blessing, Chicago, Ill. App. filed July 6, 1915. Step-by-step.

15,070 (reissue). SUBSTATION TELEPHONE CIRCUITS; Bernard D. Willis, Chicago, Ill. App. filed Aug. 19, 1919. Automatic.

1,372,042. DESK OPERATOR'S CIRCUITS; William A. Rhodes, New York, N. Y. App. filed Dec. 5, 1918. Telephone.

1,372,050. BUSY-SIGNAL-TESTING APPARATUS; John F. Toomey, New York, N. Y. App. filed April 4, 1919. Telephone.

1,372,091. LIMITER FOR ALTERNATING CURRENTS; Salvatore Salto, Milan, Italy. App. filed Feb. 15, 1919. Opens circuit on overload and recloses when overload is removed.

1,372,096. ELECTRICAL SYSTEM OF DISTRIBUTION; Marcellus R. Shedd, Lancaster, N. Y. App. filed Nov. 23, 1915. Improved regulation where storage battery is charged by generator.

1,372,097. ELECTRICAL REGULATOR; Marcellus R. Shedd, Lancaster, N. Y. App. filed Nov. 23, 1915. To vary resistance of circuit by carbon pile.

1,372,110. X-RAY APPARATUS; Sinclair Tousey, Westhampton Beach, N. Y. App. filed April 10, 1910. For improving radiographs.

1,372,162. MUFFLER ATTACHMENT FOR TELEPHONES; David Petri-Palmedo, Bridgeport, Conn. App. filed May 27, 1920. Use of telephone in presence of others without being overheard.

1,372,170. RESHARPENING OF FILES, RASPS AND THE LIKE; Sidney T. Judd, Lewisham, London, England. App. filed Jan. 26, 1921. By electrolytic action.

1,372,202. FREQUENCY MULTIPLIER; Isaac Schoenberg, London, England. App. filed Oct. 7, 1916. Frequency multiplied by single apparatus having no moving parts.

1,372,203. FREQUENCY MULTIPLIER; Isaac Schoenberg, London, England. App. filed Oct. 7, 1916. Frequency multiplied by single apparatus having no moving parts.

1,372,287. CHUCK; Bengt M. W. Hanson, Hartford, Conn. App. filed July 31, 1918. Magnetic chuck.

1,372,288. ELECTRICAL ATTACHMENT PLUG; Axel E. Hellerstedt, Great Falls, Mont. App. filed April 1, 1918. Screw plug.

1,372,330. RESISTANCE ELEMENT; Thaddeus F. Baily and Frank T. Cope, Alliance, Ohio. App. filed April 3, 1919. For electric furnaces.

1,372,361. SAFETY DEVICE FOR ELECTRIC IRONS; Thomas Martin, Vancouver, British Columbia, Canada. App. filed May 13, 1920. Fusible plug.

1,372,366. BRUSH CONNECTION; Philip P. Nungesser, Cleveland Heights, Ohio. App. filed June 23, 1919. Pigtail connection.

1,372,421. HAIR-CURLING DEVICE; Violet G. Grenall, New York, N. Y. App. filed Sept. 5, 1919. Electrically heated.

1,372,425. SYSTEM OF RADIO TELEGRAPHY AND TELEPHONY; John Hays Hammond, Jr., Gloucester, Mass. App. filed June 15, 1912. Simultaneous operation of two or more high-powered wireless stations in same neighborhood without interfering.

1,372,426. MULTIPLEX RADIOTELEPHONY; John Hays Hammond, Jr., Gloucester, Mass. App. filed May 29, 1912. One generator for the waves of any required number of sets.

1,372,432. APPARATUS FOR ELECTRIC WELDING; Edward W. Jansen, New York, N. Y. App. filed Feb. 17, 1919. For welding joints of rails.

1,372,435. BATTERY-CELL COVER; Reginald M. Jones, Toronto, Ont., Canada. App. filed Dec. 12, 1919. Cover divided into plurality of separable sections.

1,372,437. TELEPHONE-SWITCH SEPARATOR; Henry Koch, Jamaica, N. Y. App. filed Oct. 20, 1919. Easily and quickly made.

1,372,442. ELECTROLYTIC GAS GENERATOR; Isaac H. Levin, New York, N. Y. App. filed May 22, 1917. To produce hydrogen and oxygen gases by subjecting water to electrolysis.

1,372,446. ERROR-PREVENTING TERMINAL FOR DYNAMOS; Friederich Munz, Stuttgart, Germany. App. filed May 4, 1920. Wrong connections between battery and dynamo prevented.

1,372,488. ELECTRICALLY HEATED SHOE CABINET AND METHOD OF USING SAME; Arthur A. Dionne, Brockton, Mass. App. filed April 28, 1920. For dressing, finishing and repairing shoes.

1,372,507. HANGER FOR TROLLEY WIRES; Thomas J. Henderson, Columbus, Ga. App. filed Aug. 7, 1920. Suspended insulator.

1,372,541. FIXATION OF THE NITROGEN OF THE ATMOSPHERE; Richard Pearson, London, England. App. filed Feb. 13, 1919. Electrically.

1,372,570. ELECTRICAL TESTING APPARATUS; Raymond Smith, Hazardville, Conn. App. filed Oct. 20, 1919. Attachment for standard flashlamps.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME.—Freight-handling machinery will be installed by the Grand Trunk Railway Company, in connection with the proposed extensions to its steamship terminal at Portland, to cost about $500,000. The company is reported to be considering the erection of a new coaling plant at Deering to be equipped with electrically operated freight-handling machinery for loading, unloading, conveying, etc., to cost about $1,000,000.

BOSTON, MASS.—Considerable electrical and mechanical machinery will be installed in the three-story, 55-ft. x 500-ft. inspection and repair plant to be erected by the Boston Elevated Railroad Company at Forest Hills to cost about $500,000, including equipment.

SOUTH BRAINTREE, MASS.—Plans are being considered for rebuilding the factory of the Monatiquot Rubber Works, recently destroyed by fire. Considerable electrical equipment will be required. The cost of the new plant is estimated at $200,000.

WORCESTER, MASS. — The Worcester Electric Light Company has applied to the Department of Public Utilities for permission to issue $620,000 additional stock, the proceeds to be used for extensions, general operations, etc.

TOWNSHEND, VT. — Steps have been taken to form a company for the purpose of installing an electric lighting system in Townshend. J. H. Ware, C. H. Willard and others are interested.

Middle Atlantic States

ANTWERP, N. Y.—The Antwerp Light & Power Company has applied to the Public Service Commission for permission to erect an addition to its power plant and for approval of a franchise recently granted for lighting in this district.

CLARENCE, N. Y.—The proposal to install electric lamps along the highway from Transit Road and through the village of Clarence, a distance of 6 miles, is under consideration.

BURLINGTON, N. Y.—D. Thorne Gardner, Burlington, has been granted permission by the Public Service Commission for permission to erect an electric power plant at West Burlington and Edemston, Otsego County, with distribution lines in this section. Franchise has also been approved.

DANSVILLE, N. Y. — The Blum Shoe Manufacturing Company is considering the construction of a new power plant. As yet nothing definite has been decided upon S. N. Albert is purchasing agent.

FRIENDSHIP, N. Y.—The installation of an electric lighting and power system in Friendship is under consideration. Youngs & Son, who supply electricity to Belmont, Hume and other places, are interested.

MOUNT VERNON, N. Y. — Plans are being prepared by the McCormick Company, architects, Century Building, Pittsburgh, Pa., for the construction of a dairy plant, including a stable, garage and power plant for the Willow Brook Dairy Company, to cost about $250,000.

NEW YORK, N. Y.—Bids will be received by S. B. Wight, agent for the New York Central Lines, Grand Central Terminal, New York City, until April 19 for the requirements of said lines for one year, commencing April 1, 1921, of incandescent lamp bulbs, aggregating in excess of $300,000. These bulbs to be furnished in accordance with the New York Central Railroad Company's engineering department specification No. 3015, issue 2, dated July 10, 1920, copies of which may be obtained upon application to S. B. Wight, agent.

NEW YORK, N. Y.—Bids, it is reported will be opened about April 15 by W. Whitehall, architect and engineer, 12 Elm Street

for the construction of a substation on Greene Street, to cost about $160,000, and an addition to the substation on Cedar Street to cost about $130,000, for the New York Edison Company.

PERRY, N. Y.—The Perry Electric Light Company has applied to the Public Service Commission for permission to erect an electric power plant addition at Genesseo Falls.

ROCHESTER, N. Y.—The Sibley, Lindsay & Curr Company has awarded a contract to A. W. Hopeman & Sons, 569 Lyell Avenue, for the construction of a new power plant in connection with its local department store.

ORMOND, N. J.—E. I. du Pont de Nemours & Company, Wilmington, Del., contemplate the construction of a one-story manufacturing plant, including an administration building and power house, in Mammuskin. The du Pont Engineering Company, du Pont Building, Wilmington, Del., are engineers.

BEAVER FALLS, PA.—The installation of a new ornamental lighting system on Seventh Avenue is under consideration. Electrical service is furnished by the Beaver County Light Company, Pittsburgh.

COLLEGE HILL, PA.—The Hill Light Company, recently organized, plans to install and operate an electric system in College Hill. C. J. Braun, Jr., 635 Sixth Avenue, Pittsburgh, is treasurer.

DANVILLE, PA.—The board of trustees of the Danville State Hospital contemplates the erection of a new power plant at the institution to cost about $65,000. William F. Shay, Watsontown, is president of the board.

EAST STROUDSBURG, PA.—Bids will be received by Luther Hoffman until April 15 for the installation of electric wiring and for all necessary electrical work at the General Hospital of East Stroudsburg.

ANNAPOLIS, MD.—The Annapolis Public Utilities Company, a subsidiary of the Washington, Baltimore & Annapolis Electric Railroad Company, has applied to the County Commissioners for permission to erect a pole line from a point near Iglehart's Station into the Sherwood Forest community to supply power for electric lamps and motors. H. T. Connolly is superintendent of power.

BALTIMORE, MD. — The Standard Oil Company contemplates the construction of a new power plant, 93 ft. x 142 ft., to cost about $50,000, at its plant at Third Avenue and Second Street, Canton.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company plans to invest $3,500,000 during 1921 and 1922 for extensions to its system, including an expenditure of $800,000 to take care of station growth; erection of three additions to exchanges to cost $260,000; special equipment to connect exchanges $150,000; equipment of two other exchanges with electrical machinery $100,000, and conduit construction $250,000.

BETTERTON, MD.—Plans are under way for the installation of an electric lighting system in Betterton.

BLUEFIELD, W. VA.—Plans are being prepared for the construction of a cold-storage plant for the American Fruit Company, in which electrical and mechanical equipment will be installed.

LOGAN, W. VA.—Electric motors and other equipment will be installed in the addition, 110 ft. x 125 ft., to be erected by the Logan Ice & Storage Company. G. R. Travis is president and general manager.

SUTTON, W. VA.—The Sutton Chemical Company, it is reported, plans to begin work immediately on the construction of an electric power plant in the vicinity of its coal mines in Wolf Creek, Braxton County.

WHEELING, W. VA.—A petition has been presented to the City Council for the installation of an ornamental lighting system on parts of Wabasha Street, including the Wabasha Street Bridge; Robert Street, including the Robert Street Bridge; West Winifred and George Streets.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer of the Army, Washington, D. C., until April 22, proposal 5383-11CP, for furnishing twenty-seven transformers, SC type C-21. For further information address above.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until April 12, Washington, D. C., Schedule 7,832—125 battery-charging panels. Until April 15, Alexandria, Va., Schedule 7,810—five electric cranes; Portsmouth, Schedule 7,811—11,000 ft. of lighting and power wire. Until April 19, Washington, D. C., Schedule 7,845—1,000 lb. copper magnet wire. Until April 29, Mare Island, Cal., Schedule 7,858—2,500 ft. electric cable.

North Central States

FULTON, MICH.—Plans are under consideration for the installation of electric lamps in Fulton.

MARSHALL, MICH.—The construction of an auxiliary plant to the municipal light plant, to cost about $80,000, is under consideration by the Electric Light Commissioners.

COLUMBUS, OHIO.—The question of issuing $30,000 in bonds for street lighting in Bibb City will be submitted to the voters.

DEFIANCE, OHIO. — Considerable mechanical and electrical machinery, including power-plant equipment, will be installed in the plant to be built by the Farmers' Sugar Company, at an estimated cost of $1,000,000. A. H. Smith, 215 Nasby Building, Toledo, is architect. C. H. Allen is president.



NEW 66,000-VOLT LINE

New transmission line being constructed between Salem and Columbiana, Ohio, by Day & Zimmerman, Inc., for the Salem Lighting Company.

SPRINGFIELD, OHIO. — The sum of $19,700 has been appropriated for extensions to the park system, etc., of which $10,000 will be used for changes and extensions to the lighting system in Snyder Park.

SOUTH ELGIN, ILL. — At an election to be held April 19 the proposal to issue $5,000 in bonds for the purchase of street-lighting equipment will be submitted to the voters.

STERLING, ILL.—Extensions and improvements to the boulevard lighting system are under consideration. Mr. Tennant is chairman of a special committee.

WALTONVILLE, ILL. — The Southern Illinois Light & Power Company, Hillsboro, has applied to the Illinois Public Utilities Company to install an electric plant at Waltonville and erect a transmission line between Duquoin and Mount Vernon.

MILWAUKEE, WIS.—The City Council has ordered the city engineering department to prepare plans and specifications for the proposed new Riverside pumping station on the Milwaukee River to cost about $2,500,000. Percy Braman is Commissioner of Public Works.

FARGO, N. D.—At an election to be held in April the proposal to issue bonds to establish a municipal lighting plant will be submitted to the voters.

ELLINWOOD, KAN.—Improvements to the municipal electric light and water plant to cost about $40,000 are under consideration.

LYONS, KAN.—At the spring election the proposal to establish a municipal light plant in Lyons will be submitted to the voters.

OSBORNE, KAN.—The City Council is considering extensions to the municipal power plant to cost about $75,000. Archer & Stevens, 612 New England Building, Kansas City, Mo., are engineers.

Southern States

CHARLESTON, S. C.—Notice of increase in capital stock to $5,500,000 has been filed by the Charleston Consolidated Railway, Gas & Electric Company.

ALMA, GA.—The installation of an electric light plant in Alma is contemplated. J. H. McDonald is city clerk.

BAINBRIDGE, GA.—Electric light and water bonds to the amount of $20,000 have been voted.

FORT LAUDERDALE, FLA.—Arrangements are being made by the Southern Utilities Company to extend its lighting system to Las Olas Beach and Idlewyld.

GREENSBORO, ALA. — Arrangements have been made to lease the lighting system of the Greensboro Water & Light Company to be operated as municipal property. Extensions and improvements are under consideration.

LITTLE ROCK, ARK.—The City Council has appropriated funds for extensions to the street-lighting system. Present plans provide for 200 new incandescent lamps.

BOYNTON, OKLA.—Contract has been awarded to the Oklahoma Gas & Electric Company for the installation of street arc lamps in Boynton.

CHEROKEE, OKLA. — Bonds to the amount of $60,000 have been voted for extensions to the lighting plant and for fire equipment.

MAYSVILLE, OKLA.—Arrangements are under way for the erection of an electric transmission line from Pauls Valley to Maysville.

BALLINGER, TEX.—At an election to be held April 12 the proposal to issue $65,000 in bonds for the construction of an electric light and power plant will be submitted to the voters.

DALLAS, TEX.—Extensions to the lighting system on South Ervay Street to cost about $35,000 are under consideration by the Dallas Power & Light Company.

HALLETTSVILLE, TEX.—Bids will be received by S. M. Kuykendall, city secretary, until April 14 for improvements to the electric light plant, including a 120-hp. steam engine directly connected to a 90-kva., 2,300-volt, three-phase, 60-cycle alternating-current generator with exciter; switchboard panel for same; 150-hp. horizontal return-tubular boiler and fittings for both coal and oil fuel; 150-hp. open-type feed-water heater; two simplex boiler-feed pumps; necessary interconnecting pipe fittings, steam separator receiver, etc. Alternate bids will also be received on a 200-hp. steam engine directly connected to a 150-kva., 2,300-volt, three-phase, 60-cycle alternating-current generator with exciter; switchboard, boiler, heater, pumps and fittings as for previous item.

Pacific and Mountain States

SALEM, ORE. — The Oregon Pulp & Paper Company has applied to the State Engineer for permission to appropriate 465 sec.ft. of water from the north fork of the Santiam River for the development of about 1,300 hp.

TRACY, CAL.—The Trustees have adopted a resolution to install an electrolier system in Tracy. C. Frouts is clerk.

Canada

PENTICTON, B. C.—A movement has been started, it is reported, to extend the service of the West Kootenay Power & Light Company, Rossland, to Penticton. The plans would include the erection of a transmission line and a step-down transformer station to cost between $200,000 and $225,000. The erection of a secondary line to the up-the-lake section is also included in the project. Lorne Campbell is the manager.

ST. JOHN, N. B.—The Bathurst Electric Light & Water Power Company has petitioned the Public Utilities Commission for permission to increase its capital stock from $145,000 to $2,000,000 to provide funds for the enlargement of the dam at Great Falls.

Electrical World

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Moonlight Schedules Are Relics of the Past

POETS wax eloquent over the light of the moon, and we admit that as an example of uniform distribution of low intensity moonlight is most admirable. Nevertheless, the moon's constantly recurring changes and phases have caused it to be taken as a common type of changeableness or fickleness. "Oh, swear not by the moon, the inconstant moon!" pleaded Juliet, and we are moved to paraphrase her plea for those who still adhere to the so-called moonlight schedule and exclaim, "Oh, light not by the moon, the inconstant moon!" In this day, when electric light is so cheap and its advantages are so great, it seems odd that any town should still be moonstruck. Of all public expenditures from taxes that for lighting is the only one which benefits every citizen. For that reason lighting budgets should be preferential and constantly increased within reasonable limits. The slight saving effected by moonlight schedules is so greatly offset by disadvantages as to render the continuance of the practice questionable. Certainly no enterprising town wants light of that kind, and to be as dead as the moon hardly lends distinction.

Revival of Interest in Electric Vehicles

ELECTRIC vehicle shows such as the one held in New York City in February, the one this week in Newark, N. J., and the one scheduled in Chicago during the N. E. L. A. convention are creating a new interest in electric haulage. Central-station companies and manufacturers of electric road vehicles and industrial trucks are joining hands with renewed vigor in the working out of transportation problems on an engineering basis, whether these problems concern delivery on city streets or industrial-material handling at plants and warehouses. To hold an electric vehicle show in Chicago at convention time is particularly fitting, for there, as in New York and Newark, the experiences of users under conditions of service favorable to the vehicle can be reviewed over a long period. Furthermore, during the latter half of the last year the industries of Chicago have shown an increase of 25 per cent in the use of industrial trucks and 15 per cent in electric road trucks, with passenger cars holding their own. Among the large commercial users of electric trucks in the city are two prominent department stores which are holding to the policy of using nothing but these trucks for delivery purposes and increasing their fleets as conditions require. It is claimed that a saving of almost 50 per cent has been made in the cost over gasoline and horse-drawn vehicles. In the industrial plants the economies are even more striking owing to savings in labor costs and the increased speed with which both bulky and small parts are being handled in shop transfer and warehousing operations. The storage battery, which is the vital part of all electric vehicles, has not only stood the test of time but has found a permanent field of usefulness that is as extensive as the industries which the electric vehicle has invaded.

State Development of Water Power Unnecessary

IF PRIVATE utility companies under public regulation were not exercising their stewardship to good account in the development and popularization of needed hydro-electric facilities, there would be some logic in looking to the state to supply the service. Given fair conditions, however, there is little reason to fear that private capital will be found wanting in this field, and long study of the relative merits of public conduct and private conduct of business affairs has led relatively few well-informed engineers and technical executives to champion the former. The attempt sometimes made by politicians to arouse interest in the state development of water powers on the ground that these are being held back from the people by private companies ignores the fact that in many cases a marketable surplus of hydro-electric energy may exist in the very territories on whose soil and over whose streams public ownership propaganda is being spread. In common fairness to the companies that are doing their efficient best to bring their service at reasonable rates alike to the home of the humblest citizen and to the largest industrial plant, let this unworthy imputation be confuted by hard facts in every case where it is utilized as an excuse for socialistic pleas for public power development!

Play Fair with the Telephone Companies

A RECENT case in which a Middle Western utility commission rendered a decision in an action between a telephone company and a power company that seemed to establish a bad precedent contains a lesson central-station executives cannot afford to ignore. The precedent established dealt with the assessment against a power company of costs for changes in ground-return telephone lines. A careful investigation shows that the power company agreed to do certain things as a consideration in obtaining a right-of-way that was already occupied by a rural telephone company. Some guarantees as to service were made that clearly could not be lived up to. The power company failed to carry out its agreements and the matter went to the commission. After trying for nearly two years to settle the case without a formal order, the commission finally used the club that the law provides to bring such companies into line, and a decision was rendered that in

the absence of a proper understanding of the circumstances appears to be contrary to the ultimate public good.

Central-station executives must recognize first that neither telephone nor power service can exist without the use of the public highways. This involves a realization that both the telephone company and the power company must keep their plants up to the best standards that the arts have developed. They must also learn that any infringement of a telephone company's rights to give adequate service will sooner or later show results in abridgment of telephone service and produce a public reaction that must be unfavorable to the power industry.

There is only one safe path, and that lies in the direction of a broad-minded appreciation of the problem of giving the public two types of service in the most efficient way. Co-operation only will make this possible. Such conditions as those that the decision referred to was framed to remedy are inexcusable, and the central-station industry must bring its whole influence to bear in making them impossible. It will be well to remember that, after all, courts and commissions can deal only with facts set before them. With all the desire in the world to act along lines that are fundamentally right and to the point, they can be easily forced to reach their goal in an indirect and destructive manner by ill-judged conduct like that exhibited in this particular case.

New Conception of Generating Plants that Works for Simplification

FOR a long time very large power stations were looked upon as presenting unusual conditions requiring much more elaborate interrelation of parts than stations of modest output. The result of this point of view was enormous and forbidding complication, in which cost, efficiency and safety were often sacrificed to that somewhat elusive quality known as flexibility. Slowly but with increasing results there has developed quite another conception of the case. It is the realization that, substantially, a great power station is merely a small one affected by a multiplying factor and that the same fundamental principles should hold in the design of a station for 250,000 kw. as with one of 25,000 kw. The individual units will be much larger, but each one will represent about the same total proportion of the output and will have the same place in dealing with the questions of load factor, efficiency and safety. There is a realization, too, that in operating a network or ring system it is merely a matter of convenience whether the individual units which make up the equipment are under one roof or several.

It is the logical working out of this more modern and businesslike conception that is conspicuous in the Colfax station. As the article in the current issue says, the station is essentially a group of six moderately rated stations operating in parallel on duplicate high-tension buses. Each 60,000-kva. generator with its equipment is considered as an independent unit feeding into the long mains through its own proper transformers, and no attempt is made to parallel these enormous units with the 12,000-volt low-tension side. By this means a prodigious amount of auxiliary and switching equipment is dispensed with, and each working unit takes its place as an addition not to a station but to the system. In this way, despite the fact that ultimately 300,000 kva. will be concentrated under one roof, the risk of complete paralysis of the station through a short circuit inside the transformers or inside the main switching connections is minimized. Virtually the generators and transformers are considered as an individual unit and housed as such, while the high-tension switching equipment and all accessories are installed in an outdoor switching station. Our readers will do well to study the article itself.

Leadership More Essential Now than Ever Before

WHEN it is realized that the cost of conducting the business of the United States government is six times what it was in 1914 and that more than 50 per cent of individuals and firms conducting business in this country cannot show with any degree of accuracy what it costs to do business from day to day, the opportunity for leadership in the ordinary as well as the large affairs of the present is apparent. No less a business authority than Edward N. Hurley has stated his conclusion, from investigations which he conducted as chairman of the Federal Trade Commission, that among the 250,000 corporations whose affairs were known to that body nineteen out of every twenty-five either earned nothing at all or only a fair-sized salary for one good man. His explanation of the situation is that we have replaced the overcarefulness of the old-time successful business man with overcarelessness and that the present-day business executive has lost his sense of values in dealing with labor, materials and services rendered. Just how to regain this sense of values is the problem that every business man faces at the present moment. While the solution in the various divisions of all industry must be worked out by individual thinking, the correction can only be applied by group action stripped of the selfish ambition to benefit by the lax thinking even of those who have been most responsible for unsatisfactory relations with the public, trade conditions and practices in the past.

In the electrical industry such action already is apparent in the form of the broad-gaged activities of the several groups making up the industry, such as the engineering and central-station group, the jobbers, the contractor-dealers and the associations in the electrical manufacturing group. This group action is again and most fittingly reflected in the recent action of the board of directors to strengthen and broaden the work of the Society for Electrical Development by enlisting the leadership and vision of W. L. Goodwin in that work. Mr. Goodwin has intimately associated himself with the problems of the electrical industry during the past four years as a leader in trade co-operation through his ability to inspire men to action by his common-sense analysis of the fundamentals of the electrical business and his fearless attacks on loose thinking and selfish practices. On the vision of more leaders who possess, as Mr. Goodwin does, the ability to interpret the language and thinking of both the engineering and trade groups, and a closer observance of the ideals to which such leaders aspire, must the future of the electrical industry be built—a business that to those who must supply the materials and services to satisfy the demand for electric energy should reach ten billion dollars in the next four years. It is futile to expect a return to pre-war conditions as far as the electrical industry is concerned. The developments of the past five years have

so completely changed conditions and have given such a clear exhibition of the true extent to which electric service can be used that to return to conditions as they were would be more complicated than to push forward the short distance yet to be covered in the industrial readjustment and deflation process which we are now going through. Optimism and confidence equal in stability to that of the electrical industry plus evidence of leadership known to be within that industry is the key to the potential electrical resources which await development.

What Voltages Are Best for Rural Distribution?

WHAT is the distribution voltage limit at which rural service can be given? The discussion of this subject before a recent meeting of the transmission and distribution committee of the Ohio Electric Light Association set forth very clearly the possibilities from a physical standpoint. There is virtually no limit to the transformation ratio that can be used, and so far as experience goes there are no dangers to customers receiving service even with direct transformation from the highest-voltage transmission lines. The real limit is economic, and the question to be answered is what distribution will give the least over-all cost. To answer this involves the consideration of two points, the immediate business and the territory it covers. In the majority of cases the use of 2,300 volts to 6,600 volts will provide the least immediate cost, but any development will show that the voltage is too low, particularly when the business is one covering not only rural territory but the small communities that no rural service line can miss for long. The tendency in too many cases has been to rivet attention on the immediate cost and build lines on which the voltage can be raised only by reconstructing the lines at what is usually an embarrassing cost.

A number of companies that have had to deal with the irrigation problem have found the scheme of building lines for ultimate use at 11 kv. with the star connection a satisfactory method of dodging the most troublesome problems. By using a cross-arm spaced for an 11-kv. four-wire circuit, with insulators for that voltage, a comparatively small increase in original cost is incurred. The line can then be operated originally as a single-phase, 2,300-volt circuit if that voltage only is available. As business increases 6,600-volt transformers can be substituted, and with power coming on, a 6,600-volt, three-phase, delta-connected line can be obtained by running the third wire, and eventually an 11-kv., three-phase, four-wire, star-connected line will develop. The items of expense involved, if the plan is properly carried out, are the substituting of 6,600-volt transformers and protective equipment for 2,300-volt apparatus and the cost of reconnecting the 6,600-volt transformers for star operation. The cost of additional conductors is a capital charge, incurred only as business justifies.

With the lightly loaded rural lines that must be handled 11 kv. works out well from an economic standpoint, and the territory covered, even with fair-sized power loads, is sufficient to justify the investment in transmission lines of higher voltage with step-down stations at intervals feeding into the lower-voltage network. Careful study of the irrigation practice in this respect will be profitable not only to those handling scattered rural service but also to the large companies that must employ both high-voltage and low-voltage distribution. There are a great many advantages, after getting away from the low voltages used in lighting and small power service, in selecting two primary power distribution voltages with a considerable gap between them. One of the advantages lies in the ability, when a fairly high primary distribution voltage is used for heavy power consumers, to control the magnetic effects due to heavy current flows on paralleling lines of other utilities. Several instances in which these effects have been rather marked have been noted lately with heavy power lines on which the lower range of so-called transmission voltages have been employed. This introduces an element in interference that will be of growing importance as load grows and must be considered in selecting distribution voltages on any system where power loads of any size have to be handled.

Selection of Demand Meters

THE maximum demand for power which a customer makes upon an electric supply system and the time of day at which he makes it are often a consideration nearly as important in determining the cost of the power he takes as is the record of the total energy in kilowatt-hours which he consumes. At and near the peak of the daily load curve of the central station a kilowatt-hour may cost much more to generate and deliver than during the idle hours of the night. The customer who demands a large supply of power at the peak hour is a more expensive individual to the central station than if his peak-hour demand were small. Moreover, with human needs and institutions as they are, a customer who makes a large demand is almost sure to present it just at the unfortunate time, *i.e.*, near the peak load.

For the foregoing reasons the demand element has entered into rates for the supply of electrical energy to a very considerable extent, and demand meters have had to be installed in a number of public service systems. The records made by the demand meters are thus of great industrial importance. There are several types of demand meters. Principal among them are the thermal type and the time-interval integration type. The requirements which must be met by a demand meter are peculiar. They must not be too hasty; that is, they must ignore any sudden momentary demand, such as an accidental short circuit might produce before being arrested by a safety fuse. On the other hand, they must not be too tardy and fail to take cognizance of a steady overload which lasts several minutes. Between these opposite limits of Scylla and Charybdis a good demand meter must safely steer.

The subject is discussed from a very practical viewpoint in this number by Willard S. Wilder. He recites the various qualities that a good demand meter should possess from the operating point of view. An ideal instrument would, of course, cost so little that it could be given away as an advertisement; it would be absolutely foolproof and reliable; it would never have to be inspected, and once installed it would never need to be repaired. It must be confessed that between these qualities of an ideal demand meter and those found in the actual instruments there is a distinct difference. However, as time and experience go on we may hope that the difference will be lessened, for the benefit of all concerned.



Bernard Arthur Behrend

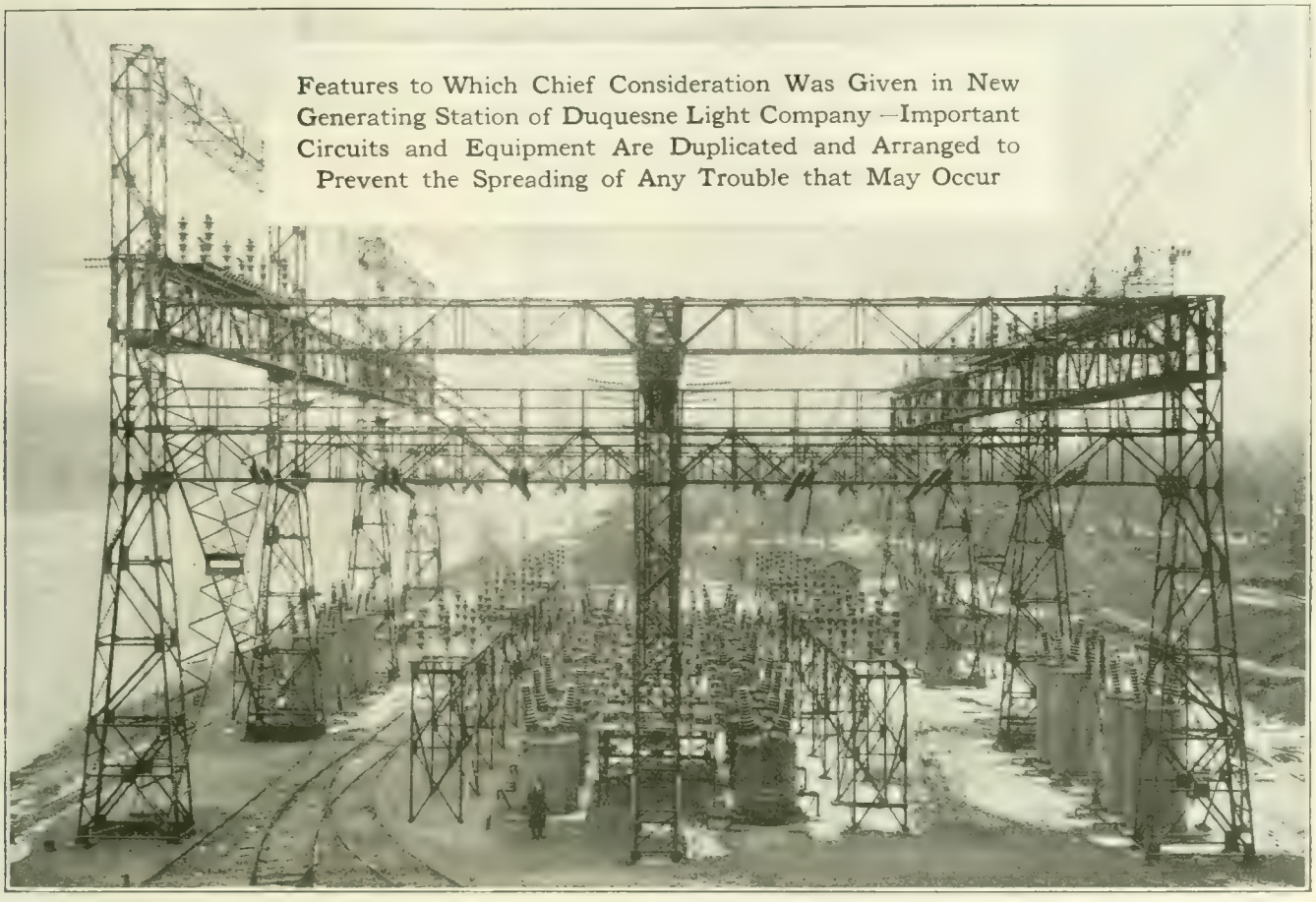
Distinguished as an engineer-scientist and for constructive achievement in the theory and design of alternating-current machinery, in which he has pioneered the way to present-day practice

FOR many years B. A. Behrend has exerted a marked influence on the development of alternating-current machinery both from the manufacturer's and the user's viewpoint. Nearly twenty-five years ago he became conspicuous for advocating high peripheral speeds for waterwheel alternators, for insisting upon the proper voltage margin of generators for low-power-factor loads, rather than extremely close regulation under hypothetical conditions, upon proper kva. to kw. proportioning of prime mover and generator, and upon coal operation under actual rather than theoretical operating conditions. The development in 1902 by Mr. Behrend of cylindrical cores with radial slots for turbo-generators has been widely adopted by both American and European manufacturers. The theory of the induction motor first presented by him in 1895 and the theory of the regulation of alternators, in 1896, have been widely recognized. The circle diagram of the induction motor now virtually in universal use in textbooks and the "leakage coefficient" of this machine employed by designers are fundamentally those first developed and described by Mr. Behrend. The rules of the standards committee of the A. I. E. E. relating to the regulation of alternators now conform to recommendations originally made by him, based upon his theoretical and experimental work.

As consulting engineer Mr. Behrend has been identified with many important engineering projects. One of the most interesting was the linking together at Montreal in 1901 of the power from the Lachine Rapids, Montreal Light, Heat & Power Company and Shawinigan Falls. Mr. Behrend designed the frequency-changing apparatus at Maisonneuve and linked successfully together for the first time three great power stations operated by different types of prime movers. In 1904, when the United States Steel Corporation reconstructed its power plants and installed large gas-engine units at the works of the Illinois Steel Company, American Steel & Wire Company, Carnegie Steel Company and Indiana Steel Company, Mr. Behrend planned the entire electrical installation and worked out the parallel operation of large gas-engine-driven generators without the usual method of trial and error.

Mr. Behrend's first position in this country was with the Bullock Electric Manufacturing Company as chief engineer. Later he was made chief electrical engineer of the Allis-Chalmers Company and established the electrical department of that company. He also served as consulting engineer for Allis-Chalmers Bullock, Ltd., of Montreal. In 1911 he opened his present consulting engineering offices at Boston. For two and a half years previous to that he served as advisory engineer of the Westinghouse Electric & Manufacturing Company in charge of its power engineering department, and he has since been retained by that company in a consulting capacity. The honors which have been conferred upon Mr. Behrend in recognition of his numerous fundamental achievements are mentioned on page 905.

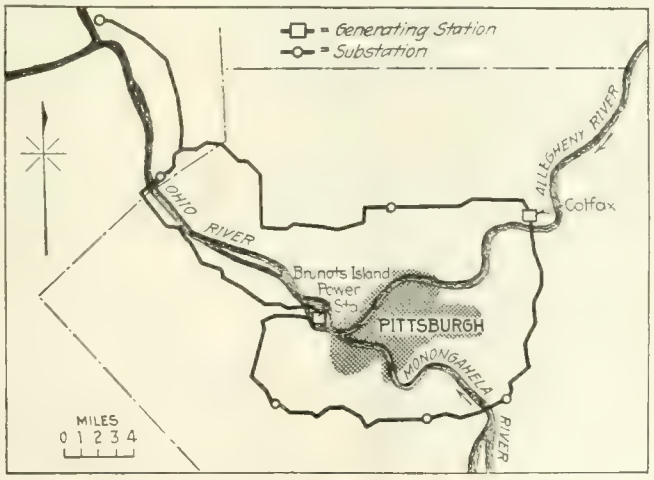
Reliability and Simplicity—Characteristics of New Colfax Station



Features to Which Chief Consideration Was Given in New Generating Station of Duquesne Light Company—Important Circuits and Equipment Are Duplicated and Arranged to Prevent the Spreading of Any Trouble that May Occur

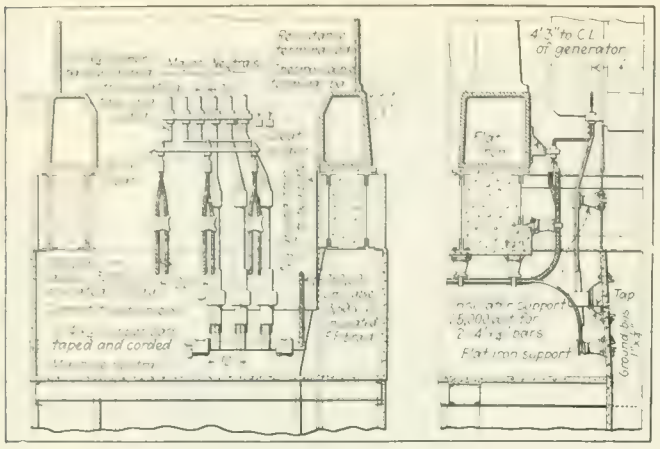
JUST as economy, dependability and simplicity were considered of prime importance in laying out and equipping the mechanical parts* of the Colfax generating station, so were reliability and simplicity regarded as vital features in the electrical end of the plant. In general these requisites were met by designing the plant in such a way that the possibility of trouble would be remote and by providing simple and convenient means for the inspection and repair of apparatus. Reliability is further increased by the duplication of some of the more important circuits and equipment and by an arrangement of apparatus that will reduce the possibility of trouble spreading from one unit to another.

Although equipped with 60,000-kw. generators and designed for an ultimate rating of 300,000 kw., the Colfax station will be essentially a group of six moderately rated stations under one roof operating in parallel on duplicate high-tension buses. By this combination economies are effected in fixed charges and operating costs which would be impossible if the plants were physically separated. The absence of a 12,000-volt multiple connection limits the short-circuit current flowing into any low-tension fault which may be established to such an extent that standard apparatus and methods of construction can be safely employed despite the large amount of generating capacity concentrated within the station. Reliability and simplicity of operation have been greatly increased by the electrical isolation of all main units, auxiliaries, excitation and control and by the relatively small number of electrical circuits and switches required. The three 12,000-volt generating elements of each turbo-



POWER LOOP AROUND PITTSBURGH TO WHICH COLFAX IS CONNECTED

*See first installment of article, ELECTRICAL WORLD, April 2, 1921.



GENERATOR LEADS ARE BROUGHT OUT SO AS PRACTICALLY TO PRECLUDE INTERPHASE SHORT CIRCUITS

generator set are operated as one machine, being switched together on a common bus and given field excitation while stationary. They are brought up to normal frequency and voltage as one generator by the admission of steam to the high-pressure turbine and are synchronized with the high-tension system through the low-tension circuit breaker of the corresponding 70,000-kva. transformer bank. While high-tension operation at present is at 66,000 volts, increase to a higher potential can be made at any time by a simple change in the transformer connections as growth in station capacity and system loads require, since all of the high-tension equipment is designed for 132,000-volt operation.

Among the methods employed to insure reliable service from the generators the following are of particular interest: Method of running the generator leads, the provision of differential relay protection, facilities for extinguishing generator fires, the use of interlocked grounding switches and ground signals, devices for determining the rise of temperature in the windings, the provision of dual drive sets for excitation and the use of a "face-plate" regulator in addition to the ordinary type of vibrating-contact voltage regulator.

Generator connections to the 12,000-volt buses have been insulated more than is usually the case. Each lead is run its entire length in a separate compartment and is made up of two 1,000,000-circ.mil, 13,200-volt insulated cables. These insulated cables are mounted on 25,000-volt insulators in the air ducts and on 15,000-volt insulators in the bus rooms.

In case of internal trouble in the generator the differential relays actuate multi-contact relays which disconnect the affected generating element from the 12,000-volt bus, trip the throttle valve, cutting off the steam supply, open the field circuit breakers, sound a fire alarm in the turbine room and light a signal lamp both over the affected generator and in the control room.

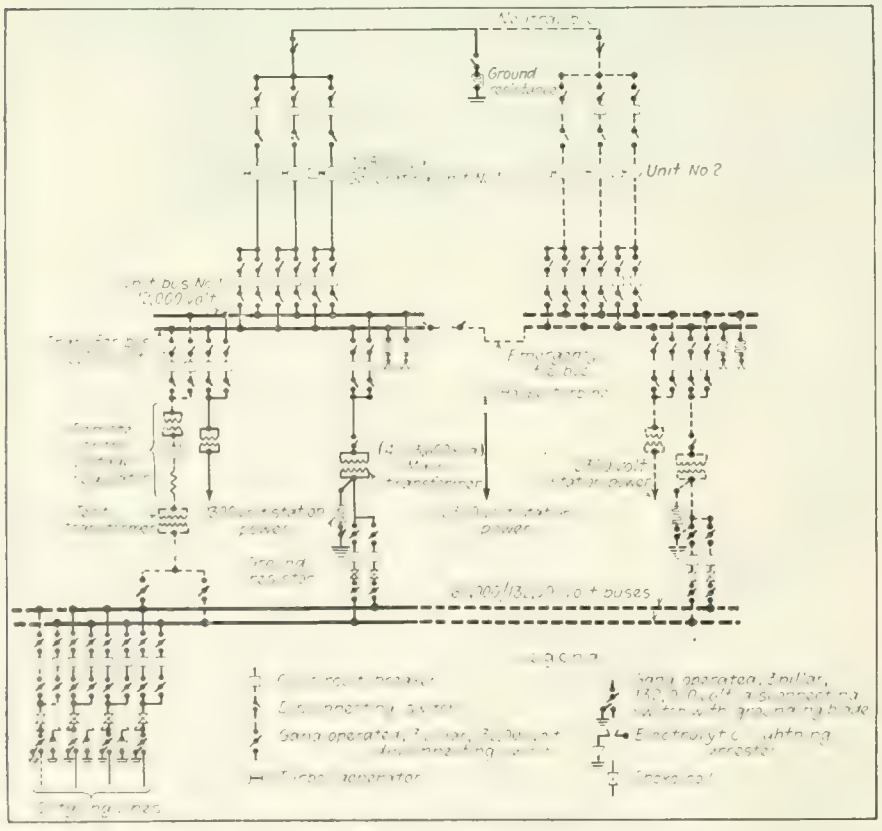
In the event of a fire inside the generators high-pressure steam may be admitted by the turbine-room attendant and the air-duct damper dropped by remote control from the switchboard room to shut off air that would otherwise sustain combustion. Both damper trip and fire-extinguisher steam valve can be connected for automatic operation if it is considered advisable.

Interlocked Grounding Switches, Temperature Coils and Assurances of Excitation

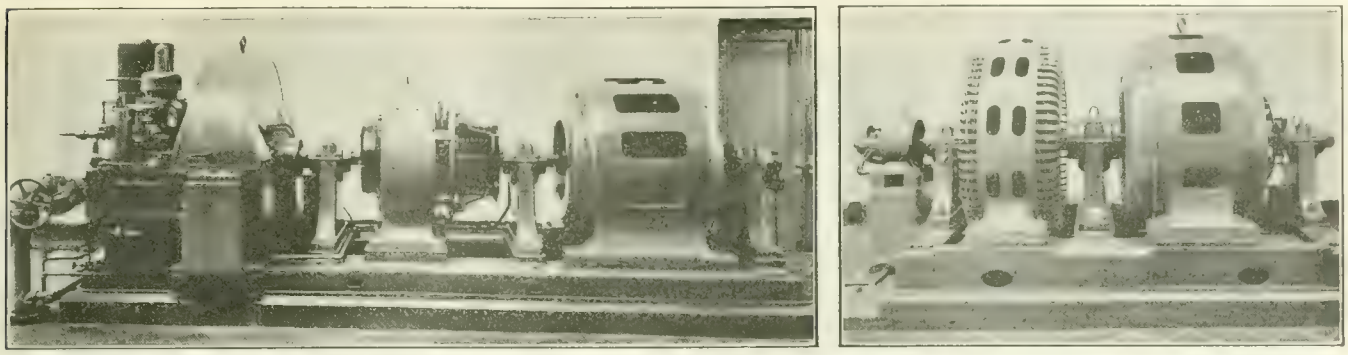
To limit the current that would flow to ground in the case of a complete breakdown a resistor of 7 ohms is installed between the generator neutral bus and ground with interlocked circuit breakers connected between each generator neutral and this bus, so that only one circuit breaker can be closed at a time. To notify the station operator when a ground occurs a green signal lamp and alarm bell in the switchboard room are connected to the secondary of a current transformer in each generator neutral.

Each generator element is equipped with six resistance coils and six thermocouples for temperature measurement, the resistance coils terminating in switchboard indicators and the thermocouples in a potentiometer pedestal, also in the control room. A resistance coil in the air duct makes it possible to determine at any time the rise of the winding temperature above incoming air temperature.

Excitation is supplied by duplex motor-and-turbine driven exciters. Two of these dual-drive sets are installed with the first unit, one to be a spare in the ultimate station. Normal operation of the exciter is by motor drive with a small amount of live steam bled into the turbine casing. In case of motor failure through low voltage or by trip-out, the resultant decrease in exciter speed automatically places the turbine in service as a prime mover, and excitation is maintained without interruption.



ABSENCE OF MULTIPLE CONNECTIONS BETWEEN TURBO-GENERATORS ON 12,000-VOLT BUS REDUCES EFFECT OF SHORT CIRCUITS THAT MAY OCCUR



DUPLEX EXCITERS WITH MOTOR AND TURBINE ON SAME SHAFT; INDUCTION-MOTOR-DRIVEN SYNCHRONOUS GENERATOR USED TO MAINTAIN HEAT BALANCE

Voltage control is secured by either of two methods. One is the usual vibrating regulator with its contacts working across the rheostat of the shunt-wound exciter. In addition, there is a "face-plate" regulator, which is a new development and is believed to possess some features of considerable value. The "face-plate" regulator consists of a voltage-control element arranged to adjust, through relay switches, the position of the motor-operated contact arm of the generator-field rheostat. With this apparatus excitation supply can be taken from a constant-pressure bus with a storage battery floating across it as a reserve if desired. The principal advantage in the use of the "face-plate" regulator is that the device is inherently simple and no extreme variations in generator voltage will result even if the contacts fail to operate properly.

23,600-Kva., Single-Phase Transformers

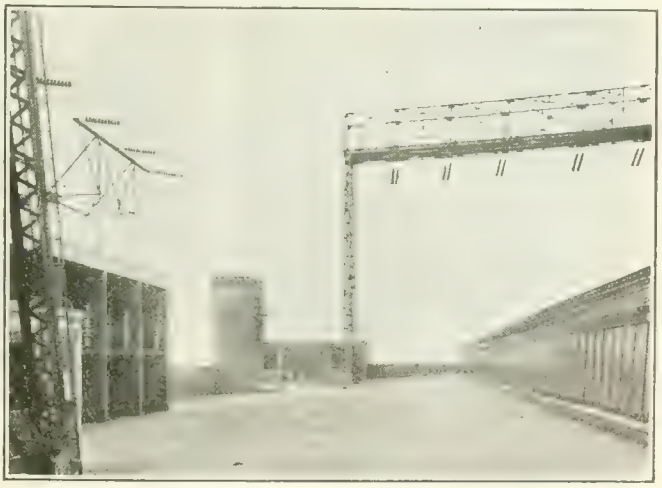
Unusually large single-phase transformers (23,600 kva. each, or 70,000 kva. per bank) are employed, four being installed with the first unit so that one may be used to supplant any single transformer which may be taken out of service. The spare unit stands with all piping connections complete, ready to be quickly connected. To avoid making or breaking the comparatively heavy low-tension connections in time of emergency the four transformers are provided with disconnecting switches on the 12,000-volt side. The spare transformer has selector switch connections between each low-tension terminal and the three supply buses. Normally, the entire six disconnecting switches on the spare unit are in the open position. In case a transformer in the bank fails, its 12,000-volt "disconnects" are opened and selector switches to the corresponding busbars are closed on the spare. On the high-tension side a removable section of copper tubing is taken out at the defective transformer and used to connect the spare to the same high-tension conductor. Water is then turned on the spare. The complete change-over will require only a few minutes. With the bank again in service at full rating, the damaged transformer unit which has been disconnected can be moved into the turbine room on permanent rails, where such repairs as are required can be made with the help of the station crane.

In addition to the usual accessories, two hot-spot temperature indicators are provided with each transformer, one placed near the transformer and the other on the switchboard in the control room. These instruments indicate a temperature equivalent to the highest temperature existing in the copper of the transformer coils at the hottest spot. This result is obtained by placing the thermometer element inside of a heating coil in series with the low-tension circuit. The heating coil is designed to operate at the same unit loss as the main winding and has corresponding insulation.

The usual differential relay protection is provided, and in addition overload relays are employed which are set so that trip-out will occur only in case of a high-tension bus short circuit. The high-voltage neutral of the transformer bank is connected to ground through a resistor of 95 ohms, and a current transformer in this circuit is connected to a curve-drawing meter, an alarm bell and a red signal lamp—all installed in the switchboard room.

Part Indoor and Part Outdoor Installation

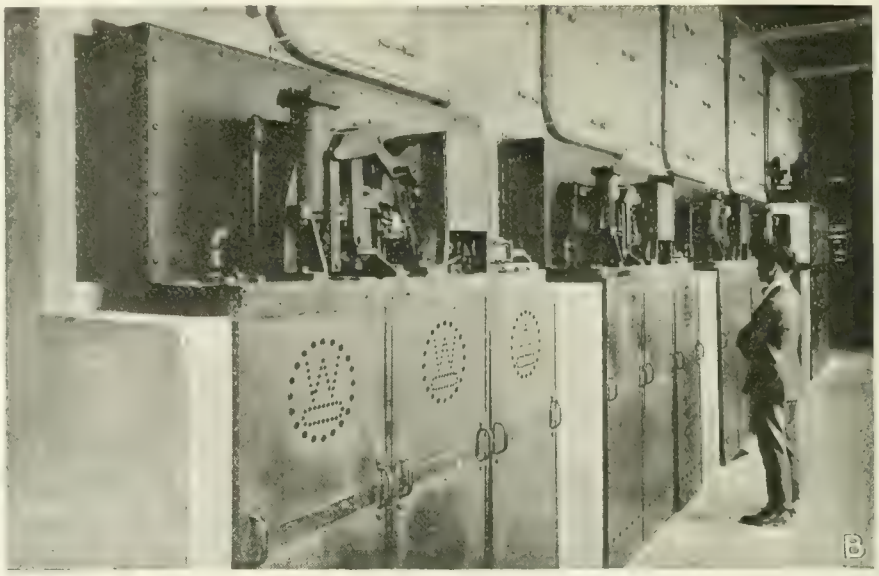
The step-up transformers and the switches required to connect them with their respective generators are placed as close to the generators as possible inside the building. The expense of placing this apparatus as well as the transformer high-tension disconnecting and oil switches in the station was found to be less than that required for an outdoor installation. Consequently such electrical apparatus as is required to place each generator on a high-tension bus and parallel it with others has been placed indoors. The arrangement of this electrical equipment inside the station and the method of carrying the high-tension leads outdoors without using roof bushings are indicated in the accompanying illustration. As shown, the high-tension leads are carried up to duplicate buses on the station roof through high-tension wells. The high-tension roof buses, which run longitudinally, can be extended as the station is extended. From the west end of the power

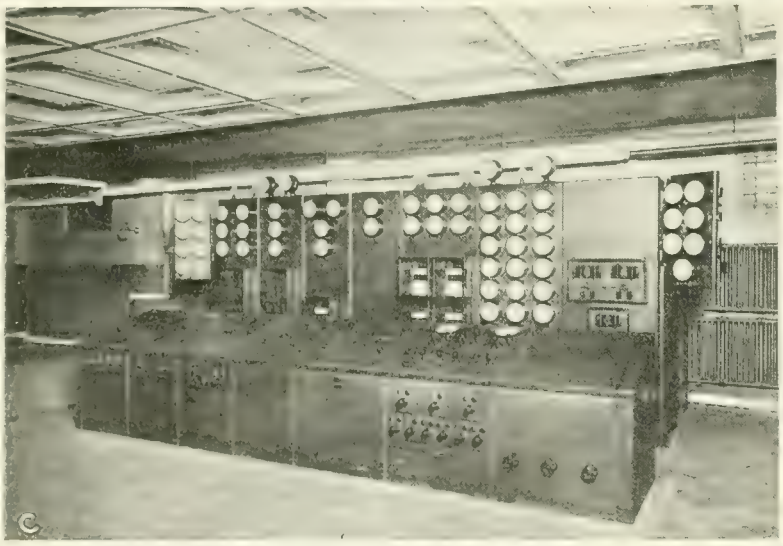


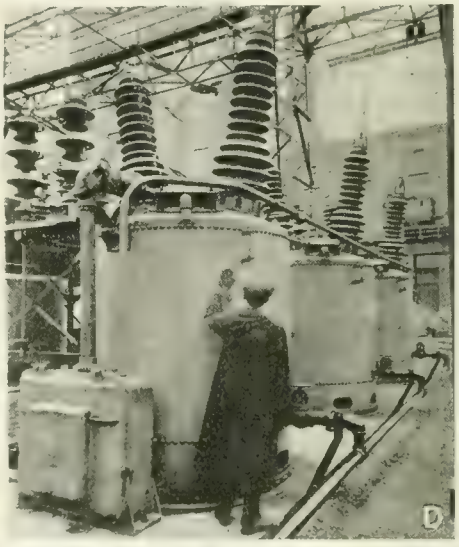
HIGH-TENSION LEADS EMERGING FROM RISER WELLS AND CONNECTING WITH ROOF BUSES

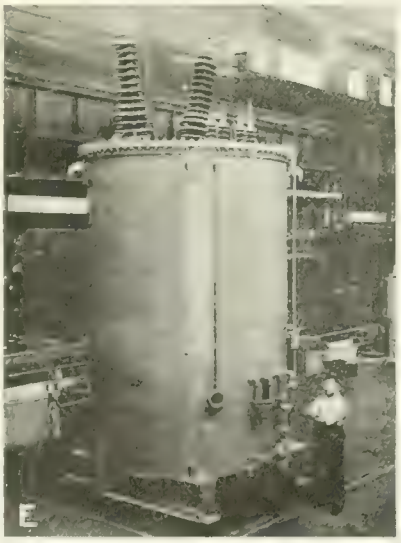
Interesting Views In and Around Colfax

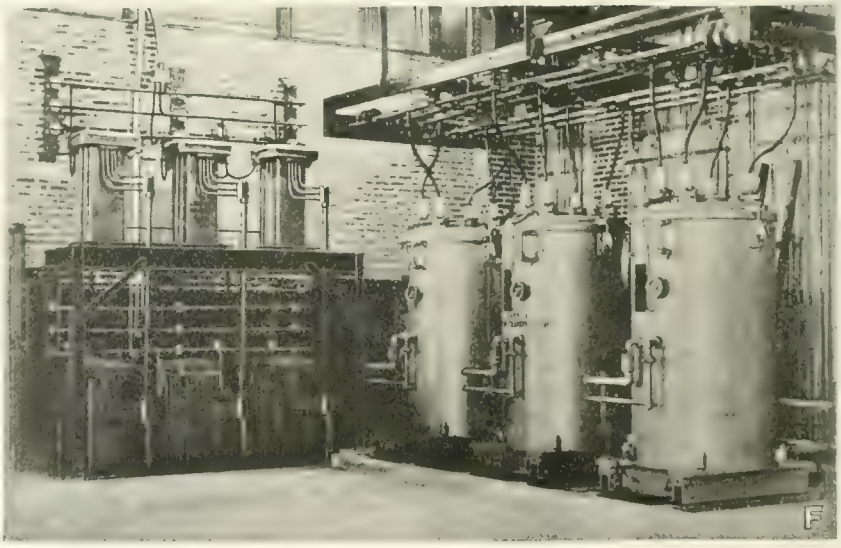












A—Typical station-service switch and bus compartment shown in detail on page 869. The lamp signal and push switch over the center of the lower door is to safeguard operators in opening disconnecting switches.

B—12,000-volt oil circuit breakers between generators and unit bus.

C—The bench board is for the control of the main units while the instruments on the vertical board behind are those which must be used in connection with the operations of starting, stopping, etc.

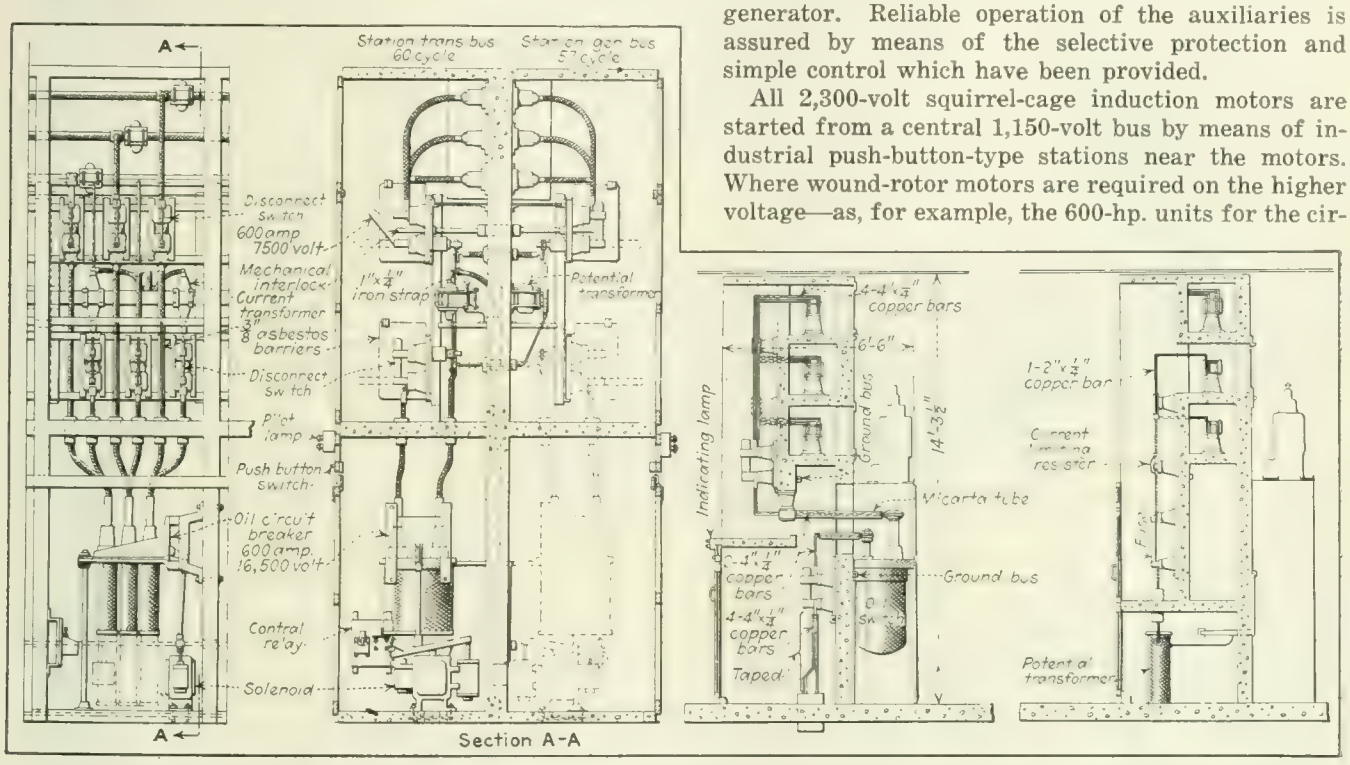
D—One of the 132,000-volt circuit breakers in outdoor station.

E—One of the mammoth 23,600-kva., 11,500/76,210-38,105-volt single-phase transformers.

F—House-service and station-auxiliary transformer installations.

station duplicate high-tension buses are carried down to the outdoor switching station, which at present consists of three feeder bays, although others will be added as required.

The outdoor switching station is particularly interesting because of the simplicity of layout and the provisions for flexible operation and avoidance of interruption of service. As shown by the accompanying illustration, the duplicate high-tension buses extend longitudinally through the outdoor switching station so that taps are easily connected to selector oil switches below and thence through disconnecting switches to the outgoing lines. The oil circuit breakers are operated by remote control from the switchboard and are equipped with bushing-type current transformers. Pipe connections are made from the oil-switch tanks to oil-storage tanks in the basement of the power station.



STATION-SERVICE SWITCH COMPARTMENTS AND 12,000-VOLT CELLS ARE CONSTRUCTED TO INSURE UNINTERRUPTED SERVICE

Gang-operated, three-pillar-type disconnecting switches are used and are operated from the ground level by handles which are equipped with locking devices. Where disconnecting switches are used as transmission-line switches they are provided with gang-operated grounding blades which are mechanically interlocked with the switch-operating mechanism to prevent simultaneous closure.

In order that any disturbance causing a discharge over the horn gaps of the lightning arresters shall not involve adjacent circuits, the lightning arrester horn gaps have been mounted at the top of the structure, above all line conductors and buses. The horns are operated from the ground by mechanical control.

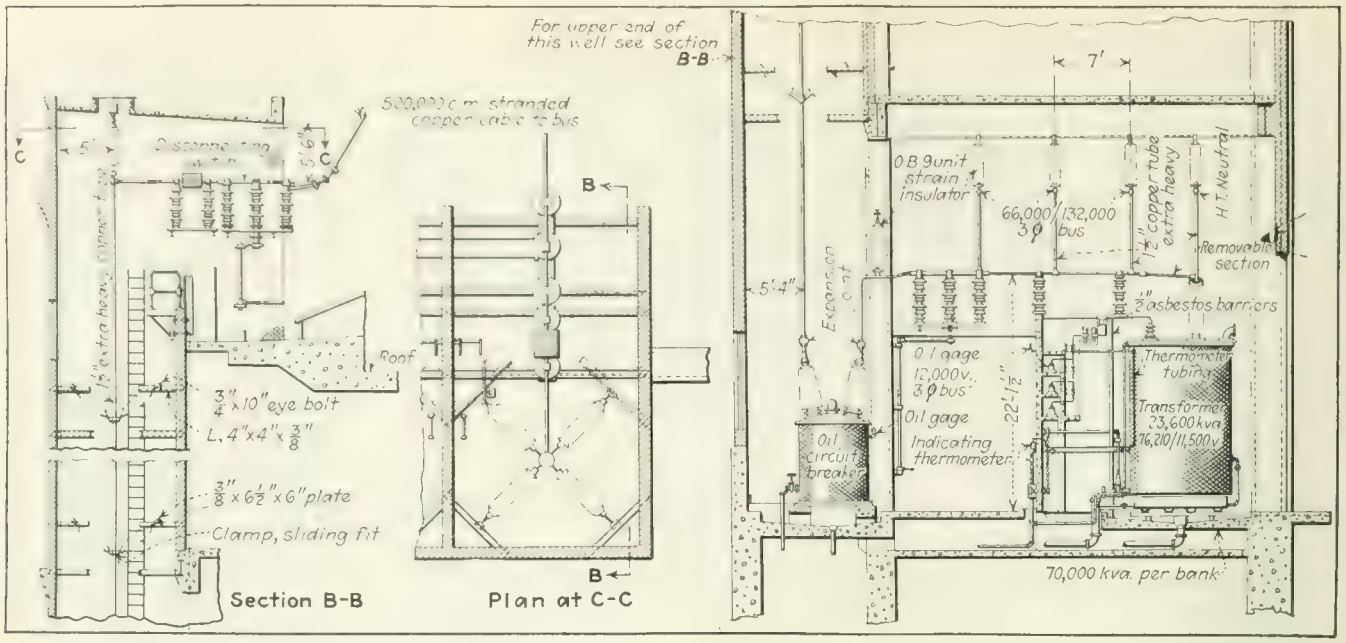
In addition to the usual soldered lugs employed in bus connections, all wire attachments in this outdoor switching station have a mechanical reinforcement in the nature of a U-bolt. Loosening of a soldered joint will thus merely result in increased resistance and discoloration by heating, which will be discovered through periodic inspection before any serious trouble can result. Such inspection has been made particularly convenient by means of railed walkways in all trusses of the main steel structure and steel ladders at convenient points. These features have been included at a relatively insignificant increase in total cost.

Selective Protection and Simple Control for Auxiliaries

With the exception of the feed pumps and fans all auxiliaries at Colfax are electrically driven, the heat balance being maintained by varying the load on the house generator, as explained in a previous article regarding the mechanical features of this plant. Motors above 75 hp. in rating are wound for 2,300 volts and smaller motors for 440 volts. Duplicate electrical supply is provided indirectly from the main unit through a step-down station service transformer bank and directly from a 2,300-volt turbo-generator known as the house generator. Reliable operation of the auxiliaries is assured by means of the selective protection and simple control which have been provided.

All 2,300-volt squirrel-cage induction motors are started from a central 1,150-volt bus by means of industrial push-button-type stations near the motors. Where wound-rotor motors are required on the higher voltage—as, for example, the 600-hp. units for the circulating water pumps—a drum-type controller is installed near the motor. In all cases the 2,300-volt and 1,150-volt circuit breakers, instrument transformers and disconnecting switches are installed in compartments in locked bus rooms in the station-service section of the electrical bay. Thus the safety of the installation is increased and the liability of shutdown from accidental interference with live circuits is reduced. Starting and running circuit breakers are electrically interlocked to prevent simultaneous closure, and sequence relays make it impossible to close the running breaker until low voltage has first been applied to the motor through the starting breaker.

Each panel-box circuit from which the 440-volt motors are supplied is connected to the bus at the point of supply through a full automatic oil circuit breaker. In the panel boxes on each motor circuit are fuses of high rating which will fail only in case of short circuit on the supply to the particular motor. At the motors automatic control is provided wherever possible to protect the motor in case of overload. Thus selective protection from the motor to the 440-volt bus is insured.



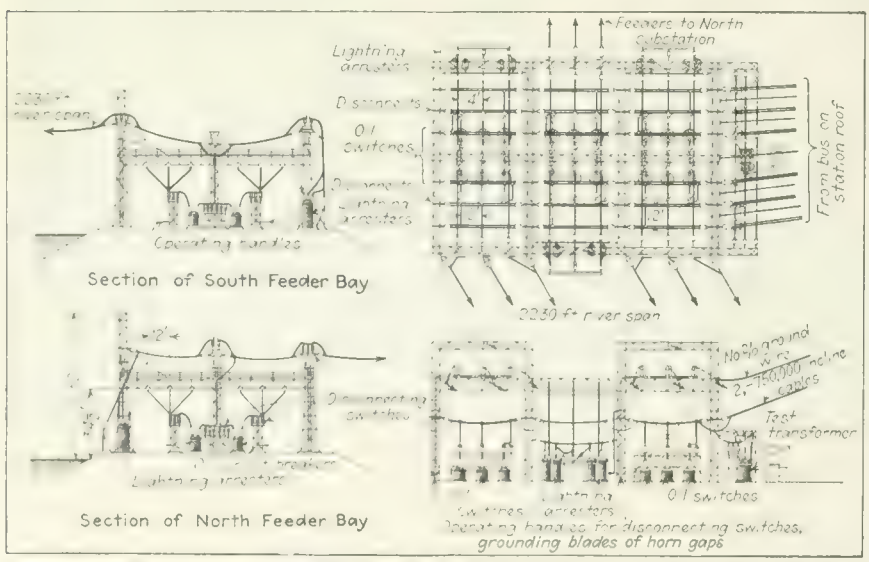
CIRCUITS FROM 70,000-KVA. TRANSFORMER BANKS PASS THROUGH INDOOR OIL CIRCUIT BREAKERS AND THEN UP HIGH-TENSION WELLS TO BUSES ON ROOF

Opening of the automatic circuit breakers or even failure of the fuses in the panel boxes will be an infrequent occurrence, these devices serving merely to localize trouble and protect other station auxiliaries from interruption.

Manual switching of auxiliaries from one supply to another would be an awkward method of changing the load on the house generator and, furthermore, would not provide the desired degree of refinement in temperature adjustment for heat balance. Paralleling the house turbine directly with the main unit would be impracticable because of the difference in characteristics, and more especially because of the hazard introduced by exposing the auxiliary system to disturbances resulting from troubles outside of the station. Consequently, a heat-balance set which consists of an induction motor driving a synchronous generator is employed as a flexible tie between the two generating systems to permit the transfer of a portion of the auxiliary power supply under normal conditions and still prevent the auxiliaries from being subjected to outside disturbances. In practice the load on the heat-balance set is controlled by changing the speed of the house turbine through the remote control of its governor. Guidance in this operation is afforded by a graphic thermometer giving a record of the feed-water temperature. Both the graphic thermometer and the governor control are installed in the control room.

The heat-balance motor-generator set is equipped with reverse power relays so that in case of any serious system trouble causing a drop in frequency on the main station bus to 54 cycles this set will trip out on reverse power, disconnecting the house-turbine system from the main generator bus and leaving the important auxiliaries supplied from the house turbine operating as a separate internal source of power unaffected by the outside disturbance. The only sacrifice will be the economy of heat balance during the period of the disturbance and until such time as the transfer set can again be synchronized with the house turbine and feed-water temperature adjusted. A tie switch is provided between the auxiliary buses and is electrically interlocked with the motor-generator breaker of the heat-balance set. In case of failure of either source of 2,300-volt supply the heat-balance set may be temporarily shut down and the two 2,300-volt buses operated as a unit.

To prevent disconnecting switches being opened or closed when the corresponding oil circuit breaker is closed each set of switches is provided with a protective device including three lamps and a flush-type, double-pole push-button switch. A red lamp indicates a closed circuit breaker, a green lamp that breaker is open and a white lamp that closing circuit to breaker is open. The latter condition is secured by pressing the switch and is indicated by the white lamp.



CONNECTED WITH THE BUSES ON THE STATION ROOF IS THE OUTDOOR SWITCHING STATION SHOWN IN PLAN AND SECTION

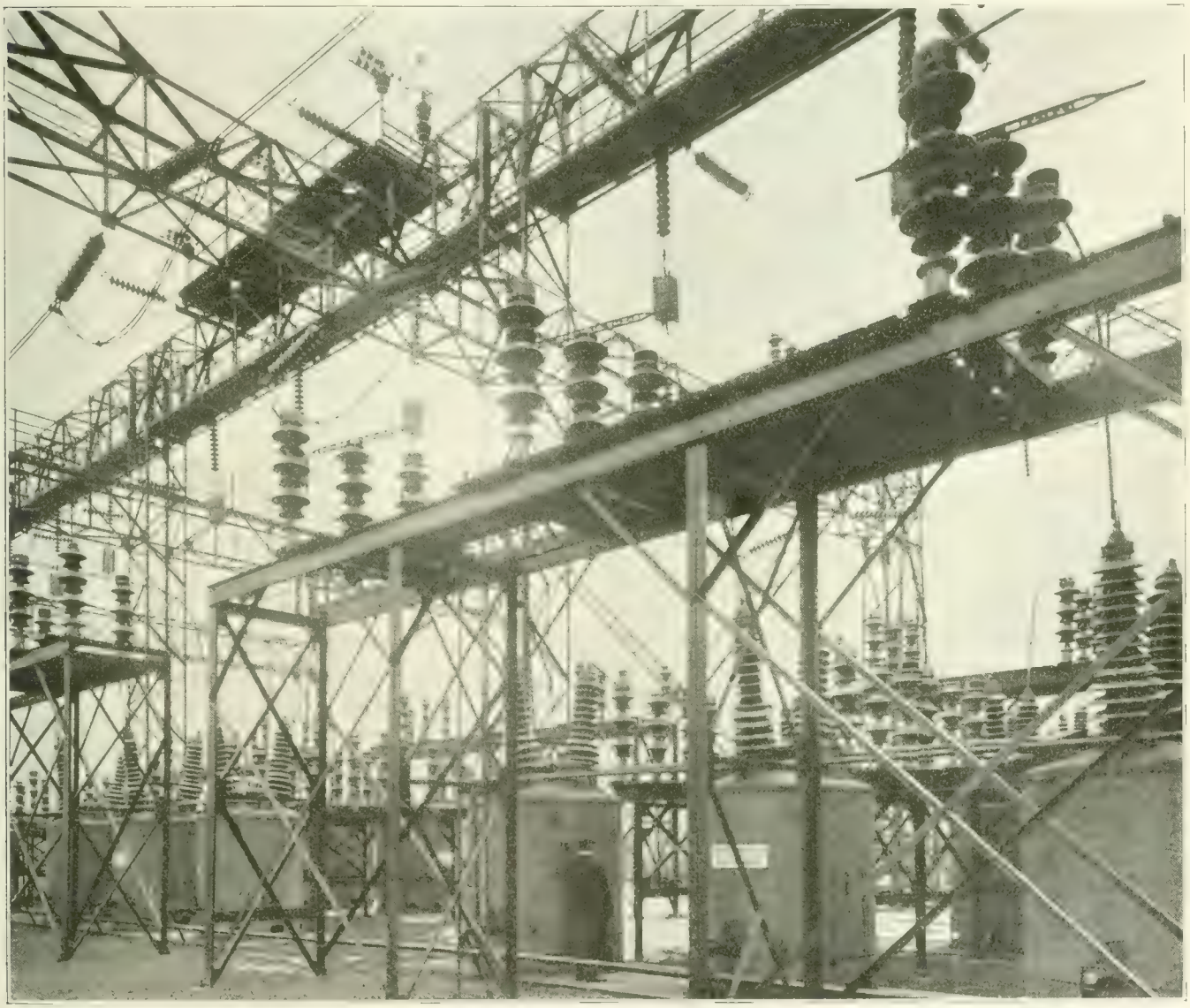
Duplicate control batteries, charging sets and control buses are provided, and all control circuits are supplied from double-throw switches by means of which any circuit may be connected to either bus. Normally, one of the batteries and one of the charging sets are connected to what is known as the operating bus, and all control circuits are connected by means of their selector switches to this bus. This leaves the duplicate bus free for overcharging the reserve storage battery or for serving as an emergency supply in case a ground develops anywhere on the control system.

An emergency lighting system is provided in which all of the emergency lamps receive their supply over independent circuits normally fed with alternating current. If this supply is interrupted, an automatic throw-over switch opens the connection and closes the circuit to the storage-battery bus. As soon as alternating current is again available the lamps are automatically thrown back onto the original source of supply.

Insufficient provision for power-station grounds is the cause of many serious power-station troubles, involving burning out of control and instrument wiring and prolonged delay in resumption of service. Therefore at Colfax seven ground plates have been buried beneath low-water mark and connected to a cable ring bus inside the building. Risers of copper strap make connections with this ring bus to the upper floors of the building, and individual circuits run from these risers to important pieces of apparatus.

To facilitate the routine operation of starting and stopping generating units, signal indicators are installed at the main turbine gage board and in the control room, affording rapid, simple and dependable communication between the members of the operating force. A push-button is operated in conjunction with this signal indicator to sound an air whistle and illuminate a signal lamp in the turbine room, the whistle calling the attention of the attendant to the signal being given and the light indicating the set receiving the signal. A buzzer alarm and lamp at each signal set in the control room correspondingly advise the switchboard operator when signals are being sent from the turbine room.

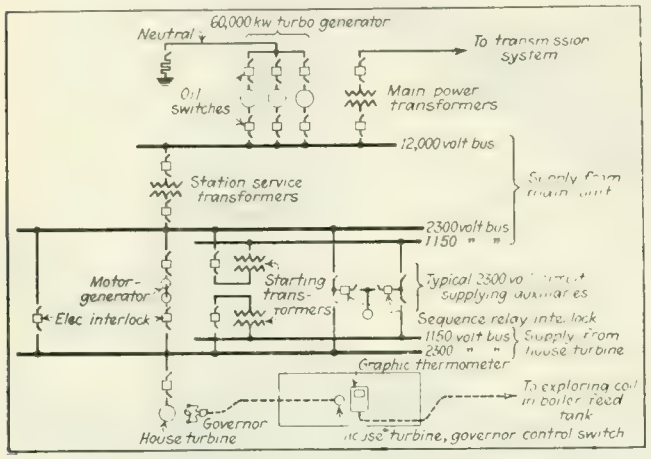
Duplicate private-branch exchange boards with special signals to permit separating commercial and operating calls provide for a maximum amount of telephone conversation with a minimum amount of interference with station operation. These exchanges serve telephones in all parts of the station. Private lines are run to



LADDERS AND PLATFORMS MAKE INSPECTION AND MAINTENANCE CONVENIENT; HORN GAPS ARE INSTALLED ABOVE STRUCTURE SO DISCHARGES WILL NOT INVOLVE ADJACENT CIRCUITS

the system operator's office in the Philadelphia Company's building in Pittsburgh, and as a reserve connection additional lines are leased from the Bell Telephone Company. A special connection equipped with a loud speaker is also provided between the gage board in the turbine room and the switchboard in the control room, so that the control-room operator is not required to use a head set.

The main benchboard is laid out with special attention to facilitating operation, the switches used most frequently being conveniently located and control for all apparatus which is operated simultaneously being grouped at the switchboards. To permit working to



PROVISIONS FOR SERVING STATION AUXILIARIES ASSURE RELIABLE OPERATION

advantage on the control-equipment connections the floor under the benchboard has been dropped so that one may stand erect beneath the control desk. Transite board barriers are provided between adjacent panels, thus confining any burn-out of control wiring to a single panel. On these barriers are mounted slate terminal blocks to which all of the control wiring is brought from equipment mounted on the benchboard. These terminal boards are marked with the conduit number of each individual pipe terminating in the pit below. Each terminal in any group assigned to a given conduit number is marked with the color of the wire which is to be connected to it. This arrangement simplifies the work of originally making switchboard connections and of replacing them in case of routine maintenance work. Spare terminals and conduits are provided for additional circuits in the future.

Because of the absence of the usual low-tension ring bus and the size of the main generating units, it has been necessary to provide some source of variable voltage for building up voltage on transmission circuits for test after work has been done on the line or after a disturbance has occurred causing a circuit outage. For this purpose a testing transformer bank is to be installed as a part of the outdoor switching station. Its low-tension voltage will be capable of adjustment in the switchboard room by means of remote control of a regulator, and its high-tension terminals will be arranged for selective connection to any transmission line. Thus tests can be quickly and conveniently made on any high-tension circuit without disturbing the operation of the generating equipment in the station or interfering with the load carried by other transmission circuits.

In spite of the fact that the station was constructed just at the time that prices of material and labor were at their maximum, the cost of that part of the plant which should be allocated to the first unit was only $105 per kilowatt. This low unit cost is due chiefly to the simplifications in design which have been outlined.

Dwight P. Robinson & Company, Inc., engineers and constructors, who designed and built the Colfax power station, were also responsible for the extension of the transmission system and the design and construction of a number of substations for the Duquesne Light Company in the electric ring around Pittsburgh.

Characteristics of Some of the Electrical Apparatus*

Main Generators

Each set to consist of one 1,800-r.p.m. and two 1,200-r.p.m., 23,600-kva., 85-per-cent-power-factor, 60-cycle, 12,000-volt, three-phase elements; 12½ per cent inherent reactance; each unit is star-connected with neutral brought out; 7-ohm resistance in ground circuit.

Main Transformers

One bank of four 23,600-kva., 11,500/38,100/76,200-volt, single-phase, 60-cycle oil-insulated, water-cooled units to each 60,000-kw. turbine set; 8.2 per cent inherent reactance; low-tension delta, high-tension star; one transformer of each bank is a spare.

Station Auxiliaries

House Turbine Generator.—One 2,000-kw., 2,300-volt, three-phase, 60-cycle unit.

Heat-Balance Set.—One 1,100-hp., 2,300-volt, three-phase, 60-cycle, wound-rotor motor driving 750-kw., three-phase, 60-cycle, 900-r.p.m., 2,300-volt synchronous generators.

Duplex Exciters.—Two sets, each consisting of a steam turbine on same shaft with 350-kw., 250-volt direct-current generator and 530-hp., 2,300-volt motor.

Station Service Transformers.—Three 833⅓-kva., 11,500/2,300-volt, single-phase, 60-cycle units, oil-insulated, water-cooled, connected delta-delta.

Auxiliary Power Transformers.—Six 200-kva., 2,300/460-volt units; two banks of three, connected delta-delta.

Station Lighting Transformers.—Six 50-kva., 2,300/230-volt-115-volt units; two banks of three, connected delta-delta.

Motor Generators.—For stokers and clinker grinder supply; two, each consisting of a 325-hp., three-phase, 60-cycle, 2,300-volt motor driving 200-kw., 250-volt direct-current generator.

Battery-Charging Sets.—Two, each consisting of a 25-hp., three-phase, 60-cycle, 440-volt motor driving 15-kw., 125-volt direct-current generator.

Elevator.—Combination passenger and freight, automatic, 2-ton capacity, serving all floors in electrical bay.

Stoker Motors.—Seven 25-hp., 230-volt, variable-speed units.

Clinker-Grinder Motors.—Fourteen 10-hp., 230-volt, variable-speed units.

Circulating Pump Motors.—Three 600-hp., 2,200-volt wound-rotor units.

Air Pump Motors.—Three 100-hp., 2,200-volt units.

Condensate Motors.—Four 100-hp., 2,200-volt units.

Storage Batteries

For circuit-breaker control and emergency lighting; two batteries of sixty-three cells with E-9 elements having normal capacity of 160 amp.-hr. in E-13 jars.

Circuit Breakers

High-Tension Circuits.—Eight electrically operated switches, type G-2, with 132,000-volt rating.

12,000-Volt Circuits.—Ten remote-controlled solenoid-operated switches, types O-2 and CO-2, with 15,000-volt rating.

2,300-Volt Circuits.—Twenty-five electrically operated switches, type B-2, with 16,500-volt rating.

1,150-Volt Circuits.—Nine electrically operated type F-2 circuit breakers, for starting service, rated at 7,500 volts.

Lightning Arresters

Three units, special electrolytic type, for 66,000 volts at the present and 132,000 volts ultimately.

*Except for the storage batteries referred to in the above table virtually all of the electrical equipment listed was furnished by the Westinghouse Electric & Manufacturing Company. The batteries were supplied by the Electric Storage Battery Company. Other equipment which was important but is not listed includes the following: Lighting fixtures—Benjamin Electric Manufacturing Company, Holophane Glass Company; insulators—Ohio Brass Company; bushings—Lapp Insulator Company, Inc., Locke Insulator Manufacturing Company; cable—Standard Underground Cable Company, Simplex Wire & Cable Company, Habirshaw Electric Cable Company and various others; load indicator—Q-P Signal Company; precision instruments—James G. Biddle; conduits—Crouse-Hinds Company; metal boxes—Star Metal Box Company; conduit and telephone equipment—Western Electric Company; fiber conduit—Fibre Conduit Company; asbestos doors and barriers—Keasby & Madison Company; boiler feed meter—Yarnall-Waring Company; power and lighting cabinets—Krantz Mfg. Co.; recording thermometers—Foxboro Co., Inc.

Electric Heat Raises Enameling Output

New Vitreous Enameling Furnace Facilitates Operations—Control of Process Superior to Old Furnace—Less Defective Enamel Because of Absence of Sulphur Fumes—Operating Data from New Installation

By JAMES W. CARPENTER
Industrial Engineer Union Electric Light & Power Company, St. Louis

A VERY interesting and important application of industrial heat has been made in the construction and operation of what is probably the first commercial installation of an electrical vitreous enamel furnace. This extension of electrical heat from the field of japanning, core baking, oil tempering and annealing to enameling has taken place during the last few months with the installation of a metallic resistor furnace in the enameling shop of the St. Louis Brass Manufacturing Company, manufacturer of a lighting fixture requiring vitreous enamel parts.



VITREOUS ENAMEL FURNACE INCREASES THE NUMBER OF CHARGES AND THE WEIGHT OF EACH CHARGE THAT CAN BE HANDLED DURING WORKING HOURS

This electric furnace installation has demonstrated fully that electric heat is applicable to the work of vitreous enameling, and the owners of this particular unit have been satisfied not only with the speed of operation obtainable, the ease with which the furnace can be placed upon part-time operation and the large amount of ware that can be placed on each charge, but they have been most highly gratified with the very fine grade of enameling which has resulted and which is attributed chiefly to the constant, even and readily controlled heat. This furnace was installed in the hope of obtaining such results and because of the general dissatisfaction with the older types of enameling furnaces.

Previous experience with coal, oil and gas furnaces had demonstrated that the temperature of 1,700 deg. Fahr. (927 deg. C.) could not be obtained or maintained constantly without the greatest of care, and repeated shutdown and loss of production resulting from sagging or breaking muffles, as well as defective enamel due to sulphur fumes or other forms of objectionable heat, caused the company to seek a new method of heating. The electric furnace is considerably higher in first cost and in operating cost. However, this furnace permits from 30 to 50 per cent more charges per hour than were obtained with coal, oil or gas furnaces and at least 25 per cent greater weight for each charge. In addition to this, there are virtually no maintenance expense and no loss of production through shutdowns or repairs. Owing to the increased rate of production the furnace will now handle 900 lb. (408 kg.) of enamel ware in one hour, and this greater output, together with the greatly reduced cost of furnace upkeep, means that with electrical energy costing 1¼ cents per kilowatt-hour enameling can be done by electrical heat at less cost than with any other type of furnace.

The new furnace is of the box type and similar in design and construction to the units used in heat treating and annealing. It measures approximately 12 ft. 11 in. (3.9 m.) in depth by 7 ft. 8 in. (2.43 m.) in width and 7 ft. 4 in. (2.13 m.) in height in over-all dimensions, while the actual space for enameling work is 4 ft. (1.2 m.) wide by 2 ft. (61 cm.) high by 10 ft. (3 m.) deep. The roof of the furnace is curved somewhat so that the actual height of the furnace varies between 26 in. (66 cm.) at the side and 30 in. (76 cm.) in the center.

The heat is obtained from ribbon "Nichrome" wire arranged in a lattice-like construction on the sides, both top and bottom, of the furnace and supported on special hanger bricks which are incorporated in the inner walls of the furnace. The "Nichrome" winding on the lower sides is double, while that on the upper sides is single except for about 22 in. (56 cm.) in back of the door, where a double winding provides for the losses occasioned by the opening and closing of the door. There are six "Nichrome" elements used in making up the complete heating equipment, and they are connected to the electrical supply by special outlets placed in the walls of the furnace. The "Nichrome" wire is approximately ⅝ in. (16 mm.) wide and 0.05 in. (1.27 mm.) thick, and careful test made on this resistance wire after sixty days' operation has shown that there has been no apparent physical or electrical change. As this wire is to be operated at a temperature not over 1,800 deg. Fahr. (982 deg. C.), suitable fuses are installed in the furnace connections to protect the

elements from destruction by temperatures exceeding their normal rating.

The furnace brickwork is built up of three courses. First there is a 4-in. (10-cm.) course of common firebrick in which the special hanger brick for the support of the "Nichrome" winding is laid as a single row. Next comes the 9-in. (23-cm.) course of special insulator brick and then a 4-in. (10-cm.) course of common red brick. There is not a great deal of radiation through the walls of the furnace, but it is probable that the entire furnace will be covered with a coat of asbestos further to reduce this heat loss. The door of the furnace is about 4½ ft. (1.4 m.) wide by 3 ft. (0.9 m.) high and is made of special insulation brick in a steel frame. Special monel-metal racks have been adopted as the standard for supporting the metal to be enameled, as these lighter racks reduce the area and weight of metal entering the furnace and give much longer service than the ordinary iron racks. The ribbon winding for the furnace has a maximum rating of 150 kw. and is operated on 230-volt, three-phase, 60-cycle current. The record of the operating temperature as well as the control of the electrical current is obtained by two thermocouples connected through the walls of the furnace, one of them measuring the temperature of the air in the furnace and the other the temperature of the winding. Connections are made to an automatic control panel installed at the rear of the furnace. This panel holds contactors and automatic switches which provide for the automatic control of the furnace, and these are operated by means of the Leeds-Northrup automatic two-point temperature recorder and controller. This equipment gives a recording chart showing the temperatures of both the ribbon and the air and includes a simple adjustment for varying the operating temperature.

The accompanying illustration shows the control panel and the temperature recorder and the connections on one side of the furnace. The heavy cables from switchboard to furnace are to be inclosed in conduit.

The electrical equipment and hanger brick supporting the "Nichrome" winding, as well as the layout and technical supervision, were supplied by the General Electric Company. The furnace was constructed by the St. Louis Brass Manufacturing Company, and the wiring and the electrical connections were made by the Union Electric Light & Power Company of St. Louis.

At the time of the purchase of the furnace guarantees were given that it would bake 8 lb. (3.6 kg.) of material per kilowatt-hour, this weight to include the racks on the basis of half of the total weight, with the understanding that the guarantee covered the operation of the furnace at the full capacity of 1,200 lb. (543 kg.) of material per hour, including the racks. Similarly, the electrical heating elements were guaranteed to maintain a temperature of 1,700 deg. Fahr. (927 deg. C.) under an operating cycle of three minutes and forty seconds, during which time the door would be opened ten seconds for loading and ten seconds for unloading with an average baking time of three minutes and twenty seconds. Furthermore, the heating elements were not to exceed a maximum demand of 150 kw. The temperature rating and demand guarantees were satisfactorily met, while the production of the furnace in pounds of material per kilowatt-hour was greatly exceeded and will be further improved upon as greater experience is obtained in the operation of this type of furnace. Moreover, the operating cycle has been reduced from the guarantee of three minutes and forty seconds to one minute and fifty seconds.

OPERATING DATA ON NEW VITREOUS ENAMELING ELECTRIC FURNACE IN THE PLANT OF THE ST. LOUIS BRASS MANUFACTURING COMPANY

Pieces of Ware	Pounds of Ware	Pounds of Racks	Hours Heating	Hours Enameling	Total Kw.-Hr.	Kw.-Hr. per Hour	Pounds Iron	Racks	Charges
1,306	3,533	6,058	10		1,600		560	1,920	139
1,568	3,448	11,625	10		1,500				180
1,848	3,160	9,025	10		1,400				145
1,252	2,672	5[illegible]	22		1,000				87
1,169	3,483	6,576	5⅛		2,900	137 8			.....
1,361	3,623	9,350	12½		1,600	133			.....
1,584	4,174	9,793	12		1,600	133			171
1,951	5,281	9,405	12	9	1,500	125*			18 5
1,716	4,370	10,035	12	9½	1,500	†			17.3
2,124	3,639	11,106	11	9	1,400	127 3			.
1,674	4,532	11,942	13½	9	1,800	138			
1,878	3,314	9,510	11	9	1,400	127.3			
2,002	3,593	8,771	10½	9	1,300	128			
1,619	3,346	8,634	11	7½	1,400	127			
554	594	1,520	9½	9	1,100	136	3,567	3,680	
1,641	3,515	7,698	13	7	1,800	138 4	.....	.....	
763	2,459	4,722	13	9	1,500	115 3	1,260	900	
534	2,388	3,085	10	7	.....	.....	.....	960	

* Oven cut out forty-seven times. † Oven cut out sixty-five times.

Cost of Furnace Higher than Older Types

The total cost of a furnace of this type will vary between $8,000 and $9,000, depending upon the equipment to be installed and the power supply available. The electrical equipment of the oven will cost about $3,500, the electrical installation will come to about $600, the construction of the oven will cost approximately $1,500, and the substation expense will vary between $2,000 and $5,000, depending upon the number of furnaces installed and the share of the substation cost borne by the electrical equipment of the factory. The cost of the electrical furnace is, of course, considerably higher in original investment than with the older type; but the difference in maintenance cost, saving in space and greatly superior product soon make the original investment a matter of minor consideration. At the present time the furnace in the factory of the St. Louis Brass Manufacturing Company is operating only on a night shift, and the hourly energy consumption has approximated 125 kw.-hr. For twenty-four-hours-a-day operation with the continuous hot earth this consumption will probably decrease about 10 per cent. The table gives data regarding the pounds of metal and kilowatt-hours used during recent operation of the furnace.

The general results thus far obtained from the operation of this furnace have been highly satisfactory, particularly with regard to the quality of the enamel produced and the speed with which the oven can be brought to temperature and operated. The electrical furnace can be brought from stone-cold condition to 1,700 deg. Fahr. (927 deg. C.) in twelve hours, which is less than one-half the time that would be required for an oil or gas furnace. The usual operation of this furnace has been to cut it out at 5 o'clock in the morning at a temperature of 1,700 deg. Fahr. (927 deg. C.) and cut it in again at 6 o'clock in the evening at 1,200 deg. Fahr. (649 deg. C.), and in forty minutes the furnace has been ready for charging at 1,600 deg. Fahr. (871 deg. C.). Special studies on production have shown that during an hour the production obtainable is 2,338 lb. (1,059 kg.) of ware and rack with the use of 130 kw.-hr. per hour, the number of charges being twenty-four. This means 900 lb. (408 kg.) of enamel ware with a consumption of 130 kw.-hr. On certain types of work the electric furnace has been able to handle at least 170 heats of No. 22 gage steel in ten hours. The results previously obtained in this factory with an oil furnace have been not more than 130 heats of the same material in the same time.

Similar installations by other enameling concerns are expected, and it is probable that in future installations a double-end furnace may be adopted. There are also possibilities of a conveyor type or a continuous-feed furnace with arrangements for preheating and slow cooling in the application of the enamel. All those who have examined the furnace and have seen it in operation have commented favorably upon its general appearance and the remarkably fine character of enamel product, and it is quite apparent that the opportunities for electric heating in vitreous enameling will be as wide as the field of enameling itself.

Specifications for Skagit River Development

SPECIFICATIONS which have recently been issued by the city of Seattle for the Skagit River development, which is in the Diablo Canyon about 100 miles from Seattle, show that two units will be installed with a rated capacity of 30,000 kva. each. The turbines are to be designed to operate under a maximum static head of 395 ft. (120 m.), of which 380 ft. (116 m.) will be pressure and 15 ft. (4.5 m.) draft head. The main tunnel through which water is conveyed to this plant will be designed to supply three turbines, of which only two are to be installed at present. The net effective head on the turbines, after deducting "draw-down" in reservoir, loss of head in tunnel and penstock, and tailwater elevation above low water, will be 375 ft. (114 m.) when the plant is carrying full load. Until such time, however, as the masonry dam can be completed the plant will operate under a net effective head of 275 ft. (84 m.).

The turbines will be vertical-shaft, single-runner, reaction-type units designed to utilize 1,000 cu.ft. (28.3 cu.m.) of water a second at a net effective head of 375 ft. (114 m.), although the runners to be first supplied will be designed to give maximum power and efficiency when operating under 275 ft. (82 m.) net effective head. The runner to be used under the ultimate head will be designed but not built, as the time during which the plant will operate under the low head is not definitely known. Three hydraulic valves operated by hydraulic pressure from the penstock will be used and arranged for both hand control at the valve and electrically operated remote control.

The electrical equipment will include two high-reactance three-phase, 60-cycle, 11,000-volt, 30,000-kva. alternating-current generators, with direct-connected 250-volt exciters. Each generator and exciter will be operated as a unit, with voltage controlled by a separate automatic voltage regulator.

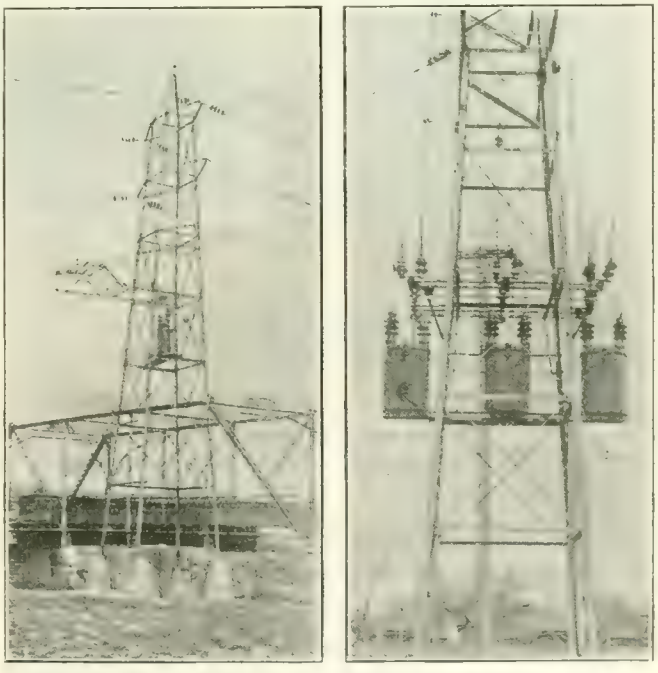
Six 10,000-kva., single-phase, 60-cycle, oil-insulated, water-cooled, outdoor-type transformers are to be operated in two three-phase banks, one for each generator. The low-tension windings will be connected in delta across the 11,000-volt bus, while the high-tension windings are to be connected in Y to give 154,000 volts between lines. The neutral point will be solidly grounded.

The output of this development will be transmitted to Seattle over a 90,000-kva., 154,000-volt, 105-mile (169 km.) transmission line. The specifications call for delivery of equipment to commence during January, 1923, and completion not later than May 1, 1923.

Serving Rural Distribution from High-Tension Lines

Long Distribution Lines Paralleling High-Tension Lines Entail High Copper Expense, While Frequent Taps Are Costly in Transformers

IT IS becoming increasingly difficult to purchase right-of-way for high-tension lines without a clause in the contract binding the company to provide electric service to the property owners. Various farm-lighting



HOW DAYTON POWER & LIGHT COMPANY PROVIDES RURAL SERVICE

Single-phase load center served by 33,000/2,300-volt transformer and (right) three 15-kva., 33,000/2,300-volt transformers for power and light service.

plants have now been in operation long enough to convince the user that the annual operating cost is rarely less than $100, and in many instances more. As a result the rural demand for central-station service is steadily

increasing, and if the rural customer is educated to use $100 worth of central-station service per year, instead of only $25 worth or less, the central stations will find it profitable to extend their lines farther and farther into rural districts. A great amount of skill is required to make rural distribution from high-tension lines as cheap as possible without sacrificing good construction. Low maintenance expense is much more important than low first cost.

There are three methods of distributing to rural customers from high-tension lines—first, by a distribution line paralleling the transmission line its entire length; second, by individual transformations for each customer or group of customers, and, third, by a combination of the first two methods with distribution lines running each way from two or three step-down points.

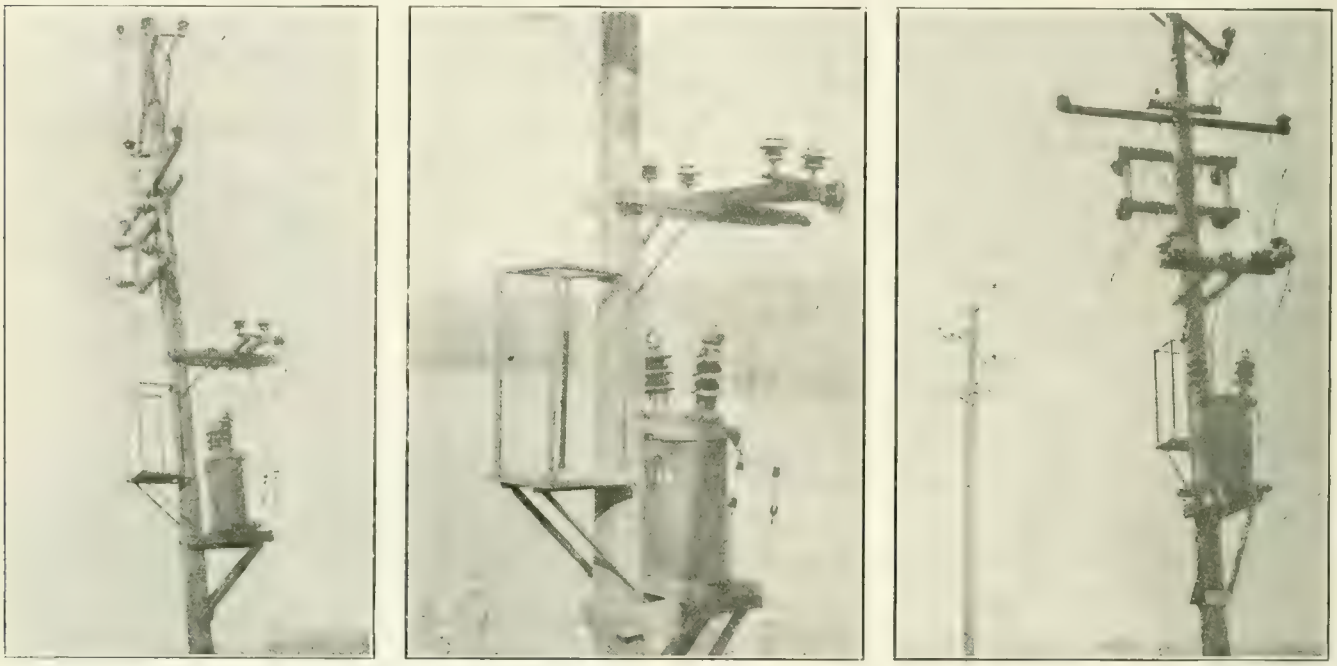
From an operating standpoint and for continuity of service the distribution line paralleling the high-tension line for its entire distance is the best. However, this method is usually the most costly—a feature which makes it prohibitive when customers are widely scattered.

The second method, employing direct transformation for each customer, is not economical in the use of transformers and becomes less and less economical the higher the transmission voltage. Furthermore, every tap weakens a high-tension line and creates a possible source of trouble. Present-day transformers and substation equipment stand up very well under operating conditions, but many high-tension line outages are traceable to some description of substation failures.

Transformer authorities agree that there is virtually no limit to the ratio of transformation which can be safely and satisfactorily used, and the Dayton Power & Light Company steps down 33,000 volts to 230/115 volts in a few isolated cases. It is a rare occasion, however, when the individual rural demands from a high-tension line approach the capacities which would make these individual transformer installations financially economical. For instance, a 25-kva. single-phase transformer with 66,000 volts costs $1,220 or $48 per kva., while a 50-kva. transformer for the same voltage costs only $28 per kva. and a 100-kva. transformer costs only $18.35 per kva. rated capacity.

The third method, which is merely a combination of the two others, is used in the majority of cases because it is the most economical in operation and in first cost. Transformers are used to step down from the high-tension voltage to an intermediate voltage which may be anything up to 14,000, and this intermediate voltage is distributed both ways along the line. The high tension step-down transformers are usually installed near the point of greatest demand.

A modified scheme to save transformer capacity and transformer losses is to step down from the high-tension line to 230/115 volts for a large power job and then step up to 2,300 volts or 6,600 volts for rural distribution along the high-tension lines. The three transformations between the high-tension line and the rural customer's service do not give such good regulation as if only two transformations were used, but this drawback is not serious.



THIS POLE-TOP CONSTRUCTION HAS PROVED SUITABLE FOR STEPPING DOWN FROM 33,000 TO 2,300 VOLTS FOR LOCAL COMMUNITIES

Transformer capacity has also been saved where the rural service is not very dense by the use of 230-volt two-wire secondaries, which can be extended four times as far with the same line loss as if regular 115/230-volt secondaries were used. Most of the customers have been willing to pay the slightly higher price of the 230-volt appliances in order to get the service with the least possible line cost. In some cases dealers would rather give their good customers a 230/115-volt balance coil than to stock the 230-volt appliances. In other cases customers have purchased dry-type balance coils which are all connected to the customer's side of the meter.

In the paper containing the foregoing discussion, which was presented at a recent meeting of the transmission and distribution committee of the Ohio Electric Light Association by R. P. Wuichet of the Dayton Power & Light Company, the author pointed out the impossibility of giving a general solution to cover all cases. He therefore set forth the advantages and disadvantages of the different systems.

Selection of Demand Meters

Study of Characteristic Curves Shows Points that Influence Choice of Meters for Different Loads and Customers—Permanent Records of Demand a Desirable Feature—Suggestions for Improvements in Design

By WILLARD S. WILDER

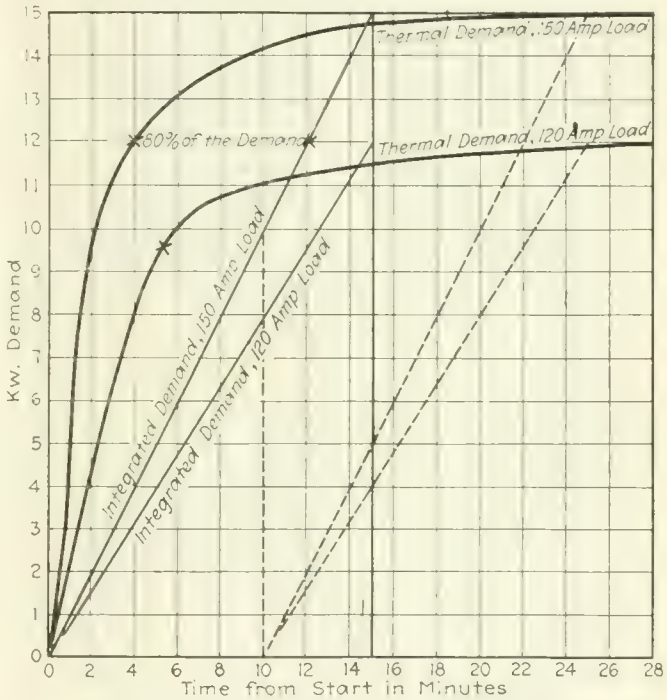
A STUDY of demand meters will show certain relations of type characteristics that influence the selection of equipment. Such points as service rates, type of load, initial cost and maintenance charges have a direct bearing on an intelligent choice of meters. The first consideration, however, is the type of meter as related to the load to be measured and a study of meter characteristics will be found helpful in analyzing such a problem.

Lagged meters and definite time-interval meters are the two general classes into which demand meters may be divided. To the former class belong thermal meters and mechanical demand meters having no fixed timing period, but which start measuring a demand as soon as it occurs. These meters are always lagged so that sudden overloads such as motor-starting currents and high demands for short duration are not recorded. Definite time-period demand meters measure the weighted average energy demand during a fixed period usually of fifteen minutes, thirty minutes or sixty minutes' duration. These meters have no characteristic curve and are simply devices which integrate a load curve over a definite period and record average demand.

Demand meters of the lagged type and of the definite-time-interval type are both subject to error on certain types of loads. The tendency of the lagged demand meters is to read too high and that of the definite-time-interval demand meters is to register too low. A discrepancy will exist on alternating-current loads of low power factor between demands measured by a thermal type of demand meter and demands indicated on an integrating kilowatt-hour demand meter. The demand as recorded by a thermal demand meter will be proportional to the heating effect of the current and is usually considered to be a sound basis for a demand charge. The demand as recorded by an integrating kilowatt-hour demand meter, on the other hand, will be based on the actual demand for power. The thermal demand meter which depends upon the heating effect of the electric current for its operation registers proportional to current values only, hence does not record the power demands on alternating-current loads operating at other than unity power factor. Consideration must be given to these differences in choosing a demand meter for any class of service as the reading must correspond with the definition of demand in the power contract.

It will be noted from the curves that it takes the thermal demand meter twenty-five minutes at a constant load of 15 kw. to record the actual demand, the time lag being thirty minutes at 12 kw. While it took four minutes for the demand meter to register 80 per cent of the demand when the load was 15 kw., it took nearly five and one-half minutes for the same meter to reach 80 per cent of the demand when the load was 12 kw. This lagging of the characteristic curves on decreased loads is common to thermal demand meters and decreases their effectiveness in registering light demands of short duration.

The definite-time-period demand-meter curve is effectively a straight line as shown in the figure. Demand meters of this type simply count the revolutions of the watt-hour-meter disk, and at the end of fifteen minutes, which is the usual time interval, the pointer returns to zero and again starts counting the demand. Hence for



CONSIDERATION OF DEMAND-METER CHARACTERISTIC CURVES WILL ENABLE AN INTELLIGENT SELECTION BASED ON REQUIREMENTS

the loads under consideration the definite-time-interval meter will register the true demand at the end of fifteen minutes, after which the pointer will be returned to zero and the meter will again start registering the demand. It will be noted that with this type of meter 80 per cent of the load is registered in twelve minutes, or 80 per cent of the fifteen-minute period, regardless of magnitude of load, owing to straight-line characteristic.

Comparison of the two characteristic curves for these demand meters shows that for constant loads of fifteen minutes or slightly longer duration the thermal demand meter will not record the true maximum, while the definite-time-period meter will record the true maximum demand. On the other hand, the thermal demand meter begins registering as soon as the load is applied, while the other demand meter may not. Thus if the load was about twenty minutes' duration the thermal demand meter would record nearly the correct demand, and if the load was applied five minutes after the time period

started on the definite-time-period meter, this meter would record but 66.6 per cent of the true demand during the remainder of the period. The time interval being up ten minutes after the load was applied, the pointer would return to zero and would again start counting the demand as shown in dotted line in the figure.

Should the total duration of the load be but twenty minutes, the definite-time-period demand meter would indicate two demands of only 66.66 per cent of the actual demand.

Permanent Records of Demand Desirable

In addition to recording the time a maximum demand occurs, a permanent record of its value is also desirable. Several demand meters furnish permanent records on paper charts, but nearly all have disadvantages that practical central-station metermen would like to see removed. Demand meters employing an inking pen are unsatisfactory because of blotting and running of the ink, and unless frequent attention in given to the pens they will not operate properly. Specially surfaced charts of wax-coated paper upon which the record is scratched by a metal pen fail to operate properly under wide ranges of temperature. In cold weather the stylus fails to make a legible impression through the cold wax, while in warm places the record is destroyed by the melting of the wax surface. A small electric light, thermostatically controlled and placed in the case of demand meters using wax-surface charts, lessens the cold-weather difficulty, but no remedy has been found that will permit the waxed charts to be used near furnaces or other warm places.

A record from a demand meter should be permanent, easily interpreted, and the demand values quickly determined from the record with a minimum of effort. Both graphic watt-meter records and demand-meter charts giving the value of any fifteen-minute demand are easy to interpret, but the demand-meter records are preferable as they do not require the averaging of a curve to determine the demand value. Records which consist of a series of periodical kilowatt-hour readings printed on a paper tape require a great deal of clerical work to place them in a convenient form. The difference between kilowatt-hour readings for consecutive demand periods must be obtained over the entire record and placed upon a sheet opposite the time of the demand before the maximum demand and time of its occurrence can be ascertained. A general inspection of the record tape will not suffice in determining the maximum demand, since the opportunity for error is too great, especially where the billing maximum demand is based on the two or more highest recorded demands. Demand records in the form of lines drawn every fifteen minutes on a paper chart prove more satisfactory when drawn on paper tape than when drawn on a circular chart. Demand records drawn on a circular chart are difficult to interpret for low values of demand, and when it becomes necessary to obtain a customer's demand during an hour of off-peak service it becomes nearly impossible to read the chart because of the wedging of these short lines between lines of much greater magnitude with a consequent loss of legibility.

The application of a demand meter to any service must not in any way interfere with the reliability of that service or with the accuracy of the metering of the energy consumption. Demand meters directly connected in the service leads introduce one more set of connections at the service entrance which may prove a weak link in the circuit. Demand meters dependent upon the watt-hour meter for operation are connected electrically or mechanically to the registering mechanism of the watt-hour meter and unless carefully installed may increase the friction of the mechanism. Difficulty is experienced in calibrating a watt-hour meter equipped with a cam and set of contacts for closing an electric circuit through the demand meter. The varying friction of the contact fingers over different steps of the cam causes a variation in drag on the watt-hour meter disk so that accurate test results cannot be obtained unless a long test interval is employed. A similar difficulty in adjusting a watt-hour meter is experienced with demand indicators directly connected to the meter shaft.

Aside from the points mentioned, the greatest difficulty—and unfortunately a very serious difficulty—is found in the demand-meter contacts. These contacts, which are mounted in the watt-hour meter, count the revolutions of the meter disk, closing a circuit through the demand meter which causes the pointer to rise. The friction of the contact arms passing over the cam teeth produce an uneven lag upon the watt-hour meter disk which makes calibration difficult and temporary. By far the most serious trouble with the contacts is caused by their chattering or vibrating, which causes the demand meter to operate when it should not. Cases have come to attention where the maximum demand of a customer as indicated by the demand meter occurred at time of very light load when the plant was nearly shut down. In these cases the watt-meter disk was moving slowly, bringing the demand meter contacts into close proximity for a short period of time, during which vibrations caused a chattering of the contacts, rapidly opening and closing the circuit and recording a high demand. The design of a suitable contactor is sorely needed for demand meters which depend upon the revolutions of the watt-hour meter, since this type of demand meter has many advantages. It is easily adapted to any circuit, is simple, reliable and requires no separate calibration from the watt-hour meter.

First Cost of Meter as Well as Operating Expense Important

While reliable metering of the demand and energy requirements of a customer are very important considerations, the initial cost and operating expenses of such equipment are also factors of great importance. In order to reduce the purchase price and installation costs of metering equipment it is desirable to combine the watt-hour meter and the demand meter into one instrument inclosed in one case, but the present tendency in design appears to favor a demand meter separate from the watt-hour meter but connected electrically to it. Demand meters of the lagged type and other meters which do not furnish a record of the time a demand occurs require less attention than those using a chart or paper which must be changed or inspected about once a week.

There is a great need for a simple and reliable demand meter which will furnish a record of the demand and the time it occurs and at the same time will require attention only once a month. Such a meter would give all the values required and would need attention only when it was read. With a few exceptions all the clock mechanism and paper records at present employed in demand meters require attention at least once a week, and where

a large number of such demand meters are in use the continual services of one or more men are necessary.

Demand meters which simply count the revolutions of the watt-hour meter disk require no calibrating, while those of the thermal type and self-contained demand meters must be kept in calibration. This increases their operating costs.

Adaptability to a large variety of conditions is desirable in demand meters in order to reduce the number of types of meters that must be kept on hand. As thermal demand meters record a demand which is proportional to the root mean square or heating value of the current, they can be used on direct-current and alternating-current circuits of any frequency. With alternating-current circuits of high voltage or large current values these demand meters may be used with current transformers. Demand meters dependent upon the watt-hour meter for operation are limited in adaptability only by the source of energy available for operating the recording mechanism. The same source of potential that supplies the watt-hour meter is generally used, although where this may be unsatisfactory for the demand meter it is not uncommon practice to operate that meter from some other source.

Another requirement for a good demand meter is to have a large recording range with convenient increments so that unusually high demands may not be lost because they are beyond the maximum range of record. Meters which continually record the revolutions of a watt-hour-meter disk and indicate the demand by the difference between consecutive energy readings can be adapted to record small increments of power and are not subject to the objection of having a limited demand range, as is the case with most other demand meters.

Some of the lines have been indicated along which improvements are needed in the design of demand meters. Cheaper meters are wanted also, to permit more extended use of these contrivances so that demand charges will no longer be based on estimates of connected load.

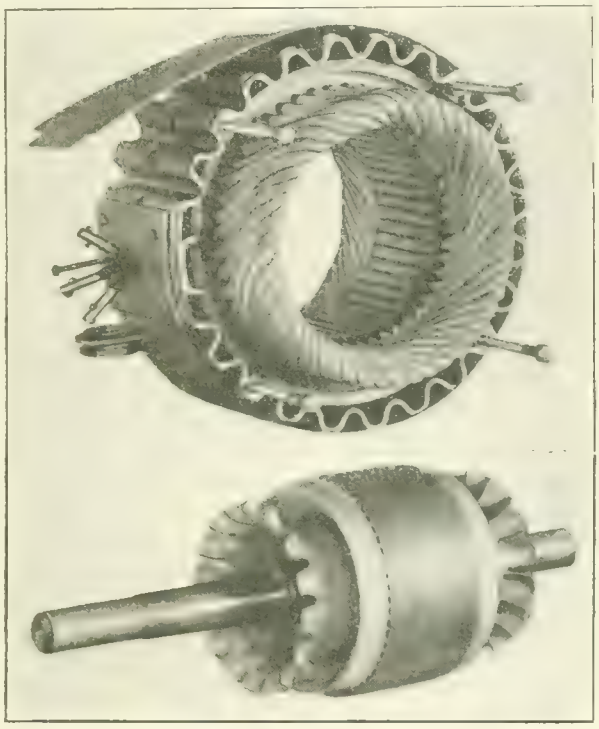
Unique Ventilation Scheme for Polyphase Motors

Designed to Prevent Dirt Accumulation and Oil from Coming in Contact with Windings—Rotor Cage Is Cast in One Piece

TO PREVENT the accumulation of oil on motor windings and the resulting collection of dirt a line of polyphase induction motors has been brought out recently in which an unusual method of ventilation is used. The scheme is to screen the ventilating air before it enters the windings and so to direct this air that it opposes the entrance of oil into the windings from the waste-packed bearings. The waste-packed oiling method has been adopted also to overcome any tendency toward spilling of oil when vibration is particularly severe.

While the motors are ventilated or air-cooled, they are virtually inclosed from a mechanical standpoint. Air enters at the periphery of the machine and is discharged at each end, the direction of air flow being exactly opposite to that found in most motors. It is claimed that oil leakage caused by careless filling cannot occasion bad results, because such oil is expelled from the ends of the motor instead of being driven into it. Hence there should be little opportunity for an accumulation of dirt and lint on the windings that might be caused by the stickiness of an oil film.

These motors are provided with a novel frame or casing consisting of a series of corrugations formed from a single piece of sheet steel. These corrugations are equidistantly spaced and in intimate mechanical contact with the stator core, so that considerable of the heat generated in this core and its winding is conducted to this casing, which therefore forms an efficient means for transferring heat to the ventilating air by radiation. Air entering at any point along the surface of the screen travels over the outside of the corrugation through holes provided at the center of these corrugations, then through the lateral ducts between casing and core, then over the windings at the end, and finally is discharged at each end of the motor. This corrugated



POLYPHASE INDUCTION MOTOR DESIGNED TO PREVENT OIL ENTERING WINDINGS AND PARTS SHOWING INTERESTING VENTILATION SCHEME

casing, therefore, contributes to the efficiency of the ventilating system to a marked degree and at the same time forms an exceedingly rigid and accurate frame for the stator core.

Fans are provided at the ends of the rotor for the purpose of drawing the cooling air through the machines. They are said to be of unique design and construction in that a stream of air is drawn directly over the bearing housings and immediately expelled without entering the motor, while another stream is drawn through the machine and expelled at the same points. These fans are made of a single piece of sheet steel and welded to the thrust collars.

These motors employ rotor windings having bars and end rings made of one piece of metal, entirely eliminating mechanical or electrical joints, the windings being molded or cast on the magnetic core.

These motors are now built in sizes up to 30 hp. at 1,800 r.p.m. for 60-cycle polyphase circuits, with corresponding capacities at other standard speeds and frequencies.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Further Data on Snyder Furnace Operation

To the Editor of the ELECTRICAL WORLD:

SIR: In the March 12 issue of the ELECTRICAL WORLD, page 605, an article appeared entitled "Operating Records of Electric Furnaces for Refining High-Grade Steels." Figures such as given in this article are misleading without some investigation of the surrounding circumstances. If the figures as published were accepted by any prospective user of electric furnaces, they would work against the electric furnace industry, and if it were not for the fact that we have changed our designs for furnaces of that size, they might injure us. The figures cited are not typical ones in making castings, which is what the article says the two 1-ton Snyder furnaces were used for.

There are a number of furnaces in use in different foundries of the exact size of the two Snyder furnaces at the plant of the United Alloys Steel Corporation. At the Pelton Steel Company in Milwaukee two furnaces of that size have turned out more steel in one month than the furnaces cited in your article turned out in a year. The furnaces referred to in the ELECTRICAL WORLD are described as 1-ton furnaces, and it is shown that they turned out something over 2 tons per heat. The plant of the Dayton Steel Foundry Company has turned out more than 250 tons from one furnace of that size in a month. In an article published in the *Foundry* for February, 1918, by C. E. Messenger, he showed that a furnace of this type and size turned out 2,029 heats in thirteen months, a total of 2,560 tons, or approximately 2,300 tons in one year.

In the article in the ELECTRICAL WORLD an electrical consumption of 1,002 kw.-hr. per ton is given. The results of the operation cited above for the Pelton Steel Company, when operating day shift only, were approximately 600 kw.-hr. per ton; results for the Dayton Steel Foundry were 524 kw.-hr. per ton, and the figures given by Mr. Messenger in the article referred to were 570 kw.-hr. per ton. In your article an electrode consumption is given which would mean a cost of approximately $4 per ton for electrodes, whereas single electrode furnaces of that type are operating for $1 and under per ton for electrodes. The figures given by Mr. Messenger showed 70 cents per ton of metal melted, but, of course, that was when electrodes were somewhat cheaper than at the present time. Allowing for the difference in market price at the date of his article and today, the price would be around $1. The author of your article shows the charging time as thirty minutes.

The Western Crucible Steel Casting Company has an exact duplicate of the furnaces at the United Alloys Steel Corporation's plant and gave us a letter showing that this furnace had been charged 2,520 times with a drop-bottom charging bucket, that it never took more than two minutes to charge and that all charging was done by one man. F. VON SCHLEGELL,
Industrial Electric Furnace Company, President.
Chicago, Ill.

The American-Swedish Electrical Commission in Switzerland

To the Editor of the ELECTRICAL WORLD:

SIR: As already stated in a former issue of the ELECTRICAL WORLD, an American-Swedish commission of electrical engineers recently inspected the Swiss electric railroads. The commission has now finished its work and has just left the country. In addition to the Director-General of the Swedish State Railways, F. H. Sheppard, director of heavy traction Westinghouse Electric & Manufacturing Company, and J. V. Dobson and F. E. Wynne, electrical engineers of the same company, took part in the inspection and consultations which followed the trip. The commission visited the Lötschberg line from Spiez to Brigue and the St. Gotthard line. A close study was made of the electric installations and power stations on both lines. Special attention was paid to the capacity and wear and tear of the heavy electric locomotives with a view to the cost of maintenance.

It was stated that the chief reason for these investigations is the difference of opinion existing among electrical engineers in regard to whether the single-phase alternating-current system or the direct-current system should be used in the construction of electric railway lines. The United States and France are in favor of direct current, while Switzerland, Germany and Sweden prefer the single-phase system, the latter having been proved to work very satisfactorily on the Swiss lines. In addition, it was stated that the cost of the direct-current system and of its maintenance was much greater than that for single-phase.

Sweden possesses an electric railway about 100 km. (62 miles) in length in the extreme north of the country, connecting the mining district of Kiruna with the Norwegian port of Lulen, the shipping port for Swedish iron ore. Four passenger trains and numerous freight trains are daily running over this line. It is now intended to extend it eastward to a port on the Bottnian Bay. At the same time the Stockholm-Gothenburg Railway, one of the most important lines in the country, is to be electrified, and it seems that the Swedish engineers who took part in the Swiss inspection trip will advocate for this line the single-phase system in use on the Swiss electric roads. The Swiss railway and electrical engineers who accompanied the foreign delegates said that the single-phase system is giving very satisfactory results. In Norway the Christiania-Bergen Railway is also about to be electrified. HENRY L. GEISSEL.
Münsingen-Berne, Switzerland.

Asserts that Choke Coil Was Patented

To the Editor of the ELECTRICAL WORLD:

SIR: The strain-type choke coil described in an article published in your paper appearing Jan. 29, on page 261, is covered by patent (No. 769,057) granted me in 1904. Such a coil is now made under royalty contract by the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Delta-Star Electric Company. GEORGE S. CARSON,
Iowa Gas & Electric Company, President.
Washington, Iowa.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Choosing Economical Size of Generator for Power Plant

IN DECIDING on the size of generators for a plant the most important factor to consider is the load conditions. As an example to show application of principles, let it be assumed that a plant is to be designed to furnish an industrial load of about 15,000 kw. average and with peaks running up to 25,000 kw. In selecting the generators the first principle to be remembered is that generally the larger the unit is the more economical it proves. To begin with, assume that two units are to carry the maximum load running up to 25,000 kw. In this case the rating of the units would be 12,500 kw. each, which happens to be a commercial size. As the average load is 15,000 kw., each will carry 7,500 kw., or about 60 per cent of the maximum load. From a steam-consumption point of view the most economical load is about 70 to 75 per cent of the maximum load. Thus it is seen that the two units would not be working quite on their most economical point as the nature of the load will not allow this. If the plant is not tied in electrically with any other plant and the load must be carried, then a spare unit should be installed, in which case the plant would be composed of three turbo-generators of 12,500 kw. each, or 37,500 kw. in all.

Now suppose the load to be carried by one unit. It must have a capacity of 25,000 kw., and a spare unit would require the installation of 50,000 kw. On the other hand, suppose the load to be carried by three units. Then each would be loaded to 8,300 kw., while the nearest commercial size is 7,500 kw. If the swings up to 25,000 kw. were of short duration and the steam pressure were high, perhaps the best thing to do would be to have the turbines designed for 200-lb. steam pressure at the throttle. Then if the steam pressure were raised to 225 lb., a 7,500-kw. unit would carry 8,300 kw., as the load carried is directly proportional to the absolute pressure of the steam. At the normal load each unit would carry 5,000 kw., which is 66 per cent of the maximum load and therefore somewhat nearer the most economical point for the unit. With one spare unit, this means four 7,500-kw. machines, or 30,000 kw. in all.

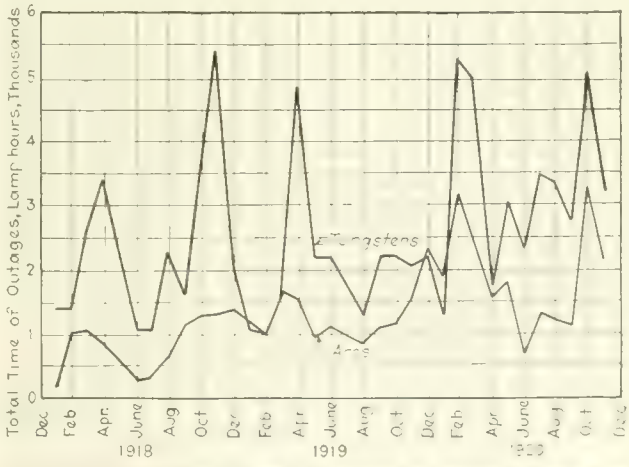
There is, therefore, a choice between two 25,000-kw. units with an aggregate rating of 50,000 kw., three 12,500-kw. units totaling 37,500 kw. and four 7,500-kw. units giving an installed capacity of 30,000 kw. Now, the cost per kilowatt is rather less the larger the unit, and this applies to the floor space covered, piping, auxiliaries, etc. Moreover, in nearly all plants the demand for power will increase, and consequently larger units will be used in extensions made later. From all points of view the three 12,500-kw. units appear to be the best for the conditions. Two will run on the load, the question of a spare depending upon whether the plant is tied in electrically with any other plant that can supply the demand if one unit breaks down.

In a plant of this kind the steam pressure and superheat should be as high as standard piping, valves and fittings will allow, which is about 250 lb. pressure and 250 deg. superheat. With these standards 250 lb. will be the maximum pressure in the boiler drum when all safety valves are blowing and relieving the boiler of the maximum weight of steam. Allowances must be made for pressure drops through piping, valves, etc., bringing down the steam pressure at the turbine throttle to about 200 lb. and the superheat to about 200 deg. Fahr. The distribution of steam pressure will be about as follows. Normal working pressure in boiler drum, 230-lb. gage; pressure after passing superheater at boiler outlet, 220-lb. gage; pressure at turbine header, 210-lb. gage. Thus, if the turbine is designed for 200 lb. pressure, there is a little leeway and it will carry easily its maximum load.

A. B. CLARK,
Sargent & Lundy, Engineer.
Chicago, Ill.

Condition of Lighting Circuits Checked by Graphic Record

ANY unusual conditions in the street-lighting circuits of the Worcester (Mass.) Electric Light Company are indicated by irregularities in the curves which are made up monthly showing the outages of both arc and incandescent street lamps. These curves show the number of lamp-hours during which the lamps were dark



OUTAGES OF STREET LAMPS PLOTTED GRAPHICALLY TO AID IN PREVENTING TROUBLE

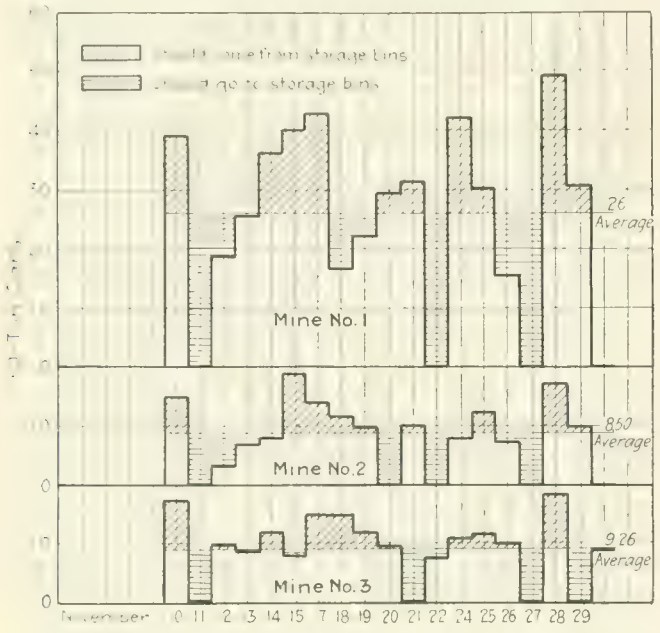
when they were supposed to be lighted. They are plotted from the monthly record from the city bills to the company for the outages.

Such graphic records are useful for many other purposes. George M. Hardy, superintendent of the company, planned and developed these records.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Storage at the Mines to Prevent Coal Shortage

THAT the storage of coal at the mines would stabilize the output, make production more uniform and provide more continous employment at the mines was brought out by John W. Lieb, vice-president



HOW PRODUCTION AT THREE WEST VIRGINIA MINES MIGHT HAVE BEEN STABILIZED

The hatched areas above the average lines indicate the amount of coal that should be stored. These loadings occurred in a non-union district during the 1919 strike. Hence the car supply was at a maximum as cars that would normally go to a union district were diverted to this district.

These curves thus show the advantage that mine storage would have when the car supply is at its best. Under average conditions this advantage would, of course, be much greater.

of the New York Edison Company, in a recent paper read before the American Society of Mechanical Engineers.

The advantages of storing coal at the mines are brought out in a striking manner by Mr. Lieb's curves showing in the accompanying illustration the output of three mines in West Virginia for a period consisting of eighteen days.

It is well known that in most cases when there are no empty cars at bituminous mines ready for loading production stops and labor is idle for the day. The irregularity in car supply and the relation between the car rating of the mine and the empty car placings, with daily maximum and average over the period, are shown in the diagram.

The amount of storage necessary depends on the size of the mine and the scarcity of cars. Roughly, the average output of the mine is not more than 60 per cent of rated capacity. Considering that this difference is caused entirely by lack of cars, it would appear from a study of the diagram that, as the car shortages are daily rather than weekly or monthly, in a 1,000-ton mine a bin storage capacity of forty cars, or approximately 2,000 tons, would be ample to take car of ordinary irregularities in car placing.

There should be a distinction between shaft mines and slope mines. In slope mines the haulage and storage problems are easy and cheap, for the cars instead of going to the tipple are switched off over the storage pocket and dumped. In shaft mines with self-dumping cages a belt conveyor below the screens will serve the same purpose.

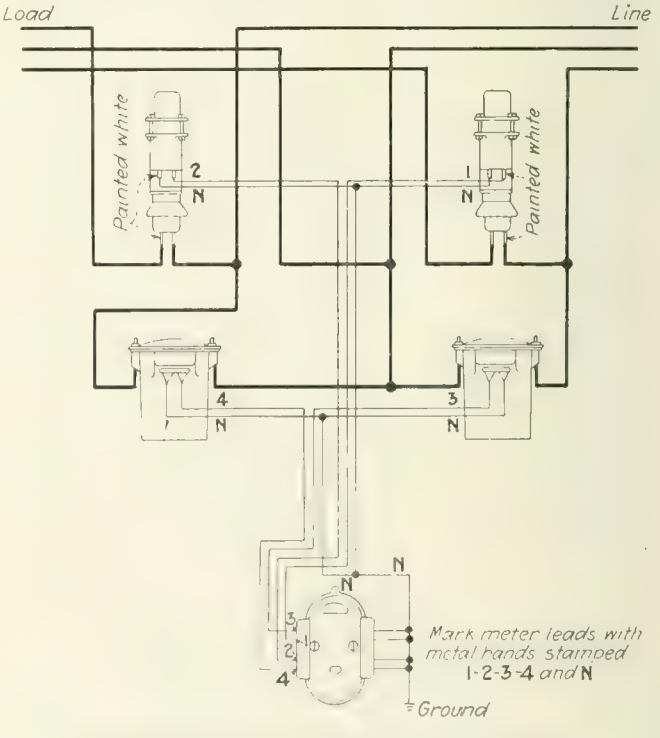
Taking the mean cost as between wooden and concrete construction, the 2,000-ton pocket and machinery would cost about $30,000, or $15 per ton, the fixed charges being 20 per cent, or $3 per year. At forty fillings this would be 7.5 cents per ton, which would be quite lost when weighed against the added output of 80,000 tons per year and the more constant employment of labor with its enhanced efficiency.

Standard Equipment Used for Outdoor Metering Sets

BY THE use of standard distribution transformers as potential transformers and other stock material in the make-up of 11,000-volt outdoor metering sets the Pacific Gas & Electric Company has made a saving of about $125 per set. The use of ordinary lighting transformers for this purpose might be questioned, but the results of tests have shown its feasibility.

These metering sets were developed primarily for the purpose of metering reclamation pumping plants where the company's rate schedule called for metering on the primary side of the transformers. Several designs of outdoor sets have been made and used by this company. A self-contained set was tried which had current and potential transformers installed in an oil-filled metal case, the meter being in a box at the base of the pole. These have all developed weaknesses such as inaccessibility and hazards, besides being too expensive.

The cost of the present set installed, excluding the pole, is $410, which compares very favorably with the

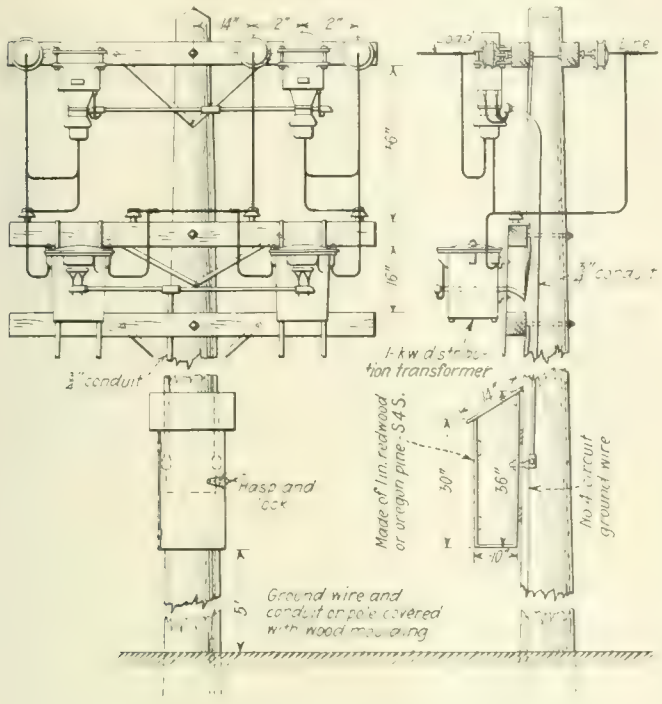


CONNECTIONS ARE INDICATED BY METAL TAGS

cost of other installations and is about $125 less expensive than the self-contained sets referred to. Attention is called to the fact that neither switch, fuse nor protective device is shown, as use is made of the main-plant switch and fuse for protection. These are installed

one pole back from the meter pole. It has for the following two reasons been found poor practice to fuse such meter installations:

It is virtually impossible to make a suitable fuse that will protect such small transformers, and if a fuse on a potential transformer did blow, it might be



THIS METERING SET USES STANDARD DISTRIBUTION TRANSFORMERS

some time before the accident was detected and more loss in revenue might be caused than the total cost of the transformer.

C. E. YOUNG.

Pacific Gas & Electric Company,
San Francisco, Cal.

Ground Wire Should Have Low Resistance and Reactance

IN GROUNDING a transformer secondary three requirements are most important: (1) The ground wire must be permanently and strongly connected. (2) A ground wire of very low resistance is important in order to protect the house circuits from high voltage due to crosses with the primary circuits, the possibility of a lightning surge, or the result of a breakdown between the primary and the secondary winding of a transformer. (3) The wire should be installed to reduce the reactance of the circuit to a minimum, thereby protecting the house circuits and transformers from lightning disturbances.

Wherever it is possible to attach a ground wire to a water system this should be done to insure both a permanent and a low-resistance ground. As this is not always convenient, the next solution is to drive an 8-ft. or 10-ft. length of ¾-in. galvanized-iron pipe into the ground at the base of the pole. It is generally considered that a ground connection of 20 ohms resistance or less is satisfactory, and therefore it is recommended that either a No. 6 or No. 4 B. & S. gage copper wire be used for the ground. Copper should be employed in preference to galvanized iron on account of its lower resistance and the possibility of the latter corroding at the ground line.

Experience has proved that a lightning arrester for the protection of the transformer should be on the same pole with the transformer, but it is undesirable to connect the lightning-arrester ground to the same ground wire as that of the secondary neutral. Therefore it is suggested that the secondary neutral ground wire be installed on the pole adjacent to the transformer and be properly protected from accidental contact by means of wood molding.

THEODORE H. RICE,
Operating Department.

Henry L. Doherty & Company,
New York, N. Y.

Diesel Engines Chosen for 2,500-Kva. Standby Plant

FOUR 750-hp. Diesel engines each direct connected to a 625-kva. generator are to be installed in the 2,500-kva. Calumet generating station of the Sanitary District of Chicago. The primary purpose of the Calumet power plant will be to supply standby energy to the electrically operated Calumet and Ninety-fifth Street sewage-pumping stations. In addition the plant will feed its energy into the general power distribution system of the Sanitary District, supplementing the hydro-electric plant at Lockport, Ill., during its peak load.

The amount of electrical energy required for the ordinary or dry-weather flow through these pumping stations is approximately 500 kw. and for the maximum or flood flow approximately 2,000 kw. The energy required will vary according to the number and severity of rainstorms.

The Lockport power plant supplies energy to various industrial and municipal works and to the street-lighting systems of the city of Chicago and vicinity. If all the energy for the pumping stations were supplied from this power plant it would mean that the maximum energy required for the pumping stations must be held in reserve at all times. It was therefore found to be more advantageous to provide a standby service than to hold in reserve this maximum energy. This standby power plant can in turn supply its energy to the general power-distribution system of the Lockport plant during its peak load, when the street-lighting load comes on before the large power users are off the line. This occurs during the winter months.

After exhaustive studies of various types of prime movers, the conclusion reached was that this standby service should be procured from a plant consisting of Diesel engines directly connected to generators. This conclusion was due to the many advantages of this type of prime mover for the sizes required. They have a very high thermal efficiency and are self-contained, there being no boiler plant with its smoke and soot. If of good make they are reliable and can give full power quickly. Moreover, the fuel saving as compared with a steam plant is considerable and for a standby plant is very marked.

Although the initial cost of a Diesel plant figures approximately 10 per cent higher than that of a condensing-type steam-turbine plant of the same size, the estimated annual charge against the Diesel plant is about one-third of what it would be against the steam-turbine plant. This difference in the annual charge over a period of three years will more than offset the initial cost.

H. I. STEFFA,
Mechanical Engineer.

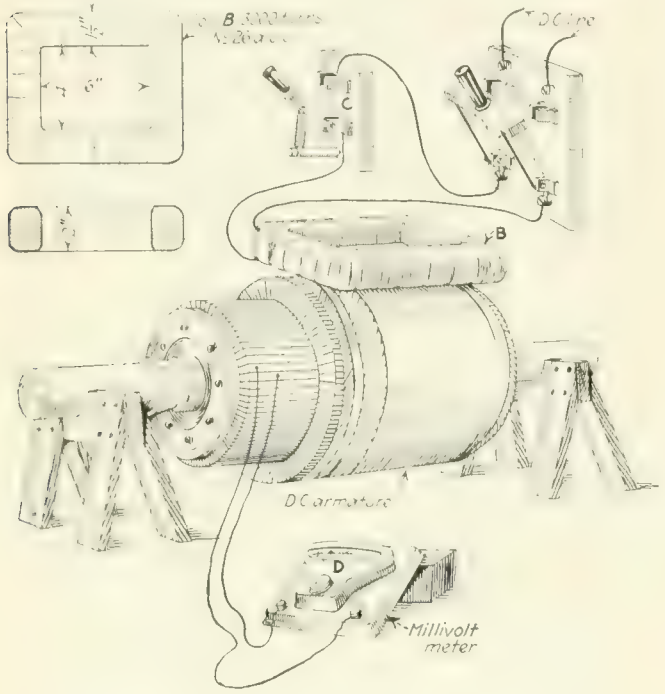
Sanitary District of Chicago,
Chicago, Ill.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Kick Method of Locating Reversed Coils

FOR locating reversed coils in an armature the "kick" method has proved very successful in a New Jersey repair shop. This method is illustrated in the accompanying sketch, showing the plan of a direct-current



A REVERSED KICK ON OPENING SWITCH *C* SHOWS A REVERSED COIL

armature which has been rewound and which it is desired to test for reversed coils. A direct-current field coil *B* is laid alongside this armature, and a direct current is passed through this coil. Current in this coil is controlled by the switch *C*. A millivoltmeter *D*, or other low-scale, permanent-magnet type voltmeter (not too dead-beat), is connected across two bars of the commutator.

When the switch *C* is opened sharply there will of course be a kick in the meter. Experience has shown that the kick when the switch is opened is greater than when it is closed, and the kick on opening is the one which should be used. Choose two bars so located that the kick is the maximum and always keep the coil under investigation in this position by rotating the armature on horses as each coil in the armature is explored. The kick should be substantially the same in value and in the same direction for every coil, provided that the armature is wound with coils all having the same number of turns. A reversed coil will show a kick in the reverse direction. If the number of turns in the armature varies, the kick will be greater for the larger number of turns in a coil. Their location in the armature can therefore also be checked.

If the armature is large or has single-turn coils or if the millivoltmeter is not sensitive enough, a greater deflection can be obtained by reversing the foregoing method. To do this a heavy current is passed through the armature and this circuit is opened to give the kick. The meter is connected across the coil B, which is held in the same position as before. This coil B is made by winding about 3,000 turns of No. 26 double-cotton-covered magnet wire on a 4-in. x 6-in. form 1½ in. to 2 in. wide. The coil may be left on the form if desired.

This method has been found to be more accurate than the standard compass method of locating reversed coils.

Newark, N. J. F. W. GAY.

Effective Lighting for Core Room

THE CORE room of a foundry, with its high shelf racks, ovens, mixing machines, etc., presents no easy lighting problem, especially where detail is so important as in the making of small and odd-shaped cores of dark sand. As an example of good lighting, a recently equipped new core room in a New Britain (Conn.) foundry may serve as a timely subject. The room has a concrete floor measuring 70 ft. x 60 ft. It has a well-ventilated roof monitor, the main ceiling being 18 ft. high, with I-beams, truss bars and chords 20 ft. apart. Thirty-two core makers' benches, arranged four in a row, are placed on the east side of the room alongside windows. Over each section of eight benches are placed two 100-watt nitrogen lamps with 15-in. steel-dome reflectors, making eight lamps in all, 10 ft. apart. There are two circuits each feeding four lamps and lighting sixteen benches. These lamps are 10 ft. above the floor, and give about 4 ft.-candles at the work on the benches.

The large cores are made along the south wall, and light is supplied by three 100-watt lamps suspended from a taut iron messenger wire, the light line running from beam to beam, supported by knobs attached to wooden blocks held up by thin steel hooks. These lamps are also 10 ft. above the floor. They have steel reflectors and are wired with pendant switches, so that any one may be shut off as desired. The wire machine is in the southwest corner and is run by a three-phase, 440-volt induction motor suspended from an overhead beam. Here a 25-watt tungsten lamp, with a wire guard for protection, affords the light. The core pilers are along the middle of the room and receive light from five 100-watt nitrogen lamps with 15-in. reflectors, suspended 12 ft. high, and controlled from the switch box. The core racks are along the north wall, arranged in a lower and an upper section, both 35 ft. long. Each section is lighted by three 25-watt lamps having key sockets. These are hung from a cord which slides along a taut iron wire, allowing them to be shifted across the face of the racks. The coal-heated oven is near the center of the room and has two 25-watt lamps on each of two sides and one over the fire pit, the last-named also lighting the thermometer of a gas oven near by. The

oven lights are controlled by a snap switch on the oven wall, and also at the switchbox. The employees' lockers and washbowls are at the north end, and light is provided by one 40-watt lamp, with wire guard, 8 ft. above the floor and in the center of the small room. A night line runs through the room from the engine room and supplies two 25-watt tungstens in opposite corners. The foreman's office has one 40-watt lamp with a china shade.

In all cases where lamps fall between the I-beams they are suspended from a taut iron wire, and where they hang under the beams 8-in. boards and knobs support the lines. The switch box, installed in the foreman's office, is of steel, with a six-circuit slate panel with push-button switches and inclosed fuses.

All circuits are controlled from the foreman's office. Conduit ½ in. in size carries the branch circuits up the wall to the ceiling, where the lines are then run open on knobs. The main, of No. 6 wire, is brought from outside, through a 12-in. brick wall, and down to the panel box in 1-in. conduit. The whole room, walls and ceiling, are coated with white cold-water paint applied with a pressure tank. The result is a remarkably well-lighted room, especially over the core makers' benches. The electrical lighting load is only 2,000 watts. The effect is easily 100 per cent better than it was in the old core room, which was torn down. The wiring took two shop electricians one week to complete, allowing time for other jobs about the plant.

H. S. RICH.

East Berlin, Conn.

Combined Conduit and Wiring Tables Aid Wiremen

IN DETERMINING the proper size of wire and conduit to use wiremen of the Southwestern Shipbuilding Company are assisted by the two tables shown herewith, which are printed on one sheet. Blueprints are made of this sheet and a copy is given to each electrician. Table I shows the approximate current per terminal for induction motors of one, two and three phases, 110, 220 and 440 volts, and from 0.5 hp. to 250 hp. After the proper current is determined Table II is consulted and the size of wire necessary to carry this current is found in the second column. When the size of wire is known, then the size of conduit necessary is determined from the body of the table. As an example, suppose the motor is a 30-hp., three-phase, 220-volt motor. In Table I, opposite to the 30-hp. notation and underneath the 220-volt, three-phase column, the amperage per terminal equals 81. Consulting Table II it is seen that for 81 amp. a No. 2 wire must be taken, as this wire is the smallest which will carry this current. Looking in the body of the table it is found that for three No. 2 wires a 1½-in. conduit is necessary. From Table I the size of fuse required is also obtained. In this case it is a 100-amp. 250-volt fuse.

TABLE I—AMPERES PER TERMINAL FOR INDUCTION MOTORS
For single-phase motor multiply values given for two-phase motor by two.

	Voltage of Motor							
	110		220		250-Volt Fuse	440		600-Volt Fuse
Hp.	Two-Phase	Three-Phase	Two-Phase	Three-Phase	Size (Amp.)	Two-Phase	Three-Phase	Size (Amp.)
0.5	3.3	3.7	1.7	1.8	5	0.9	1	5
1	6	6.5	3	3.2	5	1.5	1.6	5
2	10.5	12	5	6	12.5	2.6	3	10
3	15	17	7.5	9	25	3.8	4.5	10
5	27	30	13	15	30	6.5	7.5	15
7.5	....	....	20	22	30	10	11	25
10	....	....	25	29	35	12.5	14	30
15	....	....	35	41	50	18	20	35
20	....	....	48	55	65	24	27	60
25	....	....	54	62	75	27	31	60
30	....	....	70	81	100	35	40	60
40	....	....	95	109	125	47	54	100
50	....	....	110	127	150	55	64	100
75	....	....	165	192	225	83	96	100
100	....	....	215	248	275	108	124	150
150	....	....	320	366	400	160	183	200
200	....	....	410	475	500	205	237	400
250	....	....	510	590	625	250	290	400

TABLE II—ALLOWABLE NUMBER OF DOUBLE-BRAID RUBBER-COVERED WIRES IN CONDUIT

Allowable Current (Amp.)	B. & S. Gage No.	Size of Conduit (Inches)									
		¼	⅜	½	¾	1	1¼	1½	2	2½	3
15	14	3	6	10	18	28	44				
20	12	.	5	8	12	20	32				
25	10		4	6	10	16	26				
35	8			4	6	8	14				
50	6			2	4	6					
70	4				3	5					
90	2				2	3	5				
100	1					3	4				
125	0					2	4				
150	00						3	4			
175	000						3	4			
225	0000						2	4			
240	250,000							3	4		
275	300,000								4		
325	400,000								3	4	
400	500,000								3	4	
450	600,000								2	3	
500	700,000									3	
550	800,000									2	4
600	900,000									2	4
650	1,000,000										3
750	1,250,000										

Size of conductor for given load as limited by voltage drop: Circ.mils = 21.6 $DI \div E$. D = distance in feet; I = amperes; E = voltage drop; 21.6 = constant.

In cases where the power is transmitted a very long distance it is not advisable to use a wire as small as Table II allows. This is because the voltage drop on such a wire will be too great. When the distance is very long the size of wire may be determined by the formula underneath Table II, which gives the circular mils required corresponding to a certain voltage drop. If it is known what drop in voltage is allowable at the motor, then the size of the wire can be calculated.

Southwestern Shipbuilding Co. A. G. HUMPHREY,
East San Pedro, Cal. Electrical Engineer.

Attractive Transformer Station for Factory Yard

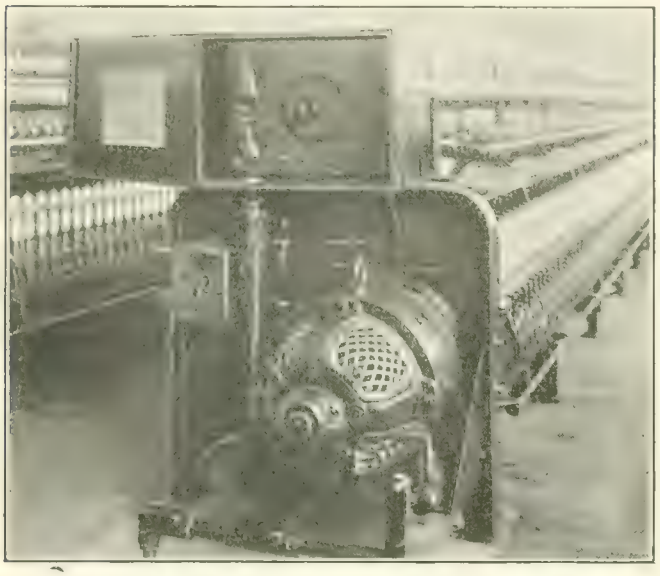


BY LOCATING an inclosed outdoor transformer station away from the main entrance and in a depression on the front lawn, maintaining small shrubs as a growing screen for the fencing and carrying low-tension circuits to the plant in three short runs of iron conduit, a Connecticut wiring-device factory obtains the advantages of an inexpensive installation without marked detriment to the general appearance of the premises. The accompanying illustration shows the sightliness of the substation.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Silk-Mill Production Aided by Applying Variable-Speed Drive to Twisters

GOOD results are reported from a recent application of variable-speed individual-motor drive to Draper twisters at the New Bedford (Mass.) factories of the National Spun Silk Company, Inc. Instead of utilizing the familiar four-frame drive from a motor mounted above the productive machines and connected with these by belts, each twister is provided with an independent 5½-hp. Westinghouse (type SK) adjustable-speed, direct-current, 250-volt motor, as shown in the accompanying photograph. The motor is compound-wound and a speed range of 500 to 1,500 r.p.m. is obtained by varying the resistance of the shunt-field circuit, twenty-one steps being provided at a control panel mounted in a cabinet at a convenient height by the end of the twister frame. The motor is



SPINDLE SPEED ON THE TWISTERS MAY BE VARIED THROUGH A WIDE RANGE

mounted 8 in. above the floor on a ⅜-in. angle-plate bracket 5 in. wide, 13 in. deep and 13 in. high, with its armature shaft directly coupled to the driving shaft of the twister. About ten times the motor speed is obtained at the spindles, of which there are 240 per frame, so that the speed control gives a wide range of spindle speeds.

Contactor switches are provided on the control panel to cut out armature circuit resistance as the motor speeds up in starting and to short-circuit the shunt-field resistance so as to start on full field strength. The resistance in the armature and full strength of shunt field give maximum torque and minimum speed while starting the motors.

In the operation of these machines the overseer adjusts the motor speed to the requirements of the material being handled, and the machine operative is neither required nor expected to attend to this. With the older method of group-driving four frames from an overhead motor, speed changes are obtainable only at the cost of considerable inconvenience. Pulleys must be changed and belts lengthened or shortened, and several machine-hours may easily be lost in this way. The immediate modification of speed to suit the conditions surrounding production attainable by the variable-speed individual drive is so valuable a characteristic that thirty twisters have already been equipped with these motors and the type of control at the New Bedford plant of the company.

FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

How to Join Furnace Electrodes

A VERY important factor in the successful use of furnace electrodes is the method of joining them. When one carbon electrode is joined to another by placing the ends in contact, the electrical resistance of the joint is naturally higher than the resistance of the electrodes themselves. This higher resistance is due to the fact that the contact of the faces is not continuous but is made up of an infinitesimal number of point contacts. A joint compound is used to fill the space between these points, and thus the faces are brought into continuous contact. To be satisfactory the compound must be plastic and adhesive so as to stick to the carbon surface and completely fill the clearance between the electrode and the connecting pin. It must not melt out of the joint when the electrode heats up, as that would impair the conductivity. Some of the manufactured compounds are very good for this purpose.

Tests in actual operation have proved that a joint made up with such compound has only about one-third the electrical resistance of a joint made up with the ordinary molasses and graphite mixture formerly so generally used. It has only about one-sixth of the electrical resistance of joints made up without any compound.

After an electrode has burned down so the top edge of the holder, when in its lowest position, is even with the beginning of the threaded section of the electrode, compound should be rubbed into the threads of the hollow threaded end until they are from one-quarter to one-half filled and there is a layer of compound about ¼ in. thick at the bottom of the hole. In addition, the compound should be rubbed into the threads of the carbon connecting pin for from one-half to three-quarters of its length. The connecting pin should then be screwed into the upper end of the electrode in the furnace until it is firmly seated against the bottom of the threaded hole. If the right amount of joint compound has been used, the connecting pin will be firmly seated and one-half its length will extend beyond the end of the electrode. Joint compound should then be rubbed into the thread of the upper half of the connecting pin and into the thread of the lower threaded section of the next electrode. A layer of joint compound ¼ in. thick should be placed on the upper half of the carbon connecting pin and a similar layer on the upper end of the electrode in the furnace. The sections are now ready to be screwed together.

To pick up the electrode to be joined a hoist pin should be used. It is screwed into the threaded end of the electrode and hooked on the crane hoist or chain falls. The new electrode is then swung into an upright position over the electrode in the furnace. When screwing the electrodes together the lower electrode is held rigidly in the electrode holder while the upper electrode—which is supported on the swivel hook—is turned round and round by means of a band wrench, the upper electrode being lowered as it turns. The electrodes should be screwed together so that joint compound squeezes out between the electrode ends in

a layer about ⅛ in. thick. Then the final tightening is accomplished by one or two quick pulls on the wrench. The electrode holder may now be run up past the joint or connecting zone on the new electrode and furnace operation resumed.

The section of an electrode through which the connecting pin extends is known as the joint or connecting zone. Care should be used never to place the electrode holder so that any portion of it extends into this joint or connecting zone, as such practice is liable dangerously to overheat or weaken the sections, causing them to break and allowing the electrode butts to fall into the bath.

This information was furnished by Frank J. Vorburgh of the National Carbon Company, Inc.

Methods of Handling Heavy Mine Cable Installations

WHERE long lengths of cables weighing 6 lb. or 8 lb. per foot are to be installed in vertical mine shafts the problem of lowering into place requires considerable ingenuity. As cables of this type are infrequently installed a very large expenditure for machinery is not justified. For that reason methods must be worked out using such equipment as is available, and at the same time the question of safety must be considered.

When possible, the cable should be installed in a pipeway or ladder road in preference to a hoisting compartment, as it is thus less liable to injury. However, where a heavily armored cable is installed in a hoisting shaft it will withstand a great deal of punishment without interruption of service. The upper support should be sufficient to carry the total weight of the cable in case the intermediate supports should become loosened. The weight may then be distributed on cleats fastened to the shaft timbers at intervals of approximately 15 ft. to 25 ft. Tap boxes may be installed at suitable points and should be of such type that strains will be transmitted by the tap box to the armor above and below. The lead sheath and armor should be solidly connected electrically around the tap.

For short lengths or light cables, where the total weight involved does not exceed 1,000 lb., a well-braced cribbing under the reel will usually be found a satisfactory method of handling. The braking is accomplished by 2-in. x 12-in. planks bearing against the under side of the drum on one or both sides. The axle upon which the drum revolves must be fastened to the cribbing in such a manner that the reel will not be lifted off the support when the brake is applied. Some method of positive locking of the reel when stopped should also be used. The inside end of the cable on the reel should be fastened very securely before starting, as numerous accidents have occurred owing to the inside end of the cable becoming unfastened and the cable as a whole slipping on the reel. Sometimes a pulley is fastened to one or both sides of the reel and band brakes are applied to these pulleys. This makes a somewhat better arrangement and allows the cable to be fed out more evenly.

Where extremely heavy cables are to be installed the regular hoisting equipment may be employed to advantage. The simplest and safest method is to unreel the cable from the bottom of the shaft by attaching one of the hoisting cables to the end of the power cable and winding in the hoisting cable on the main drum till the power cable has been pulled into position. In this manner the total weight of the power cable is transferred to the hoisting rope as it is unwound from the reel and is held until properly supported and cleated. This method unfortunately cannot generally be applied owing to the reels usually being too large for lowering in the shaft.

A method sometimes used where a heavy cable is to be installed and facilities are not available is to place clamps upon the cable and lower the cable by means of chain blocks or hand winch. The load is transferred to another set of blocks or to a rigid fastening when the blocks had been run out to the limit. This method is slow and laborious.

When a hoist is available the cable may be lowered by attaching the hoisting cable to the power cable by means of clamps at intervals of 25 ft. or 50 ft., carrying the weight on the hoisting cable. The power cable may have some slack at various points, and final adjustments may be necessary after the cable is in place. In some cases the cable has been wound on the main hoisting drum and paid out by the hoist. This may be well in a new shaft, but usually the time involved in removing the hoisting rope and reinstalling will cause considerable delay in regular hoisting operations and as this lost time must also be added to the cost of installation the method will be found expensive for a working shaft.

Careful consideration should be given to the method of clamping the hoisting and power cables in order to avoid damaging either cable. Long special clamps should be used to avoid drawing the U-bolts so tight as to flatten either cable. Damage to the cables may be avoided by filling all openings with short pieces of hoisting cable. In this way the plate does not come in contact with either cable. Where the power cable passes over sheaves under tension they should be of sufficient diameter to avoid damage to the cable. If the tension is sufficient to draw the cable down tightly around the sheaves, the diameter should not be less than fifteen times the diameter of the cable, and preferably larger.

The following methods were used in the installation of cables at two of the shafts under the supervision of the writer:

Shaft Cable No. 1.—Operating voltage, 250 volts direct current; size, 500,000 circ.mil, single conductor; insulation, 3/32-in. varnished cambric; protection, 3/32-in. lead—25 strand No. 8 steel-wire armor; weight per foot of cable, 6 lb.; total weight of cable, 7,970 lb.; vertical height suspended cable, 1,124 ft.; total length of cable, 1,328 ft.; nominal outside diameter, 2 1/16 in.

In this case the cable was delivered at the bottom of the shaft by means of an adit tunnel and was raised from the bottom of the shaft by means of the main hoisting cable. Owing to size and weight, the cable was furnished on two reels. This cable was used as a tie line between the rotary converter station at the collar of the shaft and the rotary converter station at the mouth of the adit. Power was tapped off for lighting at the floor levels at 500 ft., 600 ft., 800 ft. and 900 ft., and at the 700-ft. level for electric haulage and stationary motors.

The cable was raised through the manway by detaching the hoist cable from the cage and dropping it through the manway. The cable reel was mounted and the end of the power cable was attached to the hoisting

cable by four clamps made up of a ½-in. plate, 16 in. x 4 in., with four ½-in. U-bolts. Short pieces of ⅝-in. hoisting cable were placed to fill all openings. The bolts were drawn up snug, but not tight enough to injure the cable. The upper piece of cable was then hoisted into place. The clamps and the lower end of the cable were followed by a man who climbed the manway to see that they did not hang up on the timbers. When the cable was hoisted into place a similar clamp was installed at the top and fastened to the head frame by means of eyebolts. The cable was then held in place down the shaft by means of two-piece cast-iron clamps secured by bronze lag bolts. These clamps were sufficiently tight to prevent the cable from slipping and were approximately 15 ft. apart. When the top piece was securely anchored the lower piece was raised in place and anchored in a similar manner. This portion of the work was completed in two working days, the force being as follows: One electrical foreman, two electricians, two electrical helpers, two timbermen, two timbermen helpers, hoistman and skip tender. The last two were not used continuously, as one cage was operated out of counterbalance when the cable hoisting was not actually in progress. In order to operate at slow speed in raising the cable the hoist was thrown in counterbalance and the weight of the cage on the other rope used to raise the cable.

All tap boxes and cable terminals were installed after the cable was secured in place. The tap boxes were of a type in which the armor is clamped separately from the cover of the box. The weight of the cable below the cut was taken by clamps and eyebolts. The armor was then cut and the cable prepared for the tap. The box was clamped in place as soon as the armor was prepared to receive it. The boxes were mounted vertically. While this method of mounting is not recommended there does not appear to be any serious objection to it and it simplifies the installation greatly.

The negative return line was made up of an old cable already installed the insulation of which had broken down. The lead sheath and armor were solidly connected to the negative line at each end and at each tap box to avoid corrosion due to stray currents. After completion, the entire cable and supports received a thorough coating of asphalt paint.

Shaft Cable No. 2.—Operating voltage, 2,300-volt, three-phase, 60-cycle alternating currents; size, No. 2, 3-cond.; insulation, ⅝-in. varnished cambric and $\frac{4}{64}$-in. v.c. belt; $\frac{7}{64}$-in. lead No. 8 steel-wire armor; weight per foot of cable, 5,625 lb.; total weight of cable, 1,640 lb.; vertical height suspended, 262 ft.; total length of cable, 292 ft.; outside diameter, 2⅜ in.

In this case it was more convenient to drop the cable from the top, a small hoist being available for the work. The power cable was attached to the hoisting cable at intervals of 50 ft. and lowered by the brake drum of the hoist. The shaft has only two compartments, both of which are used for hoisting. Thus it was necessary to use one corner of the hoisting compartment. After the cable was in place it was secured by clamps at 10-ft. intervals. In this case the men worked on a platform on top of the skip. The work of lowering the cable in the shaft was completed in one shift by the following crew: One electrical foreman, four electricians, three electrical helpers, one hoistman, one skip tender.

A similar installation was made at another shaft and the same methods proved satisfactory.

El Paso, Tex. T. H. Arnold.

Scrap Value of Old Storage Batteries

LEAD batteries have a scrap value even after they can no longer be used for storing and delivering electrical energy. In the accompanying table are shown the average amounts of materials which can be salvaged from the elements of two types of "Exide" thin-plate batteries, with the current prices for the materials. These materials are of three kinds—plate lead, strap lead and sediment. When the plates are removed the strap lead is separated from the plate by sawing with a hack saw just above the highest active material of the plate, as indicated in the drawing. The strap lead or alloy is not sold, but is remolded into plate-strap connectors and cell connectors. Used in this way it is worth about 14 cents per pound.

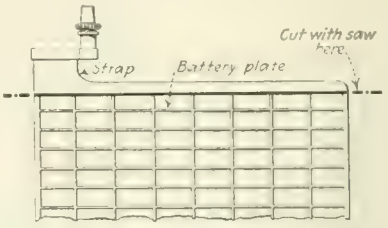


PLATE IS SAWED ALONG HEAVY LINE TO SALVAGE THE SCRAP ALLOY

AMOUNT AND VALUE OF SCRAP MATERIAL FROM STORAGE BATTERIES

Material Salvaged	Average Amount Salvaged from "Exide" Thin-Plate Batteries, Lb. Thirty-one Plate, Forty-two Cell Battery	Thirteen-Plate, Forty-two Cell Battery	Salvage Value, Cents per Pound
Plate lead	1,730	617	2
Strap lead	189	52	14*
Sediment	175	74	7 5

* Strap lead is not sold; but remelted for connectors, it is worth 14 cents per pound.

MARTIN MELIA,
Engineering Department.
Commercial Truck Company,
Philadelphia, Pa.

Motor Drive for Marine Railway

ELECTRIC driving of marine railways affords close control of ship movement into and out of the water, combined with economical use of power. The accompanying illustration shows the machinery at the railway type dry dock of the Colonna Marine Railway Corporation, Norfolk, Va., where a 4,000-ton vessel can be withdrawn from the water in forty-five minutes. In returning the ship to the water the motor is run as a generator. In this installation a 225-hp., 440-volt, three-phase Wagner motor drives the ship-hauling chains through spur gearing, an automatic brake of the solenoid type being provided to hold the machinery in a fixed position in case the supply of energy ceases. Six 2⅜-in. chains are required for handling each vessel.



DRAWS 4,000-TON VESSEL FROM WATER IN FORTY-FIVE MINUTES

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

"Keeping the Faith" with the Public Is Appreciated

IN VIEW of the attitude of the daily press toward utility companies in former years it is interesting to note an editorial published in the Minneapolis *News* for March 9 under the caption "Keeping a Promise." The comment was on the announced removal by the company of the fuel surcharge placed in effect Sept. 1, 1920, which had been made necessary because of an advance of $3.43 per ton for coal. The editorial read as follows:

"At a time when public utility corporations are generally under fire, with strenuous efforts being made to bring them also under suspicion, it is gratifying to note at least one that voluntarily 'comes across' with a reduction in its rates. Conditions affecting the Minneapolis General Electric Company may be less complex than those affecting other public utility companies; that company may be more fortunate than the others in the reduction of its operating expense, but it none the less deserves credit for passing the reduction in the cost of fuel along to its patrons. By so doing the company has justified the faith reposed in it by the public, which paid a 10 per cent bonus upon the now fulfilled promise that the charge would be suspended if fuel costs fell."

Public Utility Is Essentially a Home Industry

BECAUSE many public utilities are financed largely by out-of-town capital there is a general impression that the electric light and power or any other public service company is something of an alien in the community. That the electric light and power company is essentially a home industry and in actual practice few other businesses pay as much in taxes, furnish as much employment or make larger purchases of material and supplies in the local markets was pointed out by the Portland (Ore.) Railway, Light & Power Company in the following manner:

"It is surprising to see how few people recognize the fact that a large public utility corporation like this company is really a home industry and of great value in developing the community. Probably no institution in Portland has done as much for the upbuilding of the city as has the Portland Railway, Light & Power Company. It has a large army of employees—2,800 in number—many of whom are taxpayers and home owners. Inasmuch as nearly every one of these employees is a breadwinner for a family of several people, our company directly contributes to the support of a population of probably between 12,000 and 14,000 persons.

"The aggregate payroll of this company for the last calendar year was nearly $5,000,000, and about 90 per cent of that great sum goes directly back into the channels of local trade. This company is also the largest individual taxpayer in the community and last year paid out in taxes and public charges almost $800,000.

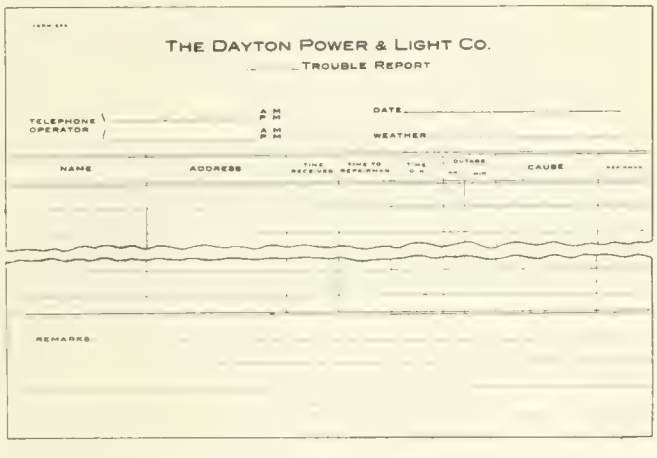
"That this company believes thoroughly in patronizing home industry is evidenced by the further fact that the purchase of supplies and materials by this company in Oregon for last year amounted to $1,345,885. In fact, every item of this character that could be bought locally was purchased here."

Prompt Attention to Trouble Calls Creates Good Will

PUBLIC good will and a reputation for rendering good service have been earned by the Dayton (Ohio) Power & Light Company by its prompt attention to trouble calls. How this work is handled and how the employees have co-operated to make the service efficient is described in the following letter from O. B. Reemelin, general superintendent of the company:

"Recently the Dayton Power & Light Company felt that it could improve the service rendered to its customers when repairs were necessary, especially in the residential districts. We first prepared the trouble report form shown here, which the trouble operator was required to fill out as the calls came in. It will be noted that in addition to the name and address of the customer the form provides spaces for entering the time the call is received, time given to repairman, time "O. K," duration of outage, cause of trouble and name of repairman.

"This report was then used as a means of stimulating the interest of the repairmen by averaging the outages


THE DAYTON POWER & LIGHT CO.

TROUBLE REPORT

TELEPHONE OPERATOR

A M
P M

DATE

WEATHER

NAME | ADDRESS | TIME RECEIVED | TIME TO REPAIRMAN | TIME O. K. | OUTAGE HR. MIN. | CAUSE

REMARKS

TROUBLE REPORT USED BY DAYTON POWER & LIGHT COMPANY

each day and showing them the result. The trouble operator was made responsible for the handling of all calls, and he was instructed that if a call was not taken by a repairman in half an hour after its receipt, it should be referred to the head of the department.

"The men in the repair department saw that the com-

pany was taking an interest in their work and immediately commenced trying to break records. As a result there were some remarkable accomplishments in the matter of prompt service. One trouble sheet showed a record of twenty-nine outages the average duration of which was twenty-one minutes.

"Following this the company began receiving words of commendation from its customers. Favorable comments were also received by the repairmen and trouble operators, and in each case the man whose work was thus complimented was notified in order that he might know that his efforts had been appreciated.

"We now have quite a long record of customers' approval, such as, 'When did you start this kind of service?' and 'This is what I call service,' after an outage of twelve minutes. In one instance the repairman reached the location, many squares distant, nine minutes after the lady of the house had reported trouble. Upon hearing him at the door she called out of the upstairs window to see what was wanted and asked how he had arrived so quickly as she had only just come upstairs from calling. One customer remarked after an outage of fifteen minutes, 'That surely is fine service; you don't have to wait on the light boys.' Another after an outage of the same duration said that the Dayton Power & Light Company was the only company giving service.

"In addition, the men now find that they are received with a smile instead of disgruntled remarks, which is an added incentive to giving good service, and they appreciate the value of good service on washing and ironing days in case an electric appliance is out of order.

"We feel therefore that the effort spent in making our department for correcting trouble more efficient has been well worth while and that promptness and efficiency in taking care of trouble calls is a big asset to the company."

Unenviable Position of Public Service Commissions

PASSING a camel through the eye of a needle presents no more obstacles to a public service commission than does the problem of handing down a rate decision satisfactory in all respects both to the public and the utility. The difficulties of the commission are well illustrated in a recent decision by the Maine Public Utilities Commission which said in part:

"Controlled as this commission is by the law which declares that rates shall be reasonable to the customer, influenced as we ought to be by a desire to treat the company with fairness and to enable it properly to perform its public duties, this commission, like any similar commission, stands in a very unenviable and delicate position. Very naturally if rates are sought to be increased each and every user of the service being affected resents and resists the increase, and no matter what may be the facts presented some customers, and oftentimes the majority of the customers, will not be convinced of the necessity or reasonableness of any increase whatever. Facts and figures do not seem to count with some, and perhaps it is no more than to be expected that during these times of high and increasing costs every addition to the burden seems not only unreasonable but unnecessary. Each person hopes and has been hoping that the burdens will be lessened, and any addition is accepted in a resentful spirit. We have been criticised severely during the past three or four years. We shall no doubt continue to be criticised, but we should be unworthy of holding the position we do if the members of this commission were in the least respect swayed either by criticism or by any other improper influence. We have a duty to perform and must perform it with fairness and courage."

Newspaper Points to Necessity of Hydro-Electric Development

CHAMPIONING the cause of hydro-electric development in California, the San Francisco *Chronicle* is regularly devoting space to a self-interest discussion of the power situation throughout the state. In one of a series of articles the consequences of the existing power shortage are placed before the public in a manner which commands attention and urges the co-operation of every resident of the state.

The far-reaching effect of the power shortage is shown by citing a particular case as follows:

"Contractors recently refused to bid on a central California hotel because they could not obtain power.

"A San Francisco firm had the contract for furnishings.

"A Los Angeles firm had the plumbing contract.

"A manager had been chosen.

"Contracts were scattered through the state.

"All plans have been withheld for lack of power.

"Somewhere this affected you.

"Look about you and you can find where the shortage of power hurts you."

Another instance was quoted in this manner:

"A few months ago a Fresno contractor was limited in the use of power to only five hours daily.

"Here is the effect:

"Fifty workers were being paid for an eight-hour day. The majority of these depended on the operation of motor-driven machinery.

"Therefore, almost one-third of his payroll was a total loss.

"The contractor had agreed to a penalty for each day completion was delayed beyond the contract date.

"The contractor's loss, therefore, included one-third of his total payroll and a large additional sum as penalty for delay.

"He lost money on the job and future construction by him will cost more.

"This because of lack of power."

In summing up the problem of hydro-electric development the article says:

"Delaying or postponing hydro-electric development is checking progress in our cities, towns and villages. In helping to foster power development we help to build our own interests, our own comforts. The power companies make new business for the state. They create new wealth. They put money into the pockets of every Californian.

"California has plenty of water power, but mostly going to waste. The development of hydro-electric power in California has boosted industry on every hand. But industry, agriculture and manufacturing, has caught up with its power supplies. If it is to go ahead it needs more power. Force of circumstances as well as economic logic demands that more water power be harnessed. We are obliged to depend upon private

enterprise for this development. Common sense, then, urges that private enterprise be relieved of hampering restrictions and in every way encouraged to go ahead with the development of our water-power resources.

"The situation is not commonly understood. Development now must turn to the big projects on the large streams. These will take a great deal of capital, and this cannot be had unless there is assurance of a fair return and safety for the investment."

California Company's High Percentage of Local Stockholders

ON JAN. 31, 1921, stockholders of the Pacific Gas & Electric Company numbered 15,735, of whom 12,708 held preferred and 3,027 held common stock. The accompanying table shows that 12,305 residents of California, constituting 78.2 per cent of the total number of stockholders, are interested in the company through

DATA ON STOCKHOLDERS OF PACIFIC GAS & ELECTRIC COMPANY

	Number of Holders Preferred	Common	Total Stockholders Number	Per Cent	Par Value
California	11,177	1,128	12,305	78 2	$42,221,388
Coast and Honolulu, excluding California	209	60	269	1 7	1,089,100
Middle States	297	482	779	4 9	4,297,900
Eastern States	973	1,212	2,185	13 9	19,596,900
Foreign	52	145	197	1 3	2,173,800
Total	12,708	3,027	15,735	100 0	$69 379,088

ownership of its stock alone, aside from holders of bonds and notes. The constantly increasing list of customers and employees who are becoming partners in the enterprise through stock ownership affords an indication of the confidence of the public in the stability and future of this company.

The total number of the company's security holders at this time exceeds 40,000.

Indiana Company Sells $500,000 of Stock to Its Customers

ANOTHER instance of the possibilities of customer ownership of electric light and power companies is shown in the recent sale by the Interstate Public Service Company, Indianapolis, Ind., of $500,000 of its 7 per cent prior lien stock to customers of the electric, gas and interurban properties operated by the company. Commenting on the success of the sale, Harry Reid, president of the company, said:

"In spite of the fact that the money market has been described as tight, and stocks and bonds generally have not been absorbed as rapidly as in normal times we have sold approximately $500,000 worth of our 7 per cent prior lien stock. The people of this state have money to invest and will put it in sound, profitable investments.

"Our company is naturally pleased to find that its customers have enough faith in it to place some of their savings or surplus funds with us. It makes them partners in the enterprise. It seems to me that this partnership relation will be beneficial both to the company and to its patrons. The public utility business is really the people's business, anyhow, and the closer the relationship between the companies and the people the better it will be for both."

The stock was sold at par and handled entirely by the employees in the various branch offices of the Interstate Public Service Company.

Daylight Lamp Increases Production of St. Louis Factory

DURING the heavy demand for paint last year one manufacturer in St. Louis could not produce enough colored paint because of inability to distinguish the colors at night. A "daylight" gas-filled lamp was installed at the suggestion of the central station, and the manufacturer found that all colors except light brown could be exactly matched by comparison with the standard under the light of this lamp. After a little practice the men were soon able to match the light-brown colors also, and the factory was then placed on a twenty-four-hour basis. The manufacturer was thus enabled to meet his demand, and the revenues of the central station were correspondingly increased.

Tying in Local Advertising with National Good-Will Publicity

AS A MEANS of supplementing the national campaign for public utility good will, the Tampa (Fla.) Electric Company has reproduced the N. E. L. A. advertisement which appeared in the *Saturday Evening Post* for March 5. As shown in the accompanying cut, the



USE OF NATIONAL GOOD-WILL PUBLICITY IN LOCAL ADVERTISEMENTS

good-will advertisement was used as a part of one of the company's regular newspaper advertisements. This use of general publicity effectively puts the problems of the local utility before the public which it serves, and adds strength to the national campaign.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Calculation of the Dissipation of Heat in Transformers.—M. VIDMAR.—Quoting from a chapter of a recently published book by the author on "Transformers," a method of calculating the heat dissipation of transformer windings and transformer tanks is given. The formula is derived from the fundamental Stephan-Boltzmann law on heat dissipation. The proper use of the formula is illustrated as applied to an actual, air-insulated, disk-coil transformer stack. —*Elektrotechnik und Maschinenbau,* Feb. 6, 1921.

Longitudinal and Transverse Heat Flow in Slot-Wound Armature Coils.—CARL J. FECHHEIMER.—Formulas for transverse and longitudinal heat flow in armature coils are worked out and checked by test results. Tests were made on a 2,400-volt, three-phase, 60-cycle, 3,600-r.p.m. turbo-generator. There is a close agreement between calculations and test for maximum temperature, minimum temperature and temperature at the end of the core, the exception being the maximum temperature at no load. It is said that there is slight difference between the calculated minimum temperature considering transverse flow only and the minimum temperature by tests. On the other hand, there may be a large difference between the calculated maximum temperature considering transverse flow only and the maximum test temperature. Thus it may be misleading even in medium-length machines to ignore the longitudinal flow. One of the principal differences between tests and calculations appears in the no-load curve. Evidently with I^2R and eddy current loss in the copper, some heat from the iron flows transversely from the iron to the copper and is transmitted longitudinally to the end coils, where it again flows transversely to the coil surface.—*Journal A. I. E. E.,* March, 1921.

Lamps and Lighting

Searchlamps with Several Light Sources.—I. KIEFER. —A new patented method is described by means of which it is possible to build searchlamps of unlimited light power by using more than one source of light. The individual lights have each their own, relatively small, ellipsoidal or parabolic reflector, all concentrating their light into one main beam. Arrangements with six and eight lamps are diagrammatically shown. Among other advantages the undisturbed service of the searchlamp is emphasized in case one of its components should fail.—*Elektro Journal,* January, 1921.

Generation, Transmission and Distribution

Powdered-Coal Firing for Electric Power Stations.—FRIEDRICH MÜNZINGER.—A detailed and analytical article on the different systems and methods used for pulverizing the coal, for feeding the powder to the boilers, and for burner construction, always with special reference to large power houses. The good experience and the wide use of such firing systems in America and England lead the author to recommend it for more general use in Germany.—*Elektrotechnische Zeitschrift,* Feb. 3, 1921.

Plants of the Chilean Exploration Company at Tocopilla and Chuquicamata.—M. NEUSTATTER.—A detailed and well-illustrated article on the power transmission plant of the Chilean Exploration Company, built by Siemens-Schuckert in Berlin for the production of electrolytically pure copper from the ores in Chile. The power station at Tocopilla is situated at the seashore. The electrolytic works are 140 km. distant at an altitude of 2,700 m. The power station has a capacity of 40,000 kva. and transmits its power at 110,000 volts. A battery of sixteen B. & W. oil-fired boilers feeds four steam turbines of 12,500 kw. each. The generators are rated at 9,000 kw. at 0.9 power factor, 5,000 volts, 50-cycles, 1,500 r.p.m. Four main transformers of 10,000 kva., three-phase, each, with oil conservators and externally cooled oil, raise the voltage to 110,000. Each transformer contains 16 tons of oil. A detailed description of the switchgear is given. At the receiving station four similar transformers step from 100,000 volts down to 5,000 volts, driving seven motor-generators of 2,500-kw. direct-current output each. Four of these units are induction-motor-driven and three are synchronous-motor-driven, each unit consisting of one alternating-current motor and two direct-current generators. A complete wiring diagram of the receiving station, details on the chemical processes, and many data on the difficult transmission line conclude the paper.—*Elektrotechnische Zeitschrift,* Jan. 6, 13 and 20, 1921.

Economy of Electric Flatirons.—R. NAUJOKS.—The article presents the report of an exact test of five different types of German electric flatirons. From the tests are derived some general directions for the most efficient and economical construction of flatirons.—*Elektrotechnische Zeitschrift,* Jan. 20, 1921.

Traction

New Theories on the Vibration Phenomena of Electric Locomotives with Rod Drives.—A. WICHERT.—This long and very detailed article gives a mechanical analysis and criticism of observations and data made by seven different European authors on the very complex problems of vibrations of rod-driven electric locomotives. The author of the paper has endeavored to familiarize the reader with interesting viewpoints taken by the different writers in their attempt to analyze and remedy dangerous vibrations on rod drives. He invites all engineers familiar with such types of locomotives to add their experiences and to help thereby to solve a problem which causes considerable trouble and is receiving little attention.—*Elektrotechnische Zeitschrift,* Feb. 3, 10 and 17, 1921.

Electrolysis Mitigation in Winnipeg.—W. NELSON SMITH.—A three-wire system has been applied to bring

ground-return conditions of the Winnipeg Electric Railway into conformity with the electrolysis act passed by the Legislature of the Province of Manitoba. A discussion of what has been done to date and why the various measures were taken.—*Electric Railway Journal*, March 26 1921.

Installations, Systems and Appliances

Control of Crane Motors by Bergmann System.—E. BLAU.—The control of the traveling and cross-traveling motors on multiple motor cranes may be achieved safely and satisfactorily by simple drum controllers, with few steps. The main lift motor should have a wide range of speeds, permitting a finely adjustable control. This is usually achieved to some extent by cutting resistance into the direct-current series motor or the slip rings on an alternating-current motor. Obviously this is an energy-wasting method, and the amount of current to be handled on large cranes does not permit of many fine steps, if the bulk of the controller is to stay within reasonable limits. The Bergmann system results from some modifications of the Leonard principle, wherein a motor-generator the voltage of which is easily regulated feeds the main direct-current lift motor. The advantages of this system are explained, emphasis being placed upon the ease and simplicity of wide-range speed control. The controller for a lift motor of several hundred horsepower, for example, has to carry only about 1 hp. to 2 hp. of power. A complete wiring diagram is reproduced.—*Elektrotechnik und Maschinenbau*, Jan. 16, 1921.

High-Speed Circuit Breakers.—G. G. GRISSINGER.—A high-speed air-break circuit breaker is described the purpose of which is to open an electric circuit, after a short circuit occurs, so quickly that the current will be unable to reach a dangerously high value. Such breakers are particularly applicable when applied to railway or similar heavy-duty service in which the converter or motor-generator set is called upon to carry sudden and heavy overloads or short circuits, thus, unless suitable protection is provided, destroying the commutating parts of the machine.—*Electri Journal*, February, 1921.

Electrophysics and Magnetism

Formation of Negative Ions in Air.—LEONARD B. LOEB.—The purpose of experiments described by the writer was to decide between the two theories of the formation of negative ions proposed by Wellisch and by J. J. Thomson. The curves were found to agree in general with the results of previous investigators and that they show anomalous mobilities below a critical pressure which was found to vary with the frequency of commutation of the emf. No "free electrons" of the Wellisch type were observed.—*Physical Review*, February, 1921.

Theory and Calculation of Variable Electrical Systems.—JOHN R. CARSON.—Variable electrical systems are defined as those in which either the circuit elements (resistance, inductance or capacity) are explicit time functions or those in which the relation between current and applied emf. is non-linear. In the present paper the theoretical methods of solution of "invariable systems" are extended to include variable systems by integral equations of the Volterra type. A number of representative problems are worked through to indicate the appropriate mathematical procedure and the applicability of the method to both transient and steady-state phenomena.—*Physical Review*, February, 1921.

Units, Measurements and Instruments

Measurement of the Electromagnetic Field of Transoceanic Radiographic Waves.—C. VALLAURI.—During the summer of 1919 the wireless station at Annapolis carried out experimental transmission tests lasting for twenty-four hours continuously. The Italian Royal Naval Electrotechnical and Radiotelegraphic Institute took the opportunity to make a quantitative measurement of the electromagnetic field at the receiving station. A table is given showing the results of these tests, and the method of making them is also described. —London *Electrician*, Feb. 25, 1921.

A Precision Form of the Kelvin Electrostatic Voltmeter.—E. H. RAYNER.—The paper describes the form of electrostatic voltmeter for precision measurements. This instrument follows the general arrangement of the Kelvin type. The chief modifications are (1) very considerable reduction in weight, permitting (2) the use of a bifilar suspension to overcome the effect of elastic fatigue, (3) a modification of the shape of the needle to produce a more satisfactory "scale law" for both small and large deflections, and (4) the provision of various mechanical details to facilitate construction and adjustment.—*Journal Institution Electrical Engineers*, London, January, 1921.

Telegraphy, Telephony and Signals

Loud-Speaking Telephones.—PHILIP R. COURSEY.—A short discussion of the arrangement and construction of loud-speaking telephones.—*Wireless World*, Feb. 19, 1921.

High-Power Radio Station at Nauen—II.—FELIX LINKE.—The Nauen station operates with four fundamental wave lengths of 16.8, 12.6, 8.4 and 6.3 km., according to a periodicity of 18,000, 24,000, 36,000 and 48,000 cycles. The efficiency of the plant, based upon continual, not telegraph, load is from 66 to 53 per cent, depending on wave length used. The highest antenna voltage permissible is about 100 kv. The power factor in the antenna using long waves is about 0.01. Great difficulties had to be overcome in the design of a reliable telegraph key capable of making and breaking on the average 320 amp. at 1,900 volts twenty times per second. A number of series copper contacts, cooled by compressed air from a 1-hp. blower, solved the problem. The contacts must be renewed after every three or four weeks of operation. The speed regulation of the high-frequency generator is kept within 0.18 per cent. A detailed description of the huge A and B antennas are given. The A antenna is supported by two towers 260 m. high and four towers 120 m. high. The B antenna consists of two 150-m. towers and one 134-m. tower. The characteristics of the two antennas are: Own frequency, A antenna, 4,800 m., and B antenna, 3,400 m.; static capacity, A, 28,000 cm., and B, 16,000 cm.; total resistance, A, 3.8 ohms, and B, 2.8 ohms; number of wires, A, 10, and B, 16. An idea of the output of the Nauen station may be gained from the fact that during nine months of 1917 a total of 3,680,000 words were sent out from there. The station has had a range capable of covering the entire globe since 1918. —*Zeitschrift des Vereines Deutscher Ingenieure*, Vol. 64, page 1,003.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

AUDION BULB, OXIDE-COATED, PHOTO-ELECTRIC EFFECT IN.

It was observed that the oxide-coated filament in high-vacuum audion bulbs showed slight photo-electric effect, both heated and when cool. When the plate element was made positive an increase in action was found. It was found that the active material was a brownish deposit on the plate and that this active material was a mixture of the elements barium, strontium and possibly calcium. The action is immediately destroyed if a trace of oxygen is admitted.—*T. W. Case, Auburn, N. Y.*

CORDS, ELECTRIC HEATER, TESTS OF.

Information is now available concerning the durability or wearing quality of various makes of heater cords on the market. The principal tests made with the view of establishing a standard of quality for such articles were bending tests and abrasion tests. The copper conductor of the cord is more susceptible to wear from bending and the insulating covering to wear from abrasion. Tests were also made on the principal types of cords with a view of determining the inflammability of various insulating mediums used and the effect of braiding and stranding on the resistance of the copper conductor. A table of relative durabilities was also compared to a similar table based on the experience of practical electric wiring men who had used the various makes of cords.—*Wiring Committee, N. E. L. A.*

CURVES, PARABOLIC AND LINEAR, ADJUSTMENT OF.

Least-squares reductions of observations that follow a parabolic or linear law, taken at equal intervals of the independent variable, frequently occur in physics and engineering practice. Makeshift devices are often employed to evade the arithmetical work in such reductions. The least-squares formulas have been subjected to mathematical treatment and rigorous solutions evolved which require an ultimate minimum of arithmetical work. A table has been constructed from which a large portion of the solutions of such problems may be written down from inspection of the observations. Applications of this method to typical problems have been made, and shown to check absolutely with the least-squares solutions.—*Bureau of Standards, Washington, D. C.*

FERRO-NICKEL ALLOY OF CRITICAL PROPERTIES.

Extensive experiments have shown that the 35 per cent nickel-iron alloy, corresponding to the composition Fe_2Ni, has physical properties more or less markedly different from the other ferro-nickels. When various physical characteristics are plotted as a function of the composition the following general facts are brought out: The melting point curve shows a maximum, specific heat a maximum, thermal conductivity a minimum, thermo-electric power a minimum, specific resistance a maximum and temperature coefficient of resistance a minimum.—*L. R. Ingersoll, University of Wisconsin, Madison.*

FURNACE, ELECTRIC, VACUUM-TYPE.

An electric vacuum furnace has been developed which produces temperatures sufficient to melt platinum, iridium, slags and refractories. Some of its various uses are: Preparation of metals, alloys and compounds; determination of melting points by an optical pyrometer or by reference to the furnace calibration curve; calibration of optical pyrometers; distillation of refractory substances for separation or purification, and study of the equilibrium of reactions depending on the pressure of the gaseous phase. The furnace comprises an electric heater inclosed in a vacuum chamber and is made in two types, vertical and box, for varying capacities. A two-stage rotary oil-sealed pump has also been developed for use in producing the vacuum for this type of furnace.—*Research Laboratory, General Electric Company, Schenectady, N. Y.*

MAGNETIC AND MECHANICAL PROPERTIES OF STEEL. CORRELATION OF.

Extensive tests have been made on nickel steel, chrome nickel steel, carbon tool steel and Swedish chrome file steel, for the purpose of discovering some relationship between their magnetic and mechanical properties. The magnetic data were obtained by use of the Fahy Simplex permeameter and included the maximum flux density at $H = 150$ ampere-turns per centimeter, the residual flux density and the coercive force. The mechanical tests included the usual Brinell hardness test, tensile strength, elongation and percentage of reduction in area. A definite relationship has been found between the area of the hysteresis loop and the Brinell hardness or tensile strength, depending on the precise nature of the heat treatment. Thus magnetic measurements offer a satisfactory method of testing and inspection of finished or partly finished steel parts without destroying the material or having any permanent effect upon it. No other known successful method of testing possesses this important advantage. Magnetic testing enables the steel maker to draw distinctions between steels where the present methods of test fail to make sufficient differentiation. The possibilities of magnetic analysis in the examination study and duplication of products which have given exceptional performance in actual service are apparent.—*N. J. Gebert, New York City.*

PHOTO-ELECTRIC CELL STRONTIUM.

A photo-electric cell has been developed using metallic strontium in high vacuum as the active element. The cell gives a current of approximately 100 micro-amperes in average sunlight and may be used to actuate an automatic recording potentiometer. The cell is not subject to injury by sunlight and has remained for three or four months without variation except for a slight deviation about a constant mean. The photo-electric effect does not vary more than 2 per cent for a range of 0 deg. to 100 deg. Fahr. The photo-electric current is proportional directly to the light intensity to which the cell is active when used with a voltage of over 170. Some suggested practical uses are: for obtaining continuous and permanent records of outdoor light conditions, for high intensity photometry for controlling artificial illumination by relay, for measuring light intensity in photography and for the determination of the quantity of light necessary to fade dyes or for any other light-quantity determination.—*T. W. Case, Auburn, N. Y.*

RADIO CURRENTS FOR ORE DETECTION.

An investigation is being carried on with the view of devising a method for the detection of bodies of copper sulphide ore by the use of radio currents of audible frequency. The work so far has given promise of success.—*Paul Cloke, Tucson, Ariz.*

SPEED INDICATOR, STROBOSCOPIC.

A new stroboscopic speed-indicating device has been perfected. The stroboscopic disk is used in conjunction with a neon tube, the discharge through which is controlled by an electrically driven tuning fork.—*Tinsley & Company, London, England.*

Suggestions for Research

ARC LAMP, HIGH-CURRENT TYPE.

The efficiency is increased by increasing the current density in the carbon. Usually it is not possible to secure a smooth, steady and silent arc with a greater current density than, say, 0.15 amp. per square millimeter of the cross-section of the positive carbon. However, if the arc is concentrated by the action of external magnetic fields the current density may be greatly increased. One device which has been tried out with some promise of success consists of a framework of metal bars surrounding the arc. The arc current is made to pass through this framework, and the constant magnetic field so formed tends to concentrate the arc in the center of the system. (See *Journal I. E. E.* (British), Vol. 58, p. 651, 1920.) Other methods are devised for increasing the efficiency and the stability of the arc. Searchlamps and floodlamps may be made much more effective if some means is found which is not too complicated.—*Editorial Suggestion.*

CIRCUIT BREAKERS, CONTACT CONSTRUCTION.

Philip Torchio has shown the importance of so shaping the contacts that the mechanical forces due to the large current at the first instant of a short-circuit tend to press the contact surfaces together rather than to separate them. This allows the necessary time for the tripping mechanism to act and prevents premature destructive arcing (*Journal A. I. E. E.*, 1921, page 120). A theoretical and experimental investigation is desired of the general nature and magnitude of such forces in order to furnish the designer with the necessary data. Tests should be preferably conducted on small models and with much smaller currents than Torchio's, using direct current in order to be able to measure the forces more readily and to observe the effect upon the parts of the switch.—*Editorial Suggestion.*

FUSES FOR POTENIAL TRANSFORMERS.

Extensive tests indicate that most potential fuses on the market cannot satisfactorily open the circuit without a resistance in series (Torchio, *Journal A. I. E. E.*, 1921, page 130). Tests and a theory are desired to determine the best value of the protective resistance for different voltages, and the most convenient and economical construction of resisters, keeping in mind the limitations in space, the necessary distances between adjacent resisters, etc.—*Editorial Suggestion.*

WAVE FILTERS, MADE OF COILS AND CONDENSERS.

Such filters are made up of elements having (a) coils in series and condensers in shunt, allowing only currents below the natural frequency of the line to pass; (b) condensers in series and coils in shunt permitting only currents above the natural frequency of the line to pass, and (c) a combination of the two, with both coils and condensers in shunt or series, permitting the passage of frequencies within a definite range. Wave filters of this kind are useful in alternating-current measurements, as artificial lines, and in telephony and wireless telegraphy for the elimination of interference. On the other hand, they may lead to considerable errors when used in the study of steep-front waves and other transient phenomena in transmission lines. A further experimental and theoretical study of their properties is desired. As a starter see "Archiv für Elektrotechnik," Vol. 8, p. 61, 1919.—*Editorial Suggestion.*

X-RAY TUBES, EXCITING CURRENT FOR.

A more efficient method of exciting X-ray tubes is desired. The ideal current for such work consists of impulses of extremely high voltage but of very brief duration, yet sufficiently sustained to have an appreciable time factor.—*R. Morton, London, England.* (N. B.—There is some controversy as to whether any part of the exciting current except the peak has a function in X-ray work. An investigation along this line, together with improvement in high-tension transformers, ought to produce a more efficient X-ray current.—EDITOR.)

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

New Jersey Public Service Holds Successful Vehicle Show

DURING the week the Public Service Electric Company has been conducting a very successful electric vehicle show at its big showroom in Newark, N. J. Road trucks, industrial trucks, passenger cars, storage batteries and charging apparatus and accessories were displayed without cost to the exhibitor for rent or energy. No admission fee was charged to the public. Between two and three thousand people visited the show daily, according to O. J. Lange, general electric vehicle representative of the company, who had charge of the show. A number of novelties were demonstrated in a way to attract the public.

"Leads" concerning a large number of prospective customers were obtained by the manufacturers, and quite a few sales were closed on the floor. Toward the close of the show the exhibitors held an informal luncheon, at which time there were many expressions of confidence in the future of the electric vehicle.

Following is a list of the exhibitors:

Commercial trucks—Commercial Truck Company, Oneida Truck Company, Walker Vehicle Company, Ward Vehicle Company.

Passenger cars—Rauch & Lang.

Industrial trucks—Automatic Transportation Company, Baker R & L Company, Crescent Truck Company, Hoagland-Thayer Company, Industrial Truck Company, Karry Lode Industrial Truck Company, Lakewood Engineering Company, Mercury Manufacturing Company, Terminal Engineering Company.

Battery manufacturers—Edison Storage Battery Company, Electric Storage Battery Company, General Lead Battery Company, Philadelphia Storage Battery Company.

Charging apparatus and accessories—Auto Electric Devices Company, Cutler-Hammer Manufacturing Company, Westinghouse Electric & Manufacturing Company, L. Bamberger & Company.

State Ownership of Water Powers Killed in Maine

BY A VOTE of 18 to 10 the Maine Senate last week killed the proposed constitutional amendment initiated by Governor Baxter to provide for the conservation, storage, control and use of waters and the development, improvement, transmission, utilization, electrical interconnection, control and sale of water powers by the state. In this action the Senate concurred with the House, which had adopted the adverse report of a majority of the judiciary committee against the submission of any constitutional amendment whatever. A minority of the committee suggested a new draft of the amendment providing generally for state control and assistance in storage matters and completely cutting out the taxation suggestions of the Governor.

Sentiment against state control and development has been strong in Maine for some time, following extended presentations of the efficient development accomplished by privately owned utilities under public regulation. At the recent hearing before the judiciary committee on the proposed amendment resulting from Governor Baxter's special message favoring state development, Walter S. Wyman, general manager Central Maine Power Company, argued against the measure on the ground that the hydro-electric interests now serving the people are taking care of every demand for energy in the state. The agitation for state development, he said, is a threat against the people who have in such large numbers invested their savings in public utility securities.

B. F. Cleaves, executive secretary of the Associated Industries of Maine and chairman of the Maine Public Utilities Commission, speaking for the former body, opposed state development and ownership, pointing out that precipitate action toward that end would be a step of extreme gravity. He questioned whether the authority exists to place a tax upon energy generated within the state to be transmitted outside solely because this would be an interference with interstate commerce.

Cities Cannot Enforce Low Rates on Contract Theory, Supreme Court Holds

PUBLIC utilities won unqualified victories when the Supreme Court of the United States on April 11, in one case, reversed the decree of a lower court which had upheld the municipal authorities in their efforts to enforce rates which were confiscatory and in another case upheld a lower court in preventing a municipality enforcing a confiscatory maximum rate. The first case was brought before the Supreme Court on appeal by the Southern Iowa Electric Company, and the second case was brought by the city of San Antonio, Tex., against the San Antonio Public Service Company. These cases have excited wide attention during their course through the courts. In the Iowa case the court holds that it is demonstrated conclusively that the lower court was in error in attempting to enforce rates upon the theory of the existence of a contract.

"The necessity for this conclusion," reads the opinion of the court, "becomes doubly manifest when it is borne in mind that the right here asserted to contract in derogation of the state law and of the rule of public policy announced by the court of last resort of the state is urged by municipal corporations whose every power depends upon the state law."

The Iowa Company has been supplying gas and electric service to various municipalities under long-term franchises, which stipulate a schedule of maximum rates. After the franchises had been in effect a few years suits were brought by the company against three cities to prevent the enforcement of these maximum rates because they were too low and amounted to confiscation. The matter dwindled down to the right of cities to enforce ordinance rates specified in contracts without reference to confiscation. The lower court up-

held the right of a city to make contracts and entered decrees enforcing the old rates, whereupon the companies filed an appeal.

The Supreme Court also held that the question hinged on the contract-making power of the utility, with the result as above reported. In arriving at its decision previously quoted the court said:

"Two propositions are indisputable: (a) That although the government agency having authority to deal with the subject may fix and enforce reasonable rates to be paid public utility corporations for the services by them rendered, that power does not include the right to fix rates which are so low as to be confiscatory of the property of such corporations, and (b) that where, however, the public service corporations and the governmental agencies dealing with them have power to contract as to rates and exert that power by fixing by contract rates to govern during a particular time, the enforcement of such rates is controlled by the obligation resulting from the contract and, therefore, the question of whether such rates are confiscatory becomes immaterial.

"It follows, if the rates here involved are conceded to be confiscatory, they cannot be enforced unless they are secured by a contract obligation. The existence of a binding contract as to the rates upon which the lower court based its conclusion is, therefore, the single issue upon which the controversy depends. Its solution turns first upon the question of the power of the parties to contract on the subject and, second, if they had the power, whether they exercised it."

In the San Antonio case the Supreme Court affirmed the action of the lower court in enjoining the city from enforcing a 5-cent fare. The lower court contended and the Supreme Court concurs that the right to enforce such a rate was not gained by the city by contract and that such enforcement was beyond the power of the city because it would mean confiscation.

The court points out that the Texas constitution prohibits "any irrevocable or uncontrollable grant of special privileges." The court rules that it is clear that the right to regulate gives no power whatever to violate the constitution.

Big Advertising Program for Chicago Electric Vehicle Show

COMPLETE co-operation with the sponsors of the Chicago Electric Vehicle Show, to be held during the National Electric Light Association convention, was promised at a meeting of exhibitors held at the Hotel Morrison on April 6. The show is being given by the Commonwealth Edison Company and the Electric Vehicle Section of the N. E. L. A. At the meeting of the exhibitors it was decided to make an advertising appropriation in addition to that by the Edison Company large enough to give extensive publicity to the advantages of the electric vehicle. Eric W. Swift, assistant superintendent of advertising of the Commonwealth Edison Company, was appointed head of a committee to determine the best method of getting the facts before the public.

Space for approximately twenty exhibitors has been arranged for in the Clark Street appliance showroom of the Commonwealth Edison Company. Reservations have been made by the following companies: Walker Vehicle Company, Ward Electric Truck Company, Commercial Truck Company of Pennsylvania, Oneida Truck Company, Electric Truck Company, Mercury Truck Company, Milburn Electric Company, Detroit Electric Car Company, Rauch & Lang, Baker R & L Company, General Electric Company, Westinghouse Electric & Manufacturing Company, Edison Battery Company, K. W. Battery Company, Edison Storage Battery Company, Philadelphia Battery Company, Schaefer Brothers, and O. P. Smith & Company.

Electrical Refrigerating Show Draws Crowds





The second of the special monthly shows held by the New York Edison Company took place last week and was devoted to electrical refrigerating equipment, both commercial and domestic. The pictures show only portions of the show, which was participated in by a dozen manufacturers. As indicated in the picture on the left the show was well attended, about five hundred people a day viewing the exhibits. The show was held without expense to the exhibitor.

Conference Club Discusses Financing of Labor Board

A MEETING of the Conference Club with members of the International Brotherhood of Electrical Workers was held in Washington March 23 to discuss financing of the National Council on Industrial Relations. There was some question as to whether the National Association of Electrical Contractors and Dealers would continue to give financial support to the council. It was finally voted, however, that no outside organization be asked to take over this burden but that the members of the contractors' association be appealed to individually to contribute to the support of the council, the funds to be administered by the association.

The executive committee of the Conference Club was increased to seven members, and the following were elected: L. K. Comstock, T. P. Curtis, G. M. Sanborn, J. G. Livingston, W. C. Peet, J. A. Cole and B. H. Bendheim.

Will Purchase Surplus Hydro Power in Effort to Cut Generating Costs

TWO large California central-station companies, the Great Western Power Company and the Pacific Gas & Electric Company, which are both requesting the California Railroad Commission to grant them permission to continue the 15 per cent surcharge on their rates previously sanctioned, have, at the instance of the commission, entered into a power-use agreement which the commission thinks will be of advantage to their customers and which Commissioner Devlin declared would have an important bearing on the consideration of the surcharge applications. The agreement is to cover delivery by the Great Western Power Company to the Pacific Gas & Electric Company of hydro-electric power generated at the Caribou plant of the Great Western company for which the latter has no market at the present time. The Pacific company has not enough hydro-electric energy to meet the demands upon it and is forced to use steam plants burning oil to generate electricity, thereby adding to the cost of power to the consumer.

The commission's order followed a declaration by its assistant chief engineer that the completion of the Great Western company's Caribou project on the Feather River about July next would give that company in excess of 100,000,000 kw.-hr. of hydro-electric energy for which it would be forced to go out and find a market, while the Pacific company, pending completion of its own hydro-electric projects on the Pit River, would be forced to use steam-generated electricity to meet the demands of its consumers. According to Power Administrator H. G. Butler, who was present at the conferences between representatives of the two companies, it was agreed that the Pacific company is to the extent of the present interconnections to take surplus hydro-electric energy from the Great Western company in so far as it can displace steam therewith. Mr. Butler said it was the joint estimate of the two companies that during the remainder of the year 30,000,000 kw.-hr. could be taken over the present interconnections. It was further estimated that the Great Western company would have an additional surplus of 28,000,000 kw.-hr.

Mr. Butler announced that it has further been agreed between the companies that the most efficient steam plants of both companies available and adequate for the purpose will be operated on joint account and that the operation of steam plants will be reduced to a minimum.

N. E. L. A. and Power Commission Agree on Water-Power Regulations

AFTER nearly three weeks of discussion, representatives of the National Electric Light Association and O. C. Merrill, the executive secretary of the Federal Power Commission, have reached an agreement as to proposed amendments of the regulations promulgated for the administration of the water-power act. The amendments will be laid before the Federal Power Commission at its next meeting. The final suggestions relate not so much to changes in principle as to the manner of application in order to avoid conflicts and duplications between the state and the federal commissions. It was agreed that the regulations had to be sufficiently general to cover industrial users of power and public utilities not under state regulation. Most of the changes provide exceptions for regulated utilities.

The proposed amendment with regard to depreciation reserves would change the section with regard to general requirements so as to read as follows:

In order that adequate provision may be made for all necessary renewals and replacements of project works and for the maintenance thereof in a condition of repair adequate for the purposes of navigation and for their efficient operation in the development and transmission of power, the licensee shall establish and maintain adequate depreciation reserves and, except as provided in Section 6 hereof and in Section 3 of Regulation 20 hereof, shall conform to such rules and regulations as the commission may from time to time prescribe for accounting for or reporting depreciation, for the classification of property for such purposes, for determining the rate or amount of depreciation to be accounted for or reported on each unit, class or group of property, and for the establishment and maintenance of depreciation reserve accounts.

The new Section 6, dealing with conflict with requirements of state commissions, reads as follows:

When the licensee is a public service corporation or a person, association or corporation developing, transmitting or distributing power for sale or use in public service, and such licensee is subject to the jurisdiction of any public utility commission or other commission or regulatory body of the state or states in which the project is located, as to the rates to be charged by such licensee for public service, the licensee shall account for depreciation on the project property in a manner required or authorized by such regulatory authority. If, in the judgment of the commission, such accounting for depreciation does not show that adequate depreciation reserves have been created and are being maintained as to the project property, the licensee shall be subject to and shall comply with any reasonable order of the commission in relation to such accounting for depreciation and to the creation and maintenance of such depreciation reserves. The results attained by accounting for depreciation as required or authorized by such state regulatory body, or by complying with any such reasonable order of the commission, shall be shown in the statements and reports of the licensee to the commission made in accordance with the provisions of the act and of Regulation 20 hereof and shall, in so far as applicable, be binding upon the licensee in the administration of the provisions of the act; and the credit balances shown upon such statements and reports prepared in accordance with such depreciation requirements of such state regulatory body or of such reasonable order of the commission, as provided in this section, shall be deemed to be the "aggregate credit balances of current depreciation accounts" within the meaning of the definition of net investment as set forth in Section 3 of the act, and for any purpose to which such net investment is applicable.

Smith Accepts Illinois Commission Chairmanship

AFTER a long delay the uncertainty as to the head of the Public Utilities Commission of Illinois was settled last week when Col. Frank L. Smith accepted the chairmanship offered him by Governor Small several months ago. No action on the various proposals to abolish or reorganize the commission has yet been taken by the Legislature. The whole utilities commission situation in Illinois stands as it did before Governor Small's election, except that the personnel of the commission is entirely new.

Kansas Public Service Association Arranges Program

THE tentative program for the convention of the Kansas Public Service Association at Kansas City, Mo., on April 20 and 21 includes the following papers: "Public Utilities the People's Business," by Martin J. Insull, president National Electric Light Association; "The Work of the Illinois Committee on Public Utilities Information," by Bernard J. Mullaney of that body; "Selling Our Securities to Our Customers," by C. M. Hamilton of the Electric Bond & Share Company New York, and a paper by C. M. Reed of the Kansas Public Utilities Commission on a subject not yet announced.

As announced previously in the ELECTRICAL WORLD, there will be held in Kansas City during the same week the convention of the Missouri Association of Public Utilities and the first Kansas City electrical show.

Engineering for London Superpower Scheme Approved

THE engineering proposals for a unified power system for London, England, submitted to the conference of local authorities owning central stations have been approved by the conference, according to advices received from the London office of the ELECTRICAL WORLD. It is proposed that the development be divided into two stages. During the first stage under the accepted plan thirty-four stations will be shut down progressively and these stations will be supplied with wholesale power from the remaining plants. At the same time superpower stations will be erected, and as these are completed the second stage will be reached, by which time twenty-six of the remaining generating stations will have been progressively shut down. Of the remaining seventeen plants existing in the area, two would be reconstructed and considerably enlarged to act as superpower plants, while seven would be permanently retained to act as auxiliary plants in conjunction with the superpower plants. The other eight stations, which are near the outskirts of the area, would have to be kept at work for a considerable period to serve the local demands until it became possible to extend the transmission lines there.

Six new superpower plants are to be erected on the Thames River, two on sites now occupied by existing stations and four on new sites. Three of the new sites are to be on the north side of the river and one on the south. The capacity of the new superpower plants will vary between 70,000 kw. and 200,000 kw., mostly in units of 25,000 kw. Several of the sites picked out will permit of much larger stations if they are required.

It is proposed that existing generating stations now used solely for street railways and for railroads continue to supply energy as heretofore to their respective systems, while any railroad not already electrified may obtain energy from the system. All these stations are steam stations, there being no water-power resources in the area.

Committees of the A. I. and S. E. E. for 1921 Are Announced

COMMITTEES of the Association of Iron and Steel Electrical Engineers for 1921 have been announced, with chairmen as follows: Electric furnace, E. T. Moore; standardization, W. T. Snyder; electric development, R. B. Gerhardt; educational, L. F. Galbreath; membership, J. F. Kelly; finance, B. W. Gilson; safety, Walter Greenwood; editing, E. Friedlaender; papers, S. S. Wales; combustion, Frank Leahy; convention, A. H. Swartz.

California Commission Orders 6 per Cent Cut in Southern California's Rates

WHAT amounts to an average cut of 6 per cent in the rates for electrical energy charged by the Southern California Edison Company was ordered last week by the Railroad Commission of California in a decision adjusting the company's schedules. This makes the second cut made in Southern California Edison rates, the commission last January having reduced the surcharge allowed the company from 27 to 20 per cent.

The rates fixed in the new order will constitute the company's definite or base schedules. They are on an average about 28 per cent higher than the rates of pre-war days and are estimated to produce a gross revenue of $15,338,225. This is about 9 per cent less than the amount asked for by the company, but sufficient, in the opinion of the commission, to enable the company to meet its financial needs and also carry out its development program.

The commission estimates that the rates will yield a return of 8.3 per cent on the company's investment, which for rate-fixing purposes the commission finds to be $94,073,656. This sum is several million dollars below the value claimed by the company, whose valuation engineer said it would cost $148,519,624 to reproduce the plant new. Depreciated, the reproduction cost, according to this engineer, would be $128,731,081.

The commission declares that it is inclined to look with favor upon a proposal to divide savings due to economies in operation among the consumers, employees and the company's stockholders and suggests that the company work out and submit a plan. The commission, however, points out that the public utilities act does not contemplate a division of increased profits resulting from changes in conditions and costs not under the control of the company.

Declaring that the economic conditions existing in the territory served by the Edison company are such that the public should not be burdened at this time with any charges in excess of the absolute minimum, the commission frowns upon the company's proposal that it be allowed to create a special reserve of $2,000,000 designed to protect against special unforeseen con-

tingencies. The idea of the company was to create a basic fund to be drawn upon in dry years or to cover possible other contingencies so as to insure continuity of earnings and stability of rates. The commission, while of the opinion that the plan should be followed out, does not believe that this is the time, in view of falling prices and normal weather conditions, to create the reserve through a charge on the consumers.

The effect in general of the new rate schedules will be to reduce the cost of electricity, but in a few cases the schedules will mean an increase owing to the fact that consumers were enjoying favorable rates. A number of special or class rate schedules have been eliminated and certain standard schedules made effective, with the result that all consumers will be placed on the same basis.

Business Men Oppose Taking Licenses from Engineering Corporations

NEW YORK CITY business men are lined up in opposition to a proposed amendment to the state law which would limit the practice of professional engineering to individuals instead of corporations and partnerships as now provided. The Merchants' Association of New York City has gone on record as opposing an amendment which would prohibit the licensing to practice of corporations and partnerships and as approving an amendment which would permit the licensing of both individuals and corporations.

The association says in a published statement: "In the opinion of the Merchants' Association the practice of engineering requires a combination of technical training and experience, of executive capacity and of business judgment matured by experience. Consequently the development of large engineering firms and corporations has been a natural evolution which permits the efficient co-operation of men who can contribute some special technical business or executive talent."

Engineering Foundation Issues Report of Sixth Year's Work

THE Engineering Foundation of the United Engineering Society has issued, through its chairman, Charles F. Rand, its report for the sixth year of its existence, which ended Feb. 10 last. The foundation is a trust fund established by Ambrose Swasey of Cleveland, who in last October added $200,000 to his two previous gifts, making a total endowment of $500,000. Its object is "the furtherance of research in science and in engineering or the advancement in any other manner of the profession of engineering and the good of mankind," and the income is administered by a board composed of members from the four big engineering societies and of members at large.

The most noteworthy undertaking of the foundation for the year under review was an investigation into the fatigue phenomena of metals in charge of Prof. H. F. Moore of the University of Illinois. A statement of the present status of this investigation is contained in the report. The General Electric Company has contributed $30,000 to it in order to include special problems connected with nickel steel. Other accomplishments of the past year were the reorganization of the division of engineering along lines corresponding to the broad fields of engineering activity, with a large advisory committee for each broad field, sponsored by an appropriate leading engineering society; the organization of a bureau of welding and establishment of ten working committees on subjects of practical importance to this new industry; organization of an advisory board on highway research to assist existing bodies by co-ordinating their research activities into a national program; progress in research by the committee on heat treatment of carbon steel; organization of a large committee on electrical insulation.

Southern Operating Engineers Form New Association

SOUTHERN electric light and power plant engineers and operators have formed a new organization known as the American Association of Operating Engineers, the aims and objects of which are to promote a better understanding between the operating men and maintenance men, as well as to provide a clearing house for their many problems. Labor problems will not be discussed by the new body. A geographical section meeting will be held three times a year. The association concluded on April 7 a three days' meeting at Atlanta at which about fifty were in attendance. The next meeting will be held early in October in Birmingham.

Representatives of the following power companies were present at the convention: Georgia Railway & Power Company, Tennessee Power Company, Alabama Power Company, Central Georgia Power Company, Columbus Power Company, Aluminum Company of America and the Kentucky Public Utilities Company.

At the closing sessions the following officers were elected: President, H. L. Wills, engineer and operating manager of the Georgia Railway & Power Company; vice-president, J. M. Oliver, Alabama Power Company; secretary, H. C. Bristol, Tallassee Power Company; treasurer; W. F. Bellinger, Georgia Railway & Power Company; members of executive committee, G. S. Nunemaker, Tennessee Power Company, and G. A. Iler, Georgia Railway & Power Company.

No formal papers were prepared for the meeting, most of the time being taken up in discussions of vital power-plant problems now confronting the operators. On Wednesday, April 6, the delegates saw the changing of the insulators on a live line on the Atlanta system. These lines come in from Tallulah Falls under a pressure of 110,000 volts. A demonstration also was given of the Bennett lightning arrester. At the conclusion of the meeting the delegates were the guests of the Georgia Railway & Power Company at its Morgan Falls plant.

New 165,000-Volt Line



On the right is pictured a tower on the new 186-mile 165,000-volt line to the new 40,000-kw. Caribou hydro-electric plant of the Great Western Power Company of California. The receiving substation is near San Francisco. The line on the left is 154 miles long, operating on 110,000 volts to the Las Plumas water-power plant of the same company.

Wireless to Aid Load Dispatching of Southern Interconnection

THE installation of two wireless stations for the purpose of intercommunication between different companies interconnected with the system is proposed by the Georgia Railway & Power Company in its load-dispatching arrangements. A government license has been obtained. The other companies forming the interconnection are also installing wireless equipments.

It is further proposed to enable the load-dispatcher's office to work in connection with high-powered stations and supervise the operation of repair and trouble crews on high-voltage line maintenance. The company expects to effect a large saving through the more efficient directing of the crews in their movements from place to place at times when interruptions occur due to the breakdown of the transmission line or structure, and it is thought that this will aid materially in shortening the time of interruptions.

Presentation of Insulating-Material Specifications Expected

AT THE 1921 annual meeting of the American Society for Testing Materials, to be held at the New Monterey Hotel, Asbury Park, N. J., June 20 to 24 inclusive, data on electrical insulating materials will, it is expected, be presented.

It is hoped to complete committee work which will permit the presentation of new tests for insulating varnishes, transformer oils and porcelain. A large amount of work has been done during the current year, it is stated, on all of these items, particularly transformer oils. In connection with the latter results of experimental work done during the last three or four years by four different laboratories have been analyzed and the conclusions utilized in the preparation of the specifications. It is expected that these data will be included in the committee's report.

A new specification for rubber gloves for electrical workers is to be proposed this year. A specification for rubber insulating tape is also under discussion.

Manitoba Water Powers and the Canadian Pulp-Wood Industry

WITH a view to meeting as quickly as possible the demand for newsprint in the provinces of Manitoba, Alberta and Saskatchewan, the United States Vice-Consul at Montreal reports, an order in council issued at Ottawa on Feb. 14 authorized the Canadian Minister of the Interior to dispose of timber rights for the manufacture of pulp wood on certain lands to the east of Lake Winnipeg in Manitoba Province at public auction or by tender.

The area covered by the order is approximately 718 square miles. Among the conditions governing the issuance of permits to applicants for purchase rights is the following one concerning the development of water power:

That the purchaser may, if he so desires, apply under the Dominion water-power regulations for the right to develop any conveniently located water power for the purpose of supplying energy to his mill or mills; and if the water power applied for is available and is, in the opinion of the Minister, the most suitable source of power for the purpose, and provided its use therefor will not conflict with the public interest, the Minister shall proceed under the water-power regulations to enter into an agreement with the purchaser whereby the purchaser shall, on the satisfactory completion of the development, become entitled to a lease of the necessary Dominion lands and a license to use the water for the purpose of his water-power development.

Uniform Coal Contract Proposed by Fuel Committee of Purchasing Agents

THE fuel committee of the National Association of Purchasing Agents, which has for some time been engaged in formulating recommendations for reasonably uniform provisions in coal contracts, has drawn up a form which it believes can be advantageously used in most commercial contracts for the purchase of coal, special clauses being added to the contract where conditions make this necessary. The form has been prepared simply as a convenience to the members of the National Association of Purchasing Agents and the trade and is submitted by the committee for the use of those whose requirements it will meet. It has been carefully worked out to cover all general conditions and is particularly designed to prevent misunderstandings between buyer and seller such as arose from loosely drawn agreements in effect last year.

Inclosure of Fuses and Switches Growing in Favor

THE inclosed switch and fuse situation was the subject of discussion at a meeting of the Western New England Association of Electrical Inspectors in Springfield, Mass., March 30, to which A. T. Wheeler, vice-president Trumbull Electric Manufacturing Company; Dr. M. G. Lloyd, assistant physicist Bureau of Standards, and B. H. Glover, associate electrical engineer Underwriters' Laboratories, Chicago, contributed. The discussion emphasized the transmission stage of the art and indicated the trend of future developments. Mr. Wheeler pointed out that the Underwriters have not assembled under one head a set of rules governing the manufacture or installation of inclosed switches and fuses, but the time appears not far distant when there will be recommended published rules covering these points, becoming imperative in a few years, and such rules will probably become mandatory in many states and municipalities even earlier. Many safety rules are at present in vogue, some of which deal with entrance devices.

If these continue to exhibit lack of uniformity, there will be confusion, and a considerable increase in investment by manufacturers in equipment and stocks will be required. Five different types of inclosed switches have become recognized in existing rules, embodying different degrees of protection as follows:

1. The ordinary fused or unfused knife switch, inclosed in a case which had to be opened to operate the switch. This affords no protection to the operator and is dangerous. It, however, prevents accidental contact with live parts when the cover is closed and locked.

2. The knife switch externally operated by a handle outside, but in which the live parts can be exposed by opening the cover with the switch closed. This has some degree of protection if the cover is kept locked.

3. The type of fused switch with cover that can only be opened when the switch is open. Switch can be closed only

after cover is closed. This affords still greater protection, especially if live incoming contacts are not readily acessible.

4. The type of fused switch having a separate compartment for fuses, the compartment being accessible only when the switch is open. The switch parts are in another compartment and are not accessible. This construction is more nearly foolproof than the others. There is still a hazard in that the switch may be wrongly wired, and it is possible to remove and not replace parts of the switch covering.

5. The foolproof types that cannot be wrongly wired and which prevent access to any live part under nearly all conditions that may arise during use. This type will in time be developed, but its cost may militate against its employment for some time. It must be capable of having its component parts in such shape that no part can be permanently removed without the switch ceasing to function.

Panel boards have kept pace with the requirements also. Within the last few months a proposed set of rules governing specified tests and providing installation requirements have been prepared by three national qualified bodies in co-operation.

Dr. Lloyd pointed out that there has been considerable sentiment among the members of the electrical committee of the National Fire Protection Association for making more stringent requirements as to switch and fuse inclosure, but that there still exists considerable difference of opinion as to how far these restrictions should go. At the last revision of the code it was decided to make a beginning at the service entrance and the rules now require the inclosing of service fuses and switches unless mounted on switchboards under competent supervision. It is also requisite now to install the switch ahead of the fuse so that the latter may be "killed" before handling.

Mr. Glover stated that many questions remain to be answered as to the inclosure of all switches regardless of voltage and current-carrying capacity, the limitations on the loading of manually operated switches, comparative safety of switch operators and the general public proportions of inclosing spaces and character of material best adapted to protective duties.

Program for American Welding Society Convention, April 27-30

THE annual meeting of the American Welding Society will be held at the Engineering Societies Building, New York, April 27 to 30. The program for the convention is as follows:

WEDNESDAY, APRIL 27

Morning—Gas welding committee; resistance welding committee.

Afternoon—Welding wire specifications committee; welding conference committee.

THURSDAY, APRIL 28

Morning—Board of directors; committee on specifications for steel to be welded.

Afternoon—Business session.

Evening—Technical session. "Applications of the Automatic Welding Machine," by P. O. Noble; "Production Welding with the Gas Flame"; "Results of Recent Thermit Welding Research," by J. H. Deppeler.

FRIDAY, APRIL 29

Morning—Board of directors; electric arc welding committee.

Afternoon—American Bureau of Welding.

SATURDAY, APRIL 30

Morning—Committee on welding of storage tanks; committee on training of operators.

Electric Light and Power Business Picking Up

SPRING business with the electric light and power companies is picking up. Evidence of this is had in the February report of the subsidiaries of the Standard Gas & Electric Company, which are widely scattered over the country.

During February contracts were secured for 5,285 new services with 2,938 kw. of lighting and 4,620 hp. in motors, a material increase over new business secured in January, 1921, and February, 1920. The net gain in connected load for the month included 1,815 customers, with 1,139 kw. of lighting and 2,770 hp. in motors. The electrical energy output for the month was 65,130,374 kw.-hr., an increase of only 1.4 per cent over February, 1920, due to the temporary idleness of industries in certain territories served. This condition is only temporary, it is stated, and there should be a decided improvement in the rate of increase of electrical energy output in the next few months.

Two new transmission lines were completed during the month by the Northern States Power Company, one to serve the Home Light & Power Company at Jasper, Minn., and one to serve the town of Brownton, where a municipally owned generating plant has been abandoned. Both of these lines were completed in the southwestern division of the territory of the Northern States Power Company, by which company the electric service will be supplied.

Two new "white-way" lighting systems have been completed, one to serve 120 standards on the main streets of Enid, Okla., and one to serve forty-six standards on First Street, Oklahoma City.

A large contract for electric ranges was secured in February at St. Paul, covering 156 5-kw. electric ranges for new apartment buildings which one contractor is arranging to complete this spring and summer.

The Minneapolis General Electric Company reports February sales of $23,000 of electric household appliances and an increase of 17 per cent in house-wiring business over February, 1920; also an increase of 100 per cent in new business connected.

Transformer Transportation



Ten horsepower to haul a 4,167-kva., single-phase transformer up to the Duquesne Light Company's new north substation which is to form part of the power loop for the Pittsburgh District.

British Columbia Farmers Want Province to Own Water Powers.—A resolution has been passed by the United Farmers' Association of British Columbia asking the provincial government to create a commission on the model of the Hydro-Electric Power Commission of Ontario "for the purpose of developing and operating as government-owned public utilities the water powers of British Columbia."

To Electrify French Canals.—It is proposed to electrify all French canals which carry more than 2,000,000 tons of traffic per annum. Sections of various canals already electrified show that this program will mean a saving of about 1,500,000 tons of coal per annum. In 1920 French canals handled 96,518,681 tons of merchandise, as against 52,428,400 tons handled in 1919. During the war 645 miles of French canals were destroyed. Since the armistice 632 miles have been wholly reconstructed. Out of 1,120 locks, culverts, etc., destroyed, 890 have been rebuilt.

Longest Overland Radio Route.—After three months' interruption of operations owing to the Russian incursion into Mongolia, the wireless station at Urga, in that province, is now able to communicate with Peking. This marks the successful completion of the first span of the longest overland wireless telegraph route in the world, says the *Wireless Age*. The Marconi company is under contract to construct stations at Urunchi (in the Chinese province of Sungaria, Central Asia) and Kashgar (in eastern Turkestan), for which construction parties are being organized.

American Specification Institute Founded.—"To improve the conditions affecting the writing of specifications and to benefit by organized effort," the American Specification Institute has been founded at Chicago, with offices at 127 North Dearborn Street. It purposes to increase knowledge concerning specifications and improve the methods of writing them, including those for buildings and engineering structures. The development of specification writers who will have professional recognition is one aim. These will be the active members of the institute, their employers to be associate members, and engineers and instructors honorary members. Gardner C. Coughlin is secretary pro tem.

Heating of Underground Cables.—The British Electrical and Allied Industries Research Association has recently, says the London *Engineer*, presented to the Institution of Electrical Engineers a report on the heating of buried cables. The greater part of the investigation was carried on at the National Physical Laboratory, where twenty-seven cables were tested under various typical conditions. It was found that the increased carrying capacity of an underground cable is greater with low-tension than with high-tension conductors owing to the thinner dielectric of the former. Further, the rate of temperature rise of a cable in ducts is more rapid than when laid solid or direct in the ground, from which it follows that for intermittent loading a cable laid in the ground will be better able to carry peak loads than one laid in ducts.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

"Board of Trade Unit" Dies.—In Great Britain the kilowatt-hour has been officially known as the "Board of Trade unit." Among the "minor tragedies" of the transfer of the control of electricity supply from the Board of Trade to the Ministry of Transport, says the *Electrician* of London, is the disappearance of this term, though "its demise has hardly been noticed, much less regretted." Efforts to bring the use of "kelvin" into popularity, the *Electrician* says, have not met with success. Apparently British usage will gradually conform to that of the United States and other nations where "kilowatt-hour" is the universally accepted term.

Growth of Nebraska Power Company.—A recent hearing before the City Council of Omaha of an application made by the Nebraska Power Company for increased electrical rates brought out the following figures showing the company's growth since its organization in 1917 to succeed the Omaha Electric Light & Power Company, sales for lighting and power in 1916 having been 48,903,160 kw.-hr.: 1917, 57,645,394 kw.-hr.; 1918, 63,646,270 kw.-hr.; 1919, 82,740,920 kw.-hr.; 1920, 96,604,047 kw.-hr. The company's net revenues during this period showed, according to the findings of the City Council, an increase from $684,463 to $938,337, excluding expenditures incurred in preparing for the investigation.

New Orleans' Big Dock Fire Was Not Caused by Electricity.—When a ten-million-dollar waterfront fire occurred in New Orleans last January picture supplements published by newspapers in Chicago and elsewhere carried photographs of the burning wharves bearing a legend to the effect that "short-circuiting of an electric wire near the surface of water that was covered with oil is believed to have caused this conflagration." The National Electric Light Association challenged this statement and drew from the chief engineer of the National Board of Underwriters the following letter: "The recent fire at the Jahncke dry dock was not caused by the breakage of an electric wire, as reported in the newspapers. An investigation by one of our engineers indicates that a hot rivet dropped from a ship undergoing repairs into oil-coated débris on the water surface was the probable cause. As a matter of fact there were no electric wires anywhere near the scene of this fire the breakage of which could possibly have ignited the oil on the water surface. A 400-volt line was in course of installation and the conduit for this line was attached to the under side of the pier flooring, but wires had not been drawn. The wires for lighting purposes are located on the land at such a distance back from the dock front as to preclude the possibility of any broken wires falling into the water."

"Hydro Municipalities" in Ontario.—In a recent *Bulletin* of the Hydro-Electric Power Commission of Ontario the "hydro municipalities" of the province are listed as follows: Niagara system, 143 municipalities, with a total of 1,122,472 hp.; Severn system, 19 municipalities, 42,906 hp.; Wasdell's system, 11 municipalities, 11,711 hp.; Nipissing system, 4 municipalities, 10,682 hp.; Muskoka system, 2 municipalities, 10,682 hp.; Eugenia system, 28 municipalities, 33,236 hp.; Ottawa system, 1 municipality, 104,067 hp.; Thunder Bay system, 1 municipality, 15,100 hp.; Central Ontario system, 37 municipalities, 118,617 hp.; St. Lawrence system, 11 municipalities, 16,470 hp.; Rideau system, 5 municipalities, 13,745 hp.; Essex County system, 7 municipalities, 10,615 hp.; Thorold system, 1 municipality, 4,325 hp. The Niagara, Thorold and Essex County systems are operated at 25 cycles, all the others at 60 cycles.

Vacuum-Tube Amplifier Used to Study Heart Beats.—A demonstration was recently given in Washington to medical men of a device developed in the Signal Corps laboratory whereby heart beats may be amplified thousands of times and made audible over long distances. The principle involved is similar to the one used in the large amplifier employed to increase the volume of the President's inaugural address. A special "heart transmitter" rests by its own weight over the patient's heart. The passage of the blood through the different valves of the heart causes vibrations in an air chamber which faithfully reproduces all of the various actions of the blood passing through the different valves of the heart. These are transmitted over the wire to an amplifying apparatus which consists of a group of standard Signal Corps vacuum tubes such as are used in wireless telephony and telegraphy, and a special receiver attached to a large horn projects the sounds. The patient may be in the middle of the Atlantic, the experts say, the difficulty of transmitting such delicate sounds being overcome by using a high-frequency carrier wave or line radio for transmitting the heart beats over the ordinary wire circuits from the receiving station. This carrier wave is in fact an electric wave of a frequency above the human ear, and such waves are guided by the telephone wire to the receiving amplifier. The carrier waves are modulated by the heart-beat variations and demodulated and amplified at the receiving apparatus.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Hearing Before Commission Must Precede Order to Public Utility to Increase Rates.—The Supreme Court of North Dakota has held, in City Commission of Bismarck vs. Bismarck Water Supply Company, that under the public utilities law of the state the Board of Railroad Commissioners can grant an increase in rates to a public service company only after a hearing has been held. The increase in dispute, having been made without notice and hearing, was void. (181 N. W. 596.)*

Operating Expenses Held to Include Federal Income Tax.—In determining in favor of the plaintiff a suit brought by the Municipal Gas Company of Albany against the Public Service Commission of New York, Second District, in which the company claimed that the statutory rate, enforcement of which was sought by the commission, was confiscatory, the New York Supreme Court held that the federal income tax levied against the company was rightly included in operating expenses, the tax being payable by the corporation and not assessed against the income of the individual stockholders. (186 N. Y. S. 541.)

Public Utilities Act of North Dakota Held Not to Affect Franchise Rates.—In an action brought by the Western Electric Company (North Dakota) against the city of Jamestown, the Supreme Court of North Dakota held that where, pursuant to a contract for one year, made in 1912, the company had furnished electrical energy from year to year and had accepted payment at the rate named in such contract, this contract was continued and renewed by practical construction, notwithstanding that in 1914 the City Council adopted a resolution canceling the contract and notwithstanding also that in February, 1918, the corporation gave notice of a surcharge of 10 per cent without the city's having agreed to pay this increased rate. The public utilities act, the court held also, did not abrogate or affect the terms of a pumping contract adopted in 1902. Nor was the city obligated to pay for electrical energy furnished to a public reading room in the city hall for which no specific request had been made by the city and no bill rendered by the company for the years from 1910 to 1914 and which it continued to supply up to the beginning of the action with knowledge that the city claimed this service was obligatory under the franchise. (181 N. W. 363.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Franchise Rate Must Not Be Changed Merely on Ground of Unprofitableness.—Although upholding an injunction obtained by the village of Warsaw to restrain the Pavilion Natural Gas Company from raising its rates (see issue of Dec. 25, 1920, page 1282) the Appellate Division of the New York State Supreme Court has found that the state in the exercise of its reserve police power has a right to modify a rate fixed in the franchise of a public service corporation in the public interest, if it be deemed unjust or unreasonable. The exercise of this power by the state does not violate the constitutional provision against impairing the obligation of contracts, the court holds, and public service contracts usually are made with the regulatory power of the state in mind. The state cannot modify a franchise rate on the mere ground that it is unprofitable, however.

Wisconsin Constitutional Provision Wrongly Applied to Contract with Electric Company. — A constitutional provision of Wisconsin requiring a municipal corporation incurring any indebtedness to provide for the collection of a direct annual tax sufficient to pay interest as it falls due and to pay the principal within twenty years has been held by the Wisconsin Supreme Court, in Milwaukee Electric Railway & Light Company vs. City of Milwaukee, to be inapplicable to a city contract which requires the company to operate a park electric lighting system, terminable after two years by the city's acquisition of title to the plant, upon payment to the company of the difference between the special investment in the park lighting system and the accumulated depreciation reserve provided for at the date of termination, there being an absence of proof that the depreciation reserve exceeded its legitimate limits and that the charge therefor was so excessive as to constitute a payment upon capital. A charge for depreciation is a necessary and proper element of the cost of each year's service and is in the nature of an expense of operation, and provision should be made therefor out of earnings. (181 N. W. 298.)

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Engineering Society of Akron.—At the meeting of the Engineering Society of Akron, Ohio, on Tuesday last, April 12, E. P. Roberts spoke on "Valuation of Public Service Properties for the Purpose of Rate Making."

Pacific Coast N. E. L. A. Convention Postponed.—The annual convention of the Pacific Coast Division of the N. E. L. A., originally scheduled for May 25, 26 and 27 at Del Monte, Cal., has been postponed to June 7, 8 and 9.

Institute Meetings.—Two sections of the A. I. E. E. were scheduled to meet last night (April 15). The Baltimore Section was to hear Dr. C. P. Steinmetz on the relation of the electric motor car to the industry, and the Schenectady Section was to listen to a discussion of illumination by W. D'A. Ryan. Next week three section meetings are announced. At Cleveland on April 19 L. D. Bale will discuss "The Automatic Railway Substation"; at New York on April 22 Prof. Comfort A. Adams will have charge of a discussion on engineering education held jointly with the A. S. M. E., and the annual business meeting will take place; at Chicago on April 25 there will be a joint meeting with the electrical and mining sections of the Western Society of Engineers and the A. I. and S. E. E., when Carl Lee will speak on the diversity factor of coal-mining loads and W. C. Adams on power distribution systems for coal mines. "Toll-Line Practice" will be the subject of J. E. Heller, of the Pacific Telephone & Telegraph Company, before the San Francisco Section on April 29, and "Electric Power in Pulp and Paper Mills" that of T. H. Crosby before the Vancouver (B. C.) Section on May 6.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Pittsburg, April 16; Chicago, April 25; Philadelphia May 7; Cleveland, May 9.

A. I. E. E. Section Meetings—Pittsburgh (joint session with A. I. and S. E. E.; for program see issue of March 19, page 672), April 16; Cleveland, April 19; New York (joint session with A. S. M. E.), April 22; Chicago, April 25; San Francisco, April 29; Vancouver B. C. May 6

American Welding Society — Metropolitan Section, New York, April 19.

Kansas Public Service Association—Kansas City, Mo., April 20-21.

Missouri Association of Public Utilities—Kansas City April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society—Washington, April 23.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers—Houston Tex., April 27

American Association of Engineers—Buffalo, May 9-11

N. E. L. A., Southwestern Geographic Division—Hot Springs Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond Va., May 19-20.

A. I. E. E., Annual Meeting—New York, May 20

American Society of Mechanical Engineers —Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago May 31-June 3

N. E. L. A., Pacific Coast Section — Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Sliding Scale for Lighting Rates Sustained Where Already in Force.—While asserting that ordinarily a sliding scale for electricity or gas dependent upon the price of coal or other commodity should not be fixed for lighting rates and that a decision permitting such a scale should not be considered a precedent for the future, the New York State Public Service Commission, Second District, permitted the Iroquois Utilities, Inc., to extend such a charge to the village of Randolph, despite the protest of the village trustees, on the ground that to do otherwise would constitute discrimination inasmuch as the rate was already in force in the rest of the territory served by the company and had aroused no complaint. A readjustment for the entire territory, the commission held, should be postponed until the rapid variations in the price of coal shall have ceased.

Gas and Electric Departments of Lighting Company Must Be Kept Separate.—The city of Kingston, N. Y., having suggested during the hearing of an application by the Kingston Gas & Electric Company for increased gas rates that the business of both the electric and gas departments of the petitioner should be taken into consideration, the New York Public Service Commission for the Second District declared, "This is not the law," quoting a court decision to the effect that in fixing the price of electricity the plaintiff is not entitled to recoup its losses upon sales of gas. For the same reason, in fixing the price of gas it is not required to make allowance for a just and reasonable profit which is the limit of permissible return upon its rates for electricity. The commission asserted its belief that a service charge, which it said was more correctly designated as a ready-to-serve charge, is a proper charge.

Voltage Variation — Inductive Interference.—An investigation of the adequacy of the service rendered by the Badger Public Service Company and of inductive interference between its lines and those of telephone companies has been made by the Wisconsin Railroad Commission, which declared the service inadequate and the voltage variation beyond the limit set by the commission. The commission held that the patrons of the company were entitled to prompt relief from the extreme voltage variation and required the company to make certain specified changes in the lines. It found that the transmission lines of the company had in several cases been constructed without due regard to the prevention of inductive interference and in violation of the commission's order covering standards for the safe construction and operation of electric systems. The company was ordered to transfer the wires of the Big Six Telephone Company to the poles of the Eastern Wisconsin Telephone Company and pay to the Eastern Wisconsin Telephone Company $1.45 per pole to prepay pole rental at 7½ cents per contact per year. In case this rental is not acceptable to the Eastern Wisconsin Telephone Company, the transfer was ordered made and the matter brought before the commission for determination.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Sinking-Fund Payments Are Not Operating Expenses.—Payments into a sinking fund for the redemption of bonds form no part of the operating expenses of a utility, the Indiana Public Service Commission took occasion to declare in passing upon a petition for approval of reduction of stock, but must be paid out of gross income, since otherwise the ratepayer would buy the corpus of the property itself and turn it over to the stockholders.

Twenty per Cent Lighting Penalty Exorbitant.—The Public Service Commission of Pennsylvania has handed down a decision in a case against the Newmanstown Electric Light & Power Company to the effect that a 20 per cent penalty for failure to pay bills for electric service in ten days, as provided by the rules of the company, is "both unreasonable and exorbitant and is out of line with the usual and ordinary penalty imposed by utilities for that purpose." In ordering the company to amend its rules in this respect, the commission says: "There is no occasion to impose an exorbitant penalty to enforce prompt payment of a bill, since a public utility has within its power the right to discontinue the service for non-payment of bills."

Responsibility for Inadequate Service.—In sustaining a complaint of inadequate service against the St. Clair County Gas & Electric Company the Illinois Public Utilities Commission made these observations: (1) Public utilities enjoying a monopoly and the benefit of protection from competition must, notwithstanding the difficulty of obtaining capital under abnormal economic conditions, find some means of procuring such funds as may reasonably be required to make necessary extensions and improvements. (2) If the commission's standards of service are to be lowered, rates commensurate with the lower grade of service should reasonably be expected. (3) The war being over, the burden of providing the necessary capital for making extensions is one that should be assumed by the utilities. Finding that a producing company, the East St. Louis Light & Power Company, was partly responsible for the inadequate service of the St. Clair County company, to which it supplied electrical energy, the commission ordered that it be made a party to the proceeding.

Compensation to City in Return for Cancellation of Franchise Disapproved as Discrimination Against Outside Customers.— The Idaho Public Utilities Commission, which in authorizing the cancellation of franchises granted by Boise to the Idaho Power Company ordered the company to raise its rates within that city to offset payments to be made to the city by the company for annulling the franchise, has refused to rescind its order at the instance of the city authorities, who claim that by this decision the company and its outside customers will receive the value of franchise rights which are the property of the city. The commission holds that these so-called rights are themselves advantages and preferences and that to permit conpensation for their surrender would give the city an unfair advantage over other localities. "Whether the privilege of the franchise is of sufficient value to the city to justify the cost is not for us to say," the commission concludes. "That is for the city to determine. Our province and duty go no further than to see that the cost of these benefits does not fall on those who receive no benefit from them; that is, to see that the rates paid by those who receive the benefits reflect all the cost of those benefits, and if the franchise were to remain in force, there would be required such rate change in the city as would lift the burden of its cost from the customers outside of the city."

Inductive Interference and Assessment of Cost of Remedial Measures.— An application from the Nebraska Power Company and Platte Valley Power Company for permission to construct a 13,200-volt electric transmission line between substations in Omaha and along a route where on certain streets both sides of the road were occupied by lines belonging to telegraph and telephone companies was denied by the Nebraska Street Railway Commission, which pointed out the possibility of the power company's using an alternate route. The commission, however, did not assent to the contention of the telephone company that if an order were issued requiring a transposition of some of the existing wires from the side of the street where they now are to the opposite side in order to permit the power company to run its line without giving rise to inductive interference, then all the costs should be assessed against the power company. "Very probably," it said, "the telephone company would find itself with properties of longer life under the removal than before. It might also have certain salvage in the old line. In so far as more expensive pole-line construction is by the telephone company found necessary, such added telephone construction would enhance the value of the telephone company's properties, and such expense ought not to be borne by the power company. Nothing in law would indicate that an existing public utility on a highway is immune to expense made necessary by an additional use of the highway in the public interest."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Shiras Morris, who since 1914 has been president and treasurer of the Hart & Hegeman Manufacturing Company, Hartford, Conn., was elected president of the Associated Manufacturers of Electrical Supplies at its recent meeting. Mr. Morris has also been elected treasurer of the Electrical Manufacturers' Council, to succeed the late E. B. Hatch. Besides his connection with the electrical industry, Mr. Morris is identified with several industrial companies and banking institutions. He is vice-president of the Hartford branch of the National Metal Trades Association, a member of the directorates of the Bush Manufacturing Company of Hartford, the Dime Savings Bank of Hartford, the Hartford Morris Plan Bank, the State Bank & Trust Company and the Terry Steam Turbine Company of Hartford. He is also a member of the board of trustees of Choate School, Wallingford, Conn., and of Trinity College, Hartford; a member of the Hartford Club, University Club, Hartford Golf Club, the Country Club of Farmington Republican Club and other social organizations. Mr. Morris was graduated from Trinity College, Hartford, in 1896 and for a short time was connected with the Pope Manufacturing Company. He very soon joined the Hart & Hegeman Manufacturing Company, and two years afterward was chosen secretary, later assuming the additional duties of treasurer.



SHIRAS MORRIS

H. W. Butler of the engineering staff of the Superpower Survey has gone to Washington to assist Harold Goodwin in the compiling of electrical data from the returns to the Bureau of the Census.

G. H. Canfield of the staff of the United States Geological Survey has been detailed to make investigations of water-power sites in Alaska for the Federal Power Commission.

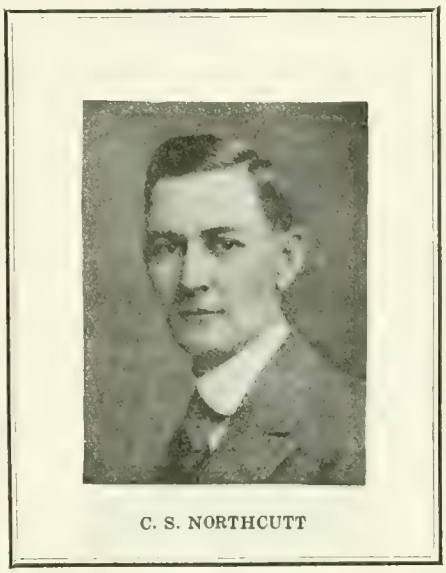
Alexander C. Barker has been placed in charge of the Montreal office of Dwight P. Robinson & Company, Inc., engineers and constructors of New York, with the title of vice-president. This company has done extensive construction and engineering work in Canada for the Canadian Pacific Railway, Canadian Salt Company, Canadian Crocker-Wheeler Company and the Grand Trunk Railway.

H. C. Ross, who has been appointed manager of the Fresno (Cal.) division of the Pacific Gas & Electric Company, has been connected with various public utilities since 1900. He was born in Baltimore in 1882 and lived there until 1910. In 1900 he entered into the employ of the Consolidated Gas & Electric Light Company of Baltimore, where he worked up through various positions to that of superintendent of shops. From 1910 to 1914 he was superintendent of shops and agent of the Manufacturers' Light & Heat Company of Pittsburgh. He was industrial engineer of the Southern California Gas Company from 1914 to 1915, when his employment by the Pacific Gas & Electric Company as new-business manager at Fresno began. From 1916 to 1919 he was in the San Francisco office of that company as sales supervisor; then he returned to Fresno as district manager, later being promoted to division manager.



H. C. ROSS

C. S. Northcutt has recently been appointed manager of the San Joaquin (Cal.) division of the Pacific Gas & Electric Company, which comprises four districts, Stanislaus, San Joaquin, Tuolumne and Electra, covering five counties in east central California. Mr. Northcutt is a native of Georgia, where he was born in 1885 and where he had a varied commercial and banking training until he went to California in 1905. Until 1909 he was employed by the United Railroads of San Francisco and later by the Union Construction Company, then engaged in building hydroelectric projects. Upon completion of construction work Mr. Northcutt was transferred to the executive offices of the Sierra & San Francisco Power Company. In 1910 he was appointed agent in Modesto, and in 1911 he was promoted to the position of manager of the Modesto district. When, in January, 1920, the Sierra & San Francisco Power Company was leased by the Pacific Gas & Electric Company Mr. Northcutt was made manager of the Stanislaus district. In January, 1921, he was brought back to Modesto and his present position.



C. S. NORTHCUTT

B. A. Behrend, whose photograph appears on page 864 of this issue, with comments on his achievements as an engineer-scientist, was born in Switzerland May 9, 1875, and was educated in England and France and at the university and Polytechnic Institute in Berlin. Upon returning to Switzerland he became assistant engineer of the Oerlikon company. In the '90s he came to this country and became identified with the Bullock Electric Manufacturing Company as chief engineer. Mr. Behrend's achievements have won for him the gold medal of the Louisiana Purchase Exposition at St. Louis, in 1904 and the John Scott medal of the Franklin Institute in 1911. He is author of "The Induction Motor, Its Theory and Design" (1900 in English, 1902 in French, 1903 in German); "The Debt of Electrical Engineering to C. E. L. Brown," 1901; "Engineering Education," 1907, and many papers on the

theory of alternating-current motors and generators. He is a fellow and past vice-president of the A. I. E. E., a fellow of the American Academy of Arts and Sciences and a member of the American Association for the Advancement of Science, the A. S. M. E. and the A. S. C. E.

Dr. Alexander Graham Bell, who during the past winter spent some time abroad, has recently returned to Nova Scotia, where his Cape Breton laboratory is located. Here Dr. Bell built his famous 70-mile-an-hour hydroplane. He is now actively engaged in special work in this laboratory. Dr. Bell celebrated his seventy-third birthday on March 4.

H. A. Strickland has been appointed sales representative for the State of Michigan for the Maring Wire Company, Muskegon, manufacturer of



H. A. STRICKLAND

enameled and cotton-covered magnet wire, with headquarters at 844 Book Building, Detroit.

Joseph T. Blondin, director of the *Revue Générale de l'Electricité,* the leading electrical journal of France, has been nominated by the French government to be a chevalier of the Legion of Honor. Mr. Blondin, who was born at Dieppe on March 19, 1863, was educated at Paris, showing special aptitude for scientific studies, and became professor of physics at the lyceum of Pointe-à-Pitre, Guadeloupe, and subsequently at lyceums in Cahors and Orléans, in France, and finally, in 1895, at the Rollin lyceum, where he still remains. He engaged in publishing technical works in 1886, in addition to his professional duties, and, beginning in 1889, he contributed to various journals, particularly *La Lumière Electrique,* of which he was long the chief scientific editor, many original articles upon mathematical physics, notable among them being the expounding of a vortical theory of electricity inspired by Henri Poincaré's work on vortexes. Mr. Blondin was the director of *L'Eclairage Electrique* from 1894 to 1904 and the *Revue Electrique* from 1904 to 1917, and when the *Revue Générale de l'Electricité* was founded in the year last named he was made director of it.

H. M. Addinsell, who for the past fifteen years has been intimately associated with the problems of public utility financing and is well known in utility banking circles, has been appointed chairman of the public utilities committee of the Investment Bankers' Association. Mr. Addinsell has been associated with Harris, Forbes & Company since December, 1905, except for a period of a year and a half when he served as captain of field artillery in the United States Army. He spent half of that time in France. Previous to his present connection he was for two years in the business department of the New York *Times.* Mr. Addinsell is a director of Harris, Forbes & Company.

Herbert J. Mayo will represent the Benjamin Electric & Manufacturing Company, Chicago, in its San Francisco office, which will be opened very shortly.

H. W. Kilkenny, for many years connected with the General Electric Company, has become associated with the Tubular Woven Fabric Company, Pawtucket, R. I., in charge of its Cleveland office.

Howard W. Maxham, formerly superintendent of automotive transportation for the American Bosch Magneto Corporation, Springfield, Mass., has resigned to take charge of the maintenance department of Gray & Davis, Inc., at Amesbury, Mass.

L. C. Williams, formerly insulator specialist for the Westinghouse Electric & Manufacturing Company of San Francisco, Cal., has resigned to engage in private business. Mr. Williams was at one time connected with the Pacific Gas & Electric Company, San Francisco, in that company's transmission department.

W. W. Joy has joined the forces of the Advance Machinery & Supply Company, Denver, Col., as vice-president and sales manager. Mr. Joy, who is a graduate of Ames College, Iowa, and a member of the A. S. M. E., for the past three years, has been special sales promotion representative for the Fisher-Governor Company, Marshalltown, Iowa. The Advance Machinery & Supply Company is the sales representative for twenty-three manufacturers of steam and electrical specialties.

Ezra B. Whitman of Baltimore has been appointed a member of the Public Service Commission of Maryland to fill the vacancy caused by the death of James C. Legg. Mr. Whitman is a member of the firm of Norton, Bird & Whitman of Baltimore, Chicago and New York. He is a graduate of Cornell University and has devoted much attention to sewerage and water-supply work, serving the city of Baltimore as water engineer and president of its water board until 1914. During the war he served as officer in charge of utilities, Quartermaster Corps, Camp Meade, Md.

E. Donald Tolles, who has recently been appointed to new duties as national representative of the Electrical Supply Jobbers' Association, was formerly secretary of the Atlantic Division of the Electrical Supply Jobbers' Association and was in addition secretary of the National Electrical Credit Association up to about a year ago. Mr. Tolles has been prominently identified with association work for a number of years. After a business career extending over several years he became associated with Franz Neilson in managing a number of trade associations. Five years ago he became secretary of the Atlantic Division of the jobbers' association and first assistant to the general secretary, Franklin Overbagh. During the war he was active in Washington in the interests of the industry, particularly in looking after the activities of the jobbers, and



E. D. TOLLES

assisted in drafting "Circular No. 23," which provided for the certification of electrical supplies. He is a graduate of Amherst College of the class of 1899 and a member of the New York State bar.

W. A. Porterfield, formerly connected with the enginering department of the General Electric Company, has been appointed general manager of the Union Metal Manufacturing Company, Canton, Ohio, in succession to C. L. Eshleman.

Obituary

Charles B. Schoenmehl, president of the Waterbury (Conn.) Battery Company, died recently.

J. F. Diehl, for many years president of the Santa Barbara (Cal.) Electric Company, died recently at his home in Santa Barbara. Mr. Diehl was born in Missouri in 1864 and moved to Santa Barbara in 1881, becoming an influential factor in the growth of that community through his connection with the electrical industry.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Sweeping Price Cuts on Western Cedar Poles

IN ORDER to do their share in bringing general prices to a level which will command public confidence and stimulate new activity in the industry, producers of Western red-cedar poles have announced decided price reductions. The extent of the cut, which was effective April 6, ranges in general from about 15 to 22 per cent. The new prices as compared with the old quotations on representative sizes are as follows: F.o.b. Chicago, 30-ft., 7-in. top, $8.50, $10.90; 35-ft., 8-in. top, $14.30, $16.25; 40-ft., 8-in. top, $16.80, $19.80. The same poles f.o.b. New York show the following new prices compared with the old: 30-ft., 7-in. top, $9.55, $12.20; 35-ft., 8-in. top, $16.10, $18.30; 40-ft., 8-in. top, $19.15, $22.40.

In addition to this decrease there is a further reduction of 6 cents per hundredweight based on the weight of poles at time of shipment, allowable as the result of lower freight rates which went into effect on Western red cedar poles April 1. On a 35-ft., 7-in. top pole this is said to amount to about 30 to 35 cents. The action of producers in dropping their prices, it is stated, is not entirely justified by lower costs, but in view of the tendency of consumers to hold off buying, it is taken in the hope that business will be stimulated thereby. Northern white-cedar poles as yet remain unchanged in price but the Southern white-cedar product was reduced about 15 per cent more than a month ago.

Demand at present is not large but seems to be on the increase, central-station companies especially showing considerable interest in the market. Electric railways are not placing many orders but producers are quite generally optimistic that before the year is out sales will have mounted to good proportions. Stocks of poles in the West are quite large, and as a result immediate shipments can be made to Eastern points. Sales west of the Mississippi are said to be in greater volume than nearer the Atlantic Coast, for in the latter territory demand has in large part been supplied by local chestnut poles, which are cheaper in first cost.

Ten per Cent Cut Marks Third Reduction on Line Hardware

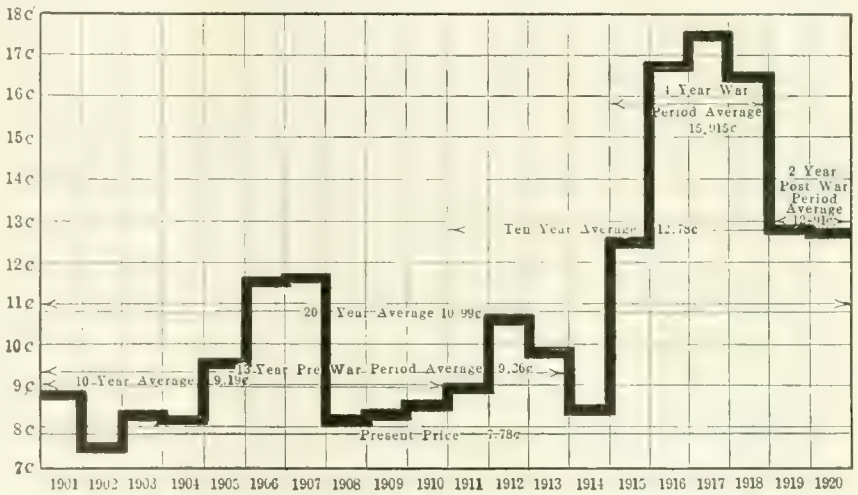
POLE-LINE hardware prices have again taken a drop The reduction as announced by a leading manufacturer, effective April 11 amounts to about 7½ per cent, but this cut has been passed on by jobbers and distributers on an average of about 10 per cent Other manufacturers are expected to follow suit in reducing quotations

Prices quoted to electric railways and central stations by jobbers on representative material, f.o.b Chicago, are as follows: Carriage bolts, ⅝ in x 4½ in., $2.25 per 100 compared with $2.45 previously; cross-arm braces 1¼ in. x ¼ in. x 28 in., $13.25 per 100 as compared with $15; machine bolts, ⅝ in. x 12 in., $9.95 per 100 as against $11.15. Lag screws, 1½ in. x 4 in., are now priced at $4.25. General price reductions of from 5 to 7½ per cent were made on line hardware the middle of last February, and previous to that decreases of 5 to 15 per cent had been made during December and early January, so this is the third decided reduction that producers have made.

In general consumers have not entered the market very actively this spring, although demand from power companies is said to be increasing recently. As a result of the quiet market producers are only operating at from 50 to 75 per cent of capacity. Reserve stocks are sufficient to care for all needs with prompt shipments.

Copper Wire Costs and Contributing Metals' Prices

THE accompanying graph shows the average composite selling price of the four metals entering into the manufacture of standard copper cable for the years 1901 to 1920 inclusive and for various shorter periods during that time. The composite price, as may be seen from the tabulation below the graph, is arrived at by taking 10 lb of cable as a basis and determining the percentage of each metal used and its price per pound. These prices are multiplied by the number of pounds of the metals used, and the addition of the results, divided by ten, gives the composite price of 1 lb. of the four metals.



COMPOSITE COST OF COPPER, LEAD, ZINC AND TIN FOR TWENTY YEARS

The composite price movement, indicated by the heavy black curve, shows that only once in the last twenty years has it gone below the present price, this being in 1902, though in 1908 and 1914 the curve went almost as low as at present The price curve has not been carried beyond Dec. 31, 1920, but the present price is indicated by the lowest dotted line

METAL PRICES AS OF MARCH 22, 1921

Per Cent	Pounds	Metal	Price	Extension
40	4 0	Lead	4 00 cents	16.000 cents
30	3 0	Copper	12 00 cents	36 000 cents
25	2 5	Zinc	4 75 cents	11 875 cents
5	0 5	Tin	28 00 cents	14 000 cents
100	10 0			77 875 cents

Briefly the graph shows that prices of the four principal non-ferrous metals are unquestionably low today. It can be seen that expressed in percentages present prices are approximately 15 per cent below the ten-year average from 1901 to 1910, 17 per cent below the thirteen-year pre-war

period, 40 per cent below the ten-year average from 1911 to 1920, 50 per cent below the four-year war period and 30 per cent below the average for the entire twenty years.

Since this chart was prepared the metal prices have advanced so that on April 12 New York spot prices, as shown in the metal table at the bottom of this page, will bring the composite price as of that date to 8.30 cents. Composite prices, however, are average yearly prices.

The graph was prepared by Paul Rich of the National Conduit & Cable Company.

Steel Corporation Reduces Prices

EFFECTIVE at once, the United States Steel Corporation, through Judge E. H. Gary, chairman of the board, on Tuesday announced reductions in prices of many of its products ranging from $1.50 per ton to $15 per ton. Reductions on tubular goods and sheets, it is understood, will be announced later. Steel rails and wire nails are unchanged.

The new price schedule, which supersedes that which went into effect in March, 1919, and which was approved by the Industrial Board, effects a reduction of $9 a ton in plates, $5 in structural steel, $5 in bars, $9 in wire rods, $7 for plain wire, $8 for sheet bars and small billets, $4 for slabs, $1.50 for 4 x 4 and heavier billets and $15 a ton for tin plates. The reductions in percentages range from 3.8 to 17 per cent. Although no statement was made regarding a reduction in wages, it is thought that this will follow.

Surveys of National Conditions by Maryland Fidelity

LAST September the Fidelity & Deposit Company of Maryland, Baltimore, through its representatives in all parts of the country, obtained a reply to the question, "What is the condition of the nation?" In view of the big question mark still stamped across the industrial map of the United States, that company has recently completed a second survey on this question, a résumé of which follows.

From an industrial standpoint cancellations have ceased, the cost of living has diminished appreciably since last September, general transportation is good, raw materials are plentiful, no failures of importance have occurred since last September, there are few strikes, wage reductions have been appreciable, productivity of labor per man has increased, and building operations are increasing in all sections of the country but New England and the Mountain States. Low-priced dwellings are needed most badly all over, warehouses and factories in New England, and high-grade dwellings and apartments in the Middle Atlantic, East North Central, West North Central and South Atlantic States.

Sentiment is not in favor of proceeding with building operations at present cost. There is no marked resumption of industrial activity, and buying by the public is still restricted. Retail prices have not been reduced in the same proportion as wholesale prices, and industrial concerns are carrying large amounts of customers' paper. Taxation and the railroad situation are indicated as having the greatest bearing on business prosperity.

As regards the financial situation banks are supplied with funds to lend except in the South Atlantic and Mountain States. From 6 to 8 per cent is the prevailing rate of interest, but the West South Central States go as high as 10. Over a six months' period deposits have generaly decreased, as have corporation accounts. Local indications all over point to lessened government tax revenue this year. All the states except the South Atlantic, East South Central and West South Central desire a higher tariff.

Touching the agricultural situation, farmers have not disposed of last season's crops and the crop outlook this season is from fair to good. Farmers are reducing their acreage, except in Illinois, Iowa, Kansas, Missouri, Nebraska and the Pacific States, because of low prices, shortage of labor and of money. They are not withholding payment of bills in the New England and Middle Atlantic States, but in all other sections lack of funds is given as the cause for withholding payments. The condition of sheep and cattle men is shown to be fair except in Kansas, Nebraska and the Mountain States, where it is poor.

The South and Reduced Cotton Acreage

IN THIS section of the issue for April 2 it was brought out that at the meeting of the Georgia Bankers' Association held in Macon on the twenty-third of March 50 per cent of last year's cotton crop was reported still in the hands of the farmers and that the reduction in cotton acreage this year will be 33 per cent. It is interesting in this connection to quote an editorial from the March 24 issue of the *Manufacturers' Record* regarding this question.

"If Southern bankers and merchants as well as cotton farmers will make a continued effort to force the cutting of cotton acreage to the very quick," says the editorial, "in order to make certain that even under the best conditions we could not raise over 5,000,000 or 6,000,000 bales, and let all the work which is usually given to plowing and planting and cultivating and picking a larger acreage be devoted to something else, notably road building and construction, the South can save itself from continued business depression and bring about a quick revival. As far as may be possible the South should be absolutely self-supporting in the way of foodstuffs for the coming year. It should be able to live at home more completely than it has done for the last fifty years, and if this policy be carried out and the cotton acreage be cut down to not more than half, at the outside, of the average acreage, the danger of continued depression will be largely eliminated and the South will have re-established itself on a firm foundation."

It is rather difficult for the country at large to feel as keenly as does the South the absolute dependence of the industrial activity of that section on the production and sale of its cotton crop. If, however, a reduction in acreage this year will re-establish the South industrially on a firm foundation, then the electrical industry should be interested to learn what steps are being taken to end the present depression.

The Metal Market Situation

THERE is no actual change in the copper market since the recent firming of prices. The advance has been maintained, copper over the second quarter being held at 12.75 to 13 cents per pound. On the other hand, offerings of copper for prompt shipment in the outside market at 12.75 cents are reported to have met with scant attention. Domestic demand is light, it is true, but the buying from abroad is better than had been expected in view of conditions there. Germany remains the chief purchaser and is paying cash.

The lead market has held its own since the advance of a week ago, but the buying movement that seemed to be started early this month has dwindled and the present market is not very active. There is more inquiry for zinc, but it seems to result from a belief that present prices represent a bargain rather than from any need to replenish stocks. The scrap-metals market is quiet, the only activity there being for lead scrap in conjunction with the advance of the parent metal.

NEW YORK METAL MARKET PRICE

	April 5, 1921	April 12, 1921
Copper	£ s d	£ s d
London, standard spot	68 7 0	69 0 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	12 75—13 00
Electrolytic	12 50—12 75	12 75
Casting	12 00	12 00
Wirebars	15 00	14 50
Lead, trust price	4 25	4 25
Antimony	5 12	5 12
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 15	5 15
Tin	28 75	29 75
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9 50— 10 25	9 50— 10 25
Brass, heavy	5 50— 5 75	5 50— 5 75
Brass, light	3 75— 4 00	3 75— 4 00
Lead, heavy	3 50— 3 65	3 50— 3 75
Zinc, old scrap	2 87½— 3 00	2 87½— 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A CONTINUED slightly improving market is reported in the electrical supply industry, but no startling improvements are seen. High labor costs are responsible today for there being less building under way than was anticipated; still, building is on the increase in almost all sections of the country. In the South building labor is accepting a cut to help stimulate the industry. In Chicago the legislative investigation into building practices is holding up activity and the Building Trades Council is balloting on a 20 per cent wage reduction.

Trade generally is optimistic. Collections are still difficult and are running a little slower on the West Coast. Motor-driven appliances are moving in good volume, but other socket devices are very quiet. Large stocks of heaters probably will be left over because of the warm spring. Fans are moving slowly.

NEW YORK

Virtually all local jobbing houses report a larger total volume of business for March than in January or February, but in view of the weak condition of the market in many lines there is still much room for improvement. The heating-appliance trade is dead, heaters are not selling, the lamp trade has started its usual spring slump, and fans have not begun to move. Demand for staple supply items, too, is only fair at best, but, on the other hand, what is probably more significant is that most supply houses now report that sales are on the up grade. Furthermore, the general view is that this trend will continue.

Collections on the whole are spotty but no worse at least, and several jobbers are finding them satisfactory. Stocks are held low and buying continues very cautious. One house is inaugurating a 10 per cent wage cut and at least one has released a couple of salesmen.

The scale on which building construction work is contemplated in this section is encouraging. In New York State and northern New Jersey building contracts let during the month of March totaled $29,772,000, an increase of nearly 40 per cent over February. More than half of this total was for residential construction.

Flexible Armored Conductor.—Some small quantity is moving, but the market remains quiet. Stocks are considered fair, with No. 14, two-wire, double-strip bringing from $62 to $65 per 1,000 ft.

Fuses.—Stocks are about normal, but the supply moves only slowly. In standard-package quantities the N. E. C. standard 30-amp. non-renewable fuse sells for 10 cents each, though as high as 12½ cents is asked. Plug fuses in this specification are worth 4 to 4½ cents each.

Conduit.—Good stocks are held, but demand is small. In 2,500-ft. lots prices quoted this week on ½-in. black range from $63.58 to $72 per 1,000 ft., ½-in. galvanized from $68.68 to $76, ¾-in. black from $83.72 to $94.50, and ¾-in. galvanized from $90.62 to $97.75.

Metal Molding.—Some of this material is moving, but not a great lot. Stocks are held to fair levels. In 1,000-ft. lots the three-wire to four-wire size brings from $62 to $72.

Rubber-Covered Wire.—Fairly large stocks are held, still too much so in a few instances, but demand holds off. No. 14 single-braid in quantities of 10,000 ft. sells for $7.50 to $7.75 per 1,000 ft. Manufacturers report a slight improvement in demand just recently and express optimism over a returning market. A large producer has just reduced base price from 18 to 16 cents.

Flush Switches.—Limited stocks are mostly carried, for demand is light. Jobbers do not expect to buy more for some time apparently.

Panel Boxes.—The call is mostly for small sizes, and these are the ones jobbers are carrying, but both demand and stocks are light. One-day deliveries can be obtained from manufacturers.

Lamps.—The usual spring slump in demand is reported, and this will probably be augmented when daylight saving is inaugurated locally the last of the month. Most jobbers state that sales are normal for this time of the year.

Heaters.—There is absolutely no movement in this line, the exceptionally early warm weather thus far having killed the usual spring sales. Some jobbers are caught with much too heavy stocks, but many others have only a low supply. Price cuts have not been made.

Lamp Cord.—The Rome Wire Company on April 5 reduced the price of all cotton and silk cord 10 per cent.

CHICAGO

The past week has been absolutely devoid of movement so far as price changes in the electrical field are concerned, and demand remains likewise stagnant. Features in the business world out of the electrical industry, yet materially affecting it, are of great interest. The most promising development was the award of a contract for the construction of 15 miles of highway by the state. Concerning the construction field the reduction in the price of common brick from $16 to $12 per 1,000, announced this week as effective April 11, is of great importance as, with the exception of lumber, this is the first of the building materials to recede very far from the peak of high prices established in 1920.

All week the various unions in the Building Trades Council have been balloting on the proposition of a reduction in wages approximating 20 per cent, to be effective May 1. Many millions in construction contracts are held up pending the wage decision, and should the unions decline the cut it is freely predicted that for the first time in many years construction will be attempted on a large scale in Chicago under the open-shop rule.

Electrical jobbers report collections as very difficult. The agricultural districts contributary to Chicago are still burdened with a large portion of last year's crops and are correspondingly short on cash. Accounts receivable on the books of most jobbers are not so great in volume as was the case last year, owing to the decline in the volume of sales, but the average date of collection has extended from around fifty days in March, 1920, to around ninety days for last month. It is a condition which holds no hope of correction until the farmer class convert more of their crops into money. This condition, combined with an accumulation of fairly heavy stocks, is giving the jobbers as a class all the burden they care to handle.

Bare Copper Wire.—The cessation of production on the part of certain copper-mining companies has had a tendency to stiffen quotations, but bona fide offers to purchase in quantity can obtain as low a price as ever. Actual demand is at a minimum and quotations are reported as nominal. In 500-lb. lots No. 8 is quoted at 19 cents and No. 10 at 21 cents per pound.

Insulated Wire.—Very light business is reported in inside wire owing to peculiar conditions existing in the building industry. Ample stocks of all sizes and styles are available, and prices are subject to some variation in accordance with the needs of buyer and seller. No. 14 rubber-covered, 5,000-ft. quantity, is $8 per 1,000 ft., No. 6 triple-braided, weatherproof, in 1,000-lb. lots, is 19 cents per pound.

Black Conduit.—Light demand and a desire to reduce stocks on the part of certain jobbers has made it possible to buy small lots of ½-in. black conduit at $1 to $2 below the quoted figure of $64 per 1,000 ft. This quotation is still adhered to by the larger houses which state that any change is dependent on steel prices.

BOSTON

Spotty market conditions prevailed at the beginning of the week. Continued labor troubles appear to be the chief obstacle to a healthy increase in business. Inquiries are multiplying in many lines and a more hopeful tone is apparent among distributers. Collections are slow and part-time production is widespread. Requests for quotations, however, are much more numerous in jobbing circles. Contractor-dealers are buying on a moderate scale despite the curtailment in building work due to strikes. Stocks, while low in relation to normal demand, are easily meeting current requirements. Non-employment is extensive pending acceptance of wage reductions.

Motors.—Small sales are being handled. Inquiries are light, but considerable interest is being shown in motor application and occasional requests for bids are thoroughly in earnest. Prices are steady and stocks are heavy.

Tape.—Little tape is moving, but deliveries are excellent. The ¾-in. black friction tape sells for 45 to 39 cents per pound in 100-lb. lots, according to quality.

Lamps.—The supply is plentiful and a fair trade is being handled. House-wiring installations are proceeding well in interior New England, and a heavy staple business is always being done in renewals. Portables are moving in response to price concessions.

Washers and Cleaners.—Trade is improving. A leading distributer states that his March business exceeded February's and that April bids fair to double the March sales. Production is increasing at the factories, one large house being back to about 75 per cent of capacity on day runs. Prices are holding firm.

Ranges.—More orders and well-distributed business are reported. The outlook is good for an active season. Recent price changes have helped to stimulate interest, and if the building situation improves orders will increase.

Wire.—Large stocks are available for immediate delivery in quantity. Trade is fairly good considering the labor situation. No. 14 rubber-covered wire sells for $8 per 1,000 ft. in 5,000-ft. lots, and for $8.75 in 1,000-ft. consignments. Weatherproof is moving on bases varying with different makers, a representative price being 18.5 cents for 200 lb. or more of No. 6. No. 0 sells at around 17 cents in 200-lb. lots or over. Bare copper wire is moving very slowly at about 15 cents base.

Rigid Conduit.—A quiet market is noted. Good supplies for present needs are in hand. Black pipe, 1-in. diameter, sells for $131.20 per 1,000 ft. in 5,000-lb. lots, the ½-in. black bringing $67.30.

Flexible Armored Conductor.—Little of this material is moving and prices are steady on the whole. In 2,500-lb. lots or over No. 14 double-strip commands $65 to $67 per 1,000 ft. Stocks await a building boom.

Lamp Cord.—Boston price on No. 18 cotton-covered, twisted cord is $18 per 1,000 ft. in 1,000-ft. lots, the No. 18 silk cord selling at $34. A fair demand is being handled.

Fans and Radiators.—Stocks appear too large to require much buying at present, but these products are developing a staple trade which is not limited by seasonal conditions.

ATLANTA

A slight increase in the activities of the electrical jobbers has given a firmer feeling to the electrical business as a whole, a majority of the leading firms reporting an encouraging increase in their March business over the prior months. Most of the activities, however, are on a smaller scale than was the case in 1920. Consulting engineers and contracting firms are beginning to receive inquiries regarding construction of various types, inquiries for municipal and educational types predominating. It is the general opinion that the reduced price of building material, combined with reduced labor cost and the increased efficiency of labor, is beginning to be reflected in construction of the more inexpensive type of dwellings, and propaganda is being used to encourage such activity. The local bricklayers' and masons' unions have voted to accept a reduction of 12½ per cent in wages for the purpose of stimulating local activities. This undoubtedly will be followed by reductions in allied lines and, it is felt, cannot but have a beneficial effect on conditions in general. The rural districts are showing considerable interest in the promise of the national government to assist in financing the export of cotton, and the feeling that conditions are due to better themselves soon in the rural districts is quite in evidence.

Air Heaters.—The recent sharp snap caused a temporary movement in this line but not sufficient to prevent dealers carrying over heavy stocks to next season. Little further activity is looked for in this line until fall.

Distribution Transformers.—In company with pole-line material the movement of this line is reported satisfactory, municipalities placing a fair volume of the orders. Stocks are reported in good shape with shipments satisfactory.

Lamps.—Lamps constitute one of the few lines that are apparently on a normal demand basis, the volume of sales approximating that of the same period last year. The demand for 50-watt white lamps is reported on the increase and, as usual, the 75-watt type-C maintains considerable popularity.

Tape.—Low stocks are the result of this item showing unexpected life; orders are being received in satisfactory volume, and purchases are much larger in unit volume than usual. The price is steady at 41 cents.

Ranges.—Heavy stocks have accumulated in the hands of numerous jobbers, little activity having as yet evidenced itself in this line despite the price reduction of several weeks ago.

Safety Switches.—The demand for this article continues brisk not only in the larger cities but also in the smaller towns, the greatest demand apparently being for the 60-amp. and 100-amp., three-pole type. Local stocks are in fair shape and no change in price is to be noted.

Meter Trim.—The policy of some central stations to insist on the installation of meter trim in connection with safety switches is on the increase, and the demand has caused stocks to become somewhat spotty. Jobbers anticipate a steady demand for this item.

ST. LOUIS

Very little change in the general condition of business was manifested here last week. There are encouraging signs of really good business in a few months, and in the meantime demand is showing gradual improvement. For stimulating more interest in building an "Own Your Home Exposition" is to be staged by the Building Industries Association the last week of this month. For the same purpose the State Legislature recently passed a law diminishing taxation on real estate loans. Prices on brick have recently been reduced and reductions in other building materials are gradually appearing. The housing shortage still exists. A small amount of residential building is under way. In the Oklahoma oil fields residential building is reported to be quite active. The principal deterrent seems to be the high labor cost, and there are no indications of an early reduction. Industrial building is at a standstill, but a number of concerns have plans to build as soon as costs warrant.

Credit conditions are about the same, the basis varying from forty-five to seventy-five days, with an average of about sixty days. Stocks are being brought to a better condition through interchange. Retailers' stocks are as a rule at the minimum, and steady orders for replacements are observed. Demand is still very low in the South except that Arkansas is showing some improvement. The territory to the north of St. Louis is showing appreciable improvement in demand.

Wire.—No. 14 rubber-covered shows a very competitive market and is moving at a fairly satisfactory rate. Quotations vary from $7.15 to $8 per 1,000 ft. in 5,000-ft. lots. There is some tendency to refuse to quote at the low prices in the expectation that the price will be higher before long. The larger sizes of rubber-covered are moving slowly. Weatherproof is on a 16-cent base, and bare wire is selling on a base from 15½ to 16⅔ cents.

Knobs and Tubes.—The previously heavy stocks are being

satisfactorily reduced by most jobbers, though the selling price remains at about $23.80 per 1,000 for "Nail-it" knobs and $8 per 1,000 for 2½-in. tubes.

Conduit.—Slight improvement in demand is noted and contractors are replenishing their stocks. Stocks in hands of jobbers are in good shape. Slightly lower prices prevail, ½-in. black selling from $61 to $70 per 1,000 ft.

Ranges.—The present demand is very low, but in view of increased gas rates and lower retail prices concurrent with the increased interest as summer approaches, the trade is making preparations to push sales. Inquiries are becoming more numerous. Stocks are in good shape.

Washing Machines.—A steadily improving demand marks the washing-machine business, and it is now about normal. Stocks are being maintained at low inventories.

Vacuum Cleaners.—Demand is improved and can be said to be about normal. Stocks in the hands of some jobbers are reported to be excessive.

SAN FRANCISCO

Business is fair but rather quieter than at the beginning of the month, when a great number of advanced schedule orders were shipped. Collections are a little slower. The California Co-operative Campaign reports a very gratifying return from its educational work in furtherance of good illumination. In fact, one manufacturer states that the demand for certain schedule material has increased about 30 per cent because of this educational work. To supplement in the merchandising field the very excellent work of the California Dealers and Contractors' Association there has been formed an association primarily of dealers, who are gradually formulating some effective merchandising methods.

Conduit.—Very good jobbers' stocks of rigid iron conduit, both black and galvanized, are reported despite the canceling of heavy pre-scheduled shipments. The dealers' demand is quite light, being confined to small buildings, although in a few weeks it may be that large buildings under construction will be ready for heavy shipments.

Conduit Fittings.—Lock-nuts and bushings are correspondingly slow with other roughing-in staples. The present price of ½-in. bushings in standard package lots is $2.16 per 100 and of lock-nuts $1.17 per 100.

Fuses.—The renewable-fuse situation is sifting itself down to a few standard makes and to a demand that is practically confined to industrials. The present price on standard-package lots of the original fuse and container is approximately 32½ cents each for the 30-amp. size, 65 cents for the 60-amp. size and $1.30 for the 100-amp. size, a decrease of about 10 per cent from previous prices.

Tape.—Commercial grades of friction tapes are selling for about 47 cents per pound in 100-lb. lots and rubber tapes for about 40½ cents.

Ironing Machines.—Although sales of practically all the household appliances have markedly decreased, yet ironers have not fallen proportionately. The result of missionary work is now apparent. Local stocks are very good.

Ranges.—Edison ranges were recently refigured in prices so as to give the dealer an excellent margin, the reason being, it is stated, an accumulation of stock at the factory because of a sudden sharp decline in jobbers' orders. These new dealers' prices are effective only for a limited period, virtually covering the rest of the month. So far, however, the acceleration of business has been rather slight.

SEATTLE—PORTLAND

Spring weather, which is prevailing generally throughout the entire Northwest, has been the determining factor in causing city, county and state officials to start street-improvement programs which have been in the making since the first of the year. It is also the reason for increasing the amount of new construction. Optimistic feeling along all lines is far more prevalent than at any time so far this year, and it is generally believed that 1921 will still give a good account of itself. The outfitting of ships in Seattle for the annual fishing and packing operations in Puget Sound and Alaskan waters has started. Recently orders in a considerable amount for electrical equipment for Alaskan mines have been placed, and this business is expected to develop during the next thirty days. Manufacturers in both the Portland and Seattle fields report business about the same. Jobbers report a slight pick-up in sales volume with a tendency toward buying in standard-package lots.

Contractors in both Seattle and Portland report an appreciable improvement in business, most of which, however, is confined to small industrial buildings and residences. Portland territory states that there is a great deal of activity in residence construction, the number of building permits issued during March being 50 per cent greater than for March of last year. Dealers in Seattle and Portland and throughout the Northwest generally report business slow but showing a slight improvement from week to week, the greatest activity being in sales of washing machines, vacuum cleaners and electric tableware.

Schedule Material.—Jobbers report business along this line picking up gradually, but say that increases are not up to original predictions or expectations. Orders, while quite numerous, are small.

Motors.—Inquiries are much heavier, and some sales, particularly of smaller sizes, are being made. The greater part of the movement is to lumber mills which are electrifying planing mills and box factories. Jobbers' stocks are equal to current demands in all sizes. The second-hand market is comparatively active.

Conduit.—Galvanized pipe in the past two weeks has shown some activity. Jobbers are not buying in large amounts. As a result stocks in some sizes are running low. The movement in flexible conduit is sluggish, but during the past week a slight increase in buying was noted despite rumors of a decrease in price.

Street-Lighting Equipment.—This line has shown some movement this spring, and it is believed that sales during the year will be in fair volume. Demand from small municipalities is for both standard and ornamental types.

SALT LAKE CITY—DENVER

With the full advent of spring there is a noticeably better feeling in business circles. The consuming public is buying more extensively in all lines of merchandise, apparently in the belief that downward prices have hit the bottom and become somewhat stabilized. Seasonable merchandise is particularly in demand, including building materials, wiring materials and hardware. Building activity is getting under way, especially the construction of homes. Collections are little improved and banks are still conservative in the granting of loans. There is a persistent hope that the shutdown of the copper mines will be only temporary. In the meantime lack of employment will have a rather depressing effect on business generally.

Ranges.—No general price reduction has come to the notice of jobbers to date. One of the largest American manufacturers, however, is unloading overstock at something like a 15 per cent cut. It is only a special concession but one large jobber reports good sales on the strength of it. All jobbers and dealers are looking forward to a good range season.

Motors.—There is a steady call for motors of small power rating, especially sizes ranging from 2 hp. to 10 hp. Jobbers are adequately stocked and ordering liberally in anticipation of good business. Several large irrigation projects now under way have called for the installation of motors of 300 hp. to 1,200 hp. Indications point to a larger and larger motor outlet in this direction.

Fans.—Dealers are making active preparation for a good fan summer, and several fine orders have already been placed with jobbers. Present stocks are varied and plentiful, and sizable orders are being placed with the factories for future delivery.

Conduit.—The demand is showing a slight pick-up with the growing activity of contractors incident to home-building operations. Price cuts range between 10 and 15 per cent. Deliveries are good.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Factory Put Up by Davidson Porcelain Company

The Davidson Porcelain Company, with post office address at East Liverpool, Ohio, and factory at Chester, W. Va., has erected a new factory with a six-kiln capacity. The company makes the "Eveready" non-assembled knob and a complete line of standard porcelain.

Expansion Provided for Lewis Electric Company

Following the increased demand for its "Kantshok" products among central stations and contractor-dealers, the Lewis Electric Company, Canton, Ohio, has recently increased its capitalization from $100,000 to $500,000. With this additional capital the company hopes to be able to increase its production materially at once and within the near future to build a new plant so that its complete product will be manufactured under one roof. The company's desire is to make not only its metal parts but also its porcelain parts as well.

Arrangements have been made with H. Lee Reynolds to take charge of sales in the Pittsburgh territory. His offices will be in the First National Bank Building, Pittsburgh.

Dealer Returns Show Good Hoover Sweeper Business

According to the April 5 *Point Sheet* of the Hoover Suction Sweeper Company, North Canton, Ohio, Hoover dealers report from all over the country that business is running at a very satisfactory rate and that sales campaigns on the company's sweepers are returning excellent results. Many dealers, central stations and distributers are predicting much heavier sales in 1921 than those experienced in any past year.

Canadian Westinghouse's 1920 Report Shows Gain

From the seventeenth annual report of the Canadian Westinghouse Company, Ltd., Hamilton, Ontario, business for the fiscal year ended Dec. 31, 1920, brought in net earnings of $916,080 before deducting dividends, so that $300,555 was added to the previous balance to make the balance carried forward Jan. 1, 1921, $2,114,828. Earnings from manufacturing operations amounted to $2,020,516. Contracts in progress represent $128,425, while inventory of materials and products on hand, including work in progress, less collections on account, are $4,637,501.

For the purpose of obtaining additional working capital, made necessary by the increased business and activities of the company, the outstanding capital stock was increased during the year from $6,229,400 to $7,417,900. By midyear, 1920, a realization began to be felt generally throughout the community that, although no overproduction of goods existed as measured by the world's needs, the question of payment for further production, particularly on the scale of prices prevailing, would have to be seriously considered for the future. A dropping off in export absorptions and the continued low exchange rate on Canadian funds were indications that could not be overlooked. Billings marked a new high record, and orders scheduled for delivery on into 1921 are equivalent to an average full output of the plants for several months. Accounts and bills receivable amounted to $2,530,863 on Jan. 1, 1921.

During the year the company took up the manufacture of incandescent lamps besides extending its activities along other lines.

R. W. Lillie Corporation Opens New Territory

The R. W. Lillie Corporation, which recently moved to larger quarters at 50 Church Street, New York City, has just opened an office in the Engineers' Building in Cleveland. C. H. Purdy, operating from Cleveland will be in charge of both this office and the new one just opened in the Oliver Building, Pittsburgh, covering Ohio and part of Pennsylvania. The accounts handled in these new offices will be Jeffrey-Dewitt Insulator Company, Electric Power Equipment Company, Maring Wire Company, Collyer Insulated Wire Company, and T. & W. Electrical Manufacturing Company for Ohio and part of Pennsylvania, and Electro Service Company's Bennett surge arresters for part of Ohio only.

The Boston office has also recently taken on the representation in New England of the Packard Electric Company.

New Warehouse for Bryant Factory

The Bryant Electric Company, Bridgeport, Conn., has completed a four-story-and-basement steel and brick building which will be used as a finished-goods warehouse and shipping department. The building is T-shaped and covers approximately 224 ft. by 60 ft. of ground area, or more than 67,000 sq.ft. of floor space.

N. E. C. A. Program for Richmond Meeting

Business, Business Methods, Credit and Collection Problems and the Association to Be Discussed on May 19 and 20 by the National Electrical Credit Association

For the twenty-second annual meeting of the National Electrical Credit Association, Secretary F. P. Vose, Marquette Building, Chicago, has announced a tentative program to occupy the two days of May 19 and 20 at the Hotel Jefferson, Richmond, Va. Besides the business program, time will be allotted for visits of an historical nature and a golf tournament is provided. Francis H. Sisson, vice-president of the Guaranty Trust Company, New York City, and W. J. Harahan, president of the Chesapeake & Ohio Railroad Company, will address the annual dinner.

On Thursday's program John M. Miller, president of the First National Bank, Richmond, will present "The Business Outlook"; J. A. Corcoran, General Electric Company, will consider "Better Business Methods"; "Effect on Sales of Rigid Credit Policy" and "Present-Day Credit and Collection Problems —How to Meet Them" will be discussed by a member of the New York and a member of the Chicago association respectively.

A Philadelphia member will lead the discussion on Friday on "Is the Credit Man a Business Builder?" The subject allotted to Thomas W. Wheelright, president of the Virginia Railway & Power Company, is "Public Utilities—Have They Seen Their Worst Period?" James A. Loring, secretary of the New England association, will commence the discussion on "Handling the Slow and Embarrassed Customer."

Of the additional themes that are scheduled, "Association Problems and Remedies" will be led by Albert H. Elliot, secretary of the Pacific Coast Association. Others cover the "Marketing of Household Devices," "Revision of Income Tax Law," "Business Conditions in the South," "Value of Accounts Receivable of Dealer-Contractors," "The Sales Manager's Viewpoint of the Credit Department," "Value of E. C. A. Membership," "The Function of the American Finance Corporation" and "Electric Credit Clubs."

Swiss Refrigerating Company's American Representation

Esher, Wyss & Company, Switzerland, about three months ago began representation in this country through Joseph Roschach, 202 Main Street, Paterson, N. J. Since the New York office was opened with the William Stickel Company, 140 Fifth Avenue, Mr. Roschach has been negotiating for representation in several other cities of the United States.

The company uses carbonic-acid gas as the refrigerant in its "Carbona"

refrigerating and ice machines, built both for household and commercial use. At present, however, only commercial machines are being imported into this country, but it is the intention to introduce residential types in a year from now. A factory is maintained at Campgaw, N. J., for servicing machines and for replacement parts. It is the intention to carry stocks of finished machines in this country as soon as those stocks can be accumulated. Machines now in transit are already purchased, and about six months' shipments are quoted on new orders. Very satisfactory sales are reported as a result of the Refrigerating show held last week by the New York Edison Company.

Larger Quarters for Metropolitan Electric Protective Company

The space at 130 West Twenty-sixth Street, New York City, having become too small for its office force, the Metropolitan Electric Protective Company has moved to 253 Seventh Avenue, where it has about 25 per cent more space for this department. The basement, first and second floors of the building, which is 25 ft. x 80 ft., have been leased and are being used now. Factory location remains unchanged at 52 West Twenty-second Street, where the company produces alarm systems for its protective service and direct-current interior fire-alarm systems.

Pierce Electric's Recent Purchase for Expansion

The Pierce Electric Company, Tampa, Fla., has just completed purchase of the wholesale department of the Jacksonville concern of Livingston, Young & Company, which includes the state agency for the manufactures of the Westinghouse Electric & Maufacturing Company. The Jacksonville purchase will be maintained as a branch, the main business remaining in Tampa.

"We have been going quietly ahead with our preparations for expansion," said President J. F. Pierce of the company. "Recently we increased our capitalization from $50,000 to $125,000, and we are building a two-story concrete warehouse on South Franklin Street which will soon be ready for occupancy. This structure which is 100 ft. square and is being constructed of fireproof material—reinforced concrete—with a concrete roof is so arranged that we can add a third story at comparatively small expense when the business demands more room." The other officers of the company are: W. G. Pierce, vice-president, and Bryant E. Pearce, secretary-treasurer.

Norwalk Iron Works Expanding Refrigeration Distribution

In order to take care of the increased distribution of its electrical refrigerating machinery for household and commercial use, the Norwalk Iron Works Company, East Norwalk, Conn., is adding new machinery and increasing its factory capacity and production. The Southern headquarters has just opened at Atlanta, Ga., with the Dixie Engineering Company.

Agencies have just been established with the Standard Scale & Fixture Company, Tampa, Fla.; W. D. Miller Company, Jacksonville, Fla.; Southern Supply Jobbers' Company, New Orleans, La.; Jarvis Engineering Company, Boston, Mass.; R. G. Halliwell Company, Chicago, Ill., and an agency is just being closed in Miami, Fla. Some central stations and holding companies are also acting as agents. The Paul E. Flotron Company, Philadelphia, has recently added this line to its branches in New York City and Baltimore. The company is also about to close agencies in Buffalo, St. Louis, Detroit and either Cleveland or Cincinnati. At all these locations stocks of finished machines will be carried.

With the reorganization of the company last November, E. Hill became president and C. L. Thompson treasurer and general manager.

U. S. Chamber of Commerce to Discuss Business Methods

The general theme of the ninth annual meeting of the Chamber of Commerce of the United States, to be held at Atlantic City April 27 to 29, will be: "In the public interest, more business methods in government, less government in management of business." Speakers will include government officials and leading business men in many lines of finance, commerce and industry. Much of the work of the convention will be done as heretofore in group sessions.

Treatment of wages, contract cancellations, better accounting methods and the need of national statistics on production will be taken up, and proper activities of trade associations also will be discussed. Other topics cover taxes, foreign commerce, natural resources, transportation, international finance, the tariff question, etc.

Mitchell-Rand Finds Better Sales of Insulating Compounds

The Mitchell-Rand Manufacturing Company, manufacturer of insulating compounds at its Jersey City (N. J.) plant and distributer of general insulating material through its office at 18 Vesey Street, New York City, reports that at present sales of the compounds, waxes, electrical insulating points, sealing material, etc., which it makes, are running ahead of its general insulation business. Cable manufacturers are beginning to order, for one thing, and, furthermore, producers making use of this class of material are finding it cheaper to buy rather than produce what they need and thus eliminate overhead cost. The company has neither reduced wages nor made a cut in working force. Present operation is at about 50 per cent of capacity. Fairly good stocks of the finished products are being carried, thus insuring immediate shipment of orders. The company is adding to its line the manufacture of "Macbeth's extra belt dressing," a compound designed to prevent belts from slipping. This was made by the company several years ago under the name of Steers Supply Company, but was afterward discontinued.

Workers' Viewpoint Broadened by Products Show

That the average worker is quite ignorant of the product turned out and of the individual efforts of his coworkers is generally conceded. This is especially true as the size of the plant increases. To offset this condition and to develop active, inquiring brains in its employees, the Western Electric Company, at its plant at Hawthorne, Ill., stages each year a product show where every type of machinery used in the factory and every little item produced in it are displayed in pieces, partly assembled and assembled and explained by demonstrators. For three days and nights the show is open to the employees and their families, and it is considered a big educational step in the industry.

Six Hundred Attend G. E.-Pettingell-Andrews Conference

A merchandising conference was held at the Copley-Plaza Hotel, Boston, March 24, under the auspices of the Pettingell-Andrews Company in conjunction with the General Electric Company and various affiliated manufacturing organizations, about 600 persons being present from all branches of the industry from every part of New England and many outside points. The conference followed the general lines of similar gatherings in other parts of the country at which merchandising topics have been discussed with demonstrations of equipment for domestic and commercial use. In calling the meeting to order, Frank S. Price, president of the Pettingell-Andrews Company, said that the success and prosperity of the electrical industry, and particularly the rapidity with which it moves forward, will largely depend on its merchandising ability.

The American Engineering Company, Philadelphia, maker of the Taylor stoker, has established a Mid-Western service station at 1772 West Lafayette Boulevard, Detroit. A complete stock of parts for all sizes and types of these stokers is carried and immediate shipments will be made, it is announced.

Hanson & Van Winkle Company, 269 Oliver Street, Newark, N. J., has filed plans for extensions and improvements to its plant, to cost about $25,000.

The New Jersey Lamp Works, 21 William Street, Newark, N. J., is reported to be receiving bids for a two-story addition, 25 ft. x 28 ft.

The Chandler Welding & Machine Company, Texarkana, Ark., is planning to install machinery for the manufacture of refrigerating equipment.

The American Thermostatic Company, Charlotte, N. C., recently organ-

ized, is making arrangements to established a plant to manufacture thermostats and other precision devices. C. L. Brookshire, 19 East Sixth Street, is president.

The Utility Compressor Company, Detroit, manufacturer of electrically controlled refrigerating equipment, is planning to move to Adrian, Mich., where it will erect a factory with a floor space of 20,000 sq.ft. The company is capitalized at $500,000 and was originally engaged in the manufacture of air compressors and vacuum pumps for garage and laboratory purposes, but for some time has been devoting its attention to refrigerating apparatus.

The Roller-Smith Company, 233 Broadway, New York City, has removed its Cleveland office from 230 Vickers Building to 7016 Euclid Avenue.

The Ideal Electric & Manufacturing Company has appointed Arthur Purdon as general sales agent for the Utah territory, with offices at 615 Newhouse Building, Salt Lake City. The home office is at Mansfield, Ohio.

The Reliable Machine Company, Bridgeport, Conn., has made arrangements with the Consolidated Wire & Machinery Company, 529 West Van Buren Street, Chicago, to act as sales representative for its magnet wire.

William G. Merowitz, 707 Ellicott Square, Buffalo, application engineer, has recently been appointed district sales engineering representative in Western New York, Erie, Pa., and nearby Canada for the products of the Ward Leonard Electric Company, Mount Vernon, N. Y.

The Brown Hoisting Machinery Company, Cleveland, Ohio, announces the opening of a Southern office at 530 Whitney-Central Building, New Orleans. The States of Texas, Louisiana, Mississippi, Alabama, Georgia and Florida will be covered from this office. Charles H. White is manager of the new office.

The Conveyors' Corporation of America, 326 West Madison Street, Chicago, announces the appointment of Robert B. M. Wilson as sales engineer of the Chicago district. E. M. Wolfe will be associated with him as an assistant. Headquarters will be maintained in the corporation's main office at 326 West Madison Street.

The Stearns Conveyor Company, Cleveland, recently organized to manufacture conveying and other equipment, has begun work on the erection of the first unit of its plant, consisting of a one-story building, 50 ft. x 200 ft.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, will be represented in the South by Thomas W. Peters, who has for the past fifteen years been located in Columbus, Ga. The Southern territory includes all the Southern states east of the Mississippi River. A regular branch office will be established at Atlanta, Ga., in the very near future, where Mr. Peters will make his headquarters.

The Eureka Vacuum Cleaner Company, Detroit, Mich., has moved its general offices, formerly at 101 Broadway, to its factory at Greenwood and Dewey Avenues, Detroit.

Foreign Trade Notes

EXTENSION TO ELECTRIC PLANT AT CARTAGO, COSTA RICA.—According to a report from Consul Guyant the Compañia de Luz Electrica de Cartago (Costa Rica) has been granted the use of additional water power near Cartago for the purpose of increasing the output of its plant.

DEMAND FOR ELECTRICAL EQUIPMENT IN BEIRUT, SYRIA.—Vice-Consul Frederick O. Bird of Beirut reports that there is a good market in that district for electrical supplies, principally wires, sockets, switches and lamps. The current used is alternating, 50 cycles, 110 volts. No electricity is used in the smaller towns.

TENDERS BEING ASKED FOR THE KOSTOLAC SCHEME, SERBIA.—Tenders are being invited by the Serb-Croat-Slovene Ministry of Public Works until May 1, according to the *Electrical Times*, London, for the construction of a power station, main conductors and transforming stations in connection with an electrical scheme at Kostolac to supply energy to Belgrade, Semlin and other places. Tenders should be addressed to the Director, Ministry of Public Works, Belgrade, Serbia. Translation of the specifications, together with a plan of the proposed works, may be seen at room 48, Department of Overseas Trade, 35 Old Queen Street, S. W. 1, London, England.

NATIONAL MOVEMENT IN THE NORWEGIAN ELECTROCHEMICAL INDUSTRY.—The Norwegian electrochemical industry before the war consisted mostly of firms operating under Norwegian methods but working with foreign capital. In war time a movement was started to create a national electrochemical industry in opposition to the foreign concerns. A number of purely Norwegian firms have sprung into existence since then. They have lately formed an association, the Landsforeningen for Elektroteknisk Industri, for the purpose of advancing the national interest and in favor of a protective tariff.

THE DELTA-STAR ELECTRIC COMPANY, 2433 Fulton Street, Chicago, has appointed the James J. Niven Company, Wellington, New Zealand, its agents for the unit line of switching and protective equipment.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A trading company in Australia (No. 34,666) desires to purchase electrical goods, electrical wires and cables, etc. This company is desirous of obtaining suitable representation to keep it regularly supplied with quotations by mail and cable of all classes of merchandise suitable for the Australian market.

An industrial engineer in Spain (No. 34,667) desires to secure an agency for the sale of electrical supplies.

A builder and contractor in Mexico (No. 34,698) desires to purchase electrical material, etc.

Industrie Elettromeccaniche Comensi, Ireo Prosdocimi, Como-Via V. Barelli 6-8, Italy, announces that as the whole of its activity is in the electrical industry, it especially studies the small-size automatically operated generating plant, as it has become convinced that this type of machine will find great use throughout Italy. The hydroelectric problem is very seriously studied and methodically worked out in Italy. The above company, having made a survey of the industrial field, desires the addresses of all manufacturers who are interested in the production of small-size automatic generating plants.

New Apparatus and Publications

RADIOPHONE. — The DeForest Radio Telephone & Telegraph Company, 1415 Sedgwick Avenue, New York City, is distributing a six-page leaflet describing the DeForest type OT-3 "Midget" radiophone.

PUMP GOVERNORS.—The Atlas Valve Company, 282 South Street, Newark, N. J., having acquired sole rights to manufacture and sell the Ideal pump governors, is now distributing its first bulletin No. 1-4, edition No. 1, describing this governor.

ELECTRIC IRONS. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has placed upon the market a new electric iron, known as the type H.

PUMPS AND CONDENSERS.—The Manistee Iron Works Company, Manistee, Mich., is distributing bulletin No. 101, illustrating its centrifugal pumps and rotary jet condensers.

RADIO PUSH SWITCHES.—The Hart & Hegeman Manufacturing Company, Hartford, Conn., has issued a four-page leaflet describing the "H & H" push switches with radio-active luminous button inserts and a radio-luminous pendant on "Paiste" pull sockets.

INSULATING VARNISH.—A black insulating varnish, "General Utility Inco Insulite No. 16," has been placed on the market by the International Paint Corporation, St. Louis.

ELECTRIC FURNACES.—Two new types of electric furnaces for melting non-ferrous metal have been developed by the General Electric Company. The 1,500-lb. size is for three-phase and the 50-lb. size is for single-phase.

REFRACTORIES.—"Clinker Proof Furnace Walls" is the title of a folder issued by the Bernitz Furnace Appliance Company, 15 State Street, Boston.

REFRIGERATION. — Bulletin No. 6 shows refrigerating plants of the Norwalk Iron Works Company, South Norwalk, Conn.

RADIO BATTERY. — Stuart Products Corporation, Chicago, is adapting its "Make-Ur-Own" batteries to radio work. Its "B" batteries are shown in a recent folder.

BLOWERS.—The "Coppus" turbo blower for undergrate draft and other industrial service is described in a recent publication of the Coppus Engineering & Equipment Company, Worcester, Mass.

LAMP GUARD.—The "Gripon," a closed-bottom, non-locking lamp guard, has been placed on the market by McGill Manufacturing Company, Valparaiso, Ind.

New Companies

THE AMERICAN LIGHTING & MANUFACTURING COMPANY, 800 Sibley Street, Chicago, Ill., has been incorporated by William J. and F. T. Davis. The company is capitalized at $100,000 and proposes to manufacture electric lighting equipment and appliances.

THE FARMERS' ELECTRIC COMPANY, Romney, W. Va., has been incorporated with a capital stock of $25,000 by J. W. Shull, James O. Blue and J. S. O'Hara.

THE HYDRO-ELECTRIC PYRO COMPANY, Jersey City, N. J., has been incorporated by Paul Andrea and Alfred H. Francfort, Jersey City, and Angelo Diani, Woodbridge. The company is capitalized at $200,000 and proposes to manufacture electrical appliances.

THE DALE LIGHT & POWER COMPANY, Dale, Ind., has been incorporated with a capital stock of $15,000 to furnish electrical service. The directors of the company are D. J. Wallace, P. W. Fuller, O. V. Brown and others.

THE POMEROY ELECTRIC COMPANY, INC., New York, N. Y., has been incorporated with a capital stock of $40,000 by S. S. Robinson, H. N. Bennett and B. H. Pomeroy. The company proposes to manufacture electrical equipment.

THE ALLIED ELECTRICAL DEALERS, INC., New York, N. Y., has been incorporated with a capital stock of $1,000,000 to manufacture and deal in electrical machinery and supplies. The incorporators are John J. Garrison, F. G. Haag and Ludlow S. Fowler.

Record of Electrical Patents

Notes on United States Patents

(Issued March 22, 1921)

1,372,603. TERMINAL STRUCTURE FOR ELECTRIC BATTERIES; Thomas R. Cook, Pittsburgh, Pa. App. filed March 10, 1920. For preventing escape of battery liquid.

1,372,634. METHOD OF AND APPARATUS FOR BRAZING; George A. Thornton, Port Washington, N. Y. App. filed Nov. 7, 1919. Electrically heating.

1,372,642. ELECTRICAL RESISTANCE ELEMENT AND METHOD OF PRODUCING SAME; John G. Clemens, Buffalo, N. Y. App. filed May 7, 1919. Lowering resistance as temperature increases to prevent heavy surge when starting motor.

1,372,650. IGNITION SYSTEM; Henry R. Davies, Toledo, Ohio. App. filed April 8, 1919. Without resistance coils or high-capacity condensers.

1,372,653. ELECTRICAL TRANSFORMER SYSTEM; Friedrich Dessauer, Frankort-on-the-Main, Germany. App. filed July 23, 1918. Voltage between windings reduced.

1,372,658. UNDERGROUND OR UNDERWATER ANTENNA SYSTEM; Edward T. Jones, New Orleans, La. App. filed April 11, 1919. For radio reception or transmission.

(Issued March 29, 1921)

15,073 (reissue). AUTOMATIC DISTRICT TELEPHONE SYSTEM; Harry E. Hershey, Whitewater, Kan. App. filed Oct. 29, 1918. Improved trunking apparatus.

1,371,908. CONVERTER; William C. Korthals-Altes, Schenectady, N. Y. App. filed Dec. 22, 1917. For converting alternating current into direct current.

1,372,678. ALARM DEVICE; Samuel M. Eisner, Newark, N. J. App. filed Oct. 7, 1919. To prevent theft of automobiles.

1,372,739. MAGNETO; Bruno Bonomini and Luigi Duca, Turin, Italy. App. filed Aug. 28, 1919. For ignition.

1,372,751. TESTING APPARATUS FOR INTERNAL-COMBUSTION-ENGINE IGNITION SYSTEMS; George L. Hogan, Chicago, Ill. App. filed June 28, 1920. For locating defects.

1,372,778. SOLDERING IRON; Roy G. Sands, Waukegan, Ill. App. filed Oct. 9, 1917. Adjustable soldering tip.

1,372,795. TELEPHONE ATTACHMENT; Harry W. Belles, Stewardson, Ill. App. filed March 4, 1920. Disinfectant holder.

1,372,798. METHOD AND APPARATUS FOR MEASURING GAS PRESSURES; Oliver E. Buckley, East Orange, N. J. App. filed Nov. 27, 1918. Measures pressures in vacuum tubes.

1,372,804. CREDIT-SLIP-AUTHORIZING APPARATUS; Herbert G. Dorsey, Gloucester, Mass. App. filed March 2, 1916. Store-service system.

1,372,805. ART OF WELDING; Joseph W. Fay, Milwaukee, Wis. App. filed April 5, 1920. Edges to be welded together spaced apart at all points.

1,372,808. APPARATUS FOR THE PRODUCTION OF INTERMITTENT OR CONTINUOUS HIGH-FREQUENCY OSCILLATIONS; Alphonsus L. Golden, Oakland, Cal. App. filed April 1, 1918. Oscillator of submerged type.

1,372,821. ELECTRIC MEASURING AND CALIBRATING METHOD; Otto A. Knopp, Oakland, Cal. App. filed Nov. 20, 1916. For calibrating or checking meters.

1,372,823. ELECTRIC HEATER; William A. Morrison and Frederick D. Lake, St. Catharines, Ontario, Canada. App. filed Aug. 25, 1919. Heating element quickly removed.

1,372,835. METHOD OF WELDING FLEXIBLE METAL HOSE; Edmund Schroder, Berlin, Germany. App. filed Jan. 13, 1917. Spirally wound metal band.

1,372,850. INDUCTANCE DEVICE; Eugene T. Turney, New York, N. Y. App. filed April 1, 1920. Used for radio signaling.

1,372,851. FLASHLIGHT; George V. C. Vreeland, East Orange, N. J. App. filed Dec. 9, 1919. Economical construction.

1,372,862. TRANSMITTER; Harold J. Carmody, Woodhaven, N. Y. App. filed June 30, 1917. For telephony and dictaphone.

1,372,920. TROLLEY-CONTROLLING MECHANISM; George M. Waterhouse, Sr., New York, N. Y. App. filed Dec. 5, 1918. For retaining trolley pole in position.

1,372,945. COMMUTATOR-INSULATION-TESTING DEVICE; Jasper F. Cullin, Detroit, Mich. App. filed Jan. 22, 1920. Tests insulation between bars.

1,372,950. BATTERY; Robert C. Houston, Greenock, Scotland. App. filed Oct. 23, 1919. Current passes in straight line through all the plates from one terminal to the other.

1,373,002. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Swissvale, Pa. App. filed May 16, 1916. System of ventilation.

1,373,007. TROLLEY; Wesley Johnson, Pittsburgh, Pa. App. filed Jan. 14, 1921. Prevents escape of trolley from wire.

1,373,012. ELECTRIC RESISTANCE ELEMENT AND METHOD OF MAKING THE SAME; Ralph E. Marbury, Wilkinsburg, Pa. App. filed March 11, 1919. High resistance for radio work.

1,373,054. ELECTROPERCUSSIVE WELDING; Lewis W. Chubb, Pittsburgh, Pa. App. filed June 9, 1919. Application of heat of relatively great intensity at instant of percussive engagement.

1,373,116. DENTAL WATER HEATER; Elmer W. Bunce, Minneapolis, Minn. App. filed May 22, 1919. Adjustable temperature.

1,373,117. ELECTRIC HEATER; Edmond Delille, Lyon, France. App. filed May 12, 1919. For radiators, flatirons, etc.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WATERVILLE, ME. — Work will be started at once on the construction of additions to the plant of the Keyes Fibre Company, College Avenue, consisting of a two-story pumping plant and machine works, 45 ft. x 95 ft.; one-story pulp department, 40 ft. x 150 ft.; and a one-story dryer works, 90 ft. x 140 ft. Considerable electrical equipment will be required.

CLARENDON, VT.—Arrangements have been made by the Vermont Hydro-Electric Corporation, Rutland, to increase the output of its generating plant.

NEW BEDFORD, MASS.—Plans have been filed by the Snell & Simpson Biscuit Company, Adams Street, for the erection of a three-story addition to its plant. Electric equipment will be required.

HARTFORD, CONN.—Plans are under consideration by the Hartford Electric Light Company to place its wires underground. Samuel Ferguson is vice-president of the company.

Middle Atlantic States

BINGHAMTON, N. Y.—Arrangements are being made by the Achilles Rubber & Tire Company for the installation of electric equipment providing for an increase in its power load to 2,400 hp. Electric service will be supplied by the Binghamton Light, Heat & Power Company.

MOUNT VERNON, N. Y.—Electrical and mechanical equipment will be installed in the one-story-and-basement addition to be built by the General Optical Company, 256 Washington Street, to cost about $75,000. Bids, it is understood, will be asked in the near future.

NEW YORK, N. Y.—Contract has been awarded to the New York Edison Company by the Frank A. Munsey Company, publisher, for electric service to operate a new plant at Seventh Avenue and Sixteenth Street. The installation, according to present plans provides for 1,600 lamps and about 600 hp. for printing presses, house pumps, etc.

SHARON SPRINGS, N. Y. — A power house will be erected in connection with a number of bath houses and other buildings at the local properties of the J. H. Gardner estate. The cost of the work is estimated at $40,000. Morrill Vroman, 3 North Main Street, Gloversville, is architect and engineer.

MORRISTOWN, N. J. — The Morris & Somerset Electric Company has been granted permission by the Board of Public Utility Commissioners to issue $150,000 in stock, of which about $50,000 will be used for proposed extensions and improvements to its plant and system.

NEWARK, N. J.—The Newark Cleaning & Dye Works will build a power house at its newly acquired plant at 9-13 Beacon Street.

SOUTH AMBOY, N. J.—The Monmouth Lighting Company, under agreement made with the City Council, plans to install new electric lamps in various parts of the city.

BALTIMORE, MD. — Plans are under way for the construction of a power plant to be used in connection with the proposed hospital building at Thirty-third and Berkeley Streets for the Union Memorial Hospital. The total cost is estimated at about $1,000,000. C. L. Reeder, 916 North Charles Street, is engineer.

BALTIMORE, MD.—The Department of Lamps and Lighting contemplates the installation of a new arc-lamp lighting system on a section of Gay Street. John J. Hanson is superintendent.

BALTIMORE, MD. — Considerable electrical equipment will be installed in the steel plant to be built in the Curtis Bay section of Baltimore by the Maryland Steel Rolling Company, to cost about $100,000. J. G. Miller is president of the company.

MOUNT SAVAGE, MD. — Contract has been awarded to Golin Gerlach, Frostburg, by the Mount Savage Fire Brick Company for additions to its plant and a power house, 50 ft. x 90 ft., to cost about $85,000.

CARLISLE, PA.—A movement has been inaugurated by the Chamber of Commerce for a new street-lighting system in Carlisle. Tentative plans are under way for the installation of ornamental lamps on the main thoroughfares.

FARRELL, PA.—F. Whitford Jones, engineer, 1845 Rosalind Avenue, Cleveland, Ohio, has prepared plans for the installation of a lighting system on various streets in Farrell, to cost about $30,000. John Terpack is president of the council.

GARRETT, PA.—The power house, tipple and office of the Consolidated Coal Company, Mine 111, at Althouse, about 2 miles from Garrett, it is reported, has been damaged by fire.

MARTINSBURG, PA.—Application has been made by J. H. Sweet, G. E. and W. B. Simpson for a charter to form a corporation to be known as the Cove Electric Company, to supply electric light, heat and power to Martinsburg and the surrounding community.

PHILADELPHIA, PA.—The construction of a central municipal power plant is contemplated to supply electricity for the city-owned buildings now under construction along the Parkway, including the Art Museum, Free Library and the Municipal Court.

SUNBURY, PA. — The Pennsylvania Power & Light Company is preparing for the construction of a hydro-electric power plant in the vicinity of Sunbury. The proposed plant, with transmission lines to connect with the present system, will cost about $3,000,000.

CAMERON, W. VA.—The Cameron Mining & Development Company is considering the installation of a power plant to supply electricity to the mines and the town of Cameron. The installation of shaft mining machinery is also under consideration.

CHARLESTON, W. VA. — The Georges Creek Coal Company plans to install new machinery at its properties, including electrical apparatus, haulage motors, etc. The company also plans to erect a new tipple. J. M. Harris is secretary and treasurer.

WASHINGTON, D. C.—Bids will be received at the office of A. L. Flint, general purchasing officer of the Panama Canal, Washington, D. C., until April 28 for furnishing electrical supplies and fixtures. (Circular 1443.) Proposal blanks and information may be obtained on application to the above office or at the office of the assistant purchasing officer, 24 State Street, New York City.

North Central States

BACYRUS, OHIO.—Plans are under way for the incorporation of the Scioto Trail Electric Distribution Company, with a capital stock of $10,000, for the erection of an electric transmission line from Bacyrus to Ridgeton, a distance of about 6 miles. The company plans to purchase electricity from the Ohio Power Company. R. M. Mead & Company, electrical engineers, Mansfield, are promoting the work.

BLUFFTON, OHIO. — The Akron, Canton & Youngstown Railway Company, it is reported, plans to install equipment for electrical operation of the Northern Ohio Railroad system, which was recently acquired by the former company.

CLEVELAND, OHIO—The City Council has adopted resolutions providing for replacing gas lamps with electric lamps on part of Worley Avenue, and to install electric lamps on parts of West Thirty-first Place and Maple Court.

COLUMBUS, OHIO.—The City Council is considering an ordinance providing for an appropriation of $110,000 for the purchase of new boiler equipment in the municipal light plant, including the installation of a boiler and stokers to replace two old 300-hp. boilers and revamping of piping to accommodate higher steam pressure.

EAST ST. LOUIS, ILL.—The Dependable Truck & Tractor Company, 231 Collinsville Street, has plans under way for the construction of a new plant, including a main building, 100 ft. x 250 ft., and a power plant, to cost about $250,000 with equipment. Riester & Rubach, Murphy Building, are architects. C. V. Morse is president.

URBANA, ILL. — Improvements to the street-lighting system, including the installation of ornamental lamps, are under consideration. Electric service is furnished by the Urbana Light, Heat & Power Company.

MILWAUKEE, WIS.—Plans have been prepared by T. C. Hatton, engineer, for the erection of electric power plants to cost $2,000,000. J. H. Fowles, City Hall, is secretary.

TWO RIVERS, WIS. — The Wisconsin Textile Manufacturing Company plans to erect a new plant, 60 ft. x 180 ft., with a separate power house and dry kiln. The company is increasing its capital stock from $50,000 to $150,000 to provide for the new construction and equipment.

CEDAR RAPIDS, IOWA.—Improvements to the lighting system, including the substitution of the present 60-cp. lamps for 100-cp. lamps, are under consideration. Electric service is furnished by the Iowa Railway & Light Company.

CLARINDA, IOWA.—The erection of a municipal electric plant in Clarinda is under consideration. Dr. C. B. Eller of the Clarinda Community Club is interested.

NEW HAVEN, MO. — Bonds to the amount of $14,000 have been voted for extensions to the electric light and water systems.

CHANUTE, KAN.—The Ash Grove Lime & Portland Cement Company, Grand Avenue Temple Building, Kansas City, Mo., has had plans prepared by the Lehrach Engineering & Construction Company, 412 American Bank Building, Kansas City, Mo., for the erection of a power plant to cost about $100,000.

Southern States

HAMILTON, N. C.—Arrangements are being made for an issue of $10,000 in electric light bonds.

HICKORY, N. C.—Permission has been granted to the United Mills Company by the Federal Power Commission to construct a hydro-electric power plant at Harpers Creek, to be used in connection with the operation of its textile mills.

BARWICK, GA. — Electric light and water bonds to the amount of $11,000 have been voted.

DELAND, FLA.—The Deland Electric Light, Power & Ice Company plans to install a 500-kw. direct-connected turbine, condenser, spray pond, piping and two 300-hp. water-tube-type boilers. E. L. Hon is general manager.

NEW AUGUSTINE, FLA. — Steps have been taken by the New Augustine Progressive League to secure a complete lighting system for this city. Estimate of the cost of installing the proposed system has been submitted by the St. Johns Electric Company, St. Augustine.

TALLAHASSEE, FLA.—The installation of an ornamental lighting system in Tallahassee is under consideration. The initial installation would include sixty lamps on Monroe and Adams Streets. Aaron Levy is interested.

MEMPHIS, TENN.—At an election to be held May 19 the proposal to issue $10,000,000 in bonds for the purchase or erection of a municipal gas and electric light plant will be submitted to the voters.

MUSKOGEE, OKLA.—Preliminary surveys have been completed for the proposed interurban car lines to connect Oklahoma City with Henryetta, Okmulgee and Muskogee. Present plans, it is reported, include the erection of a large power plant from which it is proposed to supply electric power to practically all cities in the eastern and central parts of Oklahoma. R. D. Long, Muskogee, is promoting the project.

SAND SPRINGS, OKLA. — The Sand Springs Home has applied to the Federal Power Commission for authority to erect a dam, 42 ft. high, in the Grand River, to develop about 25,000 hp.

STEPHENVILLE, TEX. — The Texas Light & Power Company is considering extensions to the local electric lighting system.



PUEBLO (COL.) STEAM PLANT OF ARKANSAS VALLEY RAILWAY, LIGHT & POWER COMPANY

Extensive additions being made to accommodate 35,000 hp. With other improvements under way the construction expenditure will be more than $1,000,000

Pacific and Mountain States

TACOMA, WASH.—A resolution has been introduced in the City Council by Ira S. Davisson, commissioner of light and water, providing for the installation of an ornamental lighting system on downtown streets running east and west from Eighth to Seventeenth Street.

VANCOUVER, WASH.—The Northwestern Electric Company, Portland, it is understood, will apply for a franchise to operate in Vancouver. The present plans also provide for an expenditure of $50,000 for construction in southern Washington. The company, it is reported, plans early construction of a power plant on the north fork of the Lewis River at Yale, to develop 25,000 hp. The cost of this project is estimated at $5,000,000.

PORTLAND, ORE.—Contracts will be awarded soon for the construction of a dam, power plant and screen house at the headworks of the Bull Run water reserve. Fred Randlett is chief engineer of the Water Bureau.

LOS MOLINOS, CAL.—The Pacific Gas & Electric Company contemplates extending its lines through the Los Molinos colony. The cost is estimated at about $5,000. H. B. Heryford is manager of the west side division of the company.

SAN FRANCISCO, CAL.—Dudley Moulton has applied for permission to divert 3,000 cu.ft. per second from the Klamath River for power purposes. Present plans provide for the erection of a dam, 900 ft. long, and the development of 60,000 hp. The cost of the project is estimated at $2,000,000.

MYTON, UTAH.—The Uintah Power & Light Company has applied to the Federal Power Commission for permission to construct a small diversion dam in the Uintah River, Duchesne County, a 5-mile conduit to forebay, a 1-mile penstock to power house on the Uintah River, a diversion dam in Pole Creek and a 2-mile conduit leading to the above-mentioned forebay, to develop 6,500 hp. Arrangements have also been made by the stockholders of the company to issue $150,000 in bonds, the proceeds to be used to pay off indebtedness and for additions to the plant and equipment.

SALT LAKE CITY, UTAH.—Thomas J. Davis, Watson, has applied to the State Engineer for permission to appropriate 20 cu.ft. of water from the White River, Uintah County, for the development of electrical energy for various purposes.

SALT LAKE CITY, UTAH.—The Sevier River, Land & Water Company, Lynndyl, has applied to the State Engineer for permission to divert 200 sec.ft. of water from the Sevier River for the development of 3,000 hp. of electrical energy to supply Lynndyl, Eureka and surrounding country. The present plans, it is understood, provide for the erection of a dam, headgate, measuring device, spillway, canal, installation of three turbine wheels, etc.

IDAHO FALLS, IDAHO.—The installation of two new 500-kw. units to replace two old 300-kw. units at the municipal power plant is contemplated by the City Council.

LIVINGSTON, MONT.—The installation of an ornamental lighting system is under consideration. Electric service is supplied by the Montana Power Company.

CHEYENNE, WYO.—William Kyne of Casper has applied for permission to erect a transmission line from Boyson Dam to Casper, a distance of 130 miles, to cost about $350,000.

COLORADO SPRINGS, COL.—The Condon Engineering Company, Harris Trust Building, Chicago, Ill., has assumed management of the Intermountain Railway, Light & Power Company and contemplates improvements to the system to cost about $400,000.

DENVER, COL. — The Denver Gas & Electric Light Company has made arrangements for an issue of $1,000,000 in bonds, part of the proceeds to be expended for extensions and improvements to its electric plants. Frank W. Frueauff is president.

CLOVIS, N. M.—The installation of additional equipment, to cost about $100,000, at the municipal power plant is under consideration.

Canada

TORONTO, ONT.—Petition will be made to the City Council by Ward Eight for improvements to the street lighting on East Queen Street in the Beaches district.

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Engineers Should Travel More

FOREIGN engineers are frequent visitors to these shores. They invariably are in search of information and usually succeed in obtaining what they come for. This leads us to question whether our own engineers travel enough in quest of first-hand knowledge and whether executives properly sense the necessity and value of such journeys. Editors cannot hope to satisfy all engineering needs, invaluable as the technical press is. It is necessary at times to supplement published information by personal inquiry because men are often willing to impart information informally when they would not put their opinions in writing. Knowledge so gained is valuable. No system, for instance, suffering a serious breakdown would, for obvious reasons, desire publicity on details, nor would the manufacturer who supplied the apparatus, and yet they may be most useful in helping engineers to guard against similar mishaps. Notwithstanding the slogan of the telephone companies, travel is good and profitable, and executives should see to it that their engineers do more of it.

Trade Practices and Living Costs

IN ADVISING the President on present trade conditions and their effect on living costs the Federal Trade Commission makes some very definite strictures on certain business practices and abuses. From the fund of data which the commission possesses it is to be assumed that it knows whereof it speaks, but whether its deductions are correct or generally applicable is another matter. Labor has a great deal to do with present conditions, but the commission cannot presume to speak for labor. Nevertheless, the report makes interesting reading and will serve to confirm the general public's belief that prices are still too high. Herein lies a danger to all legitimate and honest business because of iniquitous practices and derelictions in some quarters. That it may lead to regulation is possible but not probable; for while there is nothing to prohibit this, we question whether any industry will permit itself to become so inefficient and corrupt or so abuse its opportunities as to warrant government interference in the public interest. The electrical industry—and it is by no means perfect—does not knowingly commit infractions. Its success is predicated on public good will. Even the suspicion of wrongdoing is repugnant to it, and it can be relied on to remedy most abuses quickly and effectively as a matter of self-interest. We fancy, however, that a portion of the blame for questionable business may be laid at the door of the government itself. In this we do not mean to exculpate those combinations which studiously keep the letter but break the spirit of the law, or to condone their practices. But we believe that it is as much a function of government to advise as it is to threaten. The old adage that an ounce of prevention is worth a pound of cure still applies, and admonition is certainly just as effective in business as chastisement. We are glad to note that the Federal Trade Commission appreciates this and has suggested remedies in that spirit. We commend its report to the serious consideration of the industry.

Fruitful Field for Engineer and Manufacturer

THE most pressing mechanical problem confronting the railroads has to do with terminal facilities, and in its proper solution the electrical industry can be of great service. In fact, few fields as fertile and as remunerative are open to the electrical engineer and manufacturer at the present time. Creative genius of a high order is essential because nothing short of a radical change from present inadequate and cumbersome methods will suffice. It is unfortunate but nevertheless true that the arrangement and construction of the average freight station is archaic. Were one to hunt for the worst possible misfit for existing needs he need look no farther than freight stations in large centers. The arrangements not only militate against efficient hand operation but are to a far greater extent a handicap to the proper application of mechanical and electrical machinery. For that reason existing terminals must be replaced by structures providing for minimum time-consuming movements between cars and the shipper or consignee. Such terminals on a large scale do not exist at the present time and are a consummation devoutly to be wished. The opportunities for economy justify very generous outlays on them since it is estimated that lack of proper freight-handling equipment costs the country approximately half a billion dollars yearly. The industry should therefore actively support any plans for effectively solving terminal and freight-handling problems, first, because they mean cheaper distribution and, second, because they involve the use of electrical equipment and lots of it.

The "Big Nine" Central-Station Companies

BUSINESS as applied to finance and industrial undertakings has quite a different meaning today from that it bore fifty years ago. We have come to think of billions instead of millions as indicative of large things, and this is perfectly logical in view of the rapid growth which has taken place in every line of human endeavor. A decade ago a central-station company which generated and distributed in excess of a hundred

million kilowatt-hours was considered as one of the leaders in the industry. Today outstanding leadership based upon the extent of the annual output is designated by adding three more zeros to the quantity, bringing it into the billion kilowatt-hour range. There are now nine of these "leaders" among central-station companies when measured by this scale, seven in the United States and two in Canada. Sixty-two others are in the hundred-million class, exclusive of nine electric railway companies. The rank by companies is shown elsewhere in this issue. In the tabulation of annual output the extremes to which the larger distributers of electrical energy have been driven during the past few years are clearly brought out. Prior to the war most generating companies purchased power from other public utilities only at irregular intervals when there was an abnormal request for energy beyond the ratings of their own generating stations and to help out in emergency cases. The figures for 1920 indicate, however, that purchase of energy from competitors is now rather the rule than the exception and that a majority of the large electric distributing companies are buying a high percentage of their total output. This interchange of energy has been accentuated by the rapid advances made in the interconnection of large systems, but it is without doubt also due in no small extent to the high cost of labor and materials which has prevailed since the end of the war. However, some of the larger companies have additional generating units now under construction or contemplated, and it is probable that the next year or so will see a material reduction in the amount of electrical energy purchased by these companies for distribution to their customers.

A Record of Which Canada May Be Proud

OUR friends across the northern border have shown in the last year an amount of activity in power-plant planning and construction which speaks volumes for the energy with which they have confronted the new conditions since the war. The report presented in this issue is of the most encouraging possible character. As our readers know, the Canadian government has taken a very active hand in regulating, and indeed operating, hydro-electric propositions. The several provinces have so considerable a degree of autonomy that they operate somewhat independently, but effective efforts have been made toward community of action which should prove decidedly useful in future work. In four of the provinces the work of development and transmission is actually being undertaken by the government, these four being Nova Scotia, New Brunswick, Ontario and Manitoba. Neither of the two first-named provinces is very rich in easily available powers, but there is an ample supply for present requirements and for some little time to come. In both these provinces government activities will prove specially effective on account of the ease with which they can bring about proper co-ordination with the lumbering interests, for the benefit of which the streams have heretofore been chiefly employed.

The Province of Quebec has already done much in the improvement of its streams and more than 100,000 hp. of new development work has been moving along in this last year. Ontario, of course, with its Hydro-Electric Power Commission, is the chief seat of activity, with nearly 500,000 hp. under construction. The commission now owns more than 1,000,000 hp. in total capacity. In the western provinces of Canada there is plenty of water power awaiting development of adequate markets. Not a little work is being carried on in the general distribution of light and power by construction and transmission networks, but until one reaches the Pacific and considerable centers of population developments are necessarily limited. Their total at the present time, however, is something rather astonishing, rising to very nearly 2,500,000 hp. for a total population of about 9,000,000, a per capita supply of power surpassing that of every country in the world save Norway.

Serious Effects of Fiber Shreds in Transformer Oil

THE deleterious effect of water on transformer oil has long been known. Recently attention has been drawn also to the importance of the more complete elimination of other impurities. Of interest in this connection is a series of experiments by Thomas McLaughlin, described in a recent number of the *Electrician*, on the influence of dust and small fibers on the insulating properties of transformer oils. Paraffine and other oils supposedly pure are shown to develop sudden sharp increases in conductivity. These changes occur at widely different values of electric stress in the same oil, and the duration of time of application is an important factor. Careful experiments clearly trace the cause to the presence of minute fibers in the oil. By microscopic examination the fibers can be seen, and the sudden increase of conductivity always results when a number of the fibers link up end on end in the electric field.

Since insulation is only an extreme reduction of conductivity, the effects of impurities are much greater in insulators than in conductors. For this reason the insulating properties of any single substance show wide variation under successive tests. This is especially noticeable in compound and built-up insulation. Particularly in liquid insulation is the effect of impurities noticeable. Water with its powerful dissociating properties, loosening the bonds of the atoms, if present even in minute quantities, sharply increases the conductivity.

Much of the insulation used in transformers is fibrous in character. Waste and lint-bearing cloths are also commonly used for cleaning purposes. The experiments mentioned thus raise the questions whether complete precaution is taken against the passage of fibers into the oil, whether oils should not be examined more rigidly for impurities of this character and whether conductivity tests such as those described have not some advantages over the usual breakdown tests.

The Tangle of Existing Frequencies in Power Service

IT IS unfortunate that some duly qualified prophet could not have been on hand in the early days of power transmission to look ahead and see the general situation with regard to standard frequency. As a matter of fact, we are better off in this country than they are abroad, at least in regard to the number of frequencies in actual use. We are worse off in that there are two widely different and in a sense incommensurable frequencies both in large use. By far the greater part of new plants are for 60 cycles, but there remain, chiefly as relics of an earlier phase of experience, 25-cycle plants to an aggregate capacity so big that a general change is for the present out of the

question. In the current issue B. G. Lamme considers this frequency difficulty with reference to the installations in steel mills, which have been in the past very generally equipped for 25 cycles but now frequently make clear the desirability of taking on power from the great transmission systems at the higher frequency.

The fact is, of course, that 25 cycles is obsolescent, but this frequency has been employed on so large a scale that a long period must elapse before it passes out of use. Started in the first great Niagara plant as a compromise, the story of which would make an interesting bit of history, it has persisted there and has been also largely used in plants, chiefly for railway purposes, installed when engineers were still somewhat skeptical about building synchronous converters for the ordinary frequencies. It also found use in isolated plants for steel mills where the low frequency was often convenient for low-speed motors and also for conversion into direct current. Today there is no hesitancy about building conversion apparatus for 60 cycles, and even if it were difficult to do this, there would still remain the extremely effective cascade converter with a commutating frequency cut in half.

The great mistake which found its way into American practice was standardizing two frequencies which, as Mr. Lamme points out, were pretty nearly incommensurable. It would have been far sounder practice had engineers possessed the foresight to use either 50 cycles for high frequency and 25 for low, or 60 and 30 cycles.

Looking at the situation as it stands, when it is desirable to take 60-cycle power in one of the low-frequency plants Mr. Lamme points out five ways of meeting the situation—first, by discarding existing plant; second, by using frequency changers up to the full capacity of the existing plant, which is expensive; third, by installing additional plant for the standard frequency and holding on temporarily to the 25-cycle plant—feasible enough in some cases, but a mixed system at best; fourth, by changing over part of the plant, leaving the rest as it is until it finally becomes obsolete—again a mixed system probably for a considerable time; and, finally, the existing plant can be utilized within limits and all extensions made on the standard frequency. Here again is a double system, but not a mixture of two in the same area. Mr. Lamme's judgment, in which we think all engineers will concur, is that it is not desirable to generate two frequencies in the same local plant unless one is to be discarded within a very short time. Additions of small size can perhaps best be made on the existing frequency.

The big central-station companies of the country have been subject to a certain extent to the same mixed conditions. Rather unwisely, as engineers now generally judge, they went in largely for 25 cycles with the intention of using synchronous converters instead of distributing on alternating current. At 25 cycles with modern lamps the lighting service gets on the ragged edge of practicability, and as time goes on the direct-current service is a less and less important part of the whole. So much investment has been put in 25-cycle apparatus, however, that it is better to stand the inconvenience than to scrap the equipment, which is exactly the case in the steel mills. A frequency-changer outfit is cheaper in first cost than additional generating plant and sometimes may afford an excellent way out of the difficulty. Where cheap transmitted power is available it will commonly be better judgment to utilize it through a frequency changer than to undertake any wholesale changes in the motor plant to meet the new situation. At all events, if both frequencies are actually to be used in the service, they should be kept distinct as far as possible, in which case it has often been feasible to avoid the use of frequency changers and to keep the two frequencies independent, letting the question of future growth take care of itself.

The whole situation is an inconvenient one, the more so that the cost of a complete change in frequency is serious. The only thing to do is, following Mr. Lamme's very shrewd analysis of the situation, to treat the matter symptomatically, getting out of the tangle by the easiest feasible method, which may lead in any one of several directions.

The Job of the Line Foreman

IT IS being recognized more and more that planning engineering work is a function entirely separate from executing the practical details of that work. Both have the same ultimate object, but the points of view are sometimes diametrically opposite. The fact that the best results from all standpoints are obtained where these endeavors are handled separately invariably leads to this conclusion. To no other problem in the industrial world has more thought been given than to the separation of engineering and construction work, and none has seemed harder to solve. However, results obtained in many enterprises have conclusively proved that engineering and construction must be carried on separately but handled co-operatively. Nowhere in a central-station organization has it been more difficult to convince those interested that such a division of work is an advantage than in the distribution departments. The line foreman of old planned his work and did it. He had entire control of the situation, and the lines that he built remained standing and gave good service to the customer. But each foreman had his own ideas, and the result was a complete absence of standardization. The economics of the problem were not considered. The fact that the line foreman in most cases was successful in giving the customer the service required has made it difficult to convince not only him but often the management also that better results and higher economies could be obtained by the application of engineering principles.

One result has been constant iteration of the fallacy that were the foreman furnished with definite orders or blueprints he would become merely a machine. It is necessary simply to look over conditions in other more highly organized forms of work to find that the doing of the work in itself carries with it a possibility of unlimited mental application. It is hardly yet possible to appreciate what can be done by proper routing, by properly planning the work of line gangs, by saving time in all operations, by labor-saving methods and devices, by competition between gangs—in short, by doing a piece of line work in the least possible time with the least possible expenditure of labor while still maintaining the quality of work required for the service to be given. It is therefore necessary, in order that distribution work may keep up in efficiency with work of other kinds, to realize that the line foreman is losing nothing of his importance by giving up some of his apparent engineering duties. He is simply relieved of work for which he is not fitted and thereby permitted to spend his best efforts in doing the work that he should be best able to do.



Frederic Nicholls

The pioneer organizer of the electrical industry of Canada, who has resigned the presidency of the Canadian General Electric Company to become chairman of its board of directors

TO THE vision of Frederic Nicholls the electrical industry of Canada owes much. He was among the first to see the future of electric lighting and so started the first Canadian incandescent lighting system. The demand for electrical equipment which followed he supplied by obtaining the Canadian rights to manufacture a comprehensive line of electrical apparatus. To use the power generated he promoted street railways, and then when the demand increased he began to urge the development of Niagara Falls. To utilize this energy he became interested in the pioneer high-tension lines in Canada.

Briefly, these are the outstanding early accomplishments that have so closely linked the name of Lieut-Col. Frederic Nicholls with Canadian electrical progress for so many years. As president of the Canadian General Electric Company, essentially a Canadian organization operating entirely under its own control, he has taken a prominent part in all electrical development in the Dominion. This company, under his personal control and direction since 1889, when the initial undertaking was formed, has grown from an original investment of $10,000 to current assets of $31,000,000. With this record of achievement, he recently resigned as president to become chairman of the board of directors.

Colonel Nicholls was born in England in 1856 and was educated in Stuttgart, Germany. It was in 1874 that he came to Canada. For seven years he was secretary of the Canadian Manufacturers' Association, and until 1893 he was editor and proprietor of the *Canadian Manufacturer*, which he founded. The first system for supplying electric light to the Canadian home was the Toronto Incandescent Light Company, which came into being June 26, 1889, as the result of Colonel Nicholls' efforts. Later the company obtained the exclusive Canadian rights to the Edison lighting system, and it was amalgamated with the Toronto Electric Light Company in 1891, giving way to the Toronto Construction & Electrical Supply Company, which acted as Canadian agent for the Thomson-Houston Company. It was thus the immediate parent of the Canadian General Electric Company, which was organized on Sept. 5, 1892. Nor has Colonel Nicholls confined his activities altogether to Canada. With other prominent Canadians he was interested in the Sao Paulo (Brazil) electrical consolidation and later, for a while, in the Rio de Janeiro system.

Colonel Nicholls enjoys the honor of having been the only president of the National Electric Light Association living outside of the United States, his election to that office taking place in 1896. Since then he has been elected an honorary member of the association. He was gazetted honorary lieutenant-colonel shortly after the outbreak of the war in 1914 and took a prominent part in Canadian war activities. In Jan. 20, 1917, he was appointed to the Canadian Senate.

The Steel-Mill Frequency Problem

How to Make Economical Use of 60-Cycle Purchased Energy in a Plant with 25-Cycle Equipment Is One of the Problems that Confront the Steel Industry —Six General Methods in Arriving at a Solution

By B. G. LAMME
Chief Engineer Westinghouse Electric & Manufacturing Company

WITH the coming of large central power stations for the general supply of electric service of all kinds the frequency of 60 cycles has been brought into more general use. Consequently, in considering the purchase of power from the large supply companies, the steel mills are now confronted with the problem of utilizing 60 cycles to best advantage in plants which were originally designed for 25-cycle equipment. Various suggestions have been made from time to time as to how to handle this situation in its various forms. Probably as good a way as any to attack the problem would be to classify the various methods by which the double-frequency situation could be met. These methods may be stated as follows, although the order in which they are given has no relation to their expediency or importance:

1. Rebuilding or rendering obsolete existing plant and replacing it entirely with 60 cycles.

2. Conversion of 60-cycle purchased power to 25 cycles by frequency changers and operating in connection with existing plant. This retains the advantage of the existing 25-cycle system, but means, however, considerable losses due to the freqency changers.

3. Allowing the existing 25-cycle plant to remain in service and installing new generating and motor equipment for 60 cycles. This would allow purchased 60-cycle power to be utilized in connection with the new generating plant. It involves, however, a more or less mixed system throughout the plant.

Retaining the Existing Plant

4. Retaining the existing 25-cycle plant for those parts of the service where 25 cycles is materially better and changing other parts to 60 cycles for use on purchased power. This could be continued until the old plant and equipment became obsolete. It would probably mean a mixed system throughout the mills for years to come.

5. Utilizing the existing plant within certain areas and applying 60-cycle purchased power to extensions and new areas. This involves a double system, but not a general mixture of two systems in the same areas. Eventually, if the purchased power proved more satisfactory than the local supply, the latter could gradually be discarded. This method means, however, that in the new areas the 60-cycle energy would be applied to low-speed motors as well as all other apparatus.

Looking at the matter broadly, it does not seem advisable to generate two separate frequencies in the local plant. If 25 cycles is the existing frequency, it is not desirable to put in an additional generating plant at 60 cycles, unless such new equipment is to be of greater capacity than that already installed. In the latter case it might be advisable to put in the additional plant of 60 cycles, simply with the understanding that the older small 25-cycle plant would soon be superseded entirely. In other words, the only condition under which the two frequencies should be mixed in the one generating plant is where one of them is to be abandoned entirely within a reasonably short time. Wherever the additional plant is to be less in size than the plant already installed, or where it simply represents the normal growth, then it appears that it would be better to put in the additional plant at the same frequency rather than mix the two frequencies.

Service Should Not Be Mixed

Some of the large central stations throughout the country have encountered a similar problem. In some of these cases both 25-cycle and 60-cycle generating units have been installed in the same power plant, but as a rule they supply quite different service and areas. For instance, the 25-cycle service will be utilized almost entirely by conversion to direct current, and within a given district this will apply exclusively. In other cities the 60 cycles may be represented by entirely separate power plants supplying outlying districts mostly, a large part of the application being by direct service instead of by conversion to direct current. As far as the writer knows, in general the two services are not mixed indiscriminately. In the earlier days, when 60-cycle service came into considerable demand in connection with 25-cycle plants, frequency changers for giving 60 cycles were installed in many cases. As the 60-cycle service grew, instead of adding more frequency changers, whose sole function is to change frequency, not to generate power, the practice has been to install 60-cycle generating units often in separate power plants, the existing frequency changers then being used as a tie between the two plants. In cases where the capacity of the two power plants has been considerable compared with the capacity of the frequency changers tying them together there have been certain conditions of unusual stresses in the frequency changers at times of severe load conditions. In other words, if the link tying the two plants together is a relatively weak one, sometimes it may be broken. This problem of the two frequencies has been one of long standing with the central power stations, and as the present solutions are more or less a development from experience, this is possibly an indication that steel mills should follow along somewhat similar lines.

Using Two Frequencies in One Plant

It has been suggested that in the application of 60 cycles to steel mills this frequency might be used largely for one kind of service, such as the motor-generators or rotaries for producing direct current. In this way the 60-cycle service need not be distributed so generally throughout the mills, but would simply be

NOTE.—The above paper was presented at a joint meeting of A. I. E. E. and A. I. and S. E. E. at Pittsburgh, April 16, 1921.

supplied to the converting machinery, which is not scattered through the mills in the same way as the motors. Moreover, the modern 60-cycle synchronous motor-generator is just as cheap and economical as its 25-cycle competitor—cheaper in some cases—while the 60-cycle rotary converter, if transformers are included, approaches pretty close to the 25-cycle in general operating characteristics.

In existing mills, however, changing to 60 cycles would mean replacing or remodeling, at very considerable expense, the existing motor-generators and rotaries, and unless the future growth of such apparatus is to be very large compared with that already installed, this reconstruction or replacement might prove in the end to be relatively expensive—perhaps as expensive as the installation of frequency changers, which would allow the continuation of the existing 25-cycle frequency. Even if the existing machinery is more or less out of date, unless it has uneconomical characteristics, it can probably be kept in service for many years to come, for much of this machinery is well built and of durable construction and may still have twenty to thirty years of good operative life. In fact, some of the motor-generators and rotary converters which have been in operation for ten to twenty years in steel mills appear to be as good as when first installed, and it will be difficult to justify their obsolescence and replacement.

Something might be said further regarding frequency changers. As stated before, the function of the frequency changer is simply to change frequency at a considerable expense in power. There are other objections outside of inefficiency which count against the frequency changer, but these probably would not be dominating or controlling in themselves. On the face of it the frequency changer seems to furnish such a simple solution of the frequency problem that in some instances it might pay to sacrifice other considerations in favor of simplicity.

Proper Pole Combinations for 25-Cycle Frequency Changers

It must be kept in mind, in the first place, that there are no means for getting the exact 60 to 25 relation with an economical type of machine, for the numerical ratio of 60 to 25 allows only a 24-10 pole combination, which represents a rather low speed except for units of enormous capacity. If any other more economical combination of poles is chosen, such as 10-4 or 14-6, then with a 60-cycle supply system some other frequency than 25 cycles will be obtained. The 10-4 pole combination gives 24 cycles, while the 14-6 pole combination gives 25.7 cycles. Therefore, for either of these combinations, it would be necessary to change the steel-mill frequency slightly, for it would be almost impossible to get any general power company to change its frequency of 60 cycles. Naturally, if either of the above combinations were to be adopted, the 10-4 pole would be preferable from the standpoint of the frequency changer itself. However, there might be some question regarding the use of 24 cycles instead of 25 cycles in steel-mill applications, for this means a general reduction of 4 per cent in the speed of all the synchronous and induction motors. Thus the choice of the most advantageous speed for the frequency changer may possibly represent a material disadvantage in the motor equipment. Again, the use of the 14-6-pole frequency changer would mean increasing the mill frequency about 3 per cent, which should not be as objectionable as a reduction of 4 per cent. However, the 14-6-pole combination would not represent nearly as cheap frequency transformation.

As an offset to the cost of the frequency changer and its losses, there may be considerable saving over the installation of corresponding capacity in additional power-generating plant. In installing new or additional power plant the cost of the electric machinery represents but a small part of the total cost, and, unquestionably, the extra buildings and equipment to go with the frequency changer would be very materially less than that of additional generating plant. This saving in first cost in some cases might go a long way toward offsetting the losses of the frequency changer, especially in those cases where 50-cycle power can be obtained at a very low rate. However, no definite statement can be made as to the comparative costs, because each case would have to be worked out individually.

Pole Ratios Must Be Same for Parallel Operation

As soon as two or more frequency changers are to be installed in one plant, these to be operated in parallel with each other and with the existing generating plants, then complication comes in, possibly to such an extent as to cause most of the simplicity of the scheme to be lost. The synchronizing and proper paralleling of two or more frequency changers with each other and with their respective power plants is one of the "fussy" things which can be carried out successfully, but which nobody likes.

Attention should be called to the fact that if any particular combination of frequency changer sets is chosen, such as represented by 10-4 poles or by 14-6 poles, then this exact ratio must be retained throughout, if additional frequency changers are ever to be added to the plant. It is obviously impossible to parallel two combinations of poles which do not have the same ratio.

As to the capacities of such apparatus which are practicable in single units, 10-4-pole sets of 5,000-kva. rating have been offered recently by manufacturers. However, for larger ratings than 5,000 kva. certain difficulties arise, as the next possible pole combination is 20-8, which represents just half of the speed. In consequence, even with a 10,000-kva set, halving the speed will probably more than offset the gains in cost and efficiency resulting from larger capacities. One would assume, in consequence, that two 5,000-kva. units would be preferred to one 10,000-kva. unit, and presumably this is correct if the two units can be operated independently. For parallel operation, however, the added complexity might be considered sufficient to offset a slight increase in cost of the larger unit.

Cost of Frequency-Changer Sets Varies

For costs and efficiencies of such apparatus the following approximate figures are suggested:

For a 5,000-kva. set, including auxiliaries, switchboard appliances, etc., from $10 to $11 per kva. The combined efficiency will be approximately 92 per cent or better at full load and 89 per cent or better at half load.

For a 10,000-kva. set, having 20-8 poles, the cost per kva. could be taken roughly at $11 to $12. No figures for efficiency have yet been worked out.

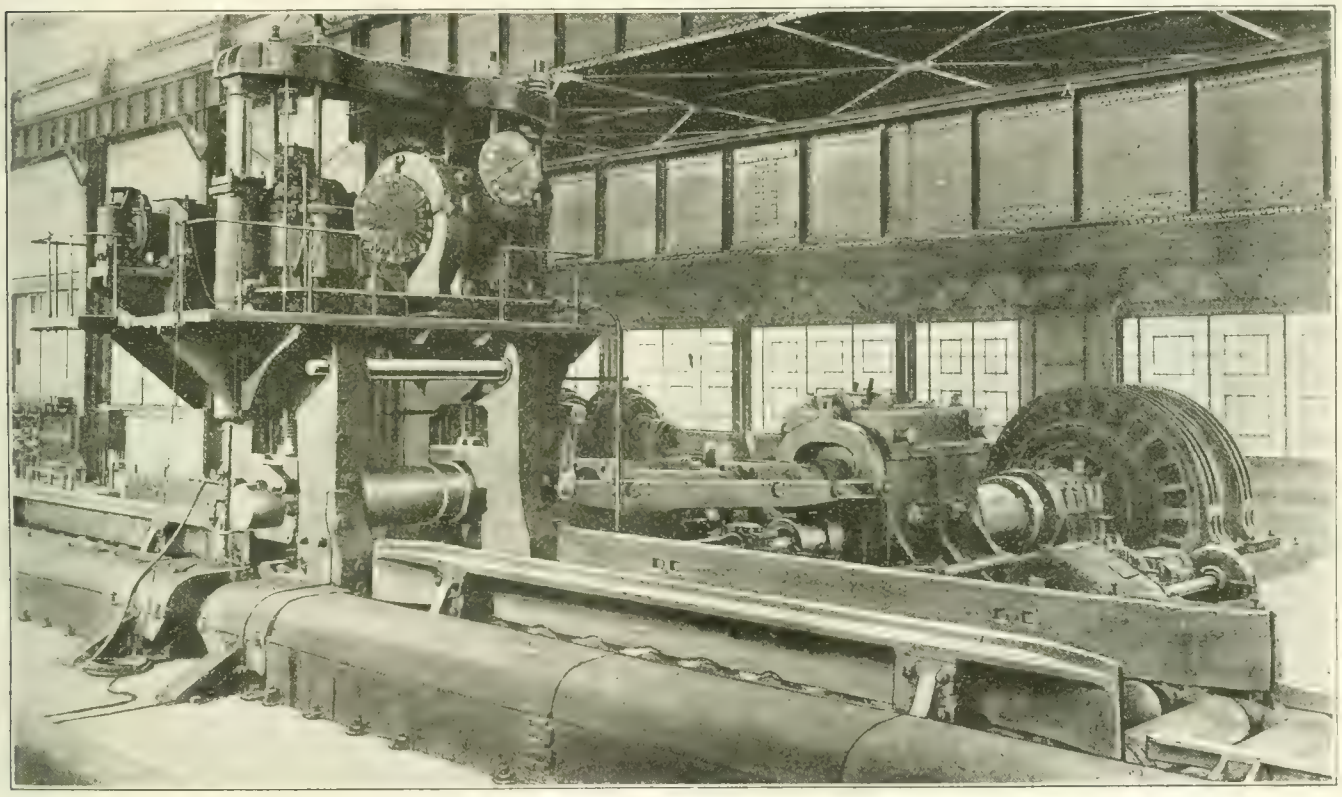
Neither of the above approximations includes cost or efficiency of stepdown transformers.

There is one other class of electric machinery used in steel mills on which the effect of frequency has not yet been considered, namely, the induction-motor speed-

regulating sets which have come into use to a considerable extent in recent years. There are three types of such speed-regulating appliances in use today, all of them requiring commutating machinery, namely, (a) those in which the secondary electrical power of the induction motor is transformed into the mechanical power and utilized as such, (b) where the secondary electrical power is transformed into direct current and utilized, and (c) where the secondary power is transformed from the variable or adjustable frequency of the secondary to some fixed frequency such as that of the line and thus utilized. The first of these schemes involves polyphase commutating-type motors, while the second requires rotary converters and the third requires commutator-type frequency changers, which are a more recent development than the other types of machinery mentioned.

From the standpoint of commutation, (a) and (c) present advantages in first cost, general performance and efficiency at 25 cycles, as compared with 60 cycles, while method (b), involving rotary converters, makes its best showing at 60 cycles, although all three arrangements are practicable at both frequencies. Arrangements (a) and (c) allow satisfactory operation both above and below the synchronous speed of the induction motor, whereas (b) has heretofore been worked only below synchronism, although auxiliary means may be found for this scheme, just as with the other two, for successfully passing the synchronous speed condition. All these methods of speed control could doubtless be used to a considerable extent, depending upon the conditions and the application; but as they can be operated successfully on both 25 cycles and 60 cycles, apparently they will have no controlling influence on the choice of frequency.

There is no good general solution to this frequency problem, and each case must be handled on its merits, taking the future tendencies and growths into account. In many cases it appears that the large existing 25-cycle local systems should be retained at least until such time as the need for replacement is more obvious than at present. Unless the future service of the mill shows strong indications of going almost entirely to 60 cycles, a mixed generating plant is not to be recommended. In those cases where existing 25-cycle power and purchased 60-cycle power are both to be used, they should at first have their own individual services or areas, as far as possible, to avoid indiscriminate mixing of services throughout the mills and to avoid frequency changers, with their attendant losses, unless conditions are such as to warrant their use. In general, where both frequencies are liable to be used for some time to come and there is any real necessity for a tie between the two, frequency changing becomes a necessity. However, as central-station service has now become quite reliable, there is not the need for a tie between two frequencies that was formerly the case, so that doubtless in many cases frequency changers can be dispensed with.



CHANGING CONDITIONS HAVE TAKEN AWAY MOST OF THE ADVANTAGES OF 25-CYCLE ENERGY

In case of a new plant, even where it expects to generate its own power, in general it should be installed at 60 cycles, if located in a 60-cycles district, simply on account of future possibilities. There is no question whatever that future central stations will supply power for general purposes at 60 cycles within certain large districts, the trend being too strong to be changed or controlled. In other large districts it will be principally at 25 cycles, as in the territory served by Niagara, for instance. There will be still other cases where both frequencies will be used, simply because the field for 25 cycles is already so large that 60 cycles cannot replace it. In consequence of this mixed service the ultimate solution of the general supply problem may mean 60 cycles for general purposes with 25 cycles as an auxiliary supply.

Output of Nine Electric Systems in 1920 Exceeded 1,000,000,000 Kw.-Hr. Each

"Electrical World" Survey Indicates that in 1920 Seventy-one Light and Power Companies of United States and Canada Reported Individual Output Exceeding 100,000,000 Kw.-Hr.

GROWTH in the electric light and power industry reaches such large yearly proportions that an annual census of operations is necessary in order to keep the statistics of the industry in such form as to be of real use. Facts which hold true one year are entirely superseded during the year succeeding, and other more astounding data take their place. Probably no other American industry can show as great advances from year to year, and certainly no other industry can surpass the growth of the electric light and power industry during the past decade.

In line with its policy of keeping in most intimate touch with the operations of the central generating plants of the country, the ELECTRICAL WORLD has just completed a survey of the electric generating and distributing companies of the United States and Canada having an annual output in excess of 100,000,000 kw.-hr. in 1920. The results of this survey are most astonishing. A similar survey undertaken last year indicated that in 1919 there were only six companies distributing in excess of a billion kilowatt-hours, five of which were operating in the United States and one in Canada. The present investigation indicates that nine electric light and power companies distributed over a billion kilowatt-hours of electrical energy in 1920. Of these nine companies, seven were operating in the United States and two in Canada. Such a growth is most remarkable in view of the very material decrease in the power load during the months of October, November and December which was reported by virtually all the large electric generating and distributing companies of this country and Canada. It is probable that had industrial depression not settled over the continent during the past fall and winter, some twelve companies would have reported an output of more than a billion kilowatt-hours in 1920.

Eighty Companies with an Output Over 1,000,000,000 Kw.-Hr. in 1920

Table II is believed to be a complete list of the electric light and power companies and electric railway companies of the United States and Canada with an output in excess of 100,000,000 kw.-hr. during 1920, giving also their total output and the amount and date of their peak load. Table I lists these companies by sections of the country and gives the proportion of the output which was generated and purchased and also the distribution of the energy between light and power customers and electric railways.

Seventy-one electric light and power companies and nine electric railway companies reported an output in excess of 100,000,000 kw.-hr. in 1920. The total output of these electric light and power companies was 33,190,281,511 kw.-hr. Deducting the output of the Canadian companies gives 27,109,529,800 kw.-hr. as the total output of the electric light and power companies in the United States having an annual output in excess of 100,000,000 kw.-hr. This would indicate that about 59 per cent of the total output of the central generating stations of this country is distributed by sixty-six companies out of the total 5,700 electric companies operating during 1920.

The Niagara Falls Power Company easily leads the country in output. It is also the only company with an output in excess of two billion kilowatt-hours. The Commonwealth Edison Company of Chicago is second, followed by the Pacific Gas & Electric Company and the Sierra & San Francisco Power Company, the output of the last two companies being combined. A glance at Table II shows that these three companies have also led the industry for the past four years. There are several companies whose output was just under 100,000,000 kw.-hr., and these companies, under usual business conditions, must undoubtedly have appeared in this tabulation.

Larger Companies Are Well Scattered Over the Country

The larger electric generating and distributing companies are fairly well scattered over the country, although most concentrated in the industrial sections. It is rather surprising that the intensely industrial New England section reports no company with an output in excess of a billion kilowatt-hours. Perhaps one of the most interesting facts to be drawn from the survey is the large part that the South Atlantic States are playing in the electrical development of the country. The figures for this section are even more impressive when the fact is taken into consideration that in some Southern states the electrical energy generated by private plants is in certain industries in excess of that purchased by these industries from the central generating stations.

The wide use of electrical energy in the Pacific Coast States is emphasized in the two companies reporting over a billion kilowatt-hours' output and the ten other companies with an output in excess of 100,000,000 kw.-hr. No other section of the country can show a better record.

A study of the reported outputs reaching more than 100,000,000 kw.-hr. in 1920 shows that privately owned plants compose almost the entire list. Only two municipal generating plants are found, both of which are in the Pacific States. The almost total absence of municipal plants is not so remarkable when the fact is considered that electric light and power plants of this class are mostly small and serve as a rule but one community, while one privately owned plant may cover a territory embracing many separate municipalities. Moreover, large cities which support municipal light and power plants are generally served by private com-

Table I—Data on Generated and Purchased Output of Largest Generating and Distributing Systems in the United States and Canada During 1920

Section and System	Rank in C'ntry	Generated and Purchased Output: Kw.-Hrs. Generated	Kw.-Hrs. Purchased	Total Output	Per Cent of Total Output of Sect'n	Distribution of Energy: Light and Power	Railways
New England States:							
New England Power Company	26	217,868,000	213,050,000	430,918,000	15 4	381,218,000	49,700,000
Edison Electric Illuminating Company of Boston	32	377,276,200	17,800,000	395,076,738	14 1	395,076,738	12,305,864
Narragansett Electric Lighting Company	46	207,900 000	5,332,000	213,232,000	7 6		
Turners Falls Power & Electric Company	47	197,097,030	15,829,500	212,926,530	7 6	180,497,030	32,429,500
New Bedford Gas & Edison Light Company	69	107,599,392	None	107,599,392	3 8	95,468,792	12,130,600
Hartford Electric Light Company	71	94,000,000	9,000,000	103,000,000	3 7	94,000,000	None
Middle Atlantic States:							
Niagara Falls Power Company	1	2,328,326,064	None	2,328,326,064	19 2	2,318,848,901	9,477,163
New York Edison Company	4	842,260,806	95,842,452	938,103,258	7 7	816,683,334	121,419,924
Public Service Electric Company	10	892,339,164	20,560,808	912,899,972	7 5	653,186,298	259,713,674
Philadelphia Electric Company	11	910,065,068	262,625	910,327,693	7 5		
Duquesne Light Company	13	807,314,770	3,086,636	810,401,406	6 7	604,340,557	206,060,849
Buffalo General Electric Company	18	117,081,600	427,211,810	544,293,410	4 5	468,716,410	75,577,000
Niagara, Lockport & Ontario Power Company	21	144,769,880	347,696,580	492,466,460	4 0		
United Electric Light & Power Company	4	406,622,147	38,344,681	444,966,828	3 7	389,964,147	55,002,681
Pennsylvania Power & Light Company	29	411,639,501	None	411,639,501	3 4		
Brooklyn Edison Company	33	382,963,027	None	382,963,027	3 1	380,952,107	2,010,920
Adirondack Power & Light Corporation	39	205,500,000	71,600,000	277,100,000	2 3	258,500,000	18,600,000
Pennsylvania-Ohio Power & Light Company	41	255,537,150	None	255,537,150	2 1	212,448,736	43,088,414
Rochester Gas & Electric Corporation	50	185,010,252	8,591,338	193,601,590	1 6	138,754,995	54,846,595
Metropolitan Edison Company	61	133,657,230	336,800	133,994,030	1 1	117,347,137	16,646,893
Scranton Electric Company	65	105,813,032	10,574,440	116,387,472	1 0	94,680,312	21,707,160
South Atlantic States:							
Southern Power Company	14	709,073,620	36,800,372	745,873,992	16 8		
Pennsylvania Water & Power Company	20	494,624,400	None	494,624,400	11 1		
Consolidated Gas, Electric Light & Power Co. of Baltimore	27	190,415,747	239,295,100	429,710,847	9 7	429,710,847	None
Georgia Railway & Power Company	37	263,254,299	30,466,991	293,721,290	6 6	240,724,193	52,997,097
Potomac Electric Power Company	45	225,994,701	None	225,994,701	5 1	136,787,425	89,207,276
Virginia Railway & Power Company	48	208,517,000	None	208,517,000	4 7	156,082,000	52,435,000
Appalachian Power Company	58	137,000,000	11,700,000	148,700,000	3 3		
East North Central States:							
Commonwealth Edison Company	2	1,883,570,000	None	1,883,570,000	16 7		
Detroit Edison Company	9	1,002,283,600	22,400	1,002,306,000	8 9	856,000,000	146,306,000
Cleveland Electric Illuminating Company	15	682,557,097	None	682,557,097	5 5	520,000,000	162,557,097
Consumers Power Company	23	458,708,927	17,386,171	476,095,098	4 2	370,401,910	105,693,188
Michigan Northern Power Company	40	257,752,195	None	257,752,195	2 3	257,012,895	739,300
Northern Ohio Electric Corporation	42	213,825,011	33,284,952	247,109,963	2 2	185,277,974	61,831,989
Union Gas & Electric Company	43	234,634,375	None	234,634,375	2 1		
Toledo Railways & Light Company	49	65,682,760	142,147,850	207,830,610	1 8	179,177,053	28,653,557
Columbus Railway, Power & Light Company	56			153,626,000	1 4		
Acme Power Company	60	137,701,000	None	137,701,000	1 2		
Dayton Power & Light Company	62	129,618,270	None	129,618,270	1 1	122,982,095	6,636,175
Indianapolis Light & Heat Company	66	114,416,094	None	114,416,094	1 1	114,416,094	None
Indiana and Michigan Electric Company	70	103,693,910	None	103,693,910	0 9	103,693,910	None
West North Central States:							
Mississippi River Power Company	17	641,353,000	2,810,000	644,163,000	19 0		
North American Company (Missouri System)	25	163,832,003	307,779,044	471,611,047	13 9	302,658,115	168,952,932
North American Company (Wisconsin System)	31	323,415,493	75,204,251	398,619,744	11 7	366,884,619	31,735,125
Minneapolis General Electric Company	34	302,670,501	56,806,150	359,476,651	10 6	359,476,651	None
Great Northern Power Company	44	229,020,840	125,890	229,146,730	6 8		
Kansas City Power & Light Company	52	109,096,054	66,843,564	175,939,618	5 2	175,939,618	None
Empire District Electric Company	57	132,224,470	16,515,750	148,740,220	4 4	148,740,220	None
Nebraska Power Company	67	114,200,500	None	114,200,500	3 4		
East South Central States:							
Alabama Power Company	22	477,686,491	10,402,570	488,089,061	29 4		
Tennessee Power Company	28	428,649,835	None	428,649,835	25 8		
West South Central States:							
Texas Power & Light Company	55	159,939,831	None	159,939,831	12 7		
Mountain States:							
Montana Power Company	6	1,103,620,644	None	1,103,620,644	36 4	931,676,544	171,944,100
Utah Power & Light Company	19	519,854,000	None	519,854,000	17 9		
Idaho Power Company	51	184,843,000	None	184,843,000	6 1		
Colorado Power Company	64	116,707,472	40,820	116,748,292	3 8	116,748,292	None
Pacific States:							
Pacific Gas & Electric Company	3	1,349,615,458	126,063,215	1,475,678,673	24 5		
Southern California Edison Company	7	1,045,553,156	33,920,935	1,079,474,091	17 9	763,082,400	316,391,691
Puget Sound Power & Light Company	24	415,389,000	57,376,800	472,765,800	7 9		
Great Western Power Company	30	407,460,730	1,117,024	408,577,754	6 8	381,160,226	27,417,528
Washington Water Power Company	35	351,087,900	None	351,087,900	5 8	334,854,093	16,233,807
San Joaquin Light & Power Corporation	36	285,265,000	14,271,000	299,536,000	5 0	294,165,000	5,371,000
Portland Railway, Light & Power Company	38	292,023,900	295,071	292,318,971	4 9	223,799,000	68,519,971
Southern Sierras Power Co. & Nevada-California Power Co.	53	175,045,183	59,625	175,104,808	2 9	175,104,808	None
Los Angeles Bureau of Power & Light	54	169,489,210	None	169,489,210	2 8	169,489,210	None
California-Oregon Power Company	59	142,404,975	620,843	143,025,818	2 4	143,025,818	None
Tacoma Department of Light and Water	63	119,886,334	711,840	120,598,174	2 0	120,598,174	None
Northwestern Electric Company	68	110,103,594	2,722,495	112,736,089	1 9		
Canada:							
Shawinigan Water & Power Company	5	1,140,759,076	None	1,140,759,076			
Ontario Power Company	8	1,016,070,500	45,525,554	1,061,596,054			
Montreal Light, Heat & Power Consolidated	12	685,279,265	215,049,492	900,328,757		870,000,000	30,328,757
Toronto Power Company	16	649,748,800	None	649,748,800		561,573,800	88,175,000
Electric Railway Companies:							
Interborough Rapid Transit Company	1	816,603,610	None	816,603,610		None	816,603,610
West Penn Railways Company	2	498,353,000	26,623,000	524,976,000		None	524,976,000
Brooklyn Rapid Transit Company	3	401,492,451	88,256	489,748,451		None	489,748,451
Philadelphia Rapid Transit Company	4	125,879,870	223,147,464	349,027,334		None	349,027,334
Boston Elevated Railways Company	5	246,312,170	None	246,312,170		None	246,312,170
Pennsylvania R.R. Co., Long Island Power Plant	6	198,880,070	859,837	199,739,907		None	199,739,907
Kansas City Railways Company	7	189,172,898	None	189,172,898		70,807,706	118,365,192
New York Central Railroad Company	8	157,132,366	None	157,132,366			
Twin City Rapid Transit Company	9	139,711,248	None	139,711,248		None	139,711,248

Table II—Data on Output and Peak Load of Largest Generating and Distributing Systems in the United States and Canada

(This table includes all lighting, power and electric railway companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

	Rank in 1920	1920 Peak Load (kw.)	1920 Date of Peak Load	1920 Yearly Output (Kw.-Hr.)	1919 Peak Load (Kw.)	1919 Date of Peak Load	1919 Yearly Output (Kw.-Hr.)	1918 Peak Load (Kw.)	1918 Date of Peak Load	1918 Yearly Output (Kw.-Hr.)	1917 Peak Load (Kw.)	1917 Date of Peak Load	1917 Yearly Output (Kw.-Hr.)
Niagara Falls Power Company	1	303,640	Apr. 29	2,328,326,064	275,803	Dec. 29	2,034,608,904	254,139	Apr. 8	2,054,360,080	152,340	Aug. 1	1,188,221,770
Commonwealth Edison Company	2	478,820	Dec. 17	1,883,570,000	428,630	Dec. 15	1,628,340,000	400,010	Dec. 2	1,508,070,000	392,330	Dec. 28	1,488,080,000
Pacific Gas & Electric and Sierra & San Francisco Power Co	3	259,004	Dec. 22	1,475,678,673	244,732		1,267,159,767	219,339		1,168,797,446	203,542		1,050,168,618
New York Edison and United Electric Light & Power Co.	4	398,535	Dec. 6 and 22	1,383,070,086	330,210	Nov. 25	1,104,521,883	286,103	Dec. 11	958,878,156	278,097	Dec. 12	954,913,584
Shawinigan Water & Power Company	5	192,200	Nov. 17	1,140,759,076	172,900	Jan. 14	1,031,111,695	136,800	Sept. 24	1,058,136,117	119,000	Dec. 21	633,573,610
Montana Power Company	6	159,700	Aug. 7	1,103,620,644	133,500	June 13	865,998,552	157,800	Nov. 21	1,108,125,350	147,712	Jan. 11	947,732,014
Southern California Edison Company	7	213,450	July 12	1,079,474,091	200,020	July 23	1,021,977,519	163,125	July 12	779,758,000	166,755	Oct. 11	685,416,000
Ontario Power Company	8	152,000	Dec. 15	1,061,596,054	150,000	Nov. 12	949,223,500	119,000	Oct. 19	963,845,200	123,500	Nov. 11	990,086,100
Detroit Edison Company	9	218,800	June 16	1,002,306,000	210,000	Dec. 5	872,583,200	172,000	Dec. 13	773,876,700	152,300	Nov. 27	672,200,600
Public Service Electric Co. of New Jersey	10	216,452	Nov. 16	912,899,972	207,890	Dec. 16	821,355,239	185,738	Dec. 5	795,481,279	181,500	Nov. 27	734,665,649
Philadelphia Electric Company	11	203,624	Nov. 23	910,327,693	199,247	Dec. 18	722,615,280	166,294	Dec. 6	693,447,962	148,931	Nov. 20	600,583,589
Montreal Light, Heat & Power Consolidated	12	169,450	Nov. 17	900,328,757	164,415	Dec. 16	852,680,550	166,730	Dec. 6	976,462,529	152,665	Nov. 12	946,832,817
Duquesne Light Company	13	162,000	Jan. 29	810,401,406	157,900	Dec. 22	623,000,000	141,000	Dec. 6	641,874,585	125,000	Nov. 9	592,575,925
Southern Power Company	14	210,000	Nov. —	745,873,992	196,500	Dec. —	585,596,925	162,600	Dec. —	551,313,367	166,300	May	563,533,763
Cleveland Electric Illuminating Company	15	155,041	Sept. 9	682,557,097	153,878	Dec. 5	576,131,649	128,319	Nov. 22	543,663,042	113,228	Nov. 27	444,735,309
Toronto Power Company	16	109,000	Dec. 21	649,748,800	115,000	Jan. 8	548,477,616	125,000	Dec. 3	897,512,877	118,000	Dec. 14	800,638,000
Mississippi River Power Company	17	115,650	Nov. 13	644,163,000	113,450	Nov. 18	590,488,000	102,950	Mar. 8	557,200,000	86,400	Oct. 31	476,500,000
Buffalo General Electric Company	18	108,500	Oct. 26	544,293,410	106,500	Nov. 22	508,583,680	104,100	Nov. 22	587,761,870	95,400	Dec. 6	440,596,100
Utah Power & Light Company	19	85,404	Nov. —	519,854,000	79,780	Jan. 14	461,531,633	81,313	Dec. 27	533,044,137	79,011	Dec. 21	502,183,000
Pennsylvania Water & Power Company	20	85,000	Very frequent	494,624,400	87,000	Nov.	512,138,100	89,000	Feb. —	500,641,122	86,000	.....	516,891,000
Niagara, Lockport & Ontario Power Company	21	88,000	Jan. 6	492,466,460	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alabama Power Company	22	97,900	Sept. 28	488,089,061	83,100	Jan. 10	347,993,284	86,850	Dec. 19	392,247,862	58,250	Nov. 14	289,715,125
Consumers' Power Company	23	106,924	May 19	476,095,098	108,847	Nov. 28	456,230,164	98,666	Nov. 21	404,412,000	94,235	.....	380,570,917
Puget Sound Power & Light Company	24	95,725	Dec. 3	472,765,800	93,900	Dec. 18	452,209,000	88,230	Dec. 20	427,800,000	83,800	Dec. 21	396,600,000
North American Company (Missouri System)	25	105,749	Dec. 21	471,611,047	99,498	Dec. 3	408,920,575	92,000	Nov. 26	395,820,236	92,300	Dec. 6	370,891,756
New England Power Company	26	103,450	Jan. 6	430,918,000	93,860	Dec. 9	357,303,224	76,900	Dec. 16	323,127,784	71,500	Oct. 30	300,600,000
Consolidated Gas, Electric Light & Pwr. Co. of Baltimore	27	88,990	Nov. 30	429,710,847	80,640	Dec. 5	392,201,280	82,760	Nov. 7	433,196,550	69,980	Dec. 4	343,523,580
Tennessee Power Company	28	74,800	Apr. 30-June 4	428,649,835	82,300	Feb. 14	422,272,590	87,800	Dec. 11	519,959,383	85,200	June 15	547,945,475
Pennsylvania Power & Light Company	29	87,685	Sept. —	411,639,501	81,435	Nov. —	342,071,900	69,100	Dec. —	310,151,400	.....	.....	.....
Great Western Power Company	30	80,600	July 27	408,577,754	48,000	May 12	213,189,992	45,780	.....	180,040,171	40,000	Oct. 24	180,583,920
North American Company (Wisconsin System)	31	90,347	Jan. 6	398,619,744	97,912	Dec. 4	331,874,192	87,855	Nov. 20	327,784,516	71,106	Nov. 30	275,966,740
Edison Electric Illuminating Co. of Boston	32	105,090	Dec. 9	395,076,738	103,136	Dec. 8	328,798,850	95,774	Dec. 6	293,966,604	83,966	Dec. 19	265,430,474
Brooklyn Edison Company	33	116,500	Nov. 30	382,963,027	105,400	Jan. 15	327,084,075	86,000	Dec. 11	282,424,822	78,000	Dec. 19	255,912,300
Minneapolis General Electric Company	34	78,010	Oct. 26	359,476,651	72,745	Oct. 24	332,264,401	66,189	Nov. 1	297,443,050	54,940	Dec. 6	222,146,210
Washington Water Power Company	35	63,955	Jan. 21	351,087,900	63,220	Dec. 3	241,761,350	33,956	Nov. 26	195,628,500	36,707	Dec. 20	188,311,100
San Joaquin Light & Power Corporation	36	47,180	Aug. 28	299,536,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Georgia Railway & Power Company	37	76,000	Apr. 9	293,721,290	71,700	Dec. 18	262,834,541	68,000	Nov. 8	238,489,012	78,200	Apr. 24	258,607,882
Portland Railway, Light & Power Company	38	62,600	Dec. 6	292,318,971	56,300	Dec. 22	271,600,300	56,900	Dec. 23	258,424,940	50,620	Dec. 31	218,086,315
Adirondack Power & Light Corporation	39	60,700	Dec. 2	277,100,000	66,000	Dec. 23	261,400,000	50,250	Nov. 8-Jan. 23	174,567,275	42,000	Dec. 7 & 14	158,570,164
Michigan Northern Power Company	40	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264,272,468	33,519	Dec. 24	233,381,654	32,990	Dec. 3	221,538,757
Pennsylvania-Ohio Power & Light Company	41	48,900	Nov. 3	255,537,150	.....	.....	.....	.....	.....	.....	.....	.....	.....
Northern Ohio Electric Corporation	42	44,400	May —	247,109,963	.....	.....	.....	.....	.....	.....	.....	.....	.....
Union Gas & Electric Company	43	65,050	Dec. 21	234,634,375	.....	.....	.....	.....	.....	.....	.....	.....	.....
Great Northern Power Company	44	46,000	Apr. 20	229,146,730	48,000	May 12	213,189,992	45,780	.....	180,040,171	40,000	Oct. 24	180,583,920
Potomac Electric Power Company	45	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204,008,647	48,000	Dec. 20	173,180,014	44,800	.....	140,762,646
Narragansett Electric Lighting Company	46	54,000	Jan. 5 & Nov 16	213,232,000	57,000	Dec. 23	155,678,890	45,000	June 20	150,028,780	33,500	Dec. 19	113,238,441
Turners Falls Power & Light Company	47	55,500	May 27	212,926,530	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virginia Railway & Power Company	48	46,150	Dec. 22	208,517,000	42,800	Dec. 18	181,280,000	35,700	Dec. 18	164,810,750	37,000	Dec. 8	153,128,026
Toledo Railways & Light Company	49	52,400	Mar. —	207,830,610	48,220	Dec. —	199,771,799	40,305	Dec. 4	161,103,970	37,627	Dec. —	162,061,232
Rochester Gas & Electric Corporation	50	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172,892,249	52,300	Nov. 22	196,171,300	42,154	Dec. 13	162,490,264
Idaho Power Company	51	34,235	July —	184,843,000	27,090	Aug. —	154,754,000	24,350	Sept. —	134,355,000	..	.....	.....
Kansas City Power & Light Company	52	35,500	Dec. 23	175,939,618	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Sierras Power Co. & Nevada-Calif. Pwr. Co.	53	32,600	July 23	175,104,808	29,200	.....	165,782,785	28,200	Aug. 6	161,347,690	25,900	Aug. 9	148,267,885
Los Angeles Bureau of Power & Light	54	46,500	Dec. 29	169,489,210	24,650	Apr. 12	134,893,270	.....	.....	.....	.....	.....	.....
Texas Power & Light Company	55	33,620	Oct. 14	159,939,831	29,000	Nov. 7	121,212,000	28,800	Sept. —	118,850,000	..	.....	.....
Columbus Railway, Power & Light Company	56	.....	.....	*153,626,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Empire District Electric Company	57	36,710	June —	148,740,220	32,030	Oct. —	130,114,100	25,400	Sept. 5	114,446,685	23,000	Apr. 1	105,487,860
Appalachian Power Company	58	35,300	Oct. —	148,700,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
California-Oregon Power Company	59	20,335	Jan. 28	143,025,818	..	..	..	..	..	..	..	..	..
Acme Power Company	60	.....	.....	137,701,000	..	..	..	..	..	..	..	..	..
Metropolitan Edison Company	61	28,000	Aug. 10	133,994,030	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dayton Power & Light Company	62	31,500	5/25 and 9/28	129,618,270	..	..	..	..	..	..	..	..	..
Tacoma Department of Light and Water	63	22,700	Nov. 10	120,598,174	..	..	..	..	..	..	..	..	..
Colorado Power Company	64	29,078	Oct. 1	116,748,292	..	..	..	..	..	..	..	..	..
Scranton Electric Company	65	26,580	Jan. 9	116,387,472	..	..	..	..	..	..	..	..	..

Indianapolis Light & Heat Company	66	27,240	Sept. 15	114,416,094	22,600	Dec. 22	97,444,900	19,700	Dec. 18	74,708,000						
Nebraska Power Company	67	25,500	Nov. 26	114,200,500												
Northwestern Electric Company	68	20,600	Dec. 10	112,736,089												
New Bedford Gas & Edison Light Co.	69	33,700	June 17	107,599,392												
Indiana & Michigan Electric Company	70	27,130	Nov. 9	103,693,910	23,100	Dec. 23	84,160,770	20,700	Dec. 15	81,625,432	18,800	Dec. 14	73,546,109			
Hartford Electric Light Company	71	32,500	Jan. 9	103,000,000												
Electric Railway Companies																
Interborough Rapid Transit Company	1	242,020	Jan. 31	816,603,610	239,940	Dec. 19	810,158,475	204,000	Dec. 30	731,058,965	184,000	Dec. 11	689,665,975			
West Penn Railways Company	2	104,618	Nov. 24	524,976,000	94,130	Dec. 22	417,911,000	78,000	Dec. —	404,200,000						
Brooklyn Rapid Transit Company	3	111,147	Jan. 15	489,748,451	111,000	Dec. 16	406,190,443	109,892	Feb. 21	385,346,075	115,792	Feb. 2	396,068,887			
Philadelphia Rapid Transit Company	4	102,210	Jan. 14	349,027,334	101,120	Dec. 18	349,542,666	94,730	Dec. 27	339,232,739	103,220	Jan. 11	348,372,056			
Boston Elevated Railway Company	5	72,295	Jan. 14	246,312,170	71,760	Mar. 23	240,429,915	67,965	Mar. 23	228,131,265	79,535	Feb. 12	262,920,065			
Pennsylvania R.R. Co., Long Island Power Plant	6	55,200	Jan. 5	199,737,907	53,900	Dec. 19	181,017,940	48,600	Jan. 3	165,377,180	45,000	Dec. 10	161,673,710			
Kansas City Railways Company	7	51,740	Jan. 8	189,122,898	49,430	Oct. 27	211,707,571	57,280	Jan. 11	209,378,747	61,350	Feb. 2	236,675,814			
New York Central Railroad Company	8	46,440	Dec. 27	157,132,366	44,100	Dec. 29	140,435,406	38,360	Jan. 22	127,412,457	42,480	Dec. 10	147,809,842			
Twin City Rapid Transit Company	9	42,700	Dec. 21	139,711,248	42,612	Nov. 28	133,676,028	44,966	Feb. 19	131,351,288	51,956	Mar. 31	152,469,348			

* Estimated for four months of 1920. Blank indicates that no report covering year was received from company.

panies as well. Such conditions do not tend to produce large municipal plants with great outputs. It is of interest to the student of the problem to study the source of the electrical energy which is distributed by these larger companies. Statistics of the industry compiled since electrical energy became one of the chief sources of power indicate that as the number of large generating stations has increased and long high-tension transmission lines have been extended over wide areas there has normally been an increasing tendency for small plants to discard their generating equipment and purchase energy from the larger and more economically operated systems. Many new stations have been installed of which the sole function is to distribute to customers the energy produced by others. It is evident from the data in Table I that this tendency toward functioning as a distributing company rather than as both a generating and distributing company has gained considerable headway among the larger systems of the country. The extent to which the large companies are purchasing power for distribution to their customers is rather surprising. Of the sixty-six American light and power companies, only twenty-four do not purchase energy and only six purchase more energy than they generate in their own plants. Of the nine electric railway companies listed only four purchased a portion of their energy and only one purchased more energy than it generated. In years past most companies have purchased power from other public utilities only at irregular intervals when there was an abnormal request for energy beyond the rating of their own generating stations. The accompanying tabulation would indicate that such an arrangement is now rather the exception than the rule and that a majority of the large electric distributing companies are purchasing a high percentage of their total output. Two possible causes for these conditions are applicable. First, many of these companies are able to purchase a large portion of their power from other public utilities cheaper than they can generate it themselves, owing to the facilities for cheap development in the locality, such as water power, having been acquired by other generating companies. Second, a comparatively high initial investment in plant and equipment of various kinds is needed to generate the additional power which is purchased. In the first case the arrangement is permanent, while in the second case a lowering in construction and equipment prices as well as a more favorable money market, including a lower rate of interest, will undoubtedly enable a large portion of these companies to construct additional units on their systems and to curtail their purchased power to enough for emergencies only. It is estimated that at the present time the central generating plants of this country are deficient in generating units to the extent of about 2,800,000 kw. Many companies indicate that they intend making large extensions to their generating equipment just as soon as prices and the industrial conditions warrant.

A few companies were unable to report their output as distributed between that sold for light and power purposes and that sold to electric railways. From those making such a distribution, however, it is possible to state that about three out of every four generating systems sell a portion of their power to electric railways. In most cases the energy sold to electric railways is less than 12 per cent of the total output, but some of the larger companies, such as the Southern California Edison Company, report a distribution of from 25 to 30 per cent of their total output to electric railways.

Reports from electric railway generating plants indicate that only nine such plants generated more than 100,000,000 kw.-hr. in 1920. Only one of these companies sold a small portion of its energy to electric light and power customers. With but two exceptions all these companies are operating in the New England and Middle Atlantic states. With the exception of the Interborough Rapid Transit Company, operating in Greater New York, and the West Penn Railway Company, operating in the Pittsburgh district, none of the electric railway companies shows such large gains in output during the past four years as are shown by practically all the large electric light and power companies. The electrical energy consumed by electric railways varies to a large extent directly as the population of the territory served, while the electrical energy distributed by electric light and power companies varies not only with the population but also with the extent to which that population is converted to the use of electricity both for light and power. It should be noted, however, that the peak load of the electric railway companies increased in every instance over that reported for 1919, and that the dates of the peak loads all occurred within thirty days of one another, with the exception of that reported by the West Penn Railway Company.

Testing for Phase Rotation in Three-Phase Circuits

In Field Measurements It Is Often Necessary to Determine Whether Current Is Leading or Lagging—Methods Requiring Little or No Auxiliary Apparatus

By F. A. Kartak
Formerly Director Standards Laboratory, University of Wisconsin

IN PREVIOUS articles in these columns by H. M. Crothers and the writer* relating to the testing of instrument transformers use was made of voltages and currents displaced in phase in connection with the determination of instrument-transformer phase angles. In the case of field testing work the suggestion was made that adjacent phases of a three-phase system be used for voltage and current circuits, thus giving a power factor of approximately 50 per cent. It was further assumed that the tester has means of knowing whether the power factor so obtained is lagging or leading, that is, whether the current is lagging or leading the voltage in phase position.

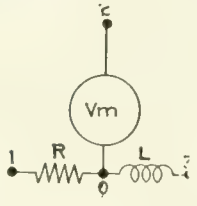
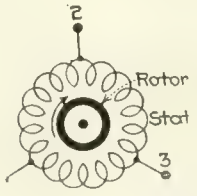
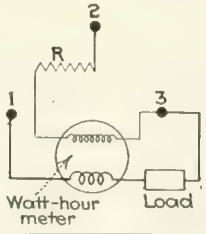
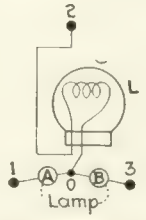
*See Electrical World, March 15 and July 19, 1919, and Feb. 7 and June 12, 1920.

Some of the field methods of testing for phase rotation to ascertain whether the power factor is leading or lagging which have been used by the standards laboratory of the University of Wisconsin are shown in the table, which includes most of the necessary information, references to the original articles describing them being also indicated. This table gives specific directions for obtaining lagging current at 50 per cent power factor, but the methods are suitable for broad application in determining phase rotation.

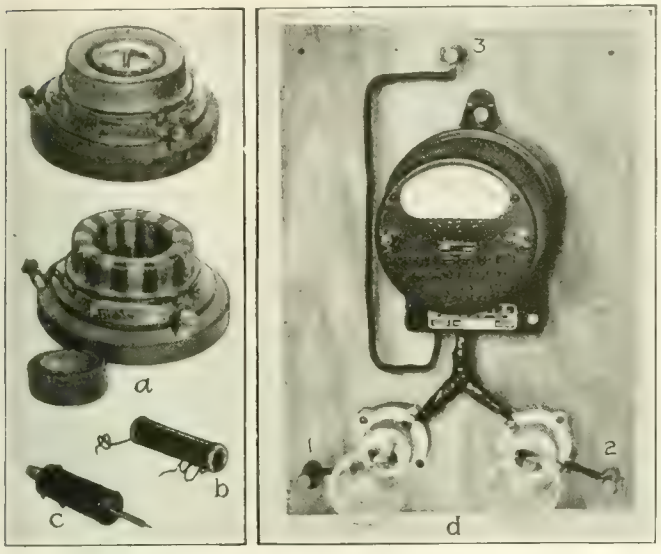
The miniature three-phase induction motor called for in method No. 2, which is shown at (*a*) in the figure, may be conveniently carried in a meterman's tool kit. By connecting the terminals of the stator to the leads of the three-phase power supply the direction of rotation of the squirrel-cage rotor indicates directly the direction of phase rotation. The only objection to this method is that the meterman is required to carry this additional apparatus.

In method No. 1 the resistance and reactance of equal

Classification of Methods of Testing for Phase Rotation

Method No.	Method Description	Apparatus Required	Connections	For Lagging Current 50 Per Cent Power Factor Connect Meter Circuits as follows:	References
1	Resistance—Reactance—Voltmeter Method	Resistance and reactance of equal value Indicating voltmeter with range 1.4 times line voltage		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if voltmeter indicates approximately 137 per cent of line voltage	W. V. Lyon El. Wld. Vol. 69, p. 968 May 19, 1917
2	Induction Motor Method	Miniature squirrel-cage rotor induction motor		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if rotation is in the direction 1 — 2 — 3	
3	Watt-hour Meter-Resistance Method	Single phase induction watt-hour meter High non-inductive resistance (about 10,000 ohms for 110 volt circuits)		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if meter operates faster when voltage circuit is connected across phase (2 — 3) than when connected across phase (1 — 2)	R. S. Brown El. Wld. Vol. 63 p. 144 Jan. 17, 1914
4	Lamp and Inductance Method	Two incandescent electric lamps of equal voltage and wattage rating One high reactance coil (voltage circuit of induction watt-hour meter)		Voltage circuit across phase (1 — 2) Current circuit across phase (3 — 1) if lamp (A) is brighter than lamp (B)	T. W. Varley El. Wld. Vol. 69, p. 466 Mar. 10, 1917

value are connected in series across one phase and a voltmeter is connected from their common junction to the third phase wire. If the voltmeter indicates approximately 37 per cent of the line voltage, phase 1-2 leads phase 2-3 by 120 deg. If the voltmeter indicates approximately 137 per cent of line voltage, phase 1-2 lags the phase 2-3. The only objection to the use of this method is that it also requires a meterman to carry additional equipment.



DEVICES USED FOR DETERMINING PHASE ROTATION AS SHOWN IN TABLE

(a) Miniature induction motor (method 2). *(b)* and *(c)* Convenient non-inductive resistances (method 3). *(d)* Lamp and meter scheme has the advantage that this equipment need not be carried, but may be obtained wherever tests are made.

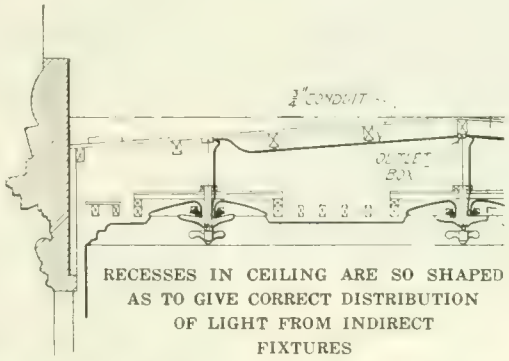
Method 3 requires only the use of a non-inductive resistor of high value (about 10,000 ohms for 110-volt circuits), such as shown at (*b*) or (*c*) in the figure. By testing the service watt-hour meter in the usual manner with a portable standard watt-hour meter, after connecting the high resistance in series with the voltage circuit of the service meter and after connecting the voltage and current circuits of the meter to adjacent phases of the power supply, the 50 per cent lagging power-factor connection is the one which shows the service meter to be operating the slower in the two tests. While this method requires the meterman to carry only a small resistor, which may be of the Ward-Leonard enameled type or may consist of a short fiber tube packed with powdered chalk and carbon dust as shown at (*b*) and (*c*), it is not extremely satisfactory in that it requires the meterman to set up and make two test runs before he is certain his connection is the correct one.

Method 4 is now being used and recommended by the standards laboratory since it requires the use of only such equipment as the meter tester always carries with him or can find available at almost every installation. By connecting in star to the three-phase supply leads two similar incandescent electric lamps and a reactor (such as the voltage circuit of the service meter or the portable standard watt-hour meter) it will be observed that the filament of one lamp will operate more brightly than that of the other, depending upon the direction of phase rotation. A 50 per cent lagging power factor is obtained by connecting the current coil or load circuit of the meters to the phase to which are connected the two lamps, and the voltage circuit of the meter to the phase terminals to which are connected the bright lamp and the meter coil. At (*d*) is shown all of the equipment necessary for making a test of this kind, this equipment as shown having been assembled for use about the laboratory.

Indirect Ceiling Fixtures Provide Even Illumination for Library

EVENLY distributed and adequate illumination has been obtained for a large library on the Pacific Coast by indirect lighting fixtures mounted close to recesses in the ceiling. These recesses are shaped to provide the correct distribution of light. So well was the design carried out that practically no shadows were formed on the floor, and the illumination produced is practically ideal for the purpose for which it is intended.

The lamp bulbs are supplied from a circuit carried in a ¾-in. (18-mm.) conduit fastened to the beams of the upper ceiling, taps being taken off of the line at points directly above the lighting fixtures. A good idea of the wiring construction may be obtained from the cross-section through these ceiling recesses. From the halftone the excellent distribution of light can be readily seen.



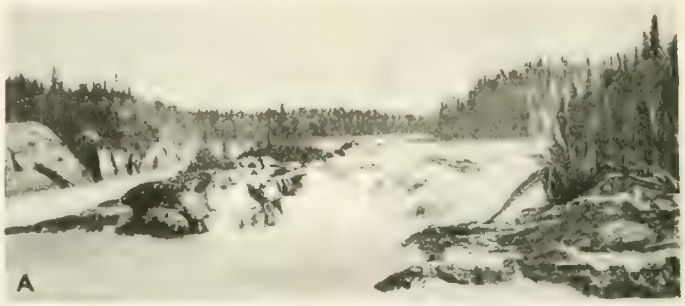
RECESSES IN CEILING ARE SO SHAPED AS TO GIVE CORRECT DISTRIBUTION OF LIGHT FROM INDIRECT FIXTURES



INDIRECT FIXTURES GIVE ADEQUATE ILLUMINATION IN THIS LIBRARY

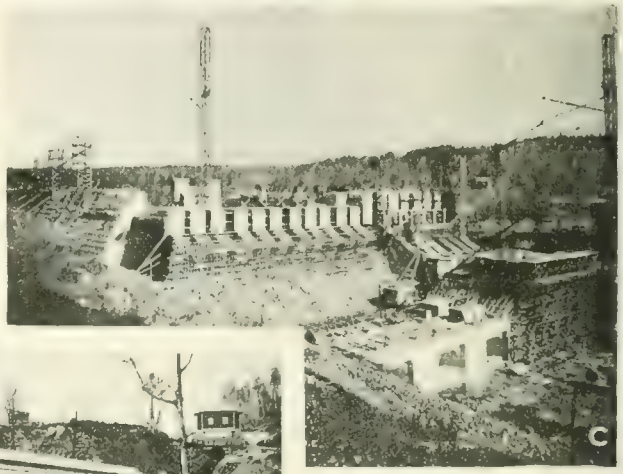
Canadian Developments Now 274 Hp. per 1,000 of Population

One feature of Canadian progress has been the development of numerous small plants for industrial purposes



There are many undeveloped sites that will be available for power purposes as the needs of the Dominion increase













A — Whitemund Falls, Nelson River, Manitoba, an undeveloped site.

B—St. Margaret's Bay development on the Northeast and Indian Rivers, Nova Scotia, which will serve the city of Halifax.

C—Cameron Falls plant on the Nipigon River, Ontario, which is a part of the Ontario Hydro-Electric Power Commission's development serving the Thunder Bay system.

D—High Falls development in the Mississippi River in Ontario, showing power house, penstock and gatehouse. This is a part of the Rideau system, Ontario Hydro-Electric Power Commission.

E—A possible site on the Nahave River in Nova Scotia, known as Indian Falls.

F—Ragged Falls on the Sepreaun River, New Brunswick, which offers possibilities as a future development. There is also another important site at Big Falls.

G—The second pitch of the Grand du Bonnet Falls, Winnipeg River, Manitoba. This part of the river is now in the process of development by the Winnipeg Power Company and will total initially 56,000 hp. with an ultimate capacity of 168,000 hp. Slave Falls is also another possible site for power development on the Winnipeg River.

Canada Shows Rapid Hydro Development

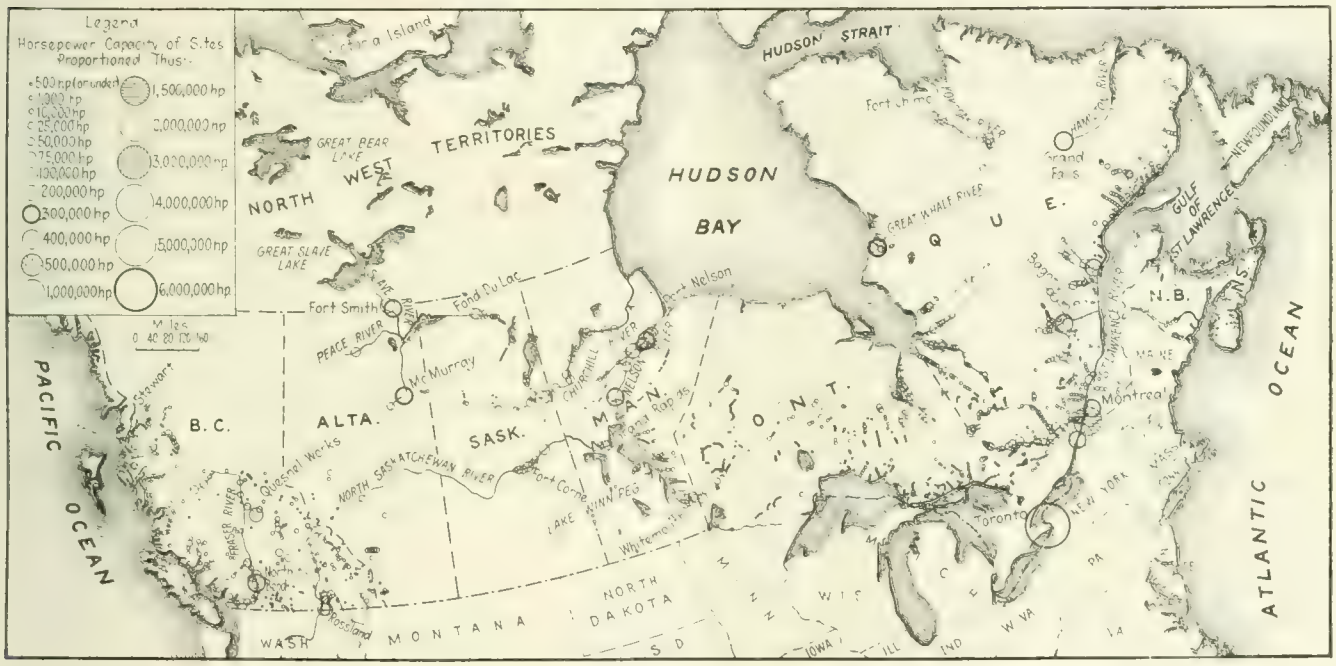
Work Completed or Under Way During 1920 Totals 650,000 Hp.—Total Developments of the Dominion Now Stand at 2,460,000 Hp.—Ontario Shows the Greatest Progress

By J. B. CHALLIS
Director of Water Power Dominion of Canada, Ottawa, Ont.

IN SPITE of the outstanding facts that financial and commercial conditions are still far from normal and that costs of construction are prohibitive for all but absolutely necessary undertakings, a review of the year's work in hydro-electric matters in Canada shows considerable progress and encouragement for the future. The total development work completed or under construction in 1920 represented approximately 650,000 hp. of installed capacity. The total developed hydro-electric power in the Dominion now stands at 2,460,000 hp. Taking the population at 9,000,000 (estimate tabled in the House of Commons April 6, 1920), the development per 1,000 of population is 274 hp., a figure far ahead of the United States and ahead of any other country in the world except Norway.

The Province of Ontario still leads in magnitude of development under construction, the total being approximately 500,000 hp. during 1920. The Province of Quebec comes next in order of development activity, while Nova Scotia and New Brunswick have entered on an active policy of provincial government development of their water-power resources. Great activity has also been shown in organized general hydrometric investigation and the planning of further development. With the exception of Quebec, all of this work has been transferred to or co-ordinated by the Dominion Water Power Branch. On July 19, 1920, the Hydrometric Survey of Canada was established by Dominion order-in-council, the work to be conducted under the supervision of the Director of Water Power. Previously there had been some confusion existing between the work carried on in the various provinces and that done by the central government. Arrangements have also been reached with the Quebec authorities so that all preliminary investigatory work will be standardized and the results co-ordinated with those of the other provinces.

Reviewing the development work in Nova Scotia in 1920, it has been shown that this province contains a number of conveniently located and economic sites, that



POSSIBLE SITES FOR WATER POWER IN CANADA, SHOWING THE ESTIMATED CAPACITY

The first projects undertaken by the Nova Scotia Power Commission and commenced in 1920 were the St. Margaret's Bay development, to supply the city of Halifax, and a hydro-electric system for the county of Lunenburg. The St. Margaret's Bay development is the first hydro-electric plant of considerable size in the province. It consists of two separate generating stations—the Tidewater generating station, at the head of St. Margaret's Bay near the mouth of Northeast River, designed to give 6,900 hp., and the Mill Lake generating station, on Northeast River, to give 3,920 hp., a present total for the two stations of 10,820 hp., with an ultimate capacity of 15,000 hp. Storage is also under construction at several points. These developments are intended to supply the city of Halifax, and it is expected that some power will be available next August.

The Lunenburg system is designed to supply Mahone,

Lunenburg, Riverport and other communities in that county. An existing plant on the Mushamush River has been taken over and extended, plans are practically completed for a new development, and a third is being considered, so that the water of this river may be used three times.

Other considerable plans are in hand by the commission, though not yet actually under construction, including the Sheet Harbor project, with an installation of 25,000 hp., to supply New Glasgow, Stellarton, Trenton and other places, and the industries of Pictou County, and the Bear River project for stations of 1,200 hp. and 7,500 hp. to supply Digby and other towns and projected industries. Among industrial concerns, the Sissiboo Pulp & Paper Company installed 2,600 hp. and other companies about 1,700 hp., of which part was for both industrial and utility purposes.

Progress in New Brunswick

In New Brunswick progress in 1920 consisted of more than 18,000 hp. installed or under construction with a number of developments in immediate prospect. Expert investigation has shown that ample water-power resources and facilities are available, and the New Brunswick Electric Power Commission (formed in 1920) has instituted the work described below.

For the supply of the city of St. John and district the following three projects have been thoroughly investigated: Musquash River, 8,000 hp.; Lepreau River, 12,000 hp.; Magaguadavis River, 15,000 hp. Construction work has been commenced on the Musquash plant, where three units totaling 11,000 hp. will be installed.

Investigations are being made with a view to developing 8,000 hp. on the Shogomoc River and 8,000 hp. from two sites on the Pokick River. Investigations have been made with the object of supplying the towns in the North Shore districts from the Tetagouche River, on which four developments can be made totaling 10,000 hp. and which has considerable storage available. It is expected to complete arrangements with the Bathurst Lumber Company, which has a 9,000-hp. plant under construction, to supply power to this district until the commission's plant is installed.

The more important new industrial work under construction in 1920 includes 2,400 hp. by Fraser's, Ltd., for pulp work; 2,000 hp. added by the Maine & New Brunswick Power Company; 3,000 hp. by Canadian Cottons, Ltd., and 9,000 hp. by the Bathurst Lumber Company.

Among the principal undertakings either completed or commenced in Quebec during the year were those of the Cedar Rapids Company, 21,600 hp.; the Shawinigan Company, 42,000 hp.; the Laurentide Company, 42,000 hp.; the Lothiniere Lumber Company, 1,680 hp.; La Corporation d'Energie de Montmagny, 3,600 hp.; Price Brothers & Company, Chicoutimi, 17,600 hp.; city of Rivière du Loup, 525 hp.; Southern Canada Power Company, Drummondville, 7,000 hp., and Canadian Consolidated Rubber Company, St. Jerome, 450 hp. The total new power development work approximated 137,000 hp., and a number of other large projects seem assured of commencement in the coming season.

Ontario Shows Largest Development

In pursuance of the co-operative agreement made in 1919 between the Hydro-Electric Power Commission of Ontario and the Department of the Interior, the Dominion Water Power Branch is now responsible for all basic investigation respecting water resources, while the province undertakes the detailed investigation for and construction of actual developments. Under the agreement a special bureau of the Dominion Water Power Branch has been formed to deal with the work, with headquarters at Ottawa; the stream measurement and investigatory studies have been largely extended, and a very thorough inventory and analysis of developed and undeveloped water-power and storage resources is in course of preparation.

Among the important investigatory work that falls naturally under the heading "Ontario," and to which much time and labor have been devoted during the past year, there may be mentioned the studies on the St. Lawrence River and on the regulation of the Lake of the Woods for storage purposes.

The installation of two new units of 20,000 hp. each by the Hydro-Electric Power Commission in the plant formerly owned by the Ontario Power Company at Niagara Falls, and of a 3,500-hp. plant at High Falls on the Mississippi River, near Perth, to supply the Rideau System, were completed in 1920. The great development at Queenston, on the Niagara River, has made substantial progress in spite of serious labor troubles, and it is expected to commence supply in September next. This plant, with an initial installation of five 60,000-hp. units and designed for an ultimate capacity of 540,000 hp., is greatly needed to meet the present power shortage. The development on the Nipigon River to supply Port Arthur, Fort William and district, with an initial installation at 25,000 hp. and an ultimate capacity of 75,000 hp., is now supplying power from the first unit. At Ranney's Falls in the Trent River, near Campbellford, the construction has been commenced of a 10,000-hp. plant to supply the central Ontario system. The total capacity of plants now owned by the Hydro-Electric Power Commission is stated to be over 1,000,000 hp.

In the list of private developments the Big Eddy Dam on Spanish River at Algoma, to create a 15,000-hp. site for the International Nickel Company, was completed. Among the more important plants under construction were those of the Spruce Falls Company on the Kapuskasing River, 11,600 hp. for a pulp mill; the Abitibi Power & Paper Company, 24,000 hp. at Twin Falls, expected to be completed next April; plants on the Sturgeon River and Vermilion River by the Spanish River Pulp & Paper Company; an extension of 9,000 hp. by the Great Lakes Power Company at Sault Ste. Marie; a plant of 4,500 hp. by Canadian Cottons, Ltd., on the Cornwall Canal, and others.

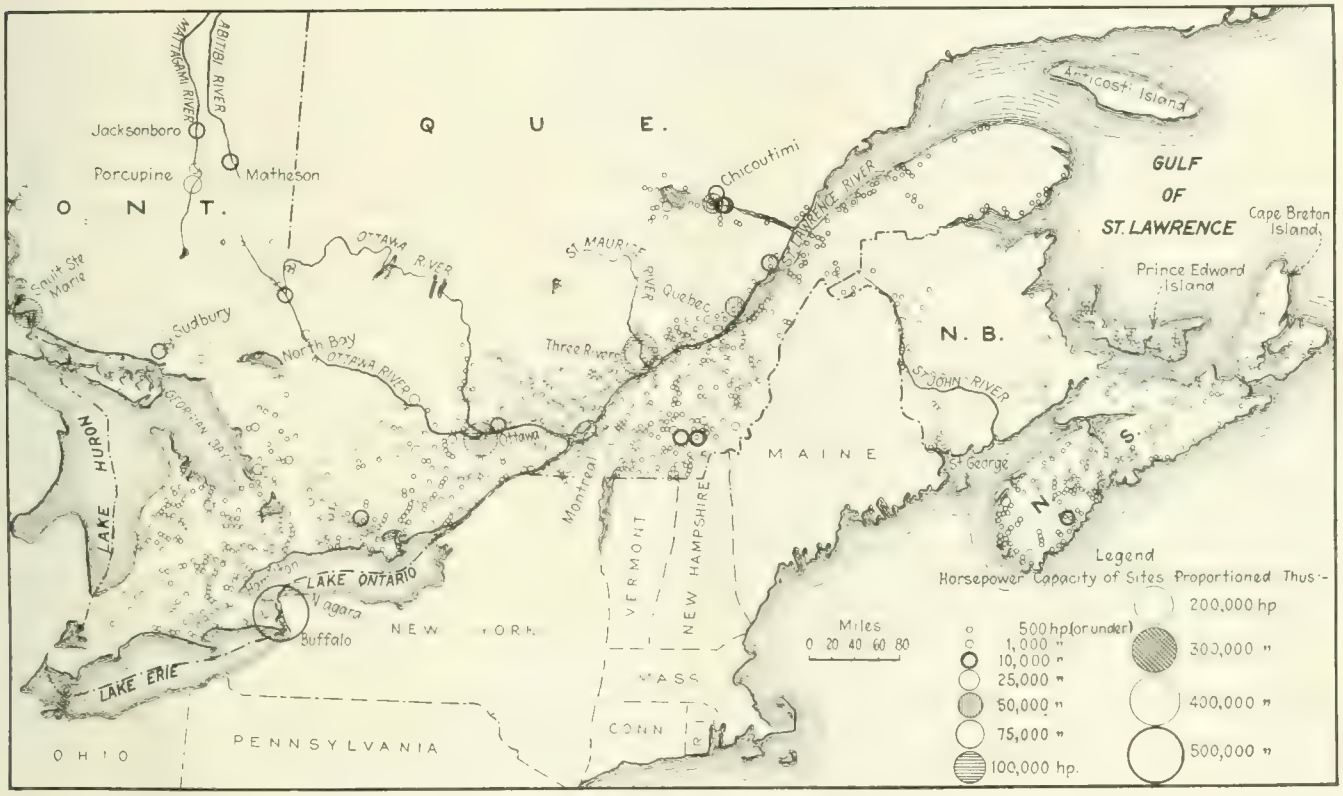
It will thus be seen that in Ontario in 1920 there was approximately 500,000 hp. of hydro-electric development under construction.

Winnipeg Developments Most Important in Manitoba

The city of Winnipeg's hydro-electric plant at Point du Bois, on the Winnipeg River, consisted at the end of 1919 of eight units totaling 46,400 hp., the headworks and draft tubes being completed for an additional eight units. Early in 1920 contracts were let for extensions to the power house and for three additional units of 6,900 hp. each, at a total cost of $300,000 and to be completed by Sept. 1, 1921. An additional transmission line at a cost of $700,000 is now nearing completion. The total capacity of this plant will then be 67,100 hp. The ultimate capacity is sixteen units, totaling more

than 100,000 hp. The Winnipeg Electric Railway Company, which gives a general electric light and power supply in addition to operating the street railway, has a plant on the Pinawa Channel of the Winnipeg River of which the capacity was 28,200 hp. Recent improvements to the channel, increasing the head, and improvements to the plant have increased the maximum capacity to 37,600 hp. This company also controls a further development under construction on the same river, referred to below under the head of the Winnipeg River Power Company.

It is of interest to note that the combined efforts of the city and the Winnipeg Electric Railway Company to supply electric power at low rates have borne marked results in the development of manufacturing industries. In number of factories and value of product Winnipeg



EXTENSIVE WATER-POWER DEVELOPMENTS ARE SHOWN IN THE EASTERN INDUSTRIAL SECTION OF THE DOMINION

now ranks as the fourth manufacturing city in Canada, and in the consumption of electric energy per annum, per head of population (823 kw.-hr.) it is surpassed by few cities in the world.

It should also be noted that the power available from the Winnipeg River exceeds 400,000 minimum twenty-four-hour continuous horsepower from nine sites within 80 miles (129 km.) of Winnipeg, sufficient to meet all requirements for many years to come.

The Winnipeg River Power Company has commenced construction on a site at Lac du Bonnet on the Winnipeg River designed for an initial development of 56,000 hp. and an ultimate capacity of 168,000 hp.

The Manitoba Power Commission, created by the electrical power transmission act of 1919, was formed for the purpose of distributing electrical energy throughout the province, and it was authorized either to purchase or to generate power for the supply of any community where this was economically feasible. The intention was not to confine operations to water power, but where it was more advisable to supply fuel-generated power to groups of communities linked up to separate systems and so to design each such system that it might eventually become a link in the general provincial system. The commission immediately undertook the supply of power to Portage la Prairie, 56 miles (90 km.) from Winnipeg, the power to be purchased in bulk from the hydro-electric plant of the city of Winnipeg, transmitted at 66,000 volts by the commission and delivered in bulk to Portage la Prairie.

Since that date the operations of the commission have developed with considerable rapidity along broad but conservative lines. Power was turned on to the Portage la Prairie line on Aug. 16, 1920, and in the meantime the matter of supplying other municipalities in central and southern Manitoba was investigated and in a number of cases undertaken. During the year the construction of transmission lines was commenced to the municipalities of Roland, Carman, Morden, Oakville, Winkler, Manitou and Gladstone, involving a transmission network of some 175 miles (281 km.), and investigations were also carried on with a view to supplying Emerson, Oakville, Rollin, Minnedosa, Virden and other municipalities that had petitioned for a supply.

While no actual development has occurred in Saskatchewan during the year, considerable progress has been made in organization of the large and important project to divert and elevate water from the South Saskatchewan River for supply to Moose Jaw, Regina and other cities and towns throughout the dry belt of south Saskatchewan.

No developments have taken place in the Province of Alberta during 1920, but the future possibilities are large and promising. The Peace, Athabasca and Slave Rivers in the north possess a number of excellent power sites, and the apparently imminent mineral developments in that region will probably lead to early development of some of these water powers for which applications have

already been received. Investigations are being made with a view to increasing the storage for the Bow River developments and also with respect to power projects in the Spray Lake district.

In British Columbia also the basic work of investigation is carried out by the Dominion Water Power Branch under a co-operative agreement with the Provincial Water Rights Branch, in force since 1913, and in view of the large amount of data and length of period these investigations cover, a comprehensive summary and analysis of the water-power resources of the province was commenced in 1920.

While these resources, estimated at 3,000,000 hp., include many accessible and favorable sites, the actual construction work in 1920 was in comparatively small units for individual mines and other purposes. Plans are, however, well advanced for a number of large developments, and among these may be mentioned that of the Bridge River Power Company at Seton Lake for an initial development of 50,000 hp., with an ultimate capacity with storage of 360,000 hp.

An outstanding feature of the year in water-power history was the acquisition by the British Columbia Electric Railway Company of the Western Power Company of Canada and its 39,000-hp. plant at Stave Falls. This is stated to have brought the total investment of the company in British Columbia to $65,000,000.

During the past year the Dominion Water Power Branch took over the administration of the water powers in the Yukon Territory formerly administered by the Mining Lands and Yukon Branch. The development of the mining industry is almost entirely dependent upon the development of water power, and during the year a hurried inspection and preliminary estimates were made of the available power resources in the Mayo district. The Yukon and Northwest Territories are well supplied with water power, and important applications have been received for their development. It is intended to carry out more detailed investigation this season.

France to Undertake the Development of Tidal Power

THE much-discussed plan to develop tidal power in France has been brought nearer to realization by the inclusion in the budget of the Minister of Public Works of an item appropriating 2,500,000 francs for the construction of machinery at the mouth of the Rance River with this object in view. The plan is simple. The Rance has a 30-ft. tide. Enormous reservoirs will be constructed into and out of which tide water will flow through openings holding turbines. When the tide rises the turbines will turn, and when the tide runs out they will also be kept in revolution.

"France must use all her natural forces," the Minister of Public Works said in support of the proposed appropriation. "To the white coal of our mountains and the green coal of our fields we are going to add the blue coal which the length of our seaboard renders available to an enormous extent." He added that the work of construction would be done by a French firm, and that he had already received applications for concessions of power. He said soundings were now going on at the mouth of the Rance with a view to starting work on the reservoirs.

The most difficult task of the French engineers was to perfect a turbine which would work reliably under water and which would turn with great quickness in response to a comparatively slow movement. It is understood that the most important part of the construction will consist of three reservoirs formed by walls 500 yd. long and 25 yd. high, measured from the bed of the river. The Minister said that he expected the Rance plant to develop 30,000 hp. or 40,000 hp.

Redesigned Stirling Boilers to Have Fewer Classes

Reclassification and Standardization that Simplifies Tube Lengths, Drum Locations and Other Fundamental Elements

IN THE redesign of the Stirling boiler to incorporate certain improvements in construction a reclassification has been worked out. Formerly boilers were sold very generally to meet a specific set of space conditions. The result of that practice was the evolution of a number of boilers of approximately the same heating surface, but with radically different over-all dimensions, the different units coming to be known as classes. The builders of the Stirling boiler, while maintaining the same features of construction and design in the different classes, apparently paid no attention to the method of variation between classes, the result being a series of classes having little in common as to relative drum locations, tube inclinations, tube lengths or ratios of grate surface or heating surface. An accompanying figure shows in outline fourteen of the classes that were developed under this system superimposed one over the other and indicates the wide variation in the features.

In the new classification the variation between the classes and sizes is simple, logical and progressive. The method in variation between classes is clearly indicated in the drawing, the system shown thereby being, of course, unlimited in the extent to which it may be carried. It is of interest to compare this with the method of variation between classes hitherto used.

While the purchaser of steam boilers is not primarily interested in methods of manufacture provided proper construction methods are followed, it is, however, the purchaser who ultimately receives the benefit of any improvements in manufacturing methods. The reclassification of the Stirling boiler will undoubtedly lead to a reduction in manufacturing cost.

The reduction in manufacturing cost that will result from the reclassification will come about through a reduction in inventory of material that must be carried and in the number of standards in use, the greater number of parts applicable to the large proportion of the boilers built, the interchangeability of such parts, the manufacturers' ability to build more nearly for stock and through an increase in flexibility of output and ability to make quicker shipments.

Although the manufacturer of this boiler will offer previous standards to complete plants in which such standards were installed, it is the intention to offer the redesigned and reclassified boilers for all new work.

The principal improvements in design over the boiler hitherto offered are stated in the following paragraphs:

First—All steam drums are now placed on the same level, the steam being taken from the rear steam drum.

The steam and water circulating tubes which come between the drums are designed and proportioned on the basis of numerous tests made under service conditions, the

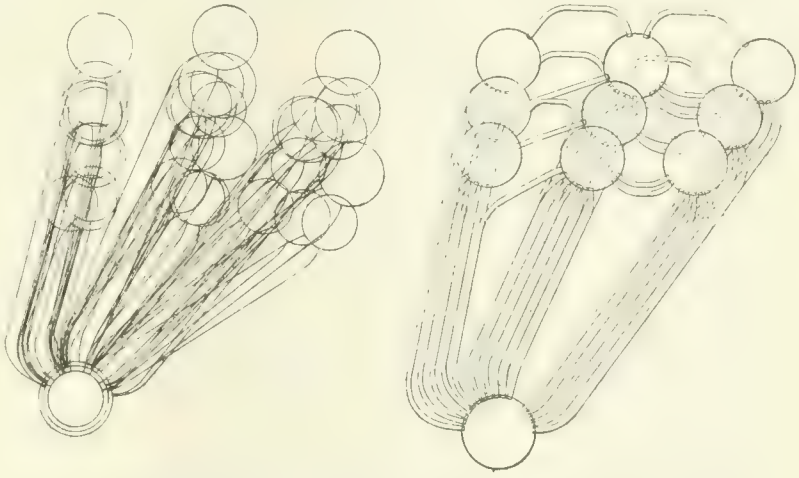
necessary degree of restriction to the flow of steam and water which they give being such that highly concentrated water can be handled without involving priming difficulties.

Within recent years there has been a marked improvement in furnace and stoker design, and combustion rates are possible today greatly in excess of what was believed possible a few years back. These increased combustion rates, together with the enhanced cost of fuel and the resulting necessity for obtaining a greater output in the way of steam production from a given amount of capital tied up in boiler and stoker equipment, have led to a gradual and increasing tendency toward higher boiler capacities.

At the higher capacities the length of time necessary for the degree of concentration of salts in the water within the boiler to build up to an objectionable point was correspondingly diminished, and some feed waters that could be readily handled at low capacities began to give trouble through priming unless the amount of blowdown was excessive. Although great advances have been made in a relatively few years in the treatment of boiler-feed water, many plants have not installed the equipment necessary for such treatment, and priming difficulties, while not general, have been encountered where feed-water conditions were bad or the load was widely and suddenly fluctuating.

Numerous experiments were made to overcome priming troubles under the special conditions encountered, with the result that in the redesigned Stirling boiler the steam is taken from the rear drum, which is raised to the level of the center steam drum. This construction enables a degree of concentration to be carried in the redesigned boiler that would undoubtedly lead in certain instances to priming with a center-drum steam outlet. The change has been made, not with any idea of advocating higher degrees of concentration than are now usual, but in order to take care of conditions under which, because of feed-water conditions, concentration unavoidably builds up rapidly.

Second—Protection of the rear steam drum is given by a baffle carried on the front tube of the rear bank, which is expanded into the center drum. In the earlier designs such protection was given either by a baffle carried on water circulators between the middle and rear drums or by the use of heavy, cumbersome and expensive cast-iron plates.



SUPERIMPOSED OUTLINE OF FOURTEEN OF THE OLD CLASSES OF STIRLING BOILERS (LEFT) AS COMPARED WITH THE NEW CLASSES

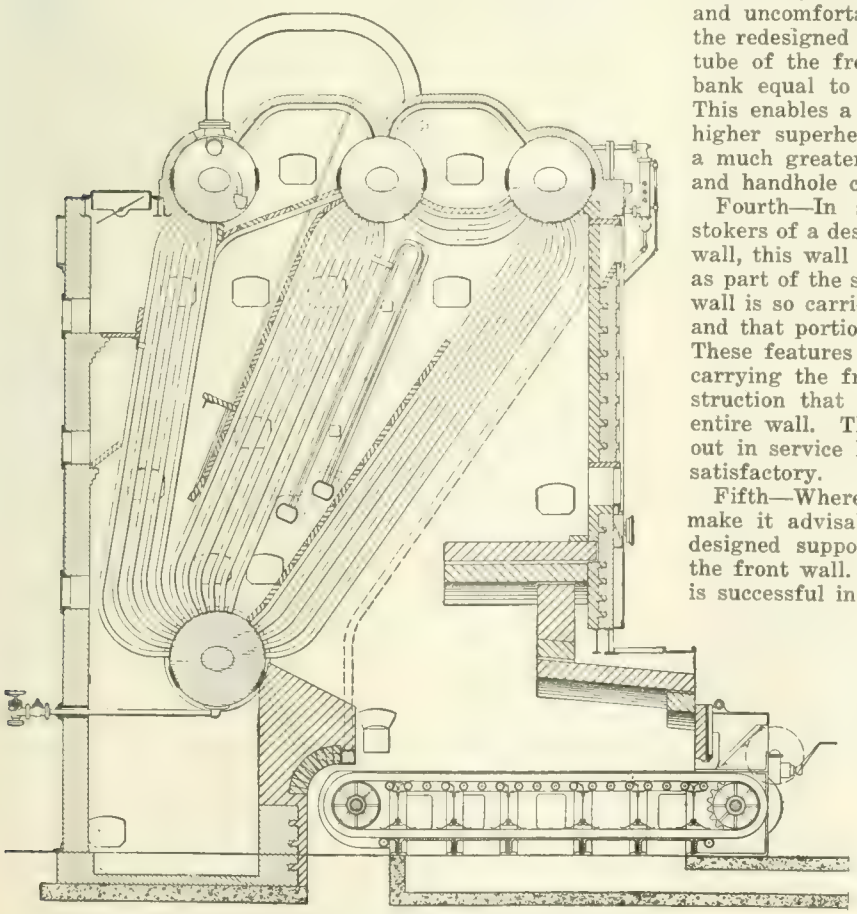
Third—The arrangement of the tubes circumferentially on the mud drum is such as to give a larger superheater chamber. In the earlier design the tubes were spaced equidistant around the mud drum, there being no space between the rear tube of the front bank and the front tube of the middle bank. This led to a superheater chamber excessively cramped at the lower end, making it difficult and uncomfortable to get at the superheater headers. In the redesigned boiler there is a space left between the rear tube of the front bank and the front tube of the middle bank equal to the space hitherto occupied by two tubes. This enables a greater amount of superheating surface for higher superheat than was hitherto obtainable and gives a much greater ease of access to the superheater headers and handhole caps.

Fourth—In stoker-fired work, except in the case of stokers of a design that permits of carrying the front boiler wall, this wall is carried on supporting members furnished as part of the standard boiler equipment. Where this front wall is so carried, a slip joint between the front boiler wall and that portion of the wall carried on the stoker is used. These features not only definitely fix the responsibility of carrying the front boiler wall, but give a front-wall construction that may be repaired without taking down the entire wall. The great number of such installations tried out in service have proved the construction to be entirely satisfactory.

Fifth—Where the size of the boiler wall is such as to make it advisable, the use of bonding tile with properly designed supporting members is standard construction in the front wall. This construction, as proved in operation, is successful in overcoming the tendency of the front wall to spring inward. This construction is used in side walls where necessary.

Sixth—In the earlier designs, where battery settings were installed, a three-legged center support was standard in the battery wall. In the redesigned boiler the center support has but two vertical members, doing away with this objection.

Seventh—In battery settings special means of access for inspection of the inside mud-drum heads is standard in the redesigned boiler. In the earlier designs no means of access at this point was supplied.



ONE OF THE NEW STIRLING CLASSES, WITH SUPERHEATER AND CHAIN GRATE STOKER

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Purpose of the Engineering Societies Building

To the Editor of the ELECTRICAL WORLD:

SIR: I am very much pleased with your editorial "The Illuminating Engineers Should Not Move," in your April 9 issue. I am not a member of the Illuminating Engineering Society, but I am a member of the A. I. E. E., the S. E. D., the N. E. L. A. and the New York Electrical Society. I am constantly visiting the United Engineering Societies Building and am familiar with conditions there.

One of the organizations occupying space in that building is using it for the strictly commercial purpose of sending out circular advertising material. Those of us who contributed to the purchase of the land had in our minds what undoubtedly Mr. Carnegie had in his when he donated the money to put up the building, namely, the erection of a home for engineering societies to which all engineers might come; and this naturally carried with it the idea of restricting the character of the work done in the building. It certainly was never intended to be used as it is being used now as an advertising headquarters for the automobile industry, and any such proceeding should be resented by the whole body of American engineers.

As a member of a number of societies and associations now in the building and as a contributor to the fund for the purchase of the land it stands upon, I protest against this proceeding and believe that the technical press should take up the fight to preserve the character of the United Engineering Societies Building. It is very rapidly deteriorating, and some action should immediately be taken. EXECUTIVE.

New York City.

Supplying Direct Current to Slip Rings of Induction Motor

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the article of Messrs. Warner and Knowlton which appeared in your issue of Nov. 20, 1920, and to the discussion of that article in the issue of Jan. 22, 1921, page 204, I should be much pleased if you would permit me to draw the attention of the public to the fact that the feature of supplying direct current to the slip rings of an induction motor for the purpose of improving the power factor was invented by Ernst Danielsson of Västeras, Sweden, in the year 1900. The invention was patented in several countries, among others the United States, on Feb. 25, 1902, under No. 694,092. A large number of installations of this kind have been built since that time by the Allmänna Svenska Elektriska Aktiebolaget of Västeras, to which the patents were assigned.

Västeras, Sweden. BIEGER NORDFELDT.

"Broadcasting" News by Radio Telephone

To the Editor of the ELECTRICAL WORLD:

SIR: I was much pleased to read your editorial in the March 26 issue of the ELECTRICAL WORLD on "The Influence of the Radio Telephone." For a long time I have been preaching this gospel in season and out, that the broadcasting by radio telephone of good music, interspersed with important news items and an occasional layman's sermon, good practical talks to farmers and to young people in the rural districts and similar features, can be made a genuine, potent factor for contentment and advance to the people of the United States.

Our installation at the California Theater in San Francisco is the first radio-telephone station which is devoted solely to this class of work. The responses we are receiving from listeners-in all over the Pacific Coast and mountain districts are most gratifying, indicating that this service is being appreciated and is a successful beginning along the lines which you are advocating.

LEE DE FOREST,
President.

De Forest Radio Telephone & Telegraph Company,
New York City.

Actual Versus Reproduction Cost in Public Utility Appraisals

To the Editor of the ELECTRICAL WORLD:

SIR: The writer has noticed a letter in your issue for Jan. 29, 1921, signed by C. Wellington Koiner, which refers to an editorial of Aug. 21, 1920. Apparently Mr. Koiner advocates the use of the original-cost basis because it is more convenient from a bookkeeping standpoint. As one having had considerable to do with accountancy, I must protest against this theory, for it is a fundamental principle of accounting that the method of keeping the accounts must fit the transactions and that the accountant has no business to try to influence a transaction so it will fit a prearranged method of accounting. Obviously this is fundamental, as after all a system of accounting is only for the purpose of furnishing a correct record of facts.

It is probably idle to write you further on this subject as the matter has now been so fully passed upon by the courts that the opinions of lawyers, accountants and engineers will have little effect on what is to be done. The courts have now definitely decided that, notwithstanding advantages from the standpoint of simplicity, etc., the pronouncement, perhaps resulting from loose thinking, on the part of commission, regulatory bodies and others, in favor of original cost as shown by the books of account is not controlling, and that present value must govern regardless of the tremendous increase in values, stated in terms of money, resulting from the cataclysm from which we are just emerging.

In the Elizabethtown Gas case in New Jersey, the Consolidated Gas case in the federal court sitting in New York, the St. Joseph case in the federal court sitting in Missouri, and the Iroquois Gas case in the court which reviews all the decisions of the New York Public Service Commission, there is complete and unhesitating unanimity that what the courts have said continually still holds, that is, that the investor in property devoted to the public service is entitled to have

a fair return on the value thereof, such value to be determined at the time of the fixation of rates. Regardless of court decisions, however, this view is economically correct. No one can read the decision of Judge Learned Hand in the Consolidated Gas case recently decided, or in fact any of the other decisions just mentioned, without agreeing that this is so. Some time ago you urged editorially that self-interest, from the standpoint of the utilities, made it more desirable in the long run that returns should be computed on original cost, because if companies spent money today at the present high cost, when these costs went down they would suffer. This is not the case when the utilities are regarded as a whole.

If a company invests $100,000 today and the public service commission allows a 10 per cent return, the rate will be so fixed that $10,000 will accrue to the company for its investors. If prices return to what they were in pre-war times within the next ten years—which no one knows anything about—of course that property would be valued at $50,000, and, assuming for simplicity the same rate of return, only $5,000 would accrue to the company. Your editorial says that this demonstrates that the utility will lose $5,000 owing to the use of the present-value rule. Not at all, for the $5,000 which the utility receives at the future date will have as much purchasing power then as the $10,000 does now; otherwise the hypothesis of a reduction in the value from $100,000 to $50,000 is unsound. H. C. Hopson,

New York City. Consulting Engineer.

Since dictating the foregoing, my attention has been called to a very interesting letter by C. M. Larsen, which appeared in your March 12 issue. While I have a very high respect for Mr. Larsen's opinions, particularly in view of his long and varied experience in dealing with these matters, I am compelled to say that I think he begs the entire question when he says that utilities ask for a value of $200 on property that cost $100 simply because it costs more to operate or because interest rates are higher. This is not at all the basis for the claim of increased value. The basis for the claim of increased value results entirely from the fact that whatever rate of return is used per $100, whether it be 8, 9 or 10 per cent, the dollars represent return, when received, for only one-half the purchasing power which they had before the war; whereas in virtually all lines of endeavor, particularly the lower grades of labor, the value of compensation is reckoned in a manner to give due account to this decreased purchasing power, or, in other words, the payments made are doubled.

Obviously it cannot be otherwise if index numbers are representative and have actually doubled as they are and have. The added quantity of return which should be received by reason of the decreased purchasing power has nothing to do, according to my understanding, with the increased cost of money as money measured by current interest rates. The forces affecting each may be somewhat the same and may work on each other, but when a man sells a piece of property for double what it cost him—though from a utilitarian standpoint it is worth no more—he not only receives the doubled price but, having received such doubled price, when he invests it, perhaps in real estate, he is not willing to take the 5 or 6 per cent which would formerly have been satisfactory, but insists upon the now prevailing rate of interest for such investment of 7, 8 or 9 per cent.

Those contending for the position which is taken by Messrs. Koiner and Larsen are, unintentionally of course, confusing the fair-minded utility people by arguing that the increased cost of money represented by increased rates of interest and the halved purchasing power measured by the change in index numbers are one and the same thing, and that they ought to be satisfied if they get the grudgingly scant consideration of the former, which is being currently given by many commissions—many up to date have refused to recognize either except in figures, confining themselves to the possibility of so doing in some future case—and that it is morally questionable, if not actually dishonest, to contend for the latter. H. C. Hopson,

New York City. Consulting Engineer.

Wanted, a Better Name than "Fixture"

To the Editor of the Electrical World:

Sir: The advent of the removable lighting unit calls for a new name, one which will more appropriately describe it than the often-abused term "fixture," by which ceiling and wall lights have heretofore been known. A fixture as defined by Webster is something fastened in place or, in law, an article affixed to the freehold and consequently confined to one place. No qualification of this word "fixture" can make it serve as an appropriate term to apply to the new lighting units, for its use would signify permanency.

The Society for Electrical Development feels that the new name—and a new one will surely be forthcoming—should be discovered or invented by one in the electrical industry and so invites the interest and co-operation of all in the search.

"Chandelier" will immediately suggest itself. This is a word derived from the noun "chandler," signifying a dealer in candles, oil, soap, paint and groceries, and was used to designate the first lighting unit of which there is any mention, the seven-branch lumière of antiquity. Early French historians classified chandeliers as chandeliers mobiles (movable units), chandeliers suspendus (hanging units) and chandeliers fixes (fixtures).

Reference is also made to the fact that the princes and "gentlefolk" had to have lumières that they could transport from their chateaus to the city or from the city to the country. The need introduced small metal lamps fashioned so they could be carried from place to place. Chandeliers suspendus developed into lumières and lustres, candelabra and girandoles. The wall bracket of today evolved from "appliqués." Lanternes, portatives or vivantes, became in time our modern lanterns.

These few references to lighting units of old have suggested "lumières mobiles" and "mobiliers" as appropriate names for the new units. Other suggestions have been "portaliers," "removaliers," "luminiers," "chatteliers," "chattelites," "plextures" and "elexiliers."

Slogans have been submitted as well, among which are: "Hang your light where it's right," "Move your lights to suit your moods," "Light right with right light," "Hang your lights—don't fix them." It is hoped that further suggestions will be forthcoming.

Reginald Trautschold.

Society for Electrical Development, Inc.,

New York City.

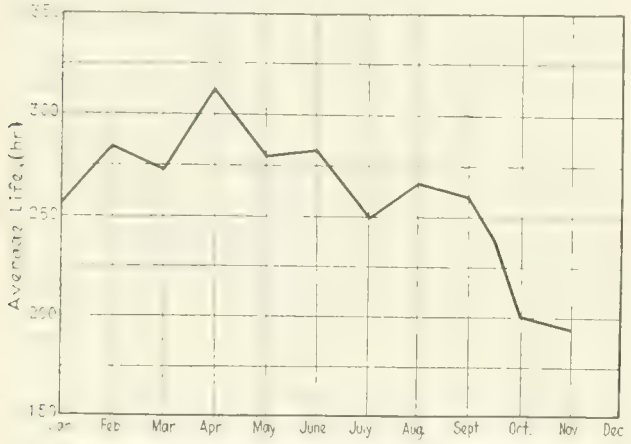
Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Quality of Electrodes for Arc Lamps Checked by Monthly Curves

FOR the purpose of keeping track of the life of electrodes used on the arc-light circuits of the Worcester (Mass.) Electric Light Company, the distribution department plots a curve from the monthly record, as shown in the accompanying drawing. This curve shows the average number of hours' life of all electrodes used in the street lamps.

Any falling off in the curve, such as that shown here in the last three months, leads to an investigation of



AVERAGE BURNING HOURS OF ARC-LAMP CARBONS SHOWN BY THIS CURVE

the cause of the decreased life. Curves of this nature have proved very useful to this department for other purposes. Descriptions of two of them were published in the ELECTRICAL WORLD for April 9 and 16. George M. Hardy, superintendent of the company, developed the curves and furnished them to the ELECTRICAL WORLD for reproduction. FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

A Ready Dressing for Serious Burns

AN EFFECTIVE solution for dressing large burns has been developed recently by H. B. Harmer, safety engineer of the Philadelphia Electric Company. This consists of a saturated solution of bicarbonate of soda in the best Russian mineral oil. About 3 per cent is taken up at ordinary temperatures, but in order to maintain such saturation an excess is put in and settles at the bottom of the container. A slight color is added for the psychological effect by a trace of one of the non-corrosive aniline dyes. This may be red, pink or green.

Large pieces of gauze bandage are rolled up and immersed in this liquid and are provided with a little knot at the ends, so as to make their extraction easy. These are one yard long and two yards wide and so will cover the entire affected part of a large burn. The dressing is contained in a two-quart glass jar with a "fruit-jar" cover made so that it can be completely opened in a moment. The solution does not deteriorate or become rancid and can be kept indefinitely.

The directions for use are as follows: "Remove gauze intact and cover burned surface thoroughly. Do not leave jar uncovered. This is to be used where large surfaces are affected, and the jar should not be tampered with. The tabs on the end of the gauze are the only part of it that should be touched while removing it from the jar. For refilling, notify the office of the supervisor of safety."

Instruments and Records for Boiler and Engine Rooms

FOR economical operation of a generating plant the proper instruments and records are imperative. Among the most important instruments are the draft gage, connected so as to read furnace, ash-pit and uptake pressures and the drop through the boiler; the pyrometer, to read flue-gas temperature, one instrument being connected to serve a number of boilers; the CO_2 recorder, or, where expense prevents its use, an "Orsat," and a thermometer in the feed line. Some method of determining the weight of coal and ash is essential, and a steam-flow meter is also desirable. By the use of the indicator varying conditions in engine operation can be detected and corrections made. The vacuum gage, preferably a mercury column, and thermometer for indicating the inlet and discharge temperature of the condenser circulating water are of great assistance in the efficient operation of the condenser and its auxiliaries.

Instruments for boiler and engine rooms which give a comprehensive view of operation have been sadly neglected till quite recently, and even now a large amout of steam is generated with the aid of no other instruments than a steam gage and gage glass. The instruments which tend to give a strong grasp on varying conditions are really signposts on the road to economy, and when they are properly used the investment is very well worth while.

Only such records should be kept as will be really useful. There is a tendency among some operators to require the power-plant employees to keep a lot of records, most of which are filed away and never consulted afterward. The writer favors a graphical form of record wherever it is possible to use such form, because it presents to the eye of the employee much better than a column of figures any change that may take place. It is of primary importance that accurate records should be kept of output and fuel. A continuous record of fuel burned, water evaporated and output is of far greater value in showing production cost and condition of equipment than any spasmodic tests of apparatus, no matter how thorough the latter. Important boiler-room records show quantity and temperature of feed water, boiler

pressure, draft and temperature of gases leaving boiler, time of cutting in and cutting out boiler, and when and how long boilers were "blown down." Important engine-room records give the load carried, vacuum, temperature of circulating water entering and leaving condenser, and hot-well temperature. Time of starting and stopping units should also be recorded.

C. A. GREENIDGE,
Chief Engineer.

J. G. White Management Corporation,
New York City.

Small Turbines Versus Electric Motors for Power-Plant Auxiliaries

AS FAR as efficiency goes, there is very little choice between driving power-plant auxiliaries by small turbines and driving them by electric motors. The electric drive requires less steam per horsepower-hour, but when the exhaust steam from the auxiliary turbine is used in the feed-water heater, then the actual quantity of heat used may be slightly in favor of the turbine.

To find exactly what choice to make the investment must be taken into account and worked out for each case. Although, generally speaking, there is not much difference in economy, there are other points in favor of electrical drive. For driving pumps motors are ideal, as hardly any attention is required and as on alternating-current circuits the speed is nearly constant, leaving no chance for a machine to run away on varying loads. The governing of small turbines on varying loads is often not perfect. For starting up with no electrical power available steam-driven auxiliaries are essential. It is sometimes advantageous to make some of the auxiliaries steam-driven and some electrical. In this way the heat balance of the station can be adjusted to give the most economical conditions.

Generally speaking, turbine-driven auxiliaries are smaller, owing to their higher speed. Turbine speeds are around 2,500 r.p.m. or higher, but the motor speeds most in use are 1,800 and 1,200 r.p.m. A two-pole, 60-cycle motor will run at 3,600 r.p.m., but pumps do not seem to be developed at this time for so high a speed.

It is sometimes thought difficult to determine just how much steam is taken by small auxiliary turbines. The following simple method is based on the fact that when they are supplied with superheated steam (this is virtually always the case at the present day) the exhaust steam is also highly superheated. It remains only to obtain the steam pressures and temperatures at the turbine throttle and exhaust, refer to steam tables, and from them to find out how much heat the steam contained before and after passing through the turbine. The difference in total heat represents the heat turned into work in the turbine and that lost by radiation, the latter being so small that it may be neglected altogether or an allowance of 1 per cent made. The difference in heat content, as found from the steam tables divided into the 2,545 B.t.u. in a horsepower-hour, gives the weight of steam per brake-horsepower-hour. The pressures and temperatures should be taken as near the turbine as possible to prevent excessive radiation losses. If really accurate results are required, the turbine should be lagged.

A. B. CLARK,
Engineer.

Sargent & Lundy,
Chicago, Ill.

Card Records for Distribution Poles

ALL INFORMATION usually required regarding the poles used in distribution systems may be kept on 4-in. x 6-in. cards. These should be filed by pole numbers or according to the numbers of houses nearest to the poles. A card of this kind which has proved valuable is reproduced herewith. The information includes the location, the year of setting, the kind of crossarms and fittings and the other equipment the pole supports.

It will be noted that consideration has been given to the matter of taxation, as experience has shown that without these data several different taxes may be paid on the same property. If it is known exactly where the property begins and ends for each of the city, county, township and school districts, this information will be valuable in connection with the assessment and payment

POLE RECORD

Street No. (a) _____ Pole No. (b) _____
City _____ Co. _____ Twp. _____ Sch. Dist. _____
Yr. Pole Set _____ Removed _____ Replaced _____
Location: Street / Alley / Private — Pole Treated: Brush / Butt / Untreated — Cross Arm: Dipped / Painted / Untreated
Kind of Wood _____ Grade _____ Height _____
Cross Arm: Fir / Pine — 8 Pin _____ 6 Pin _____ 4 Pin _____ Pin _____
Insulators: Glass / Porcelain — Pins: Wood / Steel — Braces: Flat / Angle

Co. Pole _____	Lgt. Arresters _____	Painted _____
Joint Pole _____	Street Lgt. _____	No. of Services _____
Foreign Att. _____	Stepped _____	U. G. Services _____
Transformers _____	Guyed _____	Section Sws. _____

Ft. from Pole: North / East — To Pole: South / West

Remarks: _____

Date Pole Inspected _____ By _____

FRONT — FACING _____ SIDE — FACING

Primary P _____ Street Lighting L _____
Secondary S _____ Direct Current D _____
Attachments T

Note:—(a) When pole is located in Alley or on Private property give address of the Street East or North of pole.
(b) Where poles are now being numbered you may insert number here, however, this is optional.
Any special material should be noted under "Remarks."

ALL NECESSARY INFORMATION CONCERNING A DISTRIBUTION POLE IS CONTAINED ON THIS 4-IN. X 6-IN. CARD

of taxes. The records are useful for obtaining information pertaining to the life of different poles under certain climatic conditions and also concerning what effect the different methods of treatment have upon the life of the pole.

Considerable discussion has always been raised as to the desirability of numbering poles consecutively. While the writer favors this method in properties of the larger size, some dividing line should be adopted as to towns large enough to justify its application. The writer believes that poles in cities of about 100,000 inhabitants or larger should be numbered in some systematic order.

Where poles are not numbered an excellent plan is to file the cards geographically; that is, the pole record card would bear the address of the house nearest it. A pole in an alley can be designated by the geographical location of the house on either the north or the east side of the alley, or the address in the street on the south or west side of the alley. By this plan there is no con-

fusion where there are pole lines in the alleys on both sides of a given street.

Theodore H. Rice,
Operating Department.
Henry L. Doherty & Company,
New York, N. Y.

Rules to Be Followed While Working Around Boilers and Stokers

TO SAFEGUARD men working on stokers and boilers the Consumers' Power Company has formulated a set of rules the substance of which is given in the following paragraphs:

Chain guards on Taylor stokers should be kept in position at all times. When working on the driving parts of these stokers the chain should be removed to guard against accidental starting of the stoker. When dumping Taylor hand-dump stokers care should be exercised to insert the dumping bar in the socket far enough to prevent it from slipping out. Many employees have received serious injuries through lack of this precaution. The dump pans on Taylor stokers should be lowered while repairing stokers and bridge walls. Repairmen should stand on planks instead of on the dump pans, for these might accidentally be lowered, dropping the repairman into the ash alley. Always shut off the forced-draft supply when cleaning Taylor stokers. If it is left on, it is apt to blow fire through the cleaning door and burn the fireman. Fire doors must be latched at all times. There may be a defective tube in the boiler, and if it should rupture, fire would blow out through the doors not latched. A number of serious accidents have occurred through neglect of this simple precaution.

Water columns should be blown down when the fireman comes on duty. This should be done without fail at the beginning of each shift. Chains attached to quick-closing valves on water glasses should be of such a length and hung so as not to interfere with or be an attractive hazard to passers-by. When wetting down hot ashes firemen should stand back to avoid being burned by the steam generated from them. Goggles should be worn when working around gage glasses. These glasses may break, and every possible precaution for protection should be taken. Men should not step or stand on the Dutch-Oven furnace of Wickes boilers. The failure of the brickwork might cause them to fall into the furnace.

Before men are allowed to go into a boiler the head fireman and water-tender must be notified and feed valves, steam valves and blow-off valves must be marked with the special tags provided. When blowing flues the ladder should be held by another man or otherwise secured, and when using live steam men should be very careful not to burn themselves or others. When necessary to work on coal hoppers be careful to keep clear from weighing lorry. Men have had their fingers crushed by neglecting this. Sufficient illumination should be provided in firing alleys, basements and on top of boilers. Men are liable to stumble over firing tools or miss their step when on the boilers, causing serious falls.

When removing ashes through a jet system ashmen must see that the line is open. If it is plugged up, steam will blow back and burn them. Turn on steam slowly and be sure line is clear. When throwing in or out driving pawls on Greene stokers to change the speed the operator must be careful not to get his fingers crushed in the mechanism. Counterweights on dampers should be permanently attached or hung close to the floor, to prevent them from falling and injuring any one who may be standing or passing under them. When removing tubes from boilers, if necessary to open the top boiler covering, this material should be piled so it cannot fall on men workng below.

Scuffling, horseplay and practical jokes are prohibited. Men have been seriously injured by being thrown into moving machinery. Boilers require constant attention. Employees must be on the lookout for unusual conditions and must maintain the water level and steam pressure within normal limits at all times.

Consumers' Power Company, H. J. Burton.
Jackson, Mich.

Improved Testing of Reverse Power Relays

OWING TO incorrect operation of some reverse-power (directional) relays on the system of the Utah Power & Light Company a new method of testing the connections has been worked out and put into practice. Since this relay is fundamentally an induction-type wattmeter, tending to rotate in one direction or the other according to the power flow, its torque is a measure of the power in the circuit. Hence if the movement of the disk is opposed by a spring, the deflections of the disk under various conditions will determine the proper connections. Such a spring is readily provided, after the tripping circuit has been opened for safety, by inserting a small peg back of the spring contact to shorten its length and thus to increase its stiffness so that the contacts do not quite close under the maximum torque produced by the load flowing during the test. A small pointer of tin is slipped under the data plate to register on the edge of the disk, on which are scratched a mark for zero when the potentials are off and graduations up to full deflection.

The necessary switching is then done to obtain a known condition of power flow of a dependable value. In many cases it is possible to vary the power factor of the line to give check results, though this is not essential, since an inductive load is the usual case or can be arranged for. The voltage leads are then marked *A*, *B* and *C* respectively and are arranged to be applied in consecutive pairs to the potential studs of each relay in turn. If the power factor can be made unity, deflections are first taken under a certain chosen load with each voltage pair in turn on the first relay. If the instrument transformers are installed as required to give star current and delta voltage, there will be found two pairs, say *AB* and *AC*, which give about the same deflection, each voltage being about 30 deg. out of phase with the current, while *BC* give virtually zero, since it is in quadrature. This eliminates *BC* from consideration with this relay. The selection between *AB* and *AC* is then made by having the power factor lagging in the line, when one of these voltages will give a higher and the other a lower deflection than under the previous test. Obviously the one that gives the higher torque for the same load under the lagging power-factor condition is the one that will give the most dependable action under the short-circuit conditions.

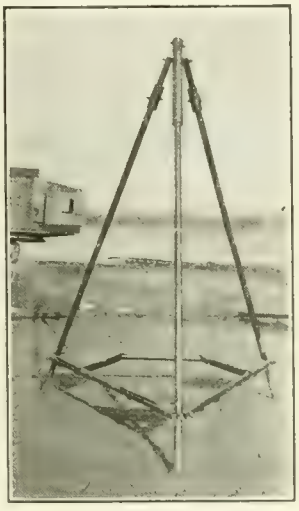
A. N. Geyer.
Utah Power & Light Company,
Salt Lake City, Utah.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Portable Rack for Supporting Outdoor Motor Circuits

FOR supporting circuits which supply energy to electric blast-hole drills the France Stone Company, North Baltimore, Ohio, developed a portable rack made of iron pipe. This rack should be useful for other applications where temporary or movable lines are used for drills, motors and similar apparatus. The racks are about 6 ft. high and in the work mentioned are placed about 50 ft. to 75 ft. apart. They keep the wires dry and prevent current leakage and short circuits. Ballast plates are provided on which weights may be laid to prevent the racks from being blown over. In using for blast-hole drills a complete circle line is carried on the racks unless the quarry is too large. Such a circle assures better voltage at any point. No. 6 stranded weatherproof wire is used for 440-volt work unless the line is exceptionally long or there is a large number of drills operating.



PORTABLE STAND FOR CARRYING MOVABLE ELECTRIC CIRCUITS

About 100 ft. of No. 8 three-conductor Duracord is employed (with three-phase, 440-volt current) for a cable to reach from the drill to the portable line. Hubbell weatherproof attachment plugs are connected every 75 ft. along the portable line for attaching the cable.

A 1½-in. swinging pipe is mounted in the top of the drill cab for supporting the cable in such a way that the wheels of the drill will not run over it. This pipe should be composed of a vertical section strapped in the cab, an elbow at top of the vertical section and free to swing horizontally, a horizontal section about 10 ft. long with a 45-deg. bend downward at the outer end. About 4 ft. out from the elbow this horizontal section should have a support on which the pipe can rest and slide from side to side. The open ends of the vertical and horizontal sections should be fitted with 1½-in. conduit bushings. The cable should be fed through this pipe and taped quite heavily at the open ends of the pipe. This prevents injury to the cable at those points. At the bottom end of the vertical pipe an ordinary cable clamp should be clamped on the cable over its heavily taped portion. This will prevent the cable from being pulled out of the pipe.

A General Electric type FP10 oil circuit breaker is used on the drills instead of knife switch and fuses. This not only provides a totally inclosed safety switch but avoids the fuse trouble that is always had where fuses are used on blast-hole drills. The vibration of the machine causes the fuses to jar loose in the clips, causing the fuses to become hot and fuse ferrules and clips to become pitted. The circuit breaker should have overload coils so as to protect the motor against overload. This type of breaker should also be used to control the power for the entire line.

D. W. YAMBERT,
Electrical Engineer.

France Stone Company,
Toledo, Ohio.

How Often Should Lighting Fixtures Be Cleaned?

THE necessary frequency of cleaning lighting fixtures may be determined by balancing the loss from decreased illumination against the cost of cleaning. The loss from decreased illumination is divisible into the loss of electrical energy which is caused by the dirt and the decrease in output of workmen due to poorer light. These losses increase daily after each cleaning. When the sum of these losses since a cleaning equals the cost of one cleaning the fixtures should be cleaned again.

By far the most difficult of these factors to determine is the loss in output of workmen due to poorer light. This must include spoilage and overhead cost of plant as well as possible labor turnover due to dissatisfaction and loss from future deteriorated eyesight. The energy loss can easily be calculated by the aid of a foot-candle meter or a photometer.

The cost of cleaning may be determined by trial. Lighting fixtures may be dusted, wiped or washed. The method used should be the one which will produce the most economical results. Sometimes a combination of methods may be employed to advantage. For instance, the fixtures may be washed every two months and dusted every two weeks between washings. The type of fixture, character of dirt, etc., determine to some extent how the cleaning should be done. The length of time required is another important determining factor. Usually it takes more time for a man to get down from one fixture and up to the next than it does to clean the fixture. When this is the case fixtures should be cleaned as thoroughly as possible.

The usual length of time between cleanings is from three to six weeks, but the right time for cleaning should be separately determined for each case. Among the factors which affect frequency of cleaning are the illumination provided by clean equipment, illumination required, kind of fixture, amount and kind of dust in the air and the season of the year. Indirect and semi-indirect fixtures are very liable to collect dust and dirt which cannot be seen but which, of course, continues to cut down the useful illumination as time passes. Although reflectors for direct lighting can be seen, it is hard to judge from their appearance how much light is being absorbed by the coating of dirt. Consequently an instrument should be used to measure the illumina-

tion. Just as the fireman's judgment as to the management of his steam plant is now assisted by instruments in addition to visual inspection of the fires and boilers, so must the judgment of the men in charge of illumination be assisted by a suitable light-measuring instrument.

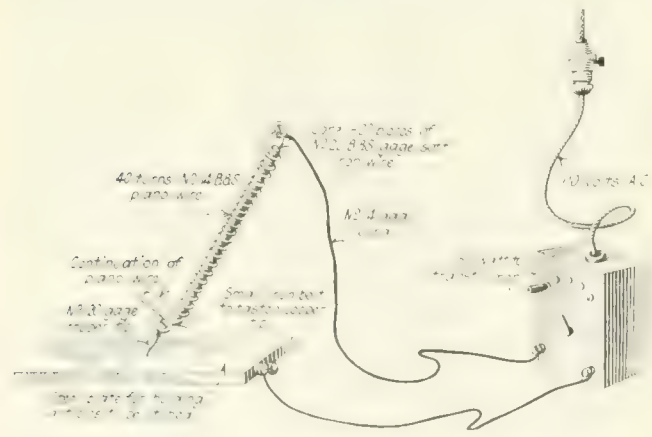
D. W. Blakeslee.

Pittsburgh, Pa.

Inexpensive Electric Etching Pencil

A PRACTICAL and inexpensive etching pencil illustrated herewith is made for use in marking tools, dies, instruments or other metal objects. It is simple in construction and any one handy with tools should be able to make one out of materials found in most machine shops. The construction of the pencil is as follows: A coil spring of No. 14 gage wire is made of about forty turns. Into this spring a soft-iron core is inserted, consisting of about twenty pieces of No. 22 gage soft-iron wire. The soft-iron wire core should be insulated from the coil by a few turns of paper of good quality. One turn of the spring coil should be turned up, to which one terminal of the transformer is to be connected (see upper part of pencil in illustration). The lower end of the spring should be shaped in a "U" and the tip looped as shown. A small iron screw and nut are used for fastening a piece of fine copper wire which serves as the etching needle. Cover the entire pencil with a few layers of paper, dip in insulating varnish and allow to dry thoroughly.

In operation the iron screw and nut holding the short piece of copper wire vibrate, which makes a series of small dots. After a little practice it will be found that very fine work can be done if the operator has a steady hand and is a good letterer. The function of the spring coil is to act as a resistor and as a magnetic coil for vibrating the copper tip. Do not attempt to use a heavy copper tip for etching, as this will take more current and heat up the entire pencil. Energy is furnished by a 150-watt toy transformer or a storage battery. In either case from 4 volts to 10



PENCIL FOR ELECTRIC ETCHING OF TOOLS, DIES, ETC.

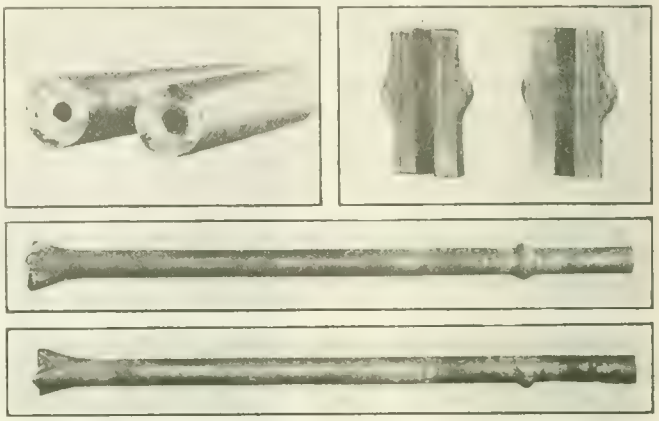
volts may be used, depending on the kind of etching desired. The pencil will have a tendency to become warm after continuous use and should be allowed to cool when it becomes too hot to be held comfortably in the hand.

John A. Toleik,
Electrical Engineer.

American Can Company,
Chicago, Ill.

Rock Drill Steels Too Short for Use Reclaimed by Welding

EXPERIMENTAL tests which have been carried out by the Thompson Company to determine the practicability of reclaiming short lengths of rock-drill steels have shown that electric butt welding is a feasible process for this work. Steels welded in this manner have given very satisfactory results when tested under conditions somewhat more severe than normal. The drills used in these experiments were hollow drills 1¼-in. in diameter containing 95 per cent to 1.05 per cent carbon. A hollow instead of a solid drill was chosen as



DRILL STEELS ELECTRICALLY WELDED HAVE SHOWN EXCELLENT RESULTS IN TESTS

Top, left—In preparing the broken steels the ends are squared off and countersunk. Top, right—A lengthwise section showing that the water hole area is not greatly reduced by welding. Center—The weld as it appears when removed from the welding machine. Lower—The upset may be removed by grinding.

presenting a more difficult type to weld, owing to the fact that the water hole must be kept open.

In welding such steels the ends to be joined should first be ground off fairly square and the greater part of the rust, scale, etc., removed for 3 in. or 4 in. back in order to insure good electrical contact with the dies of the welder. Then these two ends should be countersunk with an 80-deg. countersink to a depth of approximately ¼ in. This countersinking prevents the "flash" and metal which is pushed up during completion of weld from filling up or clogging the water hole.

The steels are then clamped in the copper dies of the welder, these dies, which conform to the shape of the drill, being in reality the terminals of the secondary of a simple current transformer, which takes any commercial power voltage on the primary side and steps it down to very low voltage in the secondary, while increasing secondary current over primary current in approximately the same ratio. The steels are clamped so as to give a length projecting from the inside edge of each pair of dies which is equivalent to from one-half to three-quarters the diameter of the drill. The drills should also be brought into accurate alignment by means of simple adjustments.

The weld is made by what is known as the part-flash, part-slow-butt method, the first step being to bring the ends into close proximity by means of a pressure device integral with the welder and then to close the primary circuit of the transformer, continuing to bring the steels together slowly until their ends actually touch each other lightly, whereupon they will "flash," that is, minute particles of molten steel will fly off. This flashing should be continued by keeping the circuit closed and

slowly forcing the ends of the steels together until the ends are "flashed" off square and are in even contact around their entire periphery. Usually, if the ends are properly prepared, a forward movement of about ⅛ in. of right-hand steel is sufficient to accomplish this. Do not "flash" too much or the water hole will become clogged.

At the end of this flashing movement a quick further forward movement will bring the ends of steels into good solid contact and stop the flashing. Now, with the circuit still closed but with little or no added pressure on steels, allow the joint to reach the welding temperature which is indicated when the metal at and around that point has a "greasy" appearance or seems on the verge of running and sparkling, when instantaneous and heavy pressure should be applied and the steels forced together, completing the weld and at the same time opening the primary circuit. Great care should be used not to overheat the steels, as not only will the structure of the steel at the joint be damaged beyond repair, but the water hole will become clogged owing to too great a "push-up" in completing the weld. Too little heat will result in only a "stick," not a weld.

A flux of plain powdered borax is sometimes used and is applied by merely sprinkling it on the joint with the fingers at the end of the flashing operation. This flux has been found to be of aid in preventing the oxidizing of the joint, and while its use is not absolutely necessary, it is recommended.

The matter of removing or leaving the "upset" at the weld is one for the user to decide. The greater the amount of this upset that can be retained, the stronger the bar at that point and the less the labor of reclamation. However, on steels where this upset has been almost entirely removed the steels in actual working tests have broken at any point except in the welded area.

The time consumed in preparing the ends to be welded is very little. For example, in the case of the 1¼-in. hollow steels it should be approximately as follows: Grinding ends square and removing scale, two minutes; countersinking, one minute. The average welding time on the above size is fifteen to twenty seconds and the power consumption is not over 0.25 kw.-hr. per weld. The open-circuit secondary voltage should be approximately 4 volts to 4.25 volts to insure ease in flashing. One man should be able to prepare and weld complete two pieces of drills of the above size in five minutes.

Every weld should be properly heat-treated to relieve any locked-in stresses and to refine the grain structure. This can be done in the welder by increasing the opening between dies to 3 in. or 4 in., again clamping the welded steel in the dies, heating to the proper temperature and forcing the metal to cool slowly by placing it in lime or a similar slow-cooling medium. This method of heat-treating, while fairly satisfactory, does not, of course, have the same merits as a furnace-heat treatment, and where a furnace is available the latter method is recommended.

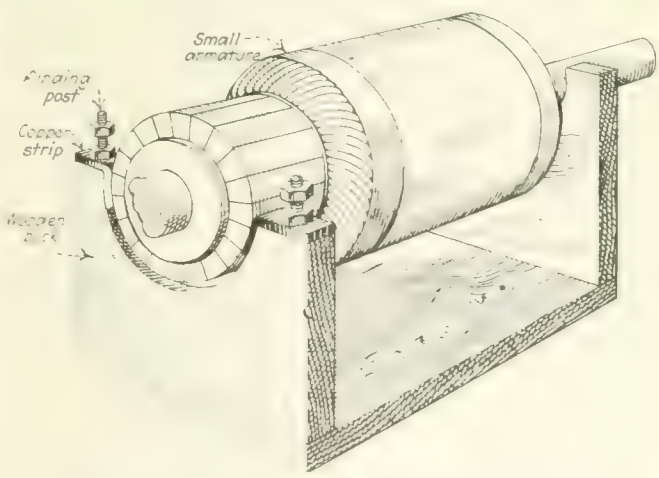
Tests on steels welded by this method were carried out by the Sullivan Machinery Company at its experimental quarry in Claremont, N. H. The drilling machine used was a Sullivan DX-61 type, which takes air at 100-lb. line pressure and strikes a blow of 100 ft.-lb. on the ends of steel at the rate of 1,400 blows per minute, the drill being continuously rotated at the rate of approximately 150 r.p.m. in free drilling. The rock drilled was what is known as blue schist, which, though not so hard as some rocks, does, perhaps, owing to its seamy structure, place fully as great a strain on the drill as the harder rocks. In all tests the steels were run unsupported. To explain: It is understood by the writer to be the general practice to feed steels used in "drifting" to the machine in lengths varying in steps of 2 ft.; that is, the first drill is a so-called 2-ft. length, the next 4 ft., and so on, so that at no time is there more than approximately 2 ft. of distance between the rock being drilled and the chuck of the drilling machine; but in all of these tests each steel started its own hole, so that there was at the start of the drilling of each hole a distance of 8 ft. to 10 ft. between the rock and the drilling machine. Each hole was about 2 ft. in depth and was drilled in approximately a horizontal plane with the steels oftentimes more or less out of line.

Six of the steels welded as described above were tested in this manner, and all except one broke at a distance anywhere from 4 in. to 3 ft. from the weld after drilling totals of from 5 ft. to 146 ft. The remaining one, which broke in the weld, had drilled 121 ft. These steels before being welded by the above method had drilled totals varying from 26 ft. to 140 ft. To sum up, the only steel which failed in the weld drilled a distance fully as great as the average total of the other five steels, all of which broke outside of the weld.

Thompson Electric Welding Co. W. T. OBER,
Lynn, Mass. Development Engineer.

Support for Bar-to-Bar Test on Small Armatures

WITH small motors it is often difficult to apply a bar-to-bar test for damaged coils and reversed leads. For making such a test easy in a certain shop a small buck, just the size for the armature to be tested, was made with one upright cut out to fit the commutator instead of the shaft. This upright was fitted with two strips of copper, as shown in the accompanying drawing, so that when the armature was placed in the buck the commutator made contact with these



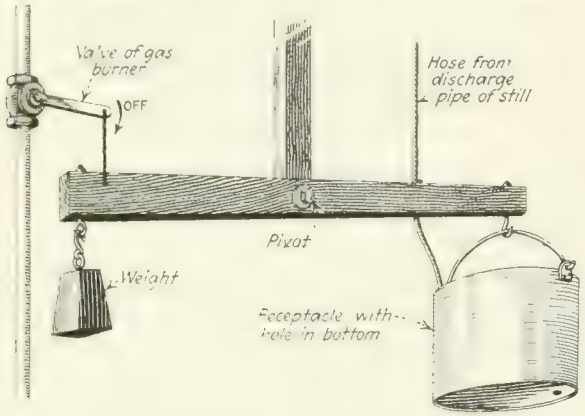
CONNECTIONS FOR BAR-TO-BAR TEST ARE MADE BY COPPER STRIPS AT SIDES OF COMMUTATORS

strips at two points directly opposite each other. The direct-current feed lines were attached to these strips by means of the binding screws. The bar-to-bar test is made by turning the armature in the buck and touching adjacent bars at the top point of the armature with the leads from a small millivoltmeter. FRANK SOETE.

Honesdale, Pa.

Preventing Burn-Out of Still Used for Storage-Battery Water

TO PREVENT the burn-out of a still used in purifying water for batteries the fire must be extinguished when the cooling-water supply fails. An automatic method for turning out the gas on failure of the water prevents such burn-outs in the vehicle battery department of the New York Edison Company. The scheme employed is indicated in the accompanying sketch. This shows a weight hung to an arm which is connected by a



WEIGHT CLOSES VALVE WHEN COOLING WATER STOPS FLOWING

wire to the valve on the gas burner. This weight tends to turn the valve to the "off" position.

The bar, which is about 4 ft. long, is pivoted in the middle, and to the other end is hung a small vessel into which the discharged cooling water flows. This vessel has a hole in the bottom through which the water runs. The hole, however, is of such a size that the vessel is always full while the water is discharging in the right quantity. The weight of this water counterbalances the iron weight on the other end of the beam. In case, however, the water ceases to flow from the discharge pipe the vessel becomes empty and the weight closes the valve of the burner.

Before the protective arrangement was used the coils of the still were overheated and badly damaged a number of times. Since its installation there has been no more such trouble.

A. SHEINAUS,
Fore Battery Man, Auto Department.
New York Edison Company,
New York, N. Y.

Properties of Resistor Materials Used for Heating Purposes

THE principal materials suitable for electric heating resistors are listed in the accompanying table together with their physical properties. There are eight classes of materials. The metals of the first group—copper, platinum, wrought iron, cast iron, tungsten and molybdenum—are used for resistors in special cases only and are not widely employed. The other groups show various specific resistances and maximum operating temperatures. The nickel-steel-chromium alloys (group 5) are suitable for electric resistors which are not subjected to temperatures higher than 1,200 deg. Fahr. The nickel-chromium alloys can be operated at temperatures as high as 1,800 deg. to 2,000 deg. Fahr. without being injuriously affected and their resistance is about sixty times that of copper. With the discovery of this group of alloys the foremost technical difficulties, which prevented the general use of electric heat, were removed. However, nickel-chromium is not suitable for all purposes under all conditions. On the contrary, electric heaters have to be carefully designed for each individual duty, and if this is not done, the possibility of "burning out" the heaters exists.

PROPERTIES OF HEATING-RESISTOR MATERIALS

Name of Substance	Physical Condition or Composition of Substance	Manufacturer or Agent (See Names Below)	Resistance in Ohms per Circ.mil Ft. at 68 Deg. Fahr.	Temperature Coefficient of Resistivity for 1 Deg. Fahr.	Specific Gravity, Grams per Cu.Cm.	Approx. Maximum Working Temp. in Open Air, Deg. Fahr.	Approx. Melting Point, Deg. Fahr.
Copper	Annealed	..	10 4	0 00217	8 89	500	1,981
Platinum	Pure		57 4	0 00204	21 50	2,700	3,190
Iron	Annealed wire		62 9	0 00280	7 78	750	2,700
Iron	Cast, gray		380 0		7 21	1,000	2,700
Nickel	Annealed		64 3	0 00400	8 90	1,200	2,940
Tungsten	Annealed		136 2	0 00250	19 10	..	5,432
Molybdenum	Annealed		34 3	0 00185	8 60	.	4,532
German silver	18 per cent copper, nickel, zinc	..	200 0	0 000172	8 50	500	1,880
German silver	30 per cent copper, nickel, zinc	..	290 0	0 000111	8 50	500	2,120
Advance	Copper nickel	1	294 0	Nil	8 90	700	2,300
Ideal	Copper nickel	2	300 0	0 00001	8 85	700	2,200
Monel	Copper nickel	3	256 0	0 00198	8 90	1,112	2,480
Krupp	Nickel steel	4	511 0	0 00039	8 10	1,100	
Climax	Nickel steel	1	525 0	0 00040	8 14	1 000	2,300
Phenax	Nickel steel	2	520 0	0 00030	8 09	1 000	2,100
Tic	Nickel steel	5	517 0	.....	.	.	.
No. 193 Alloy	Nickel, steel, chromium	1	523 0	0.00040	8 15	1,200	
Comet	Nickel, steel, chromium	2	525 0	0.00040	8 15	1,200	2,750
Nichrome	Nickel chromium	1	660.0	0 000095	8 15	1,800	2,700
Nichrome II	Nickel chromium	1	660 0	0 000099	8 02	2 000	
Kromore	Nickel chromium	1	580 0	0 000134	8 90	2 100	
Calido	Nickel chromium	2	600 0	0 000190	8 15	1,800	2 800
Rayo	Nickel chromium	2	575.0	0 000100	8 05	2,000	3,000
Chromel C	Nickel chromium	6	640.0	0.000100	8 12	.	.
Carbon	Retort		4,325*	Not constant	1 80	6,000†	6,700
Graphite	Acheson		4,875*	Not constant	2 20	6,000†	6,700
Carbon filament	Treated	.	6,950‡	Not constant		3,500†	6,700
Granular carbon	Amorphus	.	.....	Not constant	.	6,000†	6,700
Silit	II	7		Not constant		2,500	. .

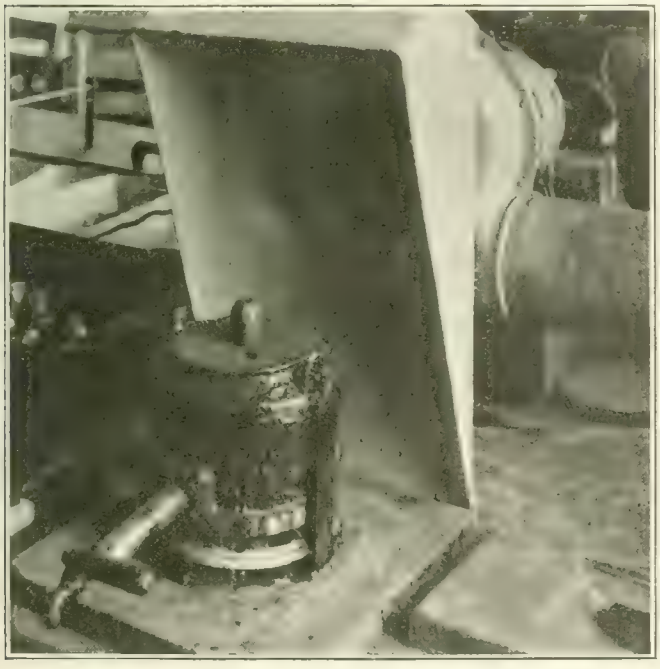
* At 5 400 deg. Fahr. † Air excluded. ‡ At 3 500 deg. Fahr.
1. Driver Harris Company. 2. Electrical Alloy Company. 3. Supplee-Biddle Hardware Company. 4. Thomas Prosser & Son. 5. American Steel & Wire Company. 6. Hoskins Manufacturing Company. 7. Gebruder Siemens & Company.

While the development of the metallic resistor was going on, carbon, graphite and similar substances were also tried out, and it appears that during the last few years resistors made of these materials have been used with success. The principal substances of this class are listed in the last two groups. Naturally, when using carbon or graphite, it has to be realized that these materials oxidize very rapidly at comparatively low temperatures. This objection, however, is not so serious as it may appear at first glance, simply because whenever carbon or graphite is used it is either inclosed in such a manner that little air can get in contact with it, or in case the air should strike the resistor, carbon monoxide and carbon dioxide are formed rapidly, retarding the oxidation. Therefore renewals of these resistors need not be made as often as might be anticipated, and since carbon and graphite are low-priced materials, this upkeep is not more expensive for a careful design than the renewals of resistors of the metallic type. Silit, mentioned in the last group, is a substance which has not yet been used extensively in this country. In Germany and Switzerland, however, excellent results have been obtained.

H. O. SWOBODA,
Pittsburgh, Pa. Consulting Engineer.

Localized Blower Improves Working Conditions

FUMES from melted resin and beeswax which formerly annoyed workers at the Boston repair shop of the Western Electric Company, Inc., are now easily exhausted from the room by the $\frac{1}{6}$-hp. motor-driven blower shown in the accompanying illustration. The blower, a Sturtevane "E-6" fan with 5-in. discharge duct, is directly connected to a 220-volt, single-phase motor running at 1,800 r.p.m. Over the rear of the



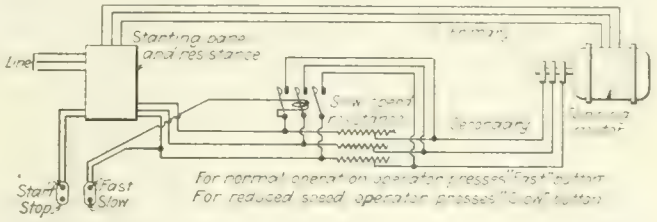
ALL FUMES FROM MATERIAL MELTED IN THIS POT ARE DRAWN OFF THROUGH THE METAL HOOD

melting pot, which is electrically heated, a 12-in. x 18-in. metal hood is placed to collect the fumes for subsequent discharge through a short duct leading outdoors. The draft thus induced had a tendency to lower the temperature of the pot. Therefore, to insure steady flowing of the melted material, which hardens almost instantly upon being exposed to the air, a supplementary electric heating coil was applied to the discharge pipe just back of the faucet.

J. S. THOMAS.
Western Electric Company, Inc.,
Boston, Mass.

Slow-Down Resistance for a Slip-Ring Motor

IT WAS FOUND desirable to slow down the speed of a continuous-duty slip-ring motor in an installation of shaking screens while handling coarser materials, returning again to normal speed for the finer material. This was accomplished by inserting in the rotor circuit a resistor which could be shunted in or out as



RESISTOR WHICH MAY BE INSERTED INTO SECONDARY LINES OF MOTOR IN ORDER TO SLOW DOWN SPEED

desired. The installation consisted of a 15-hp. slip-ring motor with remote control, having resistance designed for starting duty only. The fixed resistor for the low speed was therefore placed in the secondary leads near the motor, and a circuit with a switch in it was shunted around this resistor. This was a three-pole magnetic switch operated by push-button control at the same point as the starting control. The motor is started with the resistor cut into the secondary circuit, and when the faster speed is desired the button marked "Fast" is pushed and this shunts out the resistance.

The slow-down resistance must be of sufficient cross section to carry the secondary current continually and of such ohmic resistance as to cut the torque and therefore the speed (assuming the load be over 50 per cent of rated full load) to the desired point. If it is a three-phase machine the secondary current rating can be obtained from the motor manufacturer, or can be calculated closely enough from:

$$\text{Sec. amps} = \frac{HP \times 746}{\sqrt{3} \times \text{voltage between rings}}$$

The proper ohmic resistance is hard to figure closely as one seldom knows the exact load. The torque varies as the square of the voltage, and the speed in turn depends upon the torque and load. The practical method, having so many unknowns, is to provide a resistor of sufficient current-carrying capacity and try taps between different sections of the resistor until the machinery operates satisfactorily under the actual load.

The motor could have been slowed down by inserting resistors in only two of the three phases, but this would have drawn unbalanced currents from the line on low speed. In case the expense of an automatic switch is not warranted in such an installation, an ordinary knife-blade switch might be used instead of the magnetic type. If such an arrangement is desired on a new installation, it would be better policy to use the standard speed-control equipment furnished by manufacturers.

Chicago, Ill. H. T. N.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Employees and Customers Oversubscribe Million-Dollar Note Issue

EMPLOYEES and customers in the territory served by the company recently absorbed the entire offering of $1,000,000 of 8 per cent five-year gold notes of the Portland (Ore.) Railway, Light & Power Company in twelve days. Average daily sales during the campaign were more than $90,000, resulting in an oversubscription of the issue. The notes were in denominations of $100, $500 and $1,000, and purchasers were allowed to pay for them on a partial-payment plan if they so desired. The total number of subscribers was approximately 3,200. Commenting on the success of the sale, an executive of the company said:

"Loyalty to and confidence in the company were displayed by the employees, nearly 70 per cent of whom bought a total of almost $400,000 worth of the notes.

"Of the entire offering 90 per cent was disposed of in the immediate Portland district, the balance being scattered over the thirty-odd communities receiving light, power and transportation service from the company.

"One of the gratifying features of the campaign was the fact that nearly 70 per cent of the total sales were cash subscriptions and the wide distribution of the sales is shown by the fact that the largest individual order was for $7,500."

Company Courtesy Gains Customers' Appreciation

WHEN the Oklahoma Gas & Electric Company connects a new customer to its lines—one who has not been on the books of the company before—the following letter is sent to him:

"DEAR SIR: We are indeed gratified to have you become one of our customers, and I beg to take this, my first opportunity, to assure you that we sincerely appreciate the privilege you have given us of adding your name to our list of patrons.

"To serve you faithfully and well, with complete satisfaction in every detail, is a frank expression of the obligation we assume. Our organization and equipment are necessarily extensive to serve all the people, but we regard the individual customer as the most important consideration in our business.

"We would like you to feel that you are at all times a valued patron and that every department and individual in this company is constantly interested in seeing that you are properly, economically and courteously served. If you do not receive this attention, I shall deem it a favor to have you call the matter to my personal attention. J. F. OWENS, General Manager."

This is, of course, a form letter, designed to pave the way for friendly relations and good will between company and customers. That it is effective and that the public really appreciates this mark of courtesy is evident from the following letter recently received by the Oklahoma Gas & Electric Company from a new customer:

"I received your follow-up letter shortly after I had signed a contract for service in my residence, and while I know it is a form letter, it shows that the Oklahoma Gas & Electric Company is anxious to do all in its power to assist the customer and create a spirit of good will toward the company. It occurred to me that it was a pretty fine idea, in spite of the fact that your company has no competition in its field but seems to be going out of its way to do little things that tend to build up a spirit of co-operation and assistance between the customer and the company. It seems to me that the entire organization reflected this spirit in the small dealings I had in opening up a new account with your company."

A Practical Method of Rating Central Station Employees

BY J. E. SHUTE
Personnel Superintendent Penn Central Light & Power Company, Altoona, Pa.

ABOUT a year and a half ago the Penn Central Light & Power Company, operating in five counties in central Pennsylvania, with headquarters in Altoona, inaugurated a personnel department. In order to obtain the best system possible and to profit by the experience of others, we secured the services of Major Frank F. Hennaman, who had been engaged in this class of work in the United States Army. He prepared and submitted a tentative plan of rating employees one against the other in the same class of work, trade or duty.

Our management appreciated that the plan was more or less radical and that if it was to be successful it would have to be "sold" to the organization before it was put in operation. Every member of the company

EMPLOYEES' RATING SCALE

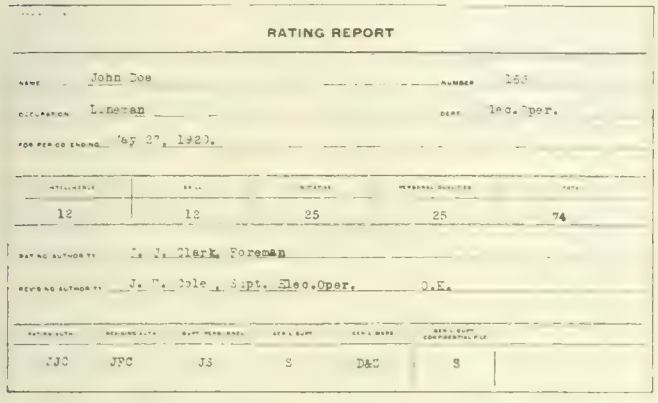
JOHN DOE, Lineman

1. Intelligence: Consider readiness of comprehension and ability to learn rapidly	Highest	*White*	15	
	High	*Brown*	12	Doc 12
	Middle	*Green*	10	
	Low	*Gray*	8	
	Lowest	*Black*	5	
2. Skill: Consider accuracy, speed, interest and adaptability	Highest	*Brown*	20	
	High	*White*	15	
	Middle	*Green*	12	Doc 12
	Low	*Gray*	9	
	Lowest	*Black*	6	
3. Initiative: Consider alertness, originality of conception and independent and prompt action particularly in a case of emergency, and the readiness to shoulder responsibility for actions	Highest	*Brown*	30	
	High	*White*	15	
	Middle	*Gray*	15	Doc 25
	Low	*Green*	10	
	Lowest	*Black*	5	
4. Personal Qualities: Consider obligation of duty to the company, spirit of co-operation, common sense, reputation, discipline, veracity and sense of right	Highest	*Green*	35	
	High	*White*	30	
	Middle	*Black*	25	Doc 25
	Low	*Brown*	20	
	Lowest	*Gray*	10	
Total rating			74	

in a position of authority was called in to a conference and the plan as submitted was placed before them for their criticisms and suggestions. After a number of conferences a system was finally agreed upon.

The plan as adopted, one which had the unanimous approval of the conference, was a man-to-man comparison of the qualifications which have a financial value to the employer. We call these intelligence, skill, initiative and personal qualities.

The rating scale is a constant and reliable gage of



RATING REPORT

John Doe — Number 163

Lineman — Dept. Elec. Oper.

For period ending May 27, 1920.

12	12	25	25	74

Rating authority: J. J. Clark, Foreman

Review authority: J. T. Dole, Supt. Elec. Oper. O.K.

JJC	JFC	JS	S	D&C	S

RATING REPORT ON WHICH THE FINAL RATING OF EACH EMPLOYEE IS MADE

an employee's merits and we believe that it completely eliminates the personal equation and justly determines merit because the rating scale calls attention separately to each of the several essential qualifications of an employee. The danger that judgment may be based on minor defects with a corresponding disregard for important virtues is reduced to a minimum.

Preparation of a Standard Scale for Rating Employees

In order to rate an employee, make a list of ten or twelve persons within or without the company's service whose work is intimately known to the rating authority, who must be the foreman or the one directly in charge of the employee being considered. Disregarding all other characteristics, select from this list the person whose intelligence surpasses any other on the list. Write his name or initials on the line marked "highest" on the accompanying "Employees' Rating Scale." On the line marked "lowest" put the name of the person who is most deficient in this respect. Put the middle or average person on the third line and the persons who range in intelligence midway between the middle and the extremes on the other two lines. The highest person will be represented by a numerical value of 15, the high person by 12, the middle 10, the low 8, and the lowest 5. Proceed similarly in constructing a scale for the other three qualities. The names selected for the highest and lowest places on the scale must represent extreme cases—the best and the worst of the trade, occupation or duty known to the rating authority. Be sure also that the middle, high and low are equally distributed, for the scale is a measuring rod for human capacity and the points by which it measures must be at equal distances. It is essential that any person whose name appears upon the scale be a person who exhibits clearly and distinctly the qualifications in the correct degree for which you are using them. With a little experience the scale can be refined and perfected until it can be used with ease and confidence.

Persons who are called upon to rate subordinates in more than one class of work, trade or duty should make a separate scale for each.

After the rating scale has been made up we are ready for the second operation, or the rating of the employee, and it is essential that personal grudge, dislike, admiration and friendship be eliminated, for the future status of the individual being rated as well as the effectiveness of the entire personnel of the organization will be affected by the result.

To arrive at the rating compare the employee to be rated specifically and directly with those whose names appear on the rating scale. Try to have as clear and vivid an idea of both as possible. For instance, under "intelligence," on the exhibit, you will notice we have the five names. While rating John Doe under "intelligence," we compare him with those five names and consider only John Doe's intelligence as compared with the intelligence of those five persons. This is essential in order that no other qualities may enter into the rating on this specific quality of John Doe other than intelligence. When you have discovered the person with whom John Doe most nearly compares in intelligence, assign the number opposite that name as John Doe's rating for intelligence. Continue to rate then on the remaining three qualities in a manner exactly as above described.

The sum of the ratings given under each of the four general qualities is the employee's final rating. These ratings are set down on the rating report by the rating authority who is the immediate superior of the employee and sent to the revising authority, who is the immediate superior of the rating authority. The revising authority under this plan is not permitted to change the rating authority's figures, but if his rating is not identical with that of the rating authority, any difference will be noted in the proper space in red.

The scale is in no sense a percentage system. The average rating, if directions are followed carefully, will be about 62 points. Stated in another way, 62 points means an average employee in the class of work in which he is engaged, but this does not mean that all employees are worth only 62 points, neither does it mean that your organization average should show 62 points, because each employee is rated by comparison with persons in the same trade, work or duty and the ratings are relative to that only. There is no reason why an office boy should not receive as high a rating as the superintendent, as a rating of each represents the relation to work, trade or duty.

After having applied the above method of rating for a year, during which time two separate ratings have been made, we have found the following comparisons:

	First Half	Second Half
Intelligence	11.4	11.7
Skill	14	14.6
Initiative	16.5	17.4
Personal qualities	28.1	28.6
Total	70	72.3

This gives an idea of the accuracy and uniformity of the ratings.

Every employee is aware that ratings are made semi-yearly. Employees are also aware of the qualities considered and are at perfect liberty at any time to consult with the superintendent of personnel in order to determine whether or not they are satisfactorily measuring

up in each of the qualities considered. However, the actual rating figures are known only to the rating authority, the revising authority and the management. We believe by this means that many employees have been helped to increase their efficiency and to develop in the qualities wherein their shortcomings are most prominent. The ratings have also been a most valuable aid in deciding on employees for promotion or transfer and are used as a guide in the granting of wage increases.

Electrical Development Necessary to British Columbia's Progress

FIGURES showing the increased demand for electrical energy and the need at an early date of further hydro-electric development were published recently by the British Columbia Electric Railway Company. Based on the ELECTRICAL WORLD'S computation that the steam and hydro-electric development in the United States between 1920 and 1925 will reach 11,700,000 kw., involving a total capital expenditure of $3,706,000,000, the company has estimated the probable Canadian requirements as follows:

"Considering Canada's population as being one-twelfth of that of the United States, we must add nearly $309,000,000 to this figure, but as there is more electrical energy used per capita in Canada, the probability is that at least $500,000,000 will be required for Canadian electric power developments."

The problem of obtaining such a vast amount of capital for development, it is pointed out, must be faced by every community whose ultimate growth and prosperity are dependent upon an adequate power supply. The article continues:

Far from this being a problem solely for the electric power companies in the field, it is now recognized as the concern of the community as a whole, because the stagnation of electric power development means the curtailment of those services essential to community progress and the cessation of all industrial development.

It will readily be seen that if there is no electric power available there can be no manufactures; if there are no manufactures, there are no employees, no business for merchants, no clients for solicitors, no patients for doctors, no subscribers for newspapers—in fact, with the cessation of electrical development comes the cessation of community advancement.

Already the newspapers and national publications throughout the continent are taking up the question from the public's point of view. They realize that the restoration of the public utility companies' credit is essential for community welfare.

The question now may well be asked: How do we stand as regards electric power in British Columbia?

In reviewing the local situation it is necessary to remember that the construction of a power plant must be begun two to three years before it is expected to start generating. Financing must begin at even an earlier date.

During the last two years our demand on the mainland system has increased approximately 17 per cent a year. This demand has fallen off during the last few months owing to the industrial depression, but as this depression is conceded to be temporary and already passing, the demand for electric power is practically certain to continue increasing shortly at the same rate as before.

If the demand had increased without any lull at 15 per cent, our plants would be inadequate. By that time we would have been required to spend a million dollars on further power development. At best this investment cannot be postponed later than the summer of 1922, in order to be in readiness for the winter load of that year.

At the same time, other expenditures must be made for transmission lines, distribution lines, railway equipment and other public utility service.

Further, the million dollars will suffice to take care of the increased demand of only one year at the present rate of increase. Still other investments must be made immediately after. A new power plant costing $8,000,000 must be financed almost before the first million dollars is spent. As much more must be spent to transmit and distribute the energy from that new plant.

How is the British Columbia Electric Railway Company to obtain such capital? The answer is, by having the credit and good faith of the people of this province firmly re-established. Only by assuring the investor that his money placed in the public utilities of this province will earn a fair return and will be given every safeguard will capital be available for new electrical development. Unless this is done, electrical development will stand still, and the community likewise.

Explanation of Service Interruptions a Good-Will Asset

INTERRUPTIONS to electric service, no matter how infrequently they occur, are a source of annoyance and inconvenience to customers, and their attitude toward the utility becomes no more friendly through being left in the dark as to the cause of the trouble. With a view to building good will for the company and believing that the public is entitled to a prompt and complete explanation of an interruption to service, the Consumers' Power Company of Jackson, Mich., recently issued the following statement to the newspapers:

A series of severe lightning storms passed over the state this morning in the region of Ausable River.

The first storm, which occurred about 7 a.m., damaged a Consumers' Power Company transformer at one of the Ausable River dams. This piece of electrical apparatus was immediately switched out of service, and although the trouble was noticed by a momentary flickering of the lights, no interruptions to service occurred in Jackson. The power was off for a few minutes in the city of Flint.

The second storm occurred about 9 a.m. and caused one of the main transmission lines in the region of the Ausable River to fail. The power was off for several minutes in Jackson, Flint, Saginaw and Bay City while the faulty line was being switched out of service.

The load dispatchers of the Consumers' Power Company who are stationed at Jackson had advance notice of the storm and had plans made to sectionalize the line should the storm do any damage, and this is the reason why the interruptions were of such short duration considering the severity of the storm and the damage done.

This story appeared in the evening papers of the same day, and the public was thus informed as to the exact cause of the trouble and the precautions which the company had taken to minimize the interruption.

Another instance of the company's efforts to inconvenience customers as little as possible is shown in the accompanying advertisement announcing in advance the time and duration of an interruption to permit of changes for the betterment of the service.

INTERRUPTION TO ELECTRIC SERVICE

Between the hours of one and five o'clock, Sunday morning, March 13, there will be a necessary interruption on account of betterment of service.

Consumers' Power Co.

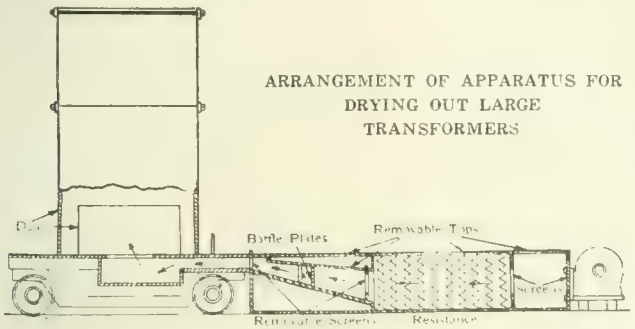
ADVANCE NOTICE OF SERVICE INTERRUPTION

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Experience in Drying Out Large Transformers.—S. H. ABBOTT.—The writer deals with experience in drying out a number of 6,000-kva., single-phase, 10,000-volt to 70,000-volt, oil-insulated, water-cooled transformers when the only available method was by external heating. He mentions two ways—(1) drying the transformer assembled in its case, and (2) drying the transformer outside its case and assembling it after it has been dried. The second method was used by the writer with an



ARRANGEMENT OF APPARATUS FOR DRYING OUT LARGE TRANSFORMERS

arrangement for applying heated air through the transformer when it was suspended in a housing as shown in the illustration.—*Electrical Journal*, March, 1921.

The Magnetic Circuit.—L. CHAMPNEY.—In this, the first of a series of two articles on the subject, the writer deals with the design and wave form of an alternator.—*Beama* (British Electrical and Allied Manufacturers' Association), February, 1921.

Generation, Transmission and Distribution

Internal-Combustion Engines.—C. S. DARLING.—The general considerations which determine the use of this type of engine for power generation. The advantages and disadvantages of each of the following types of engines are given in detail in tabular form: Steam engine or turbine, producer gas and engine, town gas or natural gas, crude-oil engines, paraffine and petrol engines.—*Beama* (British Electrical and Allied Manufacturers' Association), March, 1921.

The Modern Hydraulic Turbine.—FRANK H. ROGERS.—This discussion of the hydraulic turbine is treated under four headings—(1) modern requirements, (2) tests on models as an adjunct to design, (3) general features of design, and (4) special features of design. It is said that the requirements of the large central stations may be summarized as follows: (1) High-powered units, (2) high speed, (3) high efficiency, (4) reliability, (5) durability.—*Journal of Philadelphia Engineers' Club*, March, 1921.

The Diesel-Engine Industry.—L. H. MORRISON.—A comprehensive survey of the subject giving the distribution of Diesel engines by states and industries which is reproduced in abbreviated form here. Curves also show that this industry has grown up virtually in the last ten years. The author states that a wonderful field

DIESEL-ENGINE INSTALLATIONS IN THE UNITED STATES

	Central Stations		Ice, Pipe Lines and Irrigation, Waterworks, Colleges, Govt. Inst., Etc.		Cement, Chemical, Iron and Steel Mines, Flour and Textiles		— Total in — State	
	No. Engines	Total Hp.	No. Engines	Total Hp.	No. Engines	Total Hp.	No. Engines	Total Hp.
Maine								
Vermont								
New Hampshire	6	1,350					6	1,350
Massachusetts	1	240	7	790			8	1,030
Rhode Island			1	100	2	450	3	550
Connecticut			2	400			2	400
New York	13	3,825	22	3,565	11	2,115	46	9,505
New Jersey	2	140	23	4,020	5	920	30	5,080
Pennsylvania			29	5,200	12	2,845	41	8,045
Maryland and D.C.			9	2,580			9	2,580
Delaware			1	225			1	225
Virginia	1	100	11	1,955			12	2,055
No. Carolina							0	
So. Carolina	1	200					1	200
Georgia			1	200			1	200
Florida	11	1,610	2	300	31	8,075	44	9,985
Kentucky	3	590	6	900			9	1,490
West Virginia							0	
Tennessee	1	100					1	100
Alabama	1	100					1	100
Ohio	7	2,440	12	1,745			19	4,185
Indiana	8	1,425			12	2,165	20	3,590
Illinois	11	2,385	12	5,270			23	7,655
Michigan			2	500	1	120	3	620
Wisconsin	9	1,415	2	450			11	1,865
Minnesota	11	2,375	2	300			13	2,675
Iowa	14	2,845	1	90			15	2,935
Missouri	16	2,185	24	5,703	13	2,680	53	10,568
Arkansas	5	1,220	3	760	1	140	9	2,120
Kansas	40	5,970	63	25,830	21	9,780	124	41,580
Nebraska	20	4,590	2	190	3	480	25	5,260
No. Dakota							0	
So. Dakota	19	4,305					19	4,305
Mississippi							0	
Louisiana	26	3,725	37	7,640	2	730	65	12,095
Texas	92	19,975	182	34,035	34	8,425	308	62,435
Oklahoma	26	4,895	135	29,085	13	5,145	174	39,125
Montana	2	420					2	420
Wyoming	3	1,200	6	1,560	4	560	13	3,320
Idaho					2	460	2	460
Utah					3	100	3	100
Colorado	1	180			5	1,140	6	1,320
Nevada					5	780	5	780
Arizona	25	7,190	20	2,070	27	13,980	72	23,240
New Mexico	6	1,270			22	12,680	28	13,950
Oregon								
Washington								
California	6	1,640	13	1,735	8	1,565	27	4,940
Alaska					3	600	3	600
Total	387	79,905	630	137,198	240	75,935	1,257	293,038
Marine							91	43,690
Export:								
Cuba and West Indies							20	2,830
Mexico							29	9,640
South America							9	1,475
Philippine Islands							8	1,680
Hawaii							12	4,255
Canada							4	1,800
China							15	450
Africa, So. Sea Islands, Java, etc.							9	1,349
Total Diesels manufactured in the United States							1,454	360,207

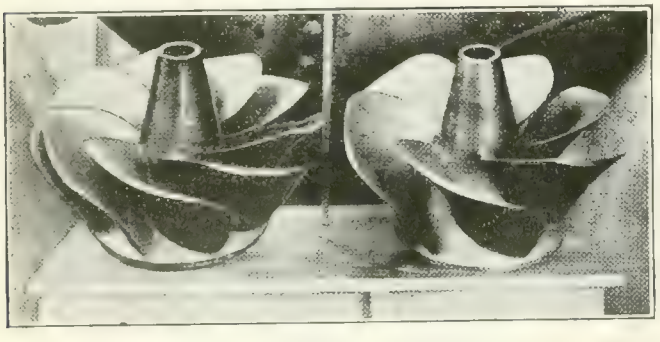
SUMMARY OF INSTALLATIONS BY INDUSTRIES

	Hp.	Per Cent
Oil pipe lines	98,823	30 7
Central stations	79,905	25 0
Mines and quarries	34,295	10 5
Exported	23,470	7 3
Chemical	19,840	6 2
Refrigeration	16,060	5 0
Waterworks, steam railways, etc	13,580	4 2
Flour mills	10,920	3 4
General industries	10,625	3 3
Machinery	8,025	2 5
Electric railways	5,000	1 5
Textiles	1,050	0 3

exists for Diesel engines in units ranging from 50 hp. to 200 hp. to replace less efficient internal-combustion engines and small steam plants. He says that with fuel oil at 85 cents to $1.50 per barrel Diesel-engine economy cannot be attained by any of its competitors.—*Power*, March 1, 1921.

Technical Problems of Large Power Transmission Systems.—J. Biermanns.—Some very interesting viewpoints on the limits and the economy of large power transmissions, with special reference to a general electrification of Germany, for which an alternating-current voltage of 110,000 is regarded as sufficiently high. By means of simple formulas a few concrete examples are figured out in detail. The question of suitable protection against overvoltage is illustrated by an actual example of the release of a 10-km. traveling wave of 250 kv. along a 100-km. line, with all numerical values calculated. The beneficial action of oil switches with auxiliary contacts ("Vorstufenschalter") is mentioned in detail.—*Elektrotechnische Zeitschrift*, Jan. 13 and 20, 1921.

Present Trend of Turbine Development.—Lewis F. Moody.—The writer deals with a few phases of the turbine's evolution that are considered worth noting and then takes up the chief elements to be considered



NEW FORMS OF RUNNERS FOR HIGH-SPEED HYDRAULIC TURBINES

in the turbine of the present, which he considers the turbine of the immediate future. These elements are as follows: (1) A casing in which the water can approach the runner symmetrically, (2) a transition space provided between the guide vanes and wheel vanes, and (3) the passage of the water through the draft tube. He explains the use of the spreading draft tube by means of which the kinetic energy of the whirling component of flow in the water discharged from the turbine runner is partly regained. New forms of runners suited to the new types of high-speed turbines are shown in the accompanying illustrations. —*Journal Philadelphia Engineers' Club*, March, 1921.

Installations, Systems and Appliances

Some Thermal Characteristics of Electric Ovens and Hot Plates.—Ezer Griffiths and F. H. Schofield.—The British Engineering Standards Association recently issued a standard specification for electrically heated cooking ranges. An account of the thermal tests specified in the report and based largely on work at the National Physical Laboratory is given in considerable detail in this article. Conclusions regarding the experiments with hot plates are summarized as follows: (1) Vessels containing liquid for testing hot plates involve difficulties due to the necessity of stirring, heat loss due to evaporation, etc. It seems preferable to rely on metallic disks of known thermal capacity for such tests. (2) The disk should be of the diameter for which the hot plate is designed. (3) The apparent efficiency of the plate depends upon the mass of the disk. Hence one should use a receiving disk of thermal capacity roughly the same as the kettles or other utensils used in practice. (4) The major part of the heat transmission with the inclosed type of hot plate is apparently by metallic conduction. Consequently the test disk should have a plane surface. (5) Disk tests might be used for defining the minimum requirements for hot plates; for example, that for a certain energy consumption the hot plate should raise the temperature of the disk to a certain maximum within a certain time, and that the energy required to maintain the disk at that temperature should not exceed a certain amount. The energy limits would be fixed relative to the effective area of the plate. Specifications for tests of ovens should cover: (1) Maximum time permissible for the oven to heat up to a certain temperature (say 200 deg. C.) from room temperature for a certain watt supply; (2) variation in temperature from top to bottom; (3) permissible variation in temperature during a period of half an hour switching down to medium heat; (4) method of stating efficiencies in relation to cubical contents. Some interesting test data are given for both hot plates and ovens of British manufacture. —London *Electrician*, Feb. 18, 1921.

Arc-Welding Equipment in the Foundry.—W. W. Reddie.—The author asserts that the work which can be performed by the arc-welding process falls into three general classes—(1) cutting of heavy risers and sink heads from steel or iron castings; (2) repairing castings, such as the filling of blowholes or building up parts omitted from the original casting; (3) repairing foundry equipment. The treatment required by each of these classes is outlined, and it is shown that the same type of welding equipment may be used for all classes of work.—*Electrical Journal*, March, 1921.

Individual-Gear Drive for Heavy Looms.—G. F. Sills.—Experience is said to show that the individual drive is being increasingly used for light work and even for heavy work, mainly because it offers advantages which may be roughly summarized as a larger output per loom, a reduction in the number of breakages owing to irregular drive, a reduction in the time lost in stoppages, a cleaner product owing to the absence of oil and dirt from overhead bearings and a freer atmosphere, while at the same time a better quality of fabric is woven and power is consumed only while the machine is running. In addition, the absence of belts and overhead gearing makes the weaving shed a lighter and pleasanter place to work in.—London *Electrician*, Feb. 4, 1921.

X-Ray Examination of Materials.—J. R. Clarke.—A review of progress made in the examination of metals and materials for the revelation of flaws, including a description of the apparatus required and methods of procedure.—*Beama* (British Electrical and Allied Manufacturers' Association), February, 1921.

Considerations in the Application of Electricity to Textile Mills.—J. T. Randles.—The success of electric drive in textile mills is not entirely due to economic reasons, but is, in fact, a result of the study of its application along true lines of research. Much of this preliminary work, apart from its bearing on the suc-

cess or failure of the employment of electric driving, may eventually result in changes in textile machinery of a far-reaching character, especially as the time appears to be coming when more and more electric mills of the true type will be completed in which full advantage can be taken of the economies and conveniences given by that form of drive in a way that has not been possible where conversions or semi-conversions of older mills have been the rule, according to the author.—London *Electrician*, Feb. 4, 1921.

Standardization in the Testing of Welds.—F. M. FARMER.—A complete summary of standards in the testing of welds as developed principally by the Bureau of Welding in the United States.—London *Engineer*, Feb. 25, 1921.

Automatic Speed Control for Sectional Paper Machine Drive.—STEPHEN A. STAEGE.—The advantages of electric drive for paper machines are set forth, and control of motors is dealt with more particularly in regard to speed control.—*Electric Journal*, March, 1921.

Electrophysics and Magnetism

The Development of Magnetic Materials.—T. D. YENSEN.—The writer deals with the development by Robert A. Hadfield and others of silicon steel, which has had such a great influence on transformer construction and design. He also points out that permeability up to 40,000 instead of 8,000 and a hysteresis loss of 300 ergs per cubic centimeter per cycle for $B = 10{,}000$, instead of 1,500 ergs, are possible for certain alloys prepared by special manufacturing methods. He refers to the uses of nickel alloys and discusses improvements in permanent magnets.—*Electric Journal*, March, 1921.

Units, Measurements and Instruments

Distortion in Thermionic Tube Circuits.—The writer says that for some uses of thermionic tubes it is essential that a faithful reproduction of the input wave be attained. Examples are the employment of tubes as generators of high frequency current for testing purposes, telephonic applications and a variety of laboratory applications to quantitative work. The author investigates the extent to which a vacuum tube causes distortion and the conditions which must be met in order to reduce the distortions to a minimum.—London *Electrician*, Feb. 25, 1921.

Telegraphy, Telephony and Signals

The Reduction of Atmospheric Disturbances in Radio Reception.—LOUIS W. AUSTIN.—The atmospheric disturbances of radio reception on the Atlantic Coast of the United States are classified as to type, effect and probable origin. The static reducing systems of the Marconi Company (Weagant system) and of the navy (Austin, Taylor and Otter Cliffs systems) are described and relative performance data of these are given. The improvement in reliability of reception to be obtained by the use of these systems is considered.—*Proceedings Institute of Radio Engineers*, February, 1921.

Thousand-Mile Amateur Radiophone.—J. O. SMITH.—Detailed description of the development and operation of the set used at Valley Stream, L. I., the operator of which is said to have listened to concerts 925 miles (1,490 km.) away.—*Wireless Age*, March, 1921.

Range of Wireless Stations.—R. CHENEVIX TRENCH.—The main constants of wireless stations are investigated in relation to range. From the theoretical radiation formula for a dipole the practical radiation from an aërial is deduced. This is applied to the Austin-Cohen formula, and after considering the questions of radiation efficiency and the power required in the receiving aërial the range formula is arrived at. Limitations of this theoretical formula are discussed and the equations arrived at are applied to the solution of practical problems with ranges varying from 4 km. to 4,000 km.—*Journal Institution Electrical Engineers*, London, January, 1921.

Relation Between Atmospheric Disturbances and Wave Length in Radio Reception.—LOUIS W. AUSTIN.—The apparent wave length of atmospheric disturbances at different times of the day and year is studied, and the results obtained are shown graphically and by description.—*Proceedings Institute of Radio Engineers*, February, 1921.

The "Leader" Cable at Portsmouth.—J. J. BENNETT.—The functions of a "leader" cable are (1) to enable a ship to make a good landfall in thick weather, (2) to lead a ship up the harbor, (3) to lead a ship from open water through a restricted channel to open water on the far side, (4) to give warning of outlying dangers, and (5) to assist a vessel to keep a straight course from port to port and thus save fuel. It is understood that a project is under consideration for carrying such a cable across the short cross-channel route. The cable at Portsmouth has been laid along the eastern approach to the harbor, extending from a shore station in Fort Blockhouse and through Spithead to a point about 6½ miles (10.5 km.) south of the Nab—a total distance of 17 nautical miles. The apparatus is much the same as that installed along Ambrose Channel in New York and described in the ELECTRICAL WORLD for Sept. 4, 1920, page 492. It is said that experiments have been carried out in depths up to 30 fathoms. There is evidence that as the depth increases the strength of signals, and consequently the range, decreases. Further trials are necessary before the relation of depth and range can be definitely fixed, it is said. The greatest length of cable employed up to date is 40 miles (64 km.). It is considered that cables should not exceed this length, since with greater length the resistance of the cable is high and signals are also reduced by attenuation of the current in the cable. It has been found that pitching and rolling of a vessel do not materially affect the reception of the signals.—London *Engineering*, Feb. 18, 1921.

A New System of Short-Wave Amplification.—EDWIN H. ARMSTRONG.—The various possible known methods of amplifying incoming signals of very short wave length (below 600 m.) are described and their limitations considered. The new method then described consists (for continuous wave reception) of the following steps: (1) Heterodyning, with the production of a beat frequency which is itself a radio frequency (for example, 100,000 cycles per second); (2) rectification of the beat current; (3) amplification at the beat radio frequency, preferably by a tuned amplifier; (4) audio frequency modulation of the amplified current; (5) rectification of the modulated current. For reception of damped wave or radiophone signals the fourth step is omitted. It is shown that in this case the quality (characteristic tone) of the incoming signals is preserved—*Proceedings Institute of Radio Engineers*, February, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

California Tax Bill Followed by Petitions for Higher Rates

THE passage of the King bill, heavily increasing California corporation taxes, has been followed by formal complaints from various electric light and power companies that their slight margin of net revenue and the tremendous claims of urgently needed new construction will not permit them to operate except at increased rates or with the continuation of war-time surcharges. These complaints are now being adjudged. The new law increases public utility taxes about one-third.

Puget Sound Co. Issues $13,734,000 in Refunding Bonds

A NEW issue of $13,734,000 of twenty-year general and refunding mortgage 7½ per cent bonds of the Puget Sound Power & Light Company came on the market this week at 97½, yielding about 7¾ per cent. Securing the bonds is a mortgage covering substantially all of the property of the company. The bonds are issued for the purpose of retiring the entire outstanding issue of the company's 7 per cent three-year notes due June 1. The company agrees to expend or to set aside for maintenance and renewals annually, beginning with Jan. 1, 1921, 13 per cent of its gross revenue from operations. This provision is subject to revision every three years by agreement or arbitration. Any deficiency will be treated as a reduction from bondable construction.

New York Goes Back to Single Commission

AT THIS time, when certain political groups in other states are urging local commissions for public utility regulation, the State of New York has, with the exception of a transit commission for New York City, abolished the dual state commission regulation. Under the law passed by the Legislature which adjourned on Saturday last there is created a single commission for the entire state, consisting of five members appointed by the Governor for ten-year terms instead of five years as at present and at an annual salary of $15,000 each. A member of the commission may be removed only for cause and by concurrent resolution by both houses of the State Legislature, carried by a two-thirds vote. The Governor has no power of removal.

The commission is empowered to require the establishment of classifications of service, to fix rates either upon complaint or upon its own motion, and to suspend rates, forms of contract, rules, etc., and pending a hearing it may establish temporary rates.

The new commission was appointed last week. It will consist of former Comptroller William A. Prendergast of New York City, chairman; W. R. Pooley, Buffalo; Charles Van Voorhis, Rochester; Oliver C. Semple, New York, and Charles G. Blakeslee, Binghamton.

Surcharge Allowed California Companies Cut from 15 to 10 per Cent

THE surcharge of 15 per cent granted last June by the California Railroad Commission to the Pacific Gas & Electric Company and the Great Western Power Company because of the abnormal power situation then existing as a result of the drought has been cut to 10 per cent by the commission pending the completion of the hearing on the companies' application for permission to continue it in effect. The money collected under this charge must, however, be kept intact by the companies subject to the commission's final order.

Ideal Power Service from Viewpoints of Seller and Buyer

"WHO is the ideal customer for a central station and what service should he get?" was the question discussed by central-station men and power purchasers at a meeting of the Western Geographical Section of the Pennsylvania Electric Association at Pittsburgh April 15. The managerial and technical viewpoints of central stations were presented at the morning session, while the opinions of one steel-mill and one coal-mine official were presented at the afternoon session.

The necessity for establishing a mutual understanding between central stations and power users was the keynote of the address by G. M. Gadsby, vice-president West Penn Power Company. The customer, he said, should be acquainted with the fact that the central-station company is always ready to give engineering advice. While rates are complicated, they are necessarily so to enable an equitable charge to be made to all customers. If a customer will recognize the investment made to serve him, he will understand the readiness-to-serve charge. Facilities are not elastic without limit, and therefore customers should advise the central station of any large extensions so that more generating and distribution equipment can be provided. Customers should realize the need of reporting troubles quickly.

A desirable customer for the central station from the technical viewpoint was defined by E. C. Stone, assistant to the general manager of the Duquesne Light Company, as one who uses standard voltage and standard frequency with reasonable continuity and without high peaks. The conditions under which service can be given at a minimum expense are that the consumer takes alternating current at generator frequency and three-phase primary voltage near a main distributing point. His load should have high diversity, load and power factors and should require only ordinary regulation of

voltage and frequency. Mr. Stone advocated a rate based on these ideal conditions with multiplying constants for cases which are departures.

J. A. Coyle, general manager of the Universal Steel Company, in discussing the paper claimed that the rates for the steel business sometimes imposed heavy burdens on the mills. For example, a furnace must not have its demand limited. If power is not available in quantity and when desired, it is not so useful. A study should be made to reduce the off-peak charge. Moreover, some reduction of the demand charge should be afforded during periods of depression.

An ideal customer, according to J. S. Jenks, vice-president West Penn Power Company, should have full confidence in the central station and in other customers. When this condition exists every problem can be worked out equitably to all. In reply to Mr. Coyle, he said that a reserve or sinking fund might be set aside to tide over depressions and thus relieve idle consumers, but it is doubtful whether commissions would be willing to do so.

Steel-Mill and Coal-Mine Viewpoint

The viewpoints of one steel-mill manager, J. A. Coyle, and of a coal-mine representative, W. L. Affelder, were the basis of the discussion during the afternoon.

Mr. Coyle, who is a sincere enthusiast in the use of central-station power, outlined some of the things which happen when power is interrupted in a steel mill. Metal may freeze in the furnace and occasion considerable delay, readjustment of metallurgical program, enormous increase in energy consumed per ton and decreased output. In a reversing blooming mill an interruption in service may allow the hot billet to burn the face of the rolls and, besides, to cool down to such a degree that it cannot be rolled so satisfactorily or at the minimum energy consumption.

W. L. Affelder, assistant to the president of the Hillman Coal & Coke Company, said that the use of central-station power in coal mines, although started in 1886, has been adopted slowly because such mines are usually not close to power lines and central-station companies have the disadvantage of interruptions. Now, however, the power loops and protective schemes have greatly improved the continuity of service. Because of the hazard resulting from interruption of service in gaseous coal mines, he said that substation men should be drilled carefully in giving reliable information regarding anticipated outages and duration of interruptions. Mr. Affelder complained of the complexity of central-station rate schedules and suggested that a simplified discount be establised. He disapproved of financing in which the user pays for equipment and gets a refund. He also believed there was a need of reducing the demand charge during a period of depression.

California Company Breaks Records Connecting New Customers

ANOTHER company broke all past records in March for connecting new customers to its lines. The San Joaquin Light & Power Company, Fresno, Cal., connected up lines for 4,500 applicants that were on the waiting list. During the month of March 24,858 acres additional were served by the company with power for irrigation, bringing the total now served up to 84,244 and adding 2,803 hp. In doing this the company has strung 150 miles of new line, with a total of 1,606 transformers installed.

Municipal Plant Interests Oppose Washington Utility Bill

AN EFFORT is being made by those opposed to the bill recently passed by the Washington Legislature relative to the obtaining of public necessity certificates by utilities to submit the measure to a referendum vote at the fall elections. The bill provides that no public service company may enter the territory of an established company without obtaining a certificate of public necessity and convenience. Established companies, however, are not required to have such a certificate for extensions. Municipal-plant interests opposed the bill.

Rate Reductions in Illinois Forecast

A HOPE that substantial rate reductions may soon be effected was expressed by Col. Frank L. Smith, the newly appointed chairman of the Illinois Public Utilities Commission, in his first public statement since his appointment. "As I conceive it," Colonel Smith said, "This commission is the protector of the public. Its duty is to get for the people who pay the bills the best service possible at the lowest possible price. Therefore, I hope, and I am sure those associated with me hope, substantial reductions may be brought about at an early date."

Narragansett Company May Increase Capitalization by $5,000,000

GOVERNOR San Souci of Rhode Island has signed an act permitting the Narragansett Electric Lighting Company of Providence to increase its capital stock from $15,000,000 to $20,000,000. The city of Providence withdrew its opposition to the bill upon the presentation by the company of proposed capital requirements during the next two years. These include the following: Oil-burning equipment in part, $110,000; new boiler house, $208,000; eight new boilers, $225,000; Elmwood-Hope transmission line in part, $51,000; miscellaneous additions to generating plant, transmission and distributing system, $156,000; new 45,000-kw. turbine installed, $980,000; storehouse, garage and office buildings, $350,000, and other outlays, exceeding, all told, $4,000,000.

Corporations May Practice Engineering If Licensed Engineers Are Engaged

AN EFFORT has been made to amend the law licensing engineers in New York, which was passed by the Legislature of that state last year, so as to limit the practice of professional engineering to individuals instead of corporations and partnerships. It was proposed to remove from the law that paragraph which provided that a corporation or partnership may engage in the practice of professional engineering provided the persons connected with the corporation or partnership in charge of the work are licensed as required under the law. Had this amendment been made as suggested it would have made it illegal for existing engineering corporations in New York to advertise or carry on any professional engineering. The bill now awaiting the Governor's signature carries a paragraph in part as follows:

"Nothing herein shall apply to a corporation, partnership or joint stock association, provided the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock associations shall be licensed engineers."

American Mission to London to Greet English Engineers

A DEPUTATION of engineers representing the four founder national engineering societies will go to London this summer to express the obligation the world owes the English engineers for the part they played in winning the war and also to make the award of the John Fritz medal to Sir Robert Hadfield at the opening meeting of the British Institution of Civil Engineers on June 29 for his invention of manganese steel.

The deputation will consist of Charles T. Main of Boston, representing the American Society of Civil Engineers; Col. Arthur S. Dwight of New York, representing the American Institute of Mining and Metallurgical Engineers; Ambrose Swasey of Cleveland, representing the John Fritz medal board of award and the American Society of Mechanical Engineers, and Dr. F. B. Jewett of New York, representing the American Institute of Electrical Engineers. Dr. Ira N. Hollis, president of Worcester Polytechnic Institute and past-president of the American Society of Mechanical Engineers, will accompany the deputation and bear the message from the American engineers.

Consumers' Power Starts Service on New 140,000-Volt Line

SERVICE was started on the new 140 000-volt line from Battle Creek to Owosso, Mich., by the Consumers' Power Company on April 3. This line links up the system with the 40,000-hp. steam plant now under construction at Battle Creek. It is expected that this plant will be completed by July 1.

With the completion of this addition the company has a 140,000-volt belt line extending from the Au Sable River, in the northeastern part of the state, through Bay City, Saginaw, Flint, Owosso, Battle Creek and Grand Rapids, to the Manistee and Muskegon Rivers in the northwestern side of the state. It is now possible to transfer large blocks of power between the different parts of the system, thus increasing the reliability of service.

The completion of this work, which was started in 1920, was made possible by the direct sale of securities to Michigan consumers. Up to April 9 approximately 3,000 individuals had been added as new stockholders of the company, and they have made available an additional $1,100,000 to the funds for construction purposes.

Residence Lighting to Be Shown at N. E. L. A. Convention

FOLLOWING its established custom of staging a lighting exhibit at the annual N. E. L. A. convention, the Lighting Sales Bureau will this year conduct a residence lighting demonstration. The residence lighting division, under the chairmanship of M. Luckiesh, is preparing this exhibit. It will consist of a large composite room and several booths on the mezzanine floor at the Drake Hotel, and its chief aim will be to demonstrate lighting effects and their possibilities.

Many novelties will be introduced and special emphasis will be placed on the charm and effectiveness of tinted light. An individual booth is being constructed which will show the extensive possibilities of portable lamps in the home. Another booth will take up various features of residence lighting. The aim is not only to depict the present possibilities but to indicate the future of light in the home. Wiring diagrams on a large scale will demonstrate the wiring and lighting of residences.

George B. Foster Sees Big Future for Electric Vehicle in Chicago

AN EMINENTLY satisfying future for the electric vehicle was outlined by George B. Foster, assistant to the vice-president of the Commonwealth Edison Company, in a talk with an ELECTRICAL WORLD representative regarding the Chicago Electric Vehicle Show to be given during the N. E. L. A. convention in May and the early part of June. The Commonwealth Edison Company, which is supplying the space for the exhibit free of charge, sees in the electric vehicle, according to Mr. Foster, the ultimate method of city transportation, and it is sponsoring the show in an effort to spread more widely a knowledge of its advantages rather than in the hope of any immediate gain for itself.

The use of the electric vehicle, and particularly of the road and industrial truck, in Chicago is fast increasing, though as yet, according to Mr. Foster, the surface has only been scratched. There are at present about 4,400 vehicles in use, representing an increase of from 15 to 20 per cent over last year and an investment of $14,000,000. The 1,300 road trucks in use serve twenty branches of industry, some of the most important being department stores, dairies, packing houses, bakeries, coal and ice dealers and express companies. In almost no case where electric trucks have superseded gasoline-driven or horse-drawn vehicles has their use been discontinued. One large Chicago department store has a fleet of 281, and such is the saving accomplished by their use that the fleet is being added to as it becomes necessary. It is a common thing, Mr. Foster said, for operators of fleets such as these to express to the Commonwealth Edison Company complete satisfaction with the installations and to tell of savings of from 30 to 40 per cent as compared with other systems of transportation.



GEORGE B. FOSTER

"There are virtually no fields of city transportation in which the electric truck shows to disadvantage," said Mr. Foster. "Department-store, laundry, grocery, bakery and soft-drink deliveries are all of the short-haul, frequent-stop type, where the electric truck is especially successful, and they compose only a few of those that might be named. High speed is not especially desirable in vehicles used for city delivery, and eventually these fields will be dominated by the electric truck, which lasts longer, is almost free from repairs and costs very little to run. There still exists a great deal of prejudice in favor of the gasoline vehicle, particularly on the part of drivers, but wherever the elec-

tric truck has had an opportunity to show its advantages in any sort of city transportation this prejudice has been quickly overcome.

"The use of the industrial truck is fast becoming a necessity where any intra-plant hauling must be done, though its possibilities are far from being fully exploited. It is in this field that the largest percentage of increase in installations has been seen recently, and numerous problems of secondary transportation are being solved in this way."

Rhode Island Electrical League Starts Co-operative Campaign

MUTUAL promotion of electrical development was advocated at the first meeting and dinner of the Rhode Island Electrical League, held in Providence on the evening of April 15 and attended by about 100 men representing all branches of the industry in southern New England. William Wilson, Providence, presided, and addresses were given by M. F. Falk, chairman of the newly formed league; R. L. Huse, Providence; E. L. Millikan, Blackstone Valley Gas & Electric Lighting Company, Woonsocket; A. H. Allcott, Providence; W. E. Sprackling, Tubular Woven Fabric Company, Pawtucket; G. Schneider, Providence, and William L. Goodwin, assistant to the president of the Society for Electrical Development. It was announced that $13,600 has already been subscribed for the publicity and other work of the league and that $6,600 has already been paid in for the first six months' campaigning, now under way. It is planned to hold monthly meetings for discussion and increase of acquaintanceship, and manufacturers' representatives will be invited to address the league. Improvement of relations within the industry and education of the public along electrical lines will be furthered.

In his message to Rhode Island Mr. Goodwin condemned the sale by hardware stores and department-store dealers of sub-standard and off-voltage appliances.

Hoover Resigns from Presidency of the Engineering Council

ACCEPTING with regret the resignation of Herbert Hoover as its president, the American Engineering Council of the Federated American Engineering Societies, meeting in Philadelphia last Saturday, voted its appreciation of Mr. Hoover's leadership during the organization period of the council and his initiation of policies and effort. Mr. Hoover's reason for resigning the presidency was that the council by its constitution was necessarily engaged in furthering national activities which involve legislation and that he as a member of the executive branch of the government could not consistently direct such activities.

One of the most important matters before the council was the report of the committee on elimination of waste in industry. The first reports of its study will be ready by June. They are being put into final form.

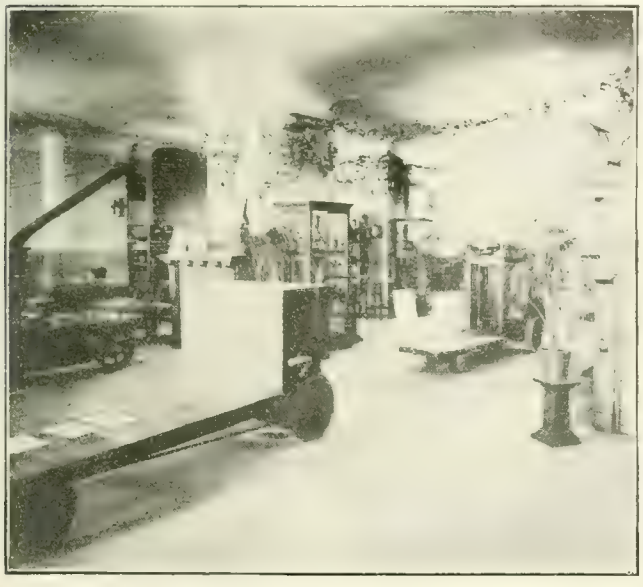
Plans for broadening the scope of the employment service were recommended and adopted.

Dealing with the licensing and registration of engineers, Secretary Wallace's report said that this had been a very active feature of the council's legislative program. "We have emphasized," he said, "that the position of the council is that we do not believe such legislation to be necessary, but where it is to become a fact we are interested in seeing that the legislation passed is of such character as to be beneficial both to the public and the engineering profession."

The report of the public affairs committee, which was adopted, recommended continuance of the public works campaign, to promote which the national public works organization will be continued.

Three new member societies have joined the federation since the last meeting. They are the Boston Society of Civil Engineers and the engineering societies of Milwaukee and Duluth. The next meeting of the council will be held in St. Louis on June 3.

Newark Holds Successful Vehicle Show





VERY favorable reports are heard about the electric vehicle show which was held by the Public Service Electric Company in its big Newark, N. J., showroom last week. Twenty-two exhibitors demonstrated commercial and industrial trucks, passenger cars, batteries, charging equipment and accessories. Between two and three thousand people visited the show during each day and a number of excellent inquiries were received.

Frequency Problem and Colfax Station Topics at Pittsburgh Meeting

STEPS which the Duquesne Light Company has taken to increase still further the continuity of its service to steel mills and the problems which arise when 25-cycle steel mills endeavor to purchase 60-cycle central-station energy were the principal topics of discussion at the joint meeting of the A. I. E. E. and the A. I. and S. E. E. last Saturday in Pittsburgh. Some evidence of the interest shown was indicated by the presence of about 1,000 engineers who visited the new Colfax station of the Duquesne company in the morning and attended the technical sessions in the afternoon and evening. Between the two sessions an informal dinner was served at the William Penn Hotel, at which A. W. Berresford, president of the A. I. E. E.; E. S. Jefferies, president of the A. I. and S. E. E., and A. W. Thompson, president of the Duquesne Light Company, were the principal speakers. The keynotes of Mr. Thompson's address were the lack of understanding between central stations and their customers, the enormous investment required to serve steel mills in Pittsburgh alone, and the necessity of engineers helping in civic problems that will bring about an industrial peace. Mr. Thompson pointed out that $33,000,000 was necessary for financing the Colfax station and that $37,000,000 more will be needed to meet the demands for electrical energy in the next five years.

Assuring Continuous Service

At the first technical session, held in the afternoon at Carnegie Hall, Messrs. D. L. Galusha and C. W. E. Clarke, of Dwight P. Robinson & Company, Inc., presented a joint paper explaining how reliability and simplicity were obtained in the Colfax station* with relatively low investment and operating costs. In opening the discussion on the subject C. S. Cook, general manager of the Duquesne Light Company, pointed out that with coal costing three times what it did before the war more attention must be given measures for economy than formerly, but not at the sacrifice of reliability of service. F. C. Hanker emphasized the value of the high-tension ring or loop around Pittsburgh as a means of maintaining reliable service and referred to the fact that the same care was taken in laying out the important auxiliary circuits at Colfax as with the main circuits. E. C. Stone, Duquesne Light Company, explained the means whereby faulty sections which may develop in the "loop" are isolated automatically. He pointed out that with resistance installed in generator neutral ground and with the high inherent reactance of the system a dead short circuit will not cause such excessive current that it cannot be interrupted by the high-capacity circuit breakers provided. Hence reactors are not required under the present conditions.

F. Hodgkinson, Westinghouse Electric & Manufacturing Company, pointed out that the chief advantages of using three-cylinder, compound turbines were the division of temperature range between three elements, the simplification of headers and the possibility of operating the high-pressure element alone with fair economy.

In answering questions raised during the afternoon session, Mr. Clarke said that economizers would not be justified in this station until coal reached a price of $7 a ton. No difficulty is experienced in operating circulating pumps 15 ft. to 20 ft. above water level. Direct-current motors were used on stokers to insure the variable speed demanded and because the high pressure and temperature of the steam were obstacles to selecting reciprocating engines. Induced draft was not used because the natural draft provided is just as effective.

Mr. Galusha said that it actually cost $500,000 less to place the high-tension transformers indoors in this case. By maintaining the same spacings between conductors as outdoors a high safety factor and convenience of inspection and repair were assured.

Steel-Mill Frequency Problem

Of the two papers delivered at the evening session that by B. G. Lamme,* chief engineer Westinghouse Electric & Manufacturing Company, dealt with the reasons for the adoption of 25 cycles in steel mills, the tendency toward purchasing central-station power and the frequency problems involved thereby. D. M. Petty, superintendent electrical department, Bethlehem Steel Company, dealt with the frequency problem from the steel man's viewpoint. Twenty-five-cycle motors have many advantages in steel-mill work, he said, but they should not stand in the way of growth of 60-cycle system if this is what is generally demanded. Although 60/25-cycle frequency changers may be objectionable because of cost, low efficiency and inability to handle short-circuit disturbances, he favors them in preference to scrapping all 25-cycle motors. As an alternative, however, Mr. Petty suggests that all auxiliary motors, furnaces and such apparatus be 60-cycle, that gear drives be supplanted and that direct-current or 15-cycle motors be used for low-speed operations.

J. Farrington, La Belle Iron Works, said that in the mill with which he is connected 25-cycle equipment has been gradually supplanted by 60-cycle in order to use purchased power. At present about 80 per cent of the installation is 60-cycle.

Federal Trade Commission Tells How Cost of Living Can Be Reduced

CAUSES tending to keep up the high cost of living and the remedies therefor are given in the report of the Federal Trade Commission to the President and alluded to by him in his recent message to Congress. Retail prices, it is stated, are not so low as is warranted by the reduced cost of basic production. President Harding as a result of the commission's report recommended to Congress an inquiry into the situation. The commission is of the opinion that it should ascertain costs and make them accessible to the public.

In summing up its report the commission suggests the following remedies:

Aside from the remedies which may be afforded by improved transportation and credit facilities, we suggest consideration of the following:

1. The passage of a bill which will meet judicial objections to the authority of this commission to continue its efforts to obtain and publish information respecting the ownership, production, distribution, cost, sales and profits in the basic industries more directly affecting the necessities of life—shelter, clothing, food and fuel—for the information of Congress and the promotion of the public welfare.

2. Vigorous prosecutions under the anti-trust laws, including a re-examination of the reviewable decrees already entered in such cases, with a view to strengthen them to meet present conditions, including also a closer scrutiny of the so-called open price associations to ascertain whether under the guise of beneficial associations they are in fact violating the law. Examination of associations of dis-

*Given elsewhere in this issue.

tributers to determine whether violations of law exist, particularly restrictions of co-operative purchases, and whether any of the activities of such associations are not of public service.

3. Positive encouragement of co-operative associations of agricultural producers and of co-operative consumers' organizations.

4. The passage of measures aimed at the elimination of unnecessary reconsignment and brokerage operations, including also "gambling in futures." Pyramiding of reconsignments and of jobbing sales, while not possible in present market conditions, was one of the causes of the buyers' strike, from which we now suffer, and may reappear whenever markets again become speculative.

5. Calling a conference of official representatives of the trading nations of the world to consider the question of clearing the channels of international trade so as to eliminate undesirable combinations and to promote fair competition.

6. Protection of the farmer against the more closely organized elements with which he has to deal by extending federal assistance in giving more adequate and timely information concerning foreign and domestic market conditions and in affording more ample and suitable local market and storage facilities for the serviceable conservation of perishable farm products.

Customer Relations, Financing and Appliance Sales Are Kansas Men's Topics

THAT the average central-station manager has an insufficient knowledge of economics and psychology was the belief expressed by W. J. Squires, chairman of the public utilities committee of the Kansas City Chamber of Commerce, at the opening session of the Kansas Public Service Association, held at Kansas City, Mo., on Wednesday. Mr. Squires based this assertion on investigations made by him. In his opinion, public feeling has been equally against private and municipally owned utilities because there has been a serious lack of public understanding of the problems of either. He suggested that engineering schools have paid too little attention to the education of men in handling utility management and public relations problems.

At the afternoon session, E. R. Conden of St. Louis and R. J. Long of Abilene discussed the sale of securities to customers. Mr. Conden said that the confidence of employees not only in the securities sold but in the company and its entire list of policies is a basic necessity for success in customer ownership movements. Short and intensive campaigns were favored and a well-trained force must be utilized. Mr. Long said that all of the Riverside Light, Power & Gas Company financing for several years has been done within the limits of its own territory, principally through the efforts of employees and by means of advertising. The subject of protection of markets came in for a lively discussion, the feeling of the meeting being that prices must be supported to the utmost to prevent loss of confidence.

J. L. Harvey of Wichita, in discussing the value of appliance sales from a revenue standpoint, brought out that the appliance sales of the Kansas Gas & Electric Company during 1920 had averaged $1.18 per month per residential customer and $1.05 for the first three months of this year. A method of stimulating sales on these properties was described. A bogie of $1.50 per month per residential meter in the smaller towns and slightly less in the larger towns has been established and, it is believed, will be reached over the whole year. The figure is higher in the small communities because of the more intimate contact between the operating forces and the public.

A joint meeting was held Thursday with the Missouri association. The Missouri association meetings continued Friday and Saturday.

Contractor-Dealers' Association in New Quarters

ON MARCH 29 the National Association of Electrical Contractors and Dealers moved into new quarters at 15 West Thirty-seventh Street, New York City. Because of its rapid growth in membership and the increasing amount of educational work in supplying information to members on cost accounting systems,



SECRETARY W. H. MORTON IN THE NEW HEADQUARTERS

improved merchandising methods and data on installations and construction materials, the association was badly cramped for space at its old location.

In the new offices, although only a small increase in floor area has been obtained, the general arrangement permits of a better and more efficient handling of office work.

Massachusetts Stock Equalization Bill Goes Over to Next Year

FOLLOWING a vigorous campaign for and against the so-called Burdett bill, introduced by the Massachusetts Gas & Electric Association and designed to equalize the cash and share capital of certain gas and electric utilities along lines previously described in the ELECTRICAL WORLD, the Massachusetts Legislature has declared against passing this act at the present session. A resolve substituted for the bill has been lying on the Senate table for a fortnight. This provides for an investigation by a special commission, including three senators, seven representatives and the Department of Public Utilities, to sit during the next recess of the Legislature and to consider whether any changes in the laws governing past or future issues of securities by gas and electric companies should be made in order to assist the department in rate regulation, to attract capital needed for development and for the promotion of the public interest. This commission would report its conclusions, with suggested drafts of acts, to the Legislature in January, 1922. It is expected that this investigation, if conducted, will open up the question of public utility financing in its broadest aspects, and that the fate of various other financing measures referred from this session to the next will depend upon the outcome of the proposed inquiry.

Atlanta to Go Ahead with Industrial Lighting Exhibit

THE Atlanta Electrical Association, whose membership consists of the leading electrical dealers, jobbers and manufacturers in Atlanta, has undertaken the installation in that city of the National Electric Light Association's industrial lighting exhibit. The installation will be made in co-operation with the Georgia School of Technology, which is furnishing the necessary space in the electrical testing laboratory at that institution. Practically all of the material required for the exhibit will be furnished without cost by manufacturers and jobbers in the respective lines. The exhibit is expected to be complete in time for the Southern Textile Association's convention in Atlanta on May 14.

Big Gains in New Services Reported by Barstow Properties

ANOTHER indication that business is picking up is afforded by the reports for the W. S. Barstow properties. During the month of March the Metropolitan Edison Company obtained 405 contracts for wiring old houses in Lebanon and Reading, Pa. This is a record month for the company.

During February the New Jersey Power & Light Company connected forty-nine lighting and power services and installed fourteen additional street lights in Succasunna, N. J.

The net gain in meters for the month of February on the system of the Binghamton (N. Y.) Light, Heat & Power Company was 111. There were also added several new power customers, varying in connected load from 1 hp. to 15 hp.

Chippawa Power Development Authorized by Ontario

THE Ontario Legislature on April 13 passed the final estimates authorizing the expenditure of $21,700,000 by the Ontario Hydro-Electric Power Commission for the purpose of completing the Chippawa power development at Niagara and Queenston. The progress report by R. S. Lea of Montreal, hydraulic engineer, said that the work is now only nine days behind schedule time as compared with fourteen days last September. There was every prospect, the report continued, of the project being completed and ready for operation by Sept. 1. It was now expected that the total cost would be $52,300,000. The present plans provide for the utilization of 15,000 sec.-ft. and the generation of between 450,000 hp. and 500,000 hp.

Electric Heating Show to Be Held in New York in June

AN ELECTRIC heating exhibit is to be held in the showrooms of the New York Edison Company, Irving Place and Fifteenth Street, New York, from June 6 to 11. This will be the first time that such a show has been held, and virtually all of the electrical appliances for industrial heating which have been perfected during the last five or ten years will be exhibited. Forty-one manufacturers have accepted the Edison company's invitation to take part, and at least a hundred different applications of electric heat will be shown. Cartridge units, tubular heaters, soldering irons, capping tools and branding irons and apparatus for candy makers and for use in shoe factories, printing plants and other industries will be exhibited and demonstrated. No charge will be made for admission.

American Association of Engineers Plans Convention

IT HAS been announced by the national headquarters of the American Association of Engineers that plans for the annual convention at the Hotel Lafeyette, Buffalo, N. Y., on May 9, 10 and 11, have been completed. The program for the first day includes the appointment of special committees, reports of officers and standing committees and the report of judges on the election of officers, which is now in progress. A discussion of chapter activities in practice by F. H. Newell, director of field forces of the association, will be followed by committee and council reports on employment, railroads, industries, federal, building and insurance trustees, salaries of engineers in public service and teaching service, education, services and fees of practicing engineers, legislation, chapter activities, municipal problems, water power and conservation, relation to foreign engineers, balloting and organization. A "smoker" and entertainment will be held in the evening.

On May 10 the report of the committee on revision of the constitution and bylaws will be received and discussed. In the afternoon a trip to Niagara Falls will be made. There will be discussion and voting on amendments to the constitution and bylaws on the morning of May 11. In the evening the annual dinner and installation of officers will be held.

To Harness the Columbia at Kettle Falls



WHERE the mighty Columbia River drops over a series of granite ledges at Kettle Falls, 72 miles north of Spokane, and 1,200 miles from its source in British Columbia, the Washington Water Power Company will probably install a hydro-electric plant. An engineering crew is in the field and the indications all point to the project proceeding. It is believed that 50,000 hp. are available.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

St. Louis Electrical Show to Be Joined with "Own Your Home Exposition."—The St. Louis Electrical Show this year will be held in conjunction with the "Own Your Home Exposition" from April 25 to May 1, under the auspices of the Building Industries Association, the electrical interests having decided to give no separate show in 1921. The purpose of the "Own Your Home Exposition" is to stimulate interest in building.

Thirty Years' Growth in Use of Electricity in Chicago.—Indicative of the enormous increase per capita in the use of electricity are figures gathered by the Illinois Committee on Public Utility Information showing that during the last thirty years the output of the Commonwealth Edison Company, which supplies Chicago with electricity, has increased 740 times. In the same period the population of the city has increased only two and one-half times. According to these figures the consumption of electricity per capita is now nearly 300 times what it was in 1890.

Storm Damages Canadian Power Plant.—A heavy storm almost equaling a cloudburst in violence broke over Parry Sound, Ontario, recently, increasing the spring flood in the Sequin River, on which the town has a hydro-electric installation, so greatly that the wing dam broke and the 2,200-hp. generating station was flooded, several employees at the plant having narrow escapes from the inrushing water. A channel 50 ft. wide has been blasted to divert the course of the water, and it is hoped that in six weeks from the day of the accident the machines will be dried, the dam repaired and the station in operation again.

Late Figures on French Water Power.—According to a consular report from Paris, a recent publication on the development of water power in France states that prior to August, 1914, the amount of hydro-electric power developed amounted to 750,000 hp. out of an available total of 8,000,000 hp. to 9,000,000 hp. By the middle of 1919 France was equipped to develop 1,165,000 hp., furnishing an average of approximately 770,000 hp. At that time more than 500,000 hp. was being developed, and it is estimated that in 1934 an average of more than 4,000,000 hp. will be reached. Much capital has been invested in the development of water power since 1918, and in three years more than 450,000,000 francs have been invested in forty-nine power-plant companies.

Electric Furnace Used in Making Record Run at University of Wisconsin.—The largest carborundum run ever attempted by the University of Wisconsin and possibly by any college in the country was accomplished recently in an electric furnace at the Wisconsin College of Engineering. Continually for sixteen hours electric current of 100 hp. at an average temperature between 4,000 deg. and 5,000 deg. Fahr. was passed through a charge of 600 lb. of sand and coke with a small amount of sawdust and salt. Sixty pounds of carborundum was produced and 250 lb. of fire sand. Eight students working in two-men shifts performed the work. Wisconsin is one of the few universities having equipment necessary for carrying on such experiments on a large scale.

Technical Education in Russia.—According to the London *Engineering*, Russia has adopted a remarkable expedient for producing the engineers of whom she stands in need. The soviet government puts the required supply at 4,500 annually. That number must be obtained from the engineering colleges and high schools, and it will therefore be necessary to fill all the colleges to their utmost capacity and to compel the students to work at the highest pressure. Technical education has been decreed to be a special kind of conscription, and the students are interned at the colleges and have to give an undertaking to devote all their time to studies. Any youth who appears at all likely to be able to follow the lectures will be accepted as a student without examination. As there are no longer any trade secrets, the students can work anywhere. A council of professors has, however, been bold enough to express doubt whether eight hours' work a day at the colleges and 200 hours' home work per month will enable the students to absorb the instruction given.

The State Commissions in 1921.—The defeat of a bill to establish a public service commission in Delaware leaves undisturbed that state's position as the only commonwealth that has no utility-regulating body of any kind. In Arkansas a Railroad Commission has taken the place of the former Corporation Commission, and efforts to abolish the commission in Illinois and other states have failed. Of the forty-seven state commissions eight—the Railroad Commissions of Florida, Kentucky, Louisiana, Texas, Mississippi and South Dakota, the Minnesota Railroad and Warehouse Commission and the New Mexico State Corporation Commission—have no jurisdiction over electric companies. Including the Public Utilities Commission of the District of Columbia and the territorial commissions of Hawaii, Porto Rico and the Philippines, there are forty-three bodies with jurisdiction over electric companies. Six of the nine Canadian provinces—Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario and Quebec—have public utilities commissions, British Columbia, Prince Edward Island and Saskatchewan being without them.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Society for Electrical Development.—The annual meeting of this society will be held at its offices, 522 Fifth Avenue, New York City, on May 10.

Cleveland Section, A. I. E. E.—On May 17 this section will hold its annual dinner, when the subject for consideration will be "Some Recent Developments in Scientific Research." C. F. Kettering of the Dayton Engineering Laboratories will be the speaker.

New York Section, I. E. S.—The New York Section of the Illuminating Engineering Society met on Thursday, April 14, when the use of lighting in the surgical, dental and ophthalmological fields was discussed in papers under different headings by four experts in their respective lines.

A. I. and S. E. E Section Meetings.—The Chicago Section of the Iron and Steel association will meet on Monday, April 25, jointly with the A. I. E. E. "Electricity in Mining" will be the topic of the meeting. On May 7 the Philadelphia Section will hold a session devoted to "general ideas and discussions," every active member being invited to prepare a paper pertaining to the application of electricity to the iron and steel industry. The Cleveland Section on May 9 will hear a paper on electric safety tools prepared by H. P. Bush of the Bush Electric Company. Philadelphia is to inspect the Lehigh and Saucon plants of the Bethlehem Steel Company at a date in May not yet announced.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Chicago, April 25; Philadelphia, May 7; Cleveland, May 9.

A. I. E. E. Section Meetings—Chicago, April 25; San Francisco, April 29; Vancouver, B. C., May 6.

United States Chamber of Commerce—Atlantic City, April 27-29.

American Society of Civil Engineers—Houston, Tex., April 27.

American Association of Engineers—Buffalo, May 9-11.

Society for Electrical Development Annual Meeting—New York, May 10.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

A. I. E. E. Annual Meeting—New York, May 20.

American Society of Mechanical Engineers—Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Section—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Protection from Confiscation.—The United States District Court for the Southern District of Texas has refused to allow the city of Houston to force the Southwestern Telegraph & Telephone Company to revert to the tariff in effect before the Postmaster-General raised telephone rates all over the country during the period of government operation. The court found the ordinance which the city sought to enforce to be confiscatory and held the company to be entitled to an increase which would enable it to earn a net return of 8 per cent on capital invested. (268 Fed. 878.)*

Commission's Findings Sustained Where Arbitrary Action Is Not Shown.—The city of Seattle having brought proceedings against the Public Service Commission of Washington to upset gas rates fixed by the defendant charged, first, that the evidence did not sustain the commission's findings and, second, that improper evidence was submitted. The Supreme Court of Washington refused to sustain either contention, declaring that the commission's decisions will not be disturbed by it in the absence of a showing of capriciousness or arbitrary action. The court assumed but did not declare that the commission should base its findings on proof submitted, and, making this assumption, found no evidence that such a course had not been followed. (195 Pac. 1017.)

Change from Hydraulic to Hydro-Electric Power Leads to Suit.—The Supreme Court of New York has decided in favor of the Cohoes Power & Light Corporation in a suit brought against it by C. H. Kavanaugh involving water rights owned by him. The action, which was of long standing and grew out of the substitution of hydro-electric for hydraulic power, involved the question whether 14.82 "mill power" or only 6 "mill power" had been acquired by the plaintiff and also a difference in rate between 50 cents and $1.50 per kilowatt-hour, or a total under a perpetual contract of between $6,000 and $7,000 a year. The plaintiff claimed that the right to the larger amount of power was confirmed by twenty years' adverse use and that the central-station company had offered the former owner of the rights in dispute the equivalent in electrical energy of 14.82 "mill power," thereby precluding its contention that only 6 "mill power," the amount named in the original leases, was called for.

*The [illegible] numbers refer to the volumes and the [illegible] numbers to the page of the National Reporter System.

Industrial Commission Cannot Fix Compensation for Injury Without Regard to Testimony.—In Schermerhorn vs. General Electric Company the defendant appealed from the action of the Industrial Commission in assessing damages under the workmen's compensation law in the case at issue on the basis of a 40 per cent injury to the use of plaintiff's hand, although the examining physicians had placed the ratio at from 25 to 33⅓ per cent. The Supreme Court of New York, Appellate Division, overruled the commission's decision as arbitrary, ordering that damages be fixed in accordance with the testimony. (186 N. Y. S. 835.)

The New Jersey Commission Case.—In McGran, Attorney-General, vs. Gaul, which involved the constitutionality of the Governor's action in removing from office the entire membership of the New Jersey Board of Public Utility Commissioners, the Court of Errors and Appeals of New Jersey found that the power of removal bestowed upon the Governor by the public utilities act was not unconstitutional as an encroachment on the judiciary. The court divided equally, thus sustaining the lower court, on the questions whether charges against commissioners should have been by formal pleading, whether the charges were rightly made against them as a board, whether intentional or willful neglect of duty should have been shown in order to justify removal, and whether the inclusion in the Governor's charges of acts or omissions which took place before the defendant, a member of the board, had taken office made the removal of the latter illegal. (112 At. 603.)

Possibility of Shock from Fallen Wire Question for Jury — Proximate Cause of Injury.—In Godbey vs. Grinnell Electric & Heating Company the plaintiff sought damages because of injury received when he endeavored to remove from his yard the end of a broken telephone wire which had been strung above an electric light wire and in falling had come and remained in contact therewith. The company held that as the telephone wire was lying along the ground it could not have caused a severe shock, and also that if such shock had been received the telephone company and not the electric light company would have been responsible. The Supreme Court of Iowa held that no question of law could be based on the first of these contentions, which was a matter of fact for the jury, and also that the proximate cause of injury was not the breaking of the telephone wire but the defective insulation of the electric light wire, the accident having been one of which the possibility should have been foreseen. If the telephone wire carried a current of its own which united with that from the electric light wire to cause the injury, that would be a concurring, not an intervening, cause of injury, and recovery might be had against either company or against both. (181 N. W. 498.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Preferential Rates Refused to City.—The city of Los Angeles will in the future pay for the power bought from the Southern California Edison Company in accordance with the schedule fixing the rate for electricity sold for resale. The city asked for a special rate, but the commission has held that "it is not entitled to any lower rate for the service as rendered than any other distributing company or municipality which is purchasing power in like quantities and under similar conditions."

Adequate Service Must Precede Higher Rates.—Declaring that a public utility company should not be permitted to procure capital for rebuilding from revenues derived through increased rates, the Wisconsin Railroad Commission refused to consider an application from a telephone company for an increase in rates in the absence of needed improvements, although standing ready to authorize any schedules fully to protect any reasonable investment necessitated in rebuilding to insure better service.

Value of Continuous Service.—In a decision fixing the valuation of the Wood River power plant at $311,380, though the capitalization of the property is only $245,000, the Public Utilities Commission of Idaho says: "The assurance of continuation of service is of even more importance than is the service presently rendered. Business and living plans are made with regard to it. Community and district growth are affected by it, and it may be said that service today is a convenience, while the assurance of continuous future service is a necessity."

Increased Rates Refused Because of Unsatisfactory Service.—Refusing to the Arkansas Light & Power Company an increase in electrical rates in the towns of Plummerville and Morrilton because of "extremely unsatisfactory" service, the Arkansas Corporation Commission said: "The commission understands that in order properly to serve the public a utility must receive a revenue sufficient to make this service possible, but the commission believes that conditions might arise by which the service might be so unsatisfactory that no increase of rates could be justified although it were shown that the company was losing money. . . . The commission does not feel that it would be just and right to allow the proposed increase in rates even though it is shown that the increase would not yield more than a fair return on the investment."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Dr. F. B. Jewett, chief engineer of the Western Electric Company, who is one of the best-known telephone engineers in the United States, has been elected to be a vice-president and director of that company. He will continue his present duties in charge of the company's technical forces engaged in manufacturing telephone equipment. Dr. Jewett, who was a lieutenant-colonel in the Signal Corps during the war and was decorated with the Distinguished Service Medal, was born in Pasadena, Cal., Sept. 5, 1879. He was graduated from the Throop Polytechnic Institute of Pasadena in 1898 with the degree of A.B. in electrical engineering. From 1898 until June, 1902, he was a graduate student in the University of Chicago, receiving the degree of Ph.D. in 1902. In the last two years of his post-graduate work he was research assistant to Professor Michelson, of the department of physics. From 1902 to 1904 Dr. Jewett was instructor in physics and electrical engineering at the Massachusetts Institute of Technology. His connection with the commercial telephone work dates from September, 1904, when he became transmission engineer for the American Telephone & Telegraph Company. While he acted in this capacity the loading of eight-gage circuits was perfected, phantom cables and phantom loading for open wires and cables were developed, the New York to Denver circuit and line was engineered, and so also was the Boston to Washington underground cable. In April, 1912, Dr. Jewett became assistant chief engineer of the Western Electric Company in charge of all development and research work. He has been chief engineer since 1916. Dr. Jewett was an advisory member of the special submarine board of the navy and contributed much toward the perfection of devices for detecting hostile submarines. The perfection of wireless telephony is one of the most notable undertakings completed under his direction.



F. B. JEWETT

H. L. Wills, electrical engineer and operating manager of the Georgia Railway & Power Company at Atlanta, was elected president of the American Association of Operating Engineers at a meeting held on April 5 in that city. This is a new organization whose aims and objects are to promote a better understanding of the problems of operating and maintenance engineers. The selection of Mr. Wills to head this organization is in recognition of his broad central-station experience in the engineering field. He entered the employ of the Georgia Railway & Electric Company in 1902 and remained with this company until 1907, holding positions as the head of the meter and repair departments. During that time he organized the testing department. In 1907 he resigned to become engineer and general manager of the Savannah (Ga.) Lighting Company. Since 1912 he has been connected with the Georgia Railway & Power Company and held various engineering positions of wide responsibility. On Feb. 1, 1919, he was appointed electrical engineer, a position which was merged with that of operating manager on Feb. 1, 1920. Throughout his career Mr. Wills has been identified with constructive work of the American Institute of Electrical Engineers, the National Electric Light Association and other societies, maintaining in all an active interest.



H. L. WILLS

Dr. Colin G. Fink of Yonkers, N. Y., who organized and has since directed the research laboratory of the Chile Exploration Company, has resigned his post as director. Dr. Fink recently invented an electrical process for the reduction of tin ores. His new insoluble anode is now being introduced at the large electrolytic copper plant at Chuquicamata, Chile. Dr. Fink was formerly in charge of the research laboratory of the Edison Lamp Works of the General Electric Company at Harrison, N. J. In 1903 he was graduated from Columbia University and went to Germany, where he studied under Ostwald, being graduated from the University of Leipsic in 1907 with the degree of Ph. D. On returning to America he entered the research laboratory of the General Electric Company at Schenectady, where he was engaged in work on the tungsten filament and the problem of ductile tungsten. A paper read by him before the Pittsburgh Section of the American Electrochemical Society in May, 1910, was the first announcement of the achievement of ductile tungsten and molybdenum. At Harrison Dr. Fink invented and developed the leading-in wire, a substitute for platinum, now used in every lamp factory in the world. His wire is also used in audions, mercury-arc rectifiers, X-ray tubes, kenotrons and other instruments. The annual resulting saving in platinum is estimated at more than $7,000,000. Dr. Fink is well known in electrometallurgical and electrochemical circles. He is a past-president of the American Electrochemical Society, is a member of the National Research Council and a fellow of the American Association for the Advancement of Science.



C. G. FINK

Frank A. Heermans has been appointed assistant secretary of the Public Utilities Commission of Illinois to succeed G. E. Doying.

Lloyd E. Oneal, formerly assistant electrical engineer of Dwight P. Robinson & Company, Inc., consulting and construction engineers, is now manager of the industrial equipment department of Charles Cory & Son, Inc., New York City.

J. S. Colt, who has been manager of the Wilmington (Del.) Electric Appliance Company since its inception nearly two years ago, is leaving this post to take up similar duties in the preliminary planning of a new enterprise. Mr. Colt will be associated with the same interests which control the above company. He is to be succeeded by H. H. Saylor of Philadelphia.

W. J. Marshall, who recently resigned the position of sales manager of the Electric Construction & Sales Company, Cleveland, has been made promotion manager of the Erner Electric Company, electrical jobber, of that city. He will be in general charge of appli-



W. J. MARSHALL

ance sales promotion work. Before going to Cleveland Mr. Marshall was for eleven years connected with the Doherty interests as new-business manager in Toledo and Warren, Ohio. He has been prominent in both the N. E. L. A. and the Ohio Electric Light Association and in the work of the Electrical League, in which organization he served as chairman of the committee which so successfully launched the "home electrical" movement in Cleveland.

Herbert H. Skinner, for the past two and one-half years representative of the Westinghouse Electric & Manufacturing Company in Rhode Island and eastern Connecticut, with headquarters at Providence, R. I., has established offices as commercial engineer at 801 Union Trust Building, Providence, representing the Godfrey Conveyor Company, Elkhart, Ind. Mr. Skinner is a native of Rome, N. Y. His early experience included eighteen months' work in the testing department of the General Electric Company's Lynn works, a year's service as assistant chief electrician of the Rhode Island Company, Providence, and a year with the Edison Electric Illuminating Company of Boston. For ten years prior to his Westinghouse connection Mr. Skinner was employed as power engineer by the Narragansett Electric Lighting Company at Providence.

R. B. Bragg, formerly district manager of the Pacific Power & Light Company at Dayton, Ore., has been transferred to the Pasco (Wash.) office. Mr. Bragg succeeds Mr. Safford.

H. W. Cooper, formerly district manager of the Pacific Power & Light Company at Pomeroy, Ore., has been transferred to Dayton to succeed R. B. Bragg.

Robert Johnston, for four years representative of the Federal Electric Company in Salt Lake City, has been transferred to Oakland, Cal., as sales manager of that district.

Charles W. Reed has been appointed New England field representative of the Electric Motor Repair Company, Springfield, Mass., with headquarters at 29 Worthington Street.

Harry E. Marshall has been appointed Pacific Coast representative of the Mueller Electric Company of Cleveland, Ohio, manufacturer of Universal battery and test clips, with offices and warehouse at 332 Leavenworth Street, San Francisco.

Gaskell S. Jacobs, assistant chief engineer of the California State Railroad Commission for the past six years, has resigned his position and will enter into private practice as a consulting electrical engineer. During his connection with the commission Mr. Jacobs has taken part in many of the important investigations conducted in that time.

W. G. Merowit, application engineer, has recently been appointed district sales engineering representative in western New York, Erie, Pa., and nearby Canada for the Ward Leonard Electric Company's lines of resistance units, battery-charging apparatus, etc. Mr. Merowit also represents in that territory the Monitor Controller Company, Baltimore; the Roller-Smith Company, New York City, and the Union Electric Manufacturing Company, Milwaukee. His headquarters will be at 707 Ellicott Square, Buffalo.

M. D. Summer, to whom charge of the Buffalo district office of the Packard Electric Company of Warren, Ohio, was given on March 1, is well known to the electrical trade in the Buffalo district. He was born in Olean, N. Y., and was graduated from the Olean high school in 1911. From the Bliss Electrical School he entered the employ of the General Electric Company and later of the Olean Light & Power Company. He left the latter company to become successively agent, district manager and sales manager with the Pittsburgh Transformer Company and more recently sales manager for the Carbon Import Company. Mr. Haig, former manager of the Buffalo district, has been transferred to the home office at Warren, Ohio, in the capacity of manager of the service department.

H. D. James has been appointed manager of the industrial division of the Cincinnati district office of the Westinghouse Electric & Manufacturing Company to succeed F. G. Kirkpatrick, who recently resigned. Mr. James was graduated from the University of Cincinnati in 1906 and afterward spent five years with the Westinghouse company. In 1911 he left that company to become power engineer with the Union Gas & Electric Company of Cincinnati. Mr. James served in the war, and at the time of his re-entering the employ of the Westinghouse company was with the Chace Engineering Company of Cincinnati.

T. W. Peters, who recently resigned as chief engineer of the Chero-Cola Company of Columbus, Ga., has been appointed district representative of the Black & Decker Manufacturing Company for the Southern States, with headquarters in Atlanta, where a new



T. W. PETERS

branch office will be established. Previous to his connection with the Chero-Cola Company early in 1919 Mr. Peters was for twelve years commercial agent of the Columbus (Ga.) Electric Company. During that period he was active in electrical association work throughout the South. He has served as secretary of the Southeastern Section of the N. E. L. A. from its organization, with the exception of the year 1913, when he was elected president.

Charles R. Dodge has been appointed Western sales manager of the Lakewood Engineering Company, Cleveland, Ohio, with headquarters at 1215 Lumber Exchange Building, Chicago.

Roy Sadler has been appointed superintendent of shops for the Electric Motor Repair Company, Springfield, Mass. Mr. Sadler was formerly connected with the Nashua (N. H.) Light, Heat & Power Company; the Hartford (Conn.) Electric Light Company; Landers, Frary & Clark Company, New Britain, Conn., and the Hartford (Conn.) Electric Machine & Repair Company. His experience covers about nineteen years of activity in the central-station and industrial fields.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Ten per Cent Drop on Cross-arms

FOLLOWING the price reduction of 9 to 15 per cent on Rainier fir and long-leaf yellow pine cross-arms that was made on March 1 as announced in the March 19 number of the ELECTRICAL WORLD, prices have again been reduced. The decrease, which was effective April 11, amounts to about 10 per cent and applies to the representative prices that were quoted in the March 19 issue. This is the third general price reduction inside of two months and a half, the first, on Feb. 1, amounting to 15 per cent.

It is hoped that this latest price decrease will serve as a stimulus to demand, especially as it comes at a time when kindred lines, such as poles and line hardware, are also reduced. Up to the present time the market has remained very quiet, and although stocks are good and deliveries prompt consumers have not followed up their inquiries.

Southwest Electrical Market Shows Encouraging Activity

ARIZONA, New Mexico and northern Mexico are dependent almost entirely upon copper mining for their industrial prosperity. Cotton is a close second in Arizona, while cattle are raised in all sections. With the curtailment of copper production there has come a rather marked slowing down of all business. A few of the properties are being entirely shut down, although the majority of them will continue pumping and some development work, particularly in the high-grade ore-bodies, will be carried on.

Extensive additions to generating equipment, mills and hoisting equipment are being made in some places in Arizona. The United Verde Copper Company is just now completing work on a modern surface station and an underground hoist at Jerome. The Miami Copper Company at Miami, Ariz., has nearly completed a new hoist and mill which have necessitated the building of a new substation and additions to its generating equipment. The Phelps-Dodge Corporation is installing several Diesel engines—some being of 2,000 hp. In addition that company is building a new mill at Bisbee. At Benson, Ariz., the same company is building a powder plant, which has necessitated a generating station.

In New Mexico several hydro-electric projects are in contemplation for the early future. Among these is the utilization of power from Elephant Butte dam to supply the territory along the Rio Grande River, including the city of El Paso. Other hydro-electric projects are in the preliminary stages of arranging for finances. In the coal fields a new market is being opened up by the electrification of existing mines and by the prospect of erecting generating stations at the mouths of mines in such mountainous regions that transportation of the coal itself would be difficult.

El Paso is in a strong position to get a large part of the jobbing business in New Mexico, western Texas, Arizona and Mexico. A strong play is being made by El Paso merchants to get the business of the western coast of Mexico, which will some day be an important factor. At the present time this territory is being jobbed partly by El Paso, but also by Dallas, Denver and Los Angeles. The freight rates to Arizona, particularly, have been a serious handicap to the establishment of jobbing houses in that state, although consideration has been given to this. At the present time many of the mining companies buy their supplies from Chicago and other distant centers, complaining that insufficient stocks are carried nearer by.

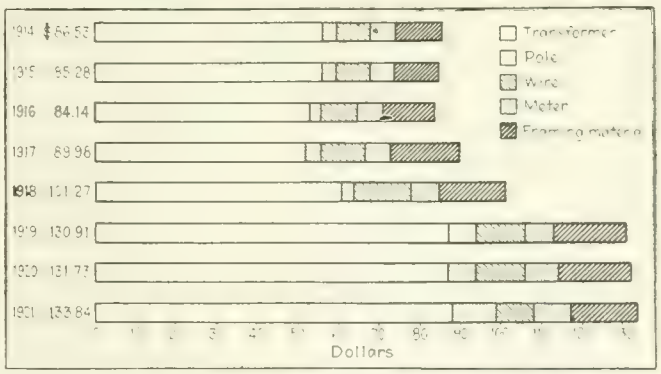
The sale of appliances and other household electrical devices has been somewhat hampered by the high prices. Stocks of almost all lines in the hands of retailers seem sufficient to meet demands. No difficulty is found in maintaining these as desired. In a few places active campaigns have been made in the past year to place such appliances as washers.

Little has been done in co-operative efforts to increase the use of household appliances. Although all the central stations carry a line of appliances and in a few instances push them actively, the dealers are quite free to develop.

Trend of Prices of Pole-Line Materials

IN AN analysis of its pole-line construction costs over the last seven years the Pacific Power & Light Company, in its April bulletin, presents some interesting figures in chart form as shown below. A typical installation in 6,600-volt, single-phase distribution-line construction was selected. It consisted of a 35-ft. untreated cedar pole and a span of 250 ft. of single-phase primary conductors. Included was a 5-kw., 6,600/220/110-volt transformer with all necessary cross-arms, insulators, pole-line hardware and grounding construction. An average length house service with 5-amp. type I-14 General Electric meter is also included, and all of this construction meets the company's usual standards.

"The total cost of this typical installation is taken from our general stores ledger as of January of each year," the



COST OF POLE-LINE CONSTRUCTION OVER SEVEN YEARS

bulletin says, "and represents the actual cost of the several items which go to make up this bill of material.

"It will be noted that most of the items have started to go down in price. This is especially true of wire and, to a small degree, applies to framing material. Since January of this year transformers have decreased 10 per cent and pole-line hardware has taken a drop of about 15 per cent."

In April hardware dropped 10 per cent, poles about 20 per cent and cross-arms 10 per cent. These decreases are not reflected in this chart because the stock on hand as of January was largely material that had been purchased previously and carried over from the preceding year, and a few months will have to elapse before these reduced costs can be reflected in a chart. The bulletin continues:

"It cannot be assumed that this chart shows the exact tendency in the complete cost of electric distribution system pole lines because labor costs are of equal importance and are not reflected in this presentation. It is safe to assume, however, that our average costs in the erection of distribution lines have increased at least as much as is shown in this chart."

Freight Prepayment Advocated by Supply Jobbers

AMONG the practical economies which the Electrical Supply Jobbers' Association seeks to put into effect is prepayment of freight by the manufacturer who sells "delivered" or "freight allowed." At a recent meeting of the association one jobber who has given the matter considerable study asserted that the adoption of the policy of prepaying freight by manufacturers would save the jobbing industry not less than $50,000 a year.

Under present conditions where manufacturers fail to prepay freight an immense amount of unnecessary detail, the jobbers state, is saddled on every party to the transaction. This is particularly emphasized where shipments are made direct to the jobber's customer.

The whole transaction of getting credit for the freight paid may take at a conservative estimate from four to six letters, it is asserted, as well as considerable extra time in searching and giving data concerning the invoice date, its number, etc. In addition each party to the transaction will make at least one ledger entry of the amount of the freight. All of this wasted time and expense, the jobbers feel, can be eliminated without harm to the manufacturer if the freight is originally prepaid.

Since this subject was first agitated some few years ago many manufacturers have sensed the jobber's position and have adopted the policy of prepaying freight, but there are some, however, who have not yet felt that they wished to take this step, and among some of the reasons advanced for hesitating to adopt this policy the following have been given:

1. Contention where goods are sold f.o.b. shipping point, freight allowed, that if the freight is prepaid by the shipper, then delivery to destination is guaranteed. This, the jobbers believe, would not be upheld in court, and furthermore they hold that if the contract of sale calls for delivery at shipping point a good delivery has been made by the shipper when he turns his goods over to the carrier whether he prepays the freight or not, and the goods in transit are the property of the purchaser.

2. Disinclination to pay the tax on the freight bill. To this objection the jobbers have answered by saying that they will absorb the tax and the amount of the taxes so paid may be charged to them on the face of their invoices.

3. Extra labor involved in actually prepaying each shipment. This, the jobbers further state, can be reduced to a minimum by arrangement with the carrier for weekly settlements of prepaid freight accounts.

As the situation stands today the jobbers of the country think that they themselves and their customers, and incidentally the manufacturers themselves, can save time and money in large amounts if the manufacturers will come to their way of reasoning; and it is confidently expected by them that as soon as this is brought home to the manufacturers prepayment of freight where goods are sold "delivered" or "freight allowed" will become a trade custom.

Returning Activity in Mechanical Refrigeration

INCREASING interest in electric refrigeration is reported by manufacturers of both residential and commercial types. Buying of the residential machines is generally at a rather low rate during the winter, but with the early warm weather this spring the market has already come back at a good rate. Consumer interest is increasing, the producers say, and prospective buyers are becoming convinced that mechanical refrigeration for home use has reached a stage of development where it can be used to great advantage. Not all producers are working at full schedule, but some of them report production capacity fully taken. Orders can be shipped in about four weeks.

The open winter and the small amount of natural ice cut have worked in favor of manufacturers of commercial machines, who have received some substantial orders so far and many of whom are working at a good rate. The activity of central stations in getting this load, much of which is synchronous-motor drive, is also a factor in increased machine output.

That the future must have much in store for mechanical refrigeration is shown by the expansion in producing capacity and in sales distribution of several representative manufacturers and by the recent entrance into the field of several new companies. Four to six weeks' shipments are being quoted.

General Reduction of Conduit Prices of from 5 to 10 per Cent

IN LINE with general reductions in steel prices within the past few months—and more particularly in view of the recent drop in prices of the United States Steel Corporation on merchant pipe and other products—general reductions on conduit have been made by manufacturers. The decrease ranges from about 5 per cent to slightly more than 10 per cent on different sizes and became effective on April 14, 15 and 18 with various producers. The number of the Pittsburgh basing discount card has in each case been increased by one, so that in different instances conduit manufacturers are now working on cards 45, 46 and 47.

The general increase in discounts that was made is the same in several instances, and amounts to two points on ½-in. conduit, three points on ¾-in. and five points on 1-in. and larger sizes, both black and galvanized. The discount on elbows and couplings is increased by three points.

Demand for conduit at the present time, manufacturers report, is very light, and new business has consequently fallen far below normal. As a result production is curtailed to a minimum, one large manufacturer operating on a 50 per cent schedule and another having closed down this department entirely for two months. Even on such a light operating basis manufacturers' stocks are too large, if anything, and shipments are of course immediate.

The outlook is for improvement in business, manufacturers think, but they also add that the returning market will probably be a slow process. The one thing above others needed to restore public confidence in the market and to stimulate building construction, it is said, is a general lower scale of wages.

The Metal Market Situation

BUYING in the copper market has not increased appreciably, but producers are content to maintain their prices of 12.75 to 13 cents per pound for deliveries over the second quarter. There is some increased domestic inquiry for small lots, but on the other hand foreign demand has fallen off with the cessation of German buying.

The lead market holds firm as to prices, but buying interest is lacking. Prices in the outside market at New York are about ¼ cent higher than the official price of 4.25 cents per pound.

NEW YORK METAL MARKET PRICE

	April 12, 1921	April 19, 1921
Copper	£ s d	£ s d
London, standard spot	69 0 0	69 15 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	12 75—13 00
Electrolytic	12 75	12 75
Casting	12 00	11 75 12 00
Wire base	14 50	14 50 15 00
Lead, trust price	4 25	4 25
Antimony	5 12	5 12
Nickel, ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 15	5 20
Tin	29 75	30 75
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9 50—10 25	9 50—10 25
Brass, heavy	5 50 - 5 75	5 50 - 5 75
Brass, light	3 75 - 4 00	3 75 - 4 00
Lead, heavy	3 50 - 3 75	3 50 - 3 75
Zinc, old scrap	2 87½- 3 00	2 87½- 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A BETTER tone is evident in the supply market, and from New England, St. Louis and the Northwest there are reports of increasing business. The Boston builders have thrown open their jobs and the response has been large. Building contracts doubled those of the week before. Chicago building is awaiting lower labor costs. Revival of plans by the industries in the South is reported because of the government aid in financing agricultural products. Merchandising conferences are stimulating business in the intermountain cities. New York is only holding its own.

With the price reductions of the Steel Corporation last week, structural steel is lower and an added incentive to large building is given. Reductions in tubular goods this week bring rigid conduit and fittings down two points. Reductions in line hardware, poles and cross-arms have reached all localities, and here and there local wire prices are a trifle softer. Repair work is moving wire and insulation. High-tension insulators are off on deliveries, but most other equipment is plentiful.

NEW YORK

The electrical trade in this territory at worst is holding its own, and in general the slight upward tendency previously noted continues. Spring sales of motor-driven socket appliances are very poor, but there is a sufficient volume of repair work being done to provide a fair demand for several staple items such as tape and rubber-covered wire. Conduit prices have just undergone a general reduction.

Buying for stock in virtually every line of goods is cautious and bids fair to remain so. Jobbers' stocks are pretty well in hand now, and there is not so much interchanging of supplies because the previously existing surplus has been largely overcome. Collections with the general run of customers are tight, but as jobbers have learned by experience to extend credit only to regular buyers, their report on the collection situation is favorable for the most part.

Loom.—Demand is slight with good stocks on hand. In 1,000-ft. lots the $\frac{7}{32}$-in. size sells for about $22 to $25 and the $\frac{1}{4}$-in. size for $24 to $27.

Conduit.—Demand is spotty among different jobbers, some finding it on the increase and others not. Fair stocks are held with very prompt shipments ruling. Price decreases have just been announced by manufacturers, as stated elsewhere in this issue.

Locknuts, Washers and Bushings.—Sales are fairly good with plentiful supplies on hand. In standard package quantities 50 per cent off list is generally quoted by jobbers.

Flexible Armored Conductor.—Stocks are adequate but not especially large, and though some houses report a little improvement in sales, general demand is light. The price of No. 14, two-wire, double-strip in 1,000-ft. lots holds steady at $62 to $66.

Lamp Cord.—The market is reported as stagnant on this item, and stocks vary from much too large down to a nominal amount. Prices cover a wide range, from $16.50 to $20.70 being quoted on 1,000 ft. of No. 18 cotton, twisted, and from $18.75 to $25 and even higher on No. 18 cotton, parallel.

Rubber-Covered Wire. — A slight spurt in demand is evident this week, with most jobbers making fairly good sales, especially on No. 14, single-braid, which brings from $7.50 to $7.75 per 1,000 ft. in 10,000-ft. lots. Stocks are good.

Tape.—Spring repair work has evidently increased sales a little as a fairly good demand is reported. Stocks are normal. Standard grades of friction tape in 100-lb. lots bring a fairly uniform price. Four jobbers quote 45 cents per pound, three quote 42 cents and one as low as 38½ cents. On rubber-tape prices there is more spread, however, as quotations range from as low as 36 cents per pound up to 48 cents, with 44 and 45 cents the happy medium.

Knife Switches.—Good stocks are carried, several jobbers having ordered fair quantities following price decreases the first of this month. The call, however, is light.

Household Appliances. — Demand for washing machines, cleaners, ironers, etc., is extremely slow this spring. Prices hold steady, and though stocks on hand are adequate, they are kept low.

CHICAGO

No appreciable change is registered in business in the Chicago district except that the long-continued period of business quiet is having the effect of deepening the pessimistic feelings of many dealers. Students of conditions, however, believe all signs point to better times in the very near future. Price adjustments by the steel interests which had the effect of lowering the price of structural steel $5 a ton, coupled with the previous 25 per cent cut in common brick, go a long step toward lower building costs. As regards the $25,000,000 in building permits which have been taken out this spring, actual work is being delayed pending lower costs. Labor is still considering a 20 per cent decrease, and should it become effective it seems certain that building will proceed with speed.

All classes of the trade are quiet. Contractors and supply jobbers are doing little and retail trade is low, apparently on account of persistent high prices. Of appliances, washing machines continue to be the best sellers, the great majority being sold on the deferred payment plan.

Bare Copper Wire. — Price bases remain unchanged. Quoted price by electrical supply houses is 16 cents per pound on No. 8 in 1,000-lb. lots. Not so much price shading is found since the Anaconda properties ceased production.

Insulated Wire.—Almost entire cessation of price cutting below the quoted figure of 19 cents per pound for No. 6 triple-braided weatherproof wire and $7.75 per 1,000 ft. for No. 14 rubber-covered is noted. All hands hold ample stocks. The feeling is that prices will be no lower.

Black Conduit. — Demand remains at a minimum and stocks are getting correspondingly heavy in jobbers' hands. Purchases, it is felt, will be very small pending new prices of steel tubing which will probably cause a new card on a lower base for conduit. Current quotation on ½-in. in 5,000-lb. lots is $64 per 1,000 ft.

Flexible Armored Conductor.—No price change and no increase in demand can be noted. Quotation is held firm at $62 per 1,000 ft. for No. 14 two-wire, in 5,000-ft. lots, few sales being negotiated.

Motors.—There is no interest manifested in motors. On the part of manufacturers prices are held firm, but many overstocked dealers are offering radical cuts, which, however, fail to attract business. General industrial inactivity rather than high prices seems to be the cause of poor trade.

Transformers. — With prices unchanged, business continues fair in the equipment for farm lines. Although no large orders are being booked, there is a continual string of small requirements.

Protective Apparatus.—In line with sales of transformers, cut-outs and arresters are moving nicely. Certain manufacturers have readjusted both price and discount sheets.

Cross-Arms. — New reduced lists became effective on cross-arms last week. N. E. L. A. specification two-pin arms, 3 ft. 2 in. x 3½ in x 4½ in., in less than 1,000 linear ft., are $66.79 per 100. Standard electric light arms, four-pin, 5-ft. x 3¼ in. x 4¼ in., are $73.83 per 100 in the same quantity. In larger lots prices are respectively $59.37 and $65.63 per 100. These quotations are f.o.b. Minnesota transfer point.

BOSTON

A decidedly better tone is evident in the market this week. The volume of trade has shown no marked increase, but several factors working toward increased business are in evidence. Boston building employers threw open their jobs a few days ago to open-shop workers, and the response has been large. Many delayed or stopped operations are now being resumed. Interest in domestic appliances has been quickened by the opening of the "Home Beautiful Show" at Boston, in which leading distributers occupy a massed central location. Collections seem to be holding their own. Building and engineering contracts in New England for the week ended April 12 totaled $4,070,000, compared with $1,955,500 for the preceding week. Stocks are somewhat spotty, although shipments from the factories are maintaining satisfactory deliveries except on high-tension insulators. Prices show downward movement in rigid conduit, cross-arms, rubber-covered wire, pole-line hardware and conduit fittings, with an upward change in wooden molding.

Storage Batteries.—Movement of batteries for automobile starting and lighting service is in good volume and shows increased sales. Prices are steady and stocks are being constantly replenished by factory shipments.

Motors.—A buyers' market still prevails and deliveries are excellent all along the line. Steady prices are reported.

Wire.—Rubber-covered wire has again weakened in price, No. 14 dropping to $7.50 per 1,000 ft. Monday on 5,000-ft. orders. Weatherproof wire is selling around 16 cents base on 1,200-lb. to 5,000-lb. orders, and bare is moving in small quantities at 16 to 18 cents base, with close competition for offered business.

Lamp Cord.—Sales are light and stocks much better than formerly. No. 18 cotton-covered sells around $25 in less than coil lots and at $18 to $20 in coil to 1,000-ft. lots. Silk No. 18 brings double these figures.

Rigid Conduit.—A new price schedule featuring reductions of 5 to 10 per cent was received Monday, effective immediately. All sizes of elbows and couplings were marked down three points. The new card quotes two points off the former on ½-in. pipe, three points off on ¾-in. and six points off on 1-in. to 6-in. pipe inclusive.

Flexible Armored Conductor.—Moderate-sized orders are being handled with steady prices, but larger quantities, running around 5,000 lb. or over, are moving at prices ranging from $55 to $60 per 1,000 ft. An increase in demand is anticipated following the resumption of building work.

Non-Metallic Flexible Conduit.—Dull trade continues, with steady prices. The 3/2-in size brings $22 per 1,000 ft. in 5,000-ft. lots and the 5/8-in. size $24. Deliveries are satisfactory from the buyer's standpoint.

Appliances. — Sales are responding to merchandising efforts and service work. The first quarter's sales of one of the largest retailers in New England slightly exceeded those of January-March, 1920. Stocks are in fine shape.

Pole-Line Material.—Cross-arms are easier in price, reduced quotations of about 10 per cent being noted among some jobbers. Hardware is off about 5 per cent; poles are quiet. Some construction work is being done, but central stations are mainly cultivating load on existing lines.

ATLANTA

Although it is impossible to point toward a specific instance as proof of the condition, nevertheless it is quite evident that the temper of business in general is showing a steady improvement in nearly all lines of activity. Although electrical jobbers report that their first week in April showed a falling off in the quantity of business, the second week witnessed a reaction that promises, if continued, to put April ahead of March in the volume of business done. The evident desire of the national government to assist in the financing of agricultural products has gone a long way toward restoring confidence throughout the section and in raising the morale of the agricultural communities. This situation is reflected by a revival of plans by industries for expansion, and a large increase in inquiries looking toward this end is being received. This is particularly true in connection with projects for electrically driven raw-water ice plants, which are badly needed to relieve the shortage in ice that exists in this section.

A slow revival in building is the result of the reduction in the cost of building material and labor, the moderate-priced home leading in this line.

Heating Devices.—This line is virtually dead, largely because retailers seem to be making no sales effort.

Safety Switches.—The usual steady demand for safety switches continues. With the exception of a reduction of 6 per cent announced by one manufacturer, no price changes have as yet been reported.

Insulating Material.—Repairs to old apparatus, in preference to purchase of new, have created a very active market for varnished-cambric cloth, rubber tape, friction tape and pressbroad. Inquiries show a steady increase and stocks have fallen to a low ebb.

Ventilating Equipment.—Early spring ushered in a brisk demand for ventilating equipment of all types, the movement this year being the earliest on record. The most popular sizes of fans are from 18 in. to 36 in.

Ceiling Fans.—A normal market is reported on this item, stocks and shipments being in good condition.

Fans.—These have begun to move in earnest, and jobbers are predicting a very heavy season in all sizes. Both stocks and shipments are reported satisfactory.

Static Condensers.—The action of power companies in requiring the correction of large customers' power factors has brought this specialty into prominence. The prospects are that an unusual quantity of orders for this class of apparatus will be booked by manufacturers and jobbers in the next few months.

Commercial Lighting Fixtures.—A reawakened activity is reported in this line, probably due to the educational campaigns by manufacturers.

Flexible Armored Conductor.—The movement is reported well sustained. Supplies are on hand in sufficient quantities, with prices on single strip, two-wire, No. 14, $77.50 per M ft.

ST. LOUIS

Increased volume of business is reported by several jobbers this week, though this applies rather to orders than to collections. One jobber reports an increase in orders of about 10 per cent over the average of the preceding few weeks, the betterment being general over the various lines carried. The cause for this change apparently lies in depleted stocks of retailers, for no appreciable increase in construction requirements has occurred. A small amount of residential building is under way, but it is far from normal. Manufacturers are building up their operations gradually, and some improvement in demand from this source may be observed in a few months. The wage controversy between the unions and the contractors is unchanged.

A 10 per cent reduction in the price of poles and cross-arms is the only price change reported this week. Stocks generally are in good shape. Collections remain on an average basis of sixty days.

Wire.—All jobbers report satisfactory movement of No. 14 rubber-covered, but the larger sizes are moving quite slowly. No. 14 can be purchased at any price from $7 to $8 per 1,000 ft. One large jobber is holding to the higher price and yet is reporting good sales. Both weatherproof and bare wire are selling on a base around 16 cents, and a fair demand is reported. Stocks are in good condition and the total St. Louis stock is being reduced through jobber interchange.

Poles and Cross-Arms.—Poles were reduced in price 10 per cent last week and cross-arms a fraction less than 10 per cent. Rainier fir arms, 3¼ x 4½ in., are quoted as follows: 3-ft., $42.53 per 100; 4-ft., $56.70; 5-ft., $70.68; 6 ft., $95.05, all in lots of 1,000 linear ft., f.o.b. St. Louis. Improved demand on the part of utilities, and particularly the railroads, is reported. Inquiries are about normal and stocks are in satisfactory shape.

Lightning Arresters. — Delivery on compression-type arresters is much improved and immediate shipment can now be given. The demand is quite light, the expected spring demand so far having failed to develop.

Conduit.—There is no great demand for conduit in any size. Stocks in hands of contractors are fairly well depleted but there is no tendency to build them up. Half-inch black sells from $61 to $70 per 1,000 ft.

Flashlamps.—Steady demand, about normal for this time of year, is reported. Stocks are in good condition in both jobbers' and retailers' hands.

Dry Cells.—Demand continues fair, with stocks easily capable of taking care of it. Prices are firm, the No. 6 cell being quoted at $36 per 100 in barrel lots.

Safety Switches.—Steady demand is being experienced, though it is substantially larger than a year ago because of code requirements. Firm prices are maintained and stocks are in healthy shape.

Motors.—Demand for motors is extremely quiet because of the lack of industrial activity, and no difficulty is experienced in getting immediately all the motors wanted of any size, usually from local stocks.

SALT LAKE CITY—DENVER

The General Electric Company's merchandising conference, which gave demonstrations recently in Denver, Salt Lake City and Butte, attracted dealers, jobbers and central-station men from far and wide. It is generally conceded that the business-stimulating features were shown in this region at an opportune time and that the big conventions have had a salutary effect on the general business morale in the field of electrical merchandising. There are indications that point to a satisfactory solution of the employment problem in this territory. The railroads have already taken back several hundred employees, the farms are absorbing hundreds of other men; many have gone into selling, and a number are being employed by electrical dealers who will pay on a commission basis. It is believed that this increased activity in the way of selling appliances in homes will more than offset the slump in demand occasioned by thousands of men having been out of work.

As they find their surplus stocks coming to the point of depletion, jobbers are having occasion to place sizable orders with their factories. By the end of May it is believed that a normal plan of operating will have been reached. Retail merchants are still disposed to conservatism in stocking, showing a tendency to buy in just large enough quantities to meet current needs. The fact that they order with regular frequency shows that there is considerable consumer demand.

Bake Ovens.—Electric bake ovens are achieving wide popularity and use in hotels, restaurants, delicatessen stores and bakeries. Type 220, with capacity for 440 loaves per hour, retails at $1,800. Fifty ovens are now listed with one service station in Salt Lake City alone.

Flatirons.—The old and regular demand is reported by jobbers to be slowly coming back after a long period of sluggish selling. The disposition to wait for lower prices is not so deterrent a factor as it has been in past months. Irons of best quality are retailing around $8, and there is no likelihood of a reduction before midsummer.

SEATTLE—PORTLAND

In both Seattle and Portland business is experiencing something of a spring revival. The consensus of opinion appears to be that the bottom has been reached and the upward turn has been made. It is admitted, however, that a long period of fair to quiet business is ahead. In some places liquidation has undoubtedly run its course, but prices are still out of balance and no broad upward movement can be hoped for until all items that go to make up the cost of living have been proportionately lowered.

Jobbers report a slight revival in business. Line material is the most active feature. Collections continue slow. An analysis of the cause of this condition in the country districts shows that farmers are still holding their produce for higher prices. Producers want more for their new fruit crops than manufacturers say they can pay and make any profit on. Contracting is showing signs of improvement both in wiring and fixtures. Dealers continue to report poor business, although the tone is better than a week ago.

Grazing conditions for this season are above normal and stock is being turned out to range. Shearing is under way with a good yield and sheep men report stock increases to be unusually heavy. Lumber production in western Oregon and Washington is reported about 40 per cent below normal, indicating a gradual improvement. New business, shipments and local orders are much improved over the past few weeks.

Poles and Cross-Arms.—Pole-line construction is showing some activity, and indications from numerous inquiries are that attractive business will materialize during April and May. Power companies are buying to a considerable extent for proposed extensions, local stocks are in good shape and replacements are coming along nicely. Deliveries on order can readily be made because of better labor conditions and the resumption of operations in lumber camps.

Flexible Armored Conductor.—Sales are not heavy but show a slight increase, the major portion being used on small repair jobs. Prices fluctuate slightly.

Porcelain.—Although the volume of sales is below normal, a gradual increase in demand is noted.

Appliances.—Movement continues gradually increasing, but the volume is not heavy in Seattle. Tacoma dealers report gratifying response to an advertising campaign conducted in local newspapers.

SAN FRANCISCO

An unusually cold spring has somewhat affected crops in various parts of the state although they have been retarded rather than damaged.

Wires and Cords.—Weatherproof wire has just suffered a ½-cent drop and triple braid base sizes are now selling for $19.50 per 100 lb. in coil lots. Coast stocks are quite heavy and the demand is very irregular both for size and quantity. Lamp cord has just dropped 10 per cent, No. 18 cotton-covered twisted cord selling for $19.50 per 1,000 ft. in 2,500-ft. lots and No 18 silk twisted for $31.50 per 1,000 ft. in the same quantity, with the privilege of assortment of sizes and styles to make that quantity. Local stocks are very good. The rubber-covered wire market continues to show special conditions with heavy quantity buying the rule. Circular-mil prices were recently slightly adjusted, but basic conditions have been steady for nearly a month. There is a tendency to shop and to pool purchases.

Pole-Line Hardware.—Here is a line on which the sales are excellent. Coast stocks are very good and are supplemented by heavy factory shipments either to stock or quite frequently direct to the job.

Knobs and Tubes.—Local stocks are good and demand is very steady. This is mainly for unit packages, which sell for 10 per cent more on an average than barrel lots. New prices representing a 10 per cent decrease are now being quoted. No. 5½ split knobs bring $23.50 per 1,000 and ⅝-in. x 3-in. tubes $9 per 1,000 in barrel lots.

Schedule Material.—A great increase in business is reported by representatives of various manufacturers, who say that the orders are not only for larger quantities but are so comprehensively assorted that it is evident dealers' and jobbers' stocks are being regularly examined for shortages, from which want lists are systematically made out to bring depleted stocks back to par. About seven out of ten orders for sockets, one manufacturer asserts, are for socket bodies alone, which seems to prove that the separable base and cap principal has been successfully put across.

Fixtures.—"Brascolites" and "Aglites" have been slightly revised downward on list and consumers' discounts in smaller quantities bettered by 10 per cent. Dealers are receiving 2 per cent additional in larger quantities. Local stocks are large and well assorted.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Company to Make Ventilating Fans

The Johnson Fan & Blower Company has been organized, with headquarters at 115 South Clinton Street, Chicago. A. J. Johnson, formerly assistant general manager of the Ilg Ventilating Company, Chicago, is at the head of the new concern. The company will manufacture ventilating fans and blowers.

American Forge Up to Production

The American Forge & Manufacturing Company, 2433-41 West 48th Street, Chicago, has announced its readiness to supply copper forgings of all sorts, those for motors and motor control apparatus being its specialty. Production was started Oct. 1, 1920, and according to the announcement has reached the point where all orders can be filled. H. A. Jackwerth is president and W. S. Cohn is secretary and treasurer.

Sales Organization Changes of Sanford Riley Stoker

The sales management for Riley underfeed stokers and Murphy furnaces has been concentrated under one head. William Pestell, formerly Western sales manager with headquarters at Chicago, now becomes sales manager with headquarters at 1226 Woolworth Building, New York City. W. L. Bigelow becomes district manager of the Pittsburgh territory, while C. Lincoln Smith goes to Cincinnati in the same capacity. To serve better the territory in and around Kansas City, the F. M. Beeson Machinery Company, 308 Mutual Building, Kansas City, has been appointed sales agent for both Riley stokers and Murphy furnaces. Sales in Denver territory will be handled by the Stearns-Roger Manufacturing Company, 1718 California Street, Denver. The Boston, Buffalo, Cleveland, Detroit, Chicago, and St. Paul offices remain as heretofore.

National Foreign Trade Council's May Convention

The paramount questions before the eighth national convention of the National Foreign Trade Council, to be held in Cleveland from May 4 to May 7, it is said, will be the revision of the tariff, the financing of foreign trade, the merchant marine and the double taxation of investments made abroad by Americans in the interests of foreign trade extension. Representatives of several government departments, particularly the Treasury and Commerce divisions, are expected to be present to discuss federal policy toward foreign trade. Special interest centers in the probable activity of the War Finance Corporation, recently revised by Congress. It is expected that the question of exemption from federal taxation of all industries abroad in the interests of foreign trade extensions will be discussed by representatives from the Philippines, China and one of the Latin-American states.

Tripled Capacity for Batterman-Truitt Company

The steady growth of the business of the Batterman-Truitt Company, 736-8 West Monroe Street, Chicago, has made it necessary to take over additional manufacturing space in order to maintain its former service. Consequently the company has negotiated a lease covering additional floors in the Gordon Building, 730-38 West Monroe Street, tripling its facilities and equipment for the manufacture of ventilating fans and blowers. This increase is necessary, the company says, in order to handle the increase in business that is expected in the year 1921.

Sunbeam Electric Moves

The plant of the Sunbeam Electric Appliance Company will be removed to Evansville, Ind., from Milwaukee, Wis., it has just been announced. W. A. Carson of Evansville will be elected president of the company and E. D. Wemyss secretary.

Union Carbide & Carbon Consolidates Laboratories

The Union Carbide & Carbon Corporation, 30 East Forty-second Street, New York City, is consolidating its principal research laboratories into a single organization in Long Island City, N. Y. For this purpose it has leased for a minimum period of five years the entire second floor of a building which covers a ground area of 200 ft. x 600 ft. The net space available for laboratory activities will be in excess of 100,000 sq.ft.

The principal research laboratories which it is intended to consolidate at the present time are those of the Union Carbide Company and the Electro Metallurgical Company at Niagara Falls, the Cleveland and Fremont laboratories of the National Carbon Company and certain of the laboratory activities of the Linde Air Products Company at Buffalo, the Prest-O-Lite Company at Indianapolis and the American Every Ready Works at Long Island City. Only such activities will be transferred as can advantageously be carried on at a point remote from the several factories. These include chemical, electrical, mechanical and physical research.

The corporation in its strictly electrical activities manufactures carbon electrodes for electric furnaces, arc lights, projectors, welding equipment, etc., carbon and metal-carbon brushes, storage batteries, dry cells, flashlight apparatus and batteries.

Betts & Betts Doubles Space for Manufacturing

This week the Betts & Betts Corporation moves from its old quarters at 511-513 West Forty-second Street to 631-641 West Forty-third Street, New York City. This change will place all the manufacturing on one floor and at the same time double production capacity. Although the company's foreign business has dropped off to a large extent, its domestic business is on a par with that for this period of last year.

Brookfield Glass Company to Effect Liquidation

The plant and factory site of the Brookfield Glass Company, 2 Rector Street, New York City, is for sale, and the company announces that it intends to go out of the glass-insulator business. It was started in the year 1853.

The factory site of about 150 acres is situated at Old Bridge, Middlesex County, N. J., where there are buildings covering about 44,000 sq.ft. The company has two blast furnaces of the continuous tank size, 20 ft. x 30 ft. and 10 ft. x 14 ft., seven lehrs, four ovens, three stacks, etc.

It has a glass sand bank of 62 acres and plant at Jamesburg, N. J. About twenty-four patents and patent rights are included, which in the company's opinion give the right to use a glass feeder and to make tests for blown glass by machinery.

Otis Elevator's Report Shows Good Year

The Otis Elevator Company, New York City, closed its year ended Dec. 31, 1920, with earnings amounting to $4,645,749 after deducting all charges for patent expense, renewals and repairs for maintenance of plant and equipment less general and special depreciation. Net income amounted to $2,880,277. The company's inventories show a total of $3,033,787 in raw materials, finished parts, etc.

During the year all debenture bonds outstanding were retired either by purchase or conversion into common stock and all bank loans were paid. Common and preferred stocks total $15,985,087. The still unsettled condition in all in-

dustries makes it exceedingly difficult to estimate the probable resumption of substantial building activities, although there are indications in some sections of the country that new construction will not be much longer delayed. The reports from affiliated companies in Great Britain and Canada show satisfactory results for the year. On the Continent of Europe, however, the conditions are still so unsettled that but little elevator business is being done at the present time.

Crescent's "Acme" Sockets Sold to Parker & Son

The Crescent Electric Company, Inc., Mountain Grove, Mo., announces that it has sold the "Acme" molded weatherproof socket department of its business to J. H. Parker & Son, Inc., Parkersburg, W. Va., where future correspondence for "Acme" composition weatherproof sockets should be addressed. The Crescent Electric Company will continue in business, devoting its efforts to the manufacture of socket screw shells, fuse shells, fuse plug caps, fuse ferrules and other special parts for electrical manufacturers.

Electric Storage Battery's 1920 Consolidated Report

The Electric Storage Battery Company and the Willard Storage Battery Company, in their consolidated statement for the year ended Dec. 31, 1920, showed that their sales, less cost of manufacture and purchases and all expenses incident thereto, amounted to $12,134,614. This provided net earnings from sales of $7,549,011. After writing off inventory adjustments of $2,013,550 to reduce values to cost or to the market, whichever was lower, the total net earnings for 1920 before payment of federal taxes came to $6,157,091. At the same time the inventory account of raw material, goods in process and finished product amounts to $10,313,079. As an indication of conditions of business, $5,775,866 covers the accounts receivable.

New American Radio & Research Sales Headquarters

The sales headquarters offices of the American Radio & Research Corporation will shortly be removed from New York City to Medford Hillside, Mass., to provide for better co-ordination between the factory, laboratory and commercial organizations of the company. A branch sales office in charge of G. R. Martin will be maintained at 21 Park Row, New York City, the present location of the company in Manhattan. Reports from the factory indicate considerable improvement in inquiries for motors, switches and other apparatus manufactured under the company's "Twin-R" division of production. The outlook is excellent for early and substantial sales. The demand for the products of the "Am-Rad" division, it is said, has held up so well that the factory has been running on full time since Jan. 1. Interest among amateur purchasers of radio equipment continues unflagging.

New Company Formed by William S. Turner

William S. Turner & Company is a new organization formed at 1006 Spalding Building, Portland, Ore., to act as manufacturers' agent for the sale of high-grade equipment for electric railways, lighting and power systems, pumping and industrial plants; to make investigations, reports and appraisals and to design and construct public utility, municipal and manufacturing works. Mr. Turner will continue as heretofore his consulting engineering business in Portland.

The following manufacturers are among those represented: Heine Safety Boiler Company, De Laval Steam Turbine Company, Sanford Riley Stoker Company, C. H. Wheeler Manufacturing Company and the James Leffel & Company.

Expansion in Company and Plant of Switchboard Maker

The Eureka Stone & Marble Company, 179 West Maple Street, Columbus, Ohio, has been incorporated in the State of Ohio at $350,000 to take over the assets, good will, contracts and all other manner of business of the Eureka Marble & Tile Works Company, at the same address, that more capital may be obtained to take care of the rapidly increasing business and to carry out large contracts on hand.

The same line of business will be continued with many needed improvements in equipment and increased space for operations. It is the intention of the company to install the latest and improved marble working outfit and gradually to enlarge factory space as conditions warrant until it shall be in a position to build its own factory, a move contemplated in the near future. Standard moisture-proof switchboards will have a special space and the company hopes to double its output in their manufacture.

Southern Supply Jobber Pushes Range Sales

Following up the national advertising being done by the Estate Stove Company, the Piedmont Electric Company, Asheville, N. C., staged a three-day demonstration of electric ranges in March. The first two days were devoted to the prospective buyers of ranges and to those interested in electric cookery. The last day was given over to the company's dealers in the surrounding territory who had either sold ranges or shown interest in their sale and had an opportunity to make sales because of advantageous cooking rates in their localities. One dealer, on his return home, was instrumental in getting a favorable cooking rate in his town.

About 500 women attended the demonstrations, and their names were obtained through the medium of a contest which carried two appliances as prizes and which required a signature on a card.

E. Donald Tolles, national representative of the Electrical Supply Jobbers' Association, on May 2 will move his offices from 52 Broadway to larger quarters located at 165 Broadway, New York City.

The Davidson Porcelain Company, East Liverpool, Ohio, makes the "Eveready" nail-assembled knob and not the non-assembled knob as stated in last week's issue.

The Bleadon-Dunn Company, Chicago, has announced the opening of district offices at 20 West Forty-second Street, New York City, and 830 Washington Street, Boston. The New York office will be in charge of M. H. Sarben, formerly export manager for the Theodore Stave Company, and the Boston office in charge of William E. Alcott and J. Bernard Lynch. A complete stock of "violetta" and violet-ray machines will be carried at both offices.

The Dodge Sales & Engineering Company, Mishawaka, Ind., has secured the exclusive agency for Kenyon cotton rope for transmission drive in the United States and Canada. The manufacturers are William Kenyon & Sons, Ltd., Dunkinsfield, England.

W. R. Ostrander & Company, 371 Broadway, New York City, has extended its services in the South through the new agency of Paul Ebersole, Muskogee, Okla., who has taken on the company's line for Oklahoma, Arkansas and northern Texas.

The Electric Power Equipment Corporation, Philadelphia, announces the opening of a district office and warehouse at 215 Tenth Street, Huntington, W. Va., under the direction of L. T. Hall, who has been with the company (formerly Lewis & Roth) as superintendent of construction for several years.

The Corliss Carbon Company, Bradford, Pa., manufacturer of carbon brushes, has increased its capital stock from $500,000 to $1,000,000.

The G. E. Engineering Company, Inc., contracting engineers, New York City, announces the removal of its offices to 449 West Forty-second Street on April 1. The change is made necessary by expansion of business.

The Commercial Truck Company, Philadelphia, announces the removal of its plant and general offices from Twenty-seventh and Brown Streets to its new plant at Hunting Park and Rising Sun Avenues. The service department of the company remains in the same location, at Girard Avenue and Twenty-seventh Street.

The Electrical Industries Manufacturing Company, 328 West Forty-first Street, New York City, has filed notice of increase in capital stock from $40,000 to $100,000.

The Underwriters' Laboratories, Inc., have arranged to transfer their Coast agency to the offices of the National Board of Fire Underwriters, 205 Merchants' Exchange Building, San Francisco.

The Crane Company, 836 South Michigan Avenue, Chicago, has recently established offices in the following cities: Bearinger Building, Saginaw, Mich., in charge of B. L. Duffy; Goodrich Building, Phoenix, Ariz., in charge of O. H. Benner; 215 South Thirteenth Street, Lincoln, Neb., in charge of F. M. Ziegler, and 512 Second Avenue, East, Cedar Rapids, Iowa, in charge of E. C. Cole.

The Standard Paint Company, 95 Madison Avenue, New York City, manufacturer of weatherproofing products, announces the change of its corporate title to the Ruberoid Company.

The M. Propp Company, New York City, has moved from 108 Bowery to 524-528 Broadway, where it has an available floor space of 12,000 sq.ft. The company manufactures Christmas tree outfits, appliance plugs, miniature receptacles, etc.

The Driver-Harris Company, Harrison, N. J., manufacturer of electrical wires and other equipment, has filed notice of increase in capital stock from $3,000,000 to $4,500,000.

The Pittsburgh Electrical & Machine Company, Barker Place, Pittsburgh, has acquired the factory building of the Pittsburgh Trunk Manufacturing Company on Fontella Street, Northside, on a site 80 ft. x 100 ft. The company, it is understood, will establish new works at this location.

The Connecticut Blower Company, Inc., Hatrford, Conn., contemplates the construction of a manufacturing and foundry building, for which plans have been prepared. The cost is estimated at $62,500.

The Western Battery Manufacturing & Supply Company, 224 West Broadway, Enid, Okla., recently organized, is planning to establish a plant and will install machinery and equipment for the manufacture of storage batteries and accessories. The present plans provide for a daily output of twenty batteries. J. G. Wright is vice-president and general manager.

Foreign Trade Notes

TORRINGTON COMPANY EXPANDS IN CANADA.—Announcement is made at the general offices of the Torrington Company, Torrington, Conn., of the addition of A. W. Calendar to the Canadian sales staff of the Torrington electric vacuum cleaner organization. Mr. Calendar will make his headquarters at Toronto. The announcement follows the establishment of a new Canadian production unit of vacuum cleaners at Upper Bedford, near Montreal. F. A. Loudon will continue to act as representative for the Upper Provinces, with headquarters at Upper Bedford.

AMERICANS MEET STRONG COMPETITION IN GERMAN ELECTRICAL GOODS IN CHILE.—American manufacturers of electrical supplies are meeting serious competition from German sources in Chile, according to reports from the Department of Commerce. Many tons of such goods have been listed in the manifest of ships from Hamburg. Well-made sockets are being sold at 10 per cent less than the price of the American article. Electric fans, stoves, fuses, insulators and supplies for street railways are said to be available at prices equally advantageous. In this class of goods the Germans are able to meet competition on a basis of quality.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN FOOCHOW, CHINA.—According to reports from Consul Hanson of Foochow, Chinese in that district are interested in the organization of a hydro-electric plant to develop power from the Min River. The proposed capital is $5,000,000, and American participation is invited.

AMERICAN ELECTRICAL APPLIANCES PREFERRED IN THE NETHERLANDS.—In a report to the Department of Commerce Consul Frank W. Mahin of Amsterdam states that while there may be a market for all American products in the Amsterdam district the greatest opportunity is said to be available for American electrical machinery and electrical appliances.

INCREASE IN PRODUCTION OF ELECTRICAL EQUIPMENT IN SOUTH AUSTRALIA.—Owing to the great increase in wages in England and allied countries the South Australian manufacturers are able to compete on an almost equal footing with the British and foreign firms for manufactured articles, including electrical fittings, turbines and centrifugal pumps. In some of the manufacturing industries the number of factories has been doubled or trebled.

THE HARRY M. HOPE ENGINEERING COMPANY, Boston, has established offices in the Dominion Express Building, Montreal, to handle its Canadian business. George W. Saunders, formerly with S. Pearon & Sons, London, is Canadian manager.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of lighting-fixture manufacturers in Italy (No. 34,722) wishes to purchase brass tubing and bright, cold-rolled steel tubing, 28 gage and lighter, round and square, from ⅛ in. to 2½ in., outside diameter.

The Niacaraguan Consulate, 15 John Street, announces the arrival in New York City of José Antonio Tigerino, representing Tigerino Brothers of Chinandiga. Mr. Tigerino is in the market for 30-kw. and 45-kw. waterwheels and generators, 20 and 40-watt lamps, 1 to 23-kw. transformers, switchboard, cable and necessary accessories. Mr. Tigerino can be addressed at the consulate.

A mercantile firm in India (No. 34,728) desires to receive catalogs of electric-lighting apparatus and novelties, etc.

New Apparatus and Publications

RHEOSTAT.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has developed a ribbon resistor unit—"Ribohm Unit"— for heavy duty rheostats.

FIXTURES.—C. G. Everson & Company, Chicago, is distributing a booklet on the subject of fashions in lighting fixtures for the home.

INSULATING MATERIAL.—The Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York City, is distributing a four-page leaflet describing Ebony Asbestos Wood for switchboard panels, bases, etc.

HAMMER DRILL.—The Chicago Pneumatic Tool Company, 6 East Forty-fourth Street, New York City, is distributing bulletin 639, covering its BQ-46 hammer drill.

AUTOMATIC MOTOR.—Bulletin No. 2008 recently issued by the Triumph Electric Company, Cincinnati, describes its "TR" self-starting automatic motor.

BAKE OVENS.—The Westinghouse Electric & Manufacturing Company has issued leaflet 3436, describing its automatic electric commercial bake ovens.

CONNECTOR PLUG.—A cord connector and motor attachment plug of smaller size than the standard devices has recently been designed by the Cutler-Hammer Manufacturing Company, Milwaukee, for use with socket appliances.

COMBUSTION.—"The Burning Question" is the title of a new book issued by the Green Engineering Company, East Chicago, Ind., dealing with the question of proper combustion. "The Green Cast Iron Hopper Book," recently issued by the company, describes the cast-iron and structural-steel hopper.

COMPENSATORS.—The Industrial Controller Company, Milwaukee, is distributing bulletin 108, covering its type C alternating-current compensators.

SCREW THREAD STANDARDS. — The Bureau of Standards, Department of Commerce, Washington, D. C., is distributing miscellaneous publication No. 42, entitled "Progress Report of the National Screw-Thread Commission." This report contains standards for screw threads ascertained and established by the commission.

CHRISTMAS TREE LIGHTS.—The Diamond Electric Specialties Corporation, Newark, N. J., is putting on the market a line of eight-light electric decorative outfits which can be plugged together to form up to thirty-two-light outfits.

RADIO APPARATUS. — The Acme Apparatus Company, Cambridge, Mass., is distributing bulletins Nos. 101, 103, 107, 113, 117 and 119, covering its different types of radio transformers and accessories.

INDUCTION COILS. — The American Radio & Research Corporation, Medford Hillside, Mass., has issued bulletin P-3, describing the "Amrad" induction coil sets.

RADIO EQUIPMENT.—The William J. Murdock Company, Chelsea, Mass., is distributing bulletin No. 20-A, describing its radio apparatus.

INDUSTRIAL TRACTOR. — The Baker R & L Company, Cleveland, is distributing a folder on its new series C electric tractor with duplex compensating suspension.

New Companies

THE MIDWAY LIGHTING & IMPROVEMENT COMPANY, Midway, N. C., has been incorporated with a capital stock of $50,000. C. C. Stonestreet is interested in the company.

THE SLATON LIGHT COMPANY, Slaton, Texas., has been incorporated with a capital of $15,000 by Foster Carroll, J. T. Elliott and L. H. Fuller.

THE FRANKLIN ELECTRIC PRODUCT COMPANY, Cleveland, Ohio, has been incorporated with a capital stock of $25,000 by H. A. Troyan and G. F. Kusel.

THE RICHMOND MUTUAL LIGHT & POWER COMPANY, Willard, Ohio, has been incorporated with a capital stock of $10,000. W. C. Miller is interested in the company.

THE SALAMANCA CENTRAL ELECTRIC COMPANY, Salamanca, N. Y., has been incorporated with a capital stock of $10,000 to operate a local electric light and power system. The incorporators are A. L. Varley, S. W. Coston and A. E. Frieger.

AGENS & COMPANY, Newark, N. J., has been incorporated by Edward B. Tousek, Sylvester H. M. Agens, Newark, and F. Raymond Powell, Irvington. The company is capitalized at $200,000 and proposes to manufacture lighting devices.

THE MOYER-SHEWEY-THURSTON ELECTRIC COMPANY, State Street Bank Building, Charleston, W. Va., has been organized with a capital stock of $100,000. H. D. Moyer is president; J. G. Shewey, vice-president, and J. A. Thurston, treasurer and general manager.

THE NORTH JACKSON LIGHT, HEAT, POWER & WATER COMPANY, North Jackson, Ohio, has been incorporated with a capital stock of $10,000 by N. Shipley, S. T. Stewart, G. L. McMillin and others.

Record of Electrical Patents

Notes on United States Patents

(Issued March 29, 1921)

1,373,127. SCREW-SHELL-CONTACT MOUNTING FOR ATTACHMENT PLUGS; Edgar H. Freeman, Trenton, N. J. App. filed July 21, 1919. Quickly assembled.

1,373,208. THERAPEUTIC ELECTRIC VIBRATOR; Stephen D. Smith, Hercules, Cal. App. filed July 8, 1920. To use very small current.

1,373,209. AUTOMOBILE-LAMP-DIMMING DEVICE; Frank E. Spelman, Malden, Mass. App. filed Feb. 12, 1920.

1,373,241. STORAGE BATTERY; Russell L. Heberling and Walter E. Holland, Philadelphia, Pa. App. filed June 2, 1920. Easily detached cell connector.

1,373,273. ELECTRODE FOR ELECTROLYTIC RECOVERY OF METALS FROM SOLUTIONS; Urlyn C. Tainton, Martinez, Cal. Precipitating gold and other metals.

1,373,314. SHORT-CIRCUITING SEGMENTS FOR ELECTRIC MOTORS; John A. Driy, St. Louis, Mo. App. filed June 14, 1920. For starting induction-repulsion motors.

1,373,340. TROLLEY GUARD; Frank J. Lowry New Orleans, La. App. filed Nov. 30, 1920. To maintain wheel in connection with wire.

1,373,383. DEVICE FOR TESTING ARMATURES; Stephen E. Couch, Springfield, Mass. App. filed Nov. 25, 1919. Used with ignition system of vehicles.

1,373,388. ILLUMINATED DARNING EGG; John B. Warren, New York, N. Y. App. filed Feb. 12, 1920.

(Issued April 5, 1921)

1,373,394. ELECTROLYTIC CELL; Edward A. Allen and Herbert I. Allen, Portland, Me. App. filed Dec. 9, 1919. For electrolysis of brine.

1,373,411. CONROLLING DEVICE; Warren F. Clark, Cleveland, Ohio. App. filed June 7, 1919. To maintain hot plate at predetermined temperature.

1,373,442. RANGE INDICATOR; Elemer Meitner, Brooklyn, N. Y. App. filed Nov. 15, 1915. For visually indicating range.

1,373,447. TELEPHONE-EXCHANGE SYSTEM; Lipa Polinkowsky, Antwerp, Belgium. App. filed Feb. 12, 1920. Selectively operable switching devices.

1,373,471. PROCESS OF SINTERING PHOSPHATIC MATERIALS; Frank S. Washburn, Rye, N. Y. App. filed July 23, 1920. Mixtures of phosphate rock and silica.

1,373,488. PLATING; Charles H. Chandler, Newport, R. I. App. filed June 26, 1919. Depositing more than one metal at same time.

1,373,504. ELECTRICAL MEASURING APPARATUS; Harry W. Hitchcock, New York, N. Y. App. filed Sept. 11, 1918. Variable air condensers.

1,373,517. ELECTRIC CLOCK; Paul Mansel, Charlottenburg, near Berlin, Germany. App. filed April 4, 1918. Secondary clock.

1,373,520. VOLTAGE REGULATOR FOR ELECTRIC DYNAMOS; Friedrich Munz, Stuttgart, Germany. App. filed May 4, 1920. For charging batteries.

1,373,533. PROCESS AND APPARATUS FOR SEVERING SHEET GLASS; Harry G. Slingluff, Mount Vernon, Ohio. App. filed April 12, 1920. Electrically heated.

1,373,557. ELECTROLYTIC PROCESS; William E. Greenawalt, Denver, Col. App. filed March 22, 1920. Deposition of metals from impure solutions.

1,373,558. APPARATUS FOR STARTING MOTORS, MORE PARTICULARLY HEAT MOTORS; Heinrich Guttinger, Baden, Switzerland. App. filed April 9, 1917. For motor cars.

1,373,576. ELECTRIC INSULATOR; Percy H. Thomas, Upper Montclair, N. J. App. filed May 16, 1913. High-tension.

1,373,583. CIGAR-LIGHTING DEVICE; Frank A. Adams, Rochester, N. Y. App. filed Aug. 20, 1919.

1,373,607. SUBSTATION TELEPHONE SET; John Erickson, Chicago, Ill. App. filed Nov. 10, 1916. Automatic party line.

1,373,611. PORTABLE ELECTRIC LIGHT; David L. Graff, New York, N. Y. App. filed April 25, 1918. Flashlamp.

1,373,612. UNDERGROUND LOOP ANTENNA; Earl C. Hanson, Washington, D. C. App. filed March 19, 1919. For receiving radio signals.

1,373,621. SAFETY CHARGING DEVICE FOR BATTERIES; James F. Lincoln, Cleveland, Ohio. App. filed March 21, 1917. Prevents current reversal.

1,373,624. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed May 10, 1916. Improvements in switches.

1,373,639. PROCESS FOR THE ELECTRIC FIXATION OF GASES; George T. Southgate, New York, N. Y. App. filed April 11, 1918. By electric arc.

1,373,689. RESISTANCE DEVICE; Alfred E. Waller, Mount Vernon, N. Y. App. filed March 3, 1919. Strong and light elements.

1,373,693. ANODE; Arthur H. Wicks, Woodstock, Ill. App. filed Feb. 19, 1920. For use in plating tanks.

1,373,710. GENERATOR OF HIGH-FREQUENCY OSCILLATIONS FOR WIRELESS TELEGRAPHY; Victor J. F. Bouchardon, Lyon, France. App. filed Oct. 24, 1919. Combined continuous and damped oscillations.

1,373,733. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Harry C. Hubbell, Irvington, N. J. App. filed July 9, 1915. Negative plate for alkaline battery.

1,373,734. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Harry C. Hubbell, Irvington, N. J. App. filed July 9, 1915. For alkaline storage battery.

1,373,751. CONDUCTOR CLAMP AND SUPPORT; Samuel S. Matthes, Mansfield, Ohio. App. filed Oct. 6, 1920. Trolley-wire clamp.

1,373,795. ADJUSTABLE MOTOR MOUNT; Arthur A. Berlin, Toledo, Ohio. App. filed Sept. 20, 1920. Stamping machine.

1,373,801. BATTERY; Edward M. Deems, Forest Hills, N. Y. App. filed Oct. 31, 1919. Primary, one-fluid type.

1,373,802. BATTERY; Edward M. Deems, Forest Hills, N. Y. App. filed Aug. 24, 1920. Primary, one-fluid type.

1,373,806. REGULATOR FOR ELECTRIC LIGHTING SYSTEMS ON MOTOR VEHICLES; John W. FitzGerald, Detroit, Mich. App. filed March 23, 1918. For Ford car.

1,373,809. VAPOR ELECTRIC HEATER; William S. Hadaway, Jr., New Rochelle, N. Y. App. filed July 11, 1917. Vapor passage of varying cross-section.

1,373,818. ELECTROTHERAPEUTIC APPARATUS; Charles L. Ireland, Fort McPherson, Ga. App. filed May 24, 1920. For producing sinusoidal currents.

1,373,820. MINER'S ELECTRIC SAFETY LAMP; John W. Jones, Cannock, England. App. filed May 10, 1920. Can be carried in pocket.

1,373,825. RESISTANCE BOX; Francis W. Magin, Milwaukee, Wis. App. filed June 9, 1920. For motor starting.

1,373,838. PLUG SOCKET; Giorgio Scoppola, Rome, Italy. App. filed Dec. 11, 1920. Applied to line to tap off current.

1,373,842. MINER'S ELECTRIC SAFETY LAMP; Theodore Stretton, Cardiff, Wales. App. filed May 10, 1920.

1,373,846. CONTROLLER FOR ELECTRIC MOTORS; Hermon L. Van Valkenburg, Milwaukee, Wis. App. filed Nov. 21, 1918. For starting and regulating speed.

1,373,873. SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed May 29, 1920.

1,373,895. ELECTRIC HEATER UNIT; Leslie V. Leonard, Richmond, Victoria, Australia. App. filed July 1, 1919. Radiators, stoves, toasters, etc.

1,373,901. DYNAMO-ELECTRIC APPARATUS; Charles Marcus, New York, N. Y. App. filed June 27, 1918. Generator for motor vehicles.

1,373,910. SYSTEM OF DISTRIBUTION; Wilbur A. Pressey, Boston, Mass. App. filed April 23, 1920. Very high voltage transformed to low voltage.

1,373,922. MEANS FOR PREVENTING VOLTAGE FLUCTUATIONS IN DISTRIBUTING CIRCUITS; Louis W. Thompson, Schenectady, N. Y. App. filed May 18, 1918. To prevent objectionable variations in voltage.

1,373,923. ELECTRICAL SYSTEM FOR POWER TRANSMISSION; Magnus Unger, Pittsfield, Mass. App. filed June 14, 1920. To maintain voltage constant.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WAKEFIELD, MASS.—At a special town meeting to be held on April 25 the proposal to appropriate $10,000 for the installation of about 200 additional lamps in Wakefield will be submitted to the voters.

Middle Atlantic States

BROOKLYN, N. Y.—J. L. Hopkins, 477 Keap Street, it is reported, is receiving new bids for the construction of a one-story power house, 34 ft. x 45 ft.

GENEVA, N. Y.—The Geneva Preserving Company, 55 North Street, contemplates the erection of a three-story cold-storage plant, 190 ft. x 200 ft., to cost about $75,000. Electric motors, refrigerating machinery and other mechanical equipment will be installed.

POPLAR RIDGE, N. Y.—The Poplar Ridge Cayuga County Lighting Company has applied to the Public Service Commission, Second District, for permission to erect a lighting plant for service in the town of Venice.

SILVER CREEK, N. Y.—The Silver Creek Electric Company has applied to the Public Service Commission for permission to furnish electricity in Forestville.

TROY, N. Y.—The Ford Motor Company, Detroit, Mich., has awarded a contract for the foundation work for its proposed electric generating plant at Green Island, near Troy. The cost of the plant is estimated at about $2,000,000.

CAMDEN, PA.—The power house and laundry at the Cooper Hospital, it is reported, has been damaged by fire, causing a loss of about $75,000.

MOSCOW, PA.—The Moscow-Elmhurst Electric Company has been organized recently to supply electricity to Moscow, Elmhurst, Roaring Fork, Madison and Covington townships. Energy will be furnished by the Scranton Electric Company.

NEWTOWN SQUARE, PA.—Plans have been prepared for the construction of a power house at the Dunwoody Home for Convalescents.

PHILADELPHIA, PA.—Arrangements are being made by the Philadelphia Electric Company to issue $5,000,000 in stock, the proceeds to be used for improvements, extensions, etc.

PITTSBURGH, PA.—Plans have been prepared for a new one-story power house, 40 ft. x 85 ft., to cost about $45,000, for the Oliver Iron & Steel Company. The W. G. Wilkens Company, Westinghouse Building, is architect.

PITTSBURGH, PA.—Considerable electrical equipment will be installed in the plant of the Crane Company, manufacturer of valves, steam specialties, etc., to be located on Twenty-fourth Street. The cost is estimated at $1,000,000, including equipment. The Hunting-Davis Company, Century Building, is architect.

READING, PA.—Electrical and mechanical equipment will be installed in the proposed municipal filtration plant to be erected at a cost of about $800,000.

SHIPPENSBURG, PA.—A company is being formed by George S. McLean and Lee M. Hale for the purpose of erecting and operating an ice-manufacturing and cold-storage plant. Plans provide for the installation of considerable electrically operated machinery.

BEL AIR, MD.—The Baltimore & Bel Air Electric Company has been granted permission by the Public Service Commission to issue $25,000 in stock for line extensions and improvements.

MILFORD, DEL.—The Milford Electric Company contemplates the installation of new electric generating machinery at its plant.

CHARLESTON, W. VA.—The Cameva Coal Company, Masonic Temple, recently organized, contemplates the installation of electrical equipment at its properties. W. I. Campbell is president.

HUNTINGTON, W. VA.—Considerable electrical equipment and machinery will be installed in the proposed local plant and rolling mill of the International Nickel Company, 43 Exchange Place, New York City. The cost of the plant is estimated at about $2,000,000. Frank I. Ellis, Farmers' Bank Building, Pittsburgh, Pa., is consulting engineer.

WHEELING, W. VA.—The Whitaker-Glessner Company has applied for permit for the construction of a power plant and boiler house at its Manchester plant, north of Wheeling, to cost about $50,000.

RICHMOND, VA.—The question of placing wires on Hull Street in underground conduits is under consideration.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until April 29, Brooklyn, Schedule 7,905—ignition cable. Schedule 7,902—lighting and power wire; Philadelphia, Schedule 7,861—electric hoists. Until May 10, Erie, Pa., and Western yards, Schedule 7,904—electric cable and wire; Schedule 7,927—battery-charging panel; Schedule 7,903—electric wire. Applications for proposal blanks should designate the schedule desired by number.

AURORA, ILL.—The Western United Gas & Electric Company plans to issue $3,000,000 in stock, the proceeds to be used to meet the increasing demands for service.

LENA, ILL.—The Lena Electric Light & Power Company has taken over the lighting plant in Martintown, Wis., which also supplies electricity in Winslow. A transmission line will be erected from Lena to Martintown. Plans are also under way to furnish Monroe with electricity.

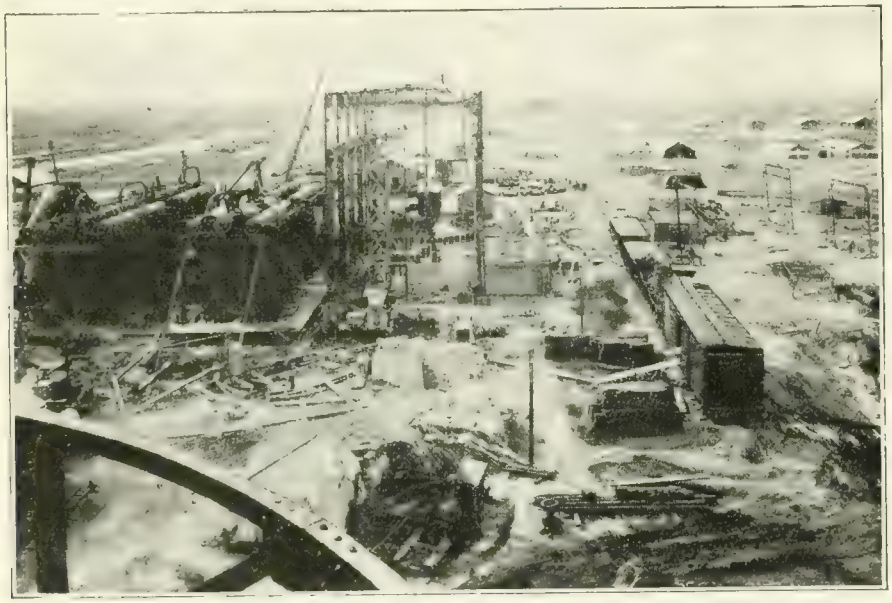
ARENA, WIS.—The installation of an electric street-lighting system in Arena is under consideration.

KAUKAUNA, WIS.—Improvements to the municipal light and water systems to cost about $30,000 are under consideration.

MARTINTOWN, WIS.—The local electric light plant has been acquired by the Lena (Ill.) Electric Light & Power Company.

GLENWOOD, MO.—The Raven Coal Company plans to erect a transmission line from Glenwood to Lancaster and Downing, a distance of 6 miles, to furnish electricity in those towns.

INDEPENDENCE, MO.—The proposal to issue $35,000 in bonds for the installa-



NATURAL GAS BURNING STEAM POWER PLANT OF SAN JOAQUIN LIGHT & POWER COMPANY

Gas for this 12,500-kw. plant at Buttonwillow, in Kern County, Cal., will be supplied from the famous Elk Hills gasser, 9 miles away, at a pressure of 450 lb.

North Central States

CINCINNATI, OHIO.—The City Council has granted the Union Light, Heat & Power Company a ten-year franchise to furnish electric lighting service in Bellevue, Ky. Provision is made for the installation of new lamps in place of the arc lamps now in use.

COLUMBUS, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies until April 29 for transformers. Specifications may be obtained at room 204, City Hall.

DAYTON, OHIO.—The installation of a cluster lighting system on Ludlow, Jefferson, Main, Second, Third, Fourth and Fifth Streets to cost about $18,000, is contemplated.

AUXIER, KY.—The United Block Coal Company has plans under way for the construction of a new power plant at its properties. J. C. Snyder is president.

BLUFFTON, IND.—The substation and interlocker plant on the Bluffton-Fort Wayne interurban line, north of Bluffton, was recently damaged by fire, causing a loss of about $20,000.

tion of machinery in the municipal electric light plant will be submitted to the voters on June 1

Southern States

MIDWAY, N. C.—The Midway Lighting & Improvement Company, recently organized with a capital stock of $50,000, plans to operate a local electric system. C. C. Stonestreet is interested in the company.

COLUMBIA, S. C.—The Columbia River & Navigation Company, care of J. Fraser Lyon, Columbia, has applied to the Federal Power Commission for preliminary permit to construct a navigable canal, 24 miles long, from Ferguson on the Santee River to Moncks Corner on the Cooper River, and to develop power near the southern end of the canal for public utility purposes.

LANDRUM, S. C.—The Town Council is considering the installation of a municipal electric power plant and system.

LAKE WORTH, FLA.—The Council is considering an issue of $75,000 in bonds for extensions and improvements to the light and water plants.

MIAMI, FLA.—The Miami Beach Electric Company will submit a proposal to the County Commissioners to light the highway across Biscayne Bay from Miami to Miami Beach.

PABLO BEACH, FLA.—Negotiations are under way between John S. Bond of the Jacksonville City Commission and the City Council of Pablo Beach to purchase electricity for the beach city. A trunk power line, 24 miles long, would be required to convey the power.

ST. PETERSBURG, FLA.—Extensions to the municipal water-works are contemplated. Present plans provide for the construction of a power plant on Mirror Lake, new pumping plant with new machinery and electrically driven pump, two additional wells and water mains. Bonds to the amount of $118,000 are available for this work.

ST. ROSE, LA.—The Petroleum Export & Import Company contemplates the construction of a new power plant and electrically operated pumping plant at its local works.

KAW, OKLA.—The City Council has been petitioned to hold an election to submit to the voters a proposal to issue bonds for improvements to the electric light plant.

LAMONT, OKLA.—Contract has been awarded to the Oklahoma Gas & Electric Company to furnish electricity in Lamont.

AUSTIN, TEX.—The Texas Interurban Railway Company, recently incorporated with a capital stock of $2,500,000, proposes to construct and operate a system of interurban electric railways from Dallas to a number of other cities in Texas. The construction of the line from Dallas to Terrell, a distance of 30 miles, is already under way. J. F. Strickland is among the incorporators.

DALLAS, TEX.—The question of issuing $16,000 in bonds for extensions and improvements to the street and park lighting system in Highland Park, a suburb of Dallas, is under consideration.

FREDERICKSBURG, TEX.—The Fredericksburg Light & Power Company plans to rebuild its local electric power plant, recently damaged by fire. H. A. Ries, vice-president and general manager of the Fredericksburg & Northern Railway Company, is in charge.

WHITNEY, TEX.—Steps will be taken at once to rebuild a local electric plant, owned by C. Gollihar, recently destroyed by fire.

Pacific and Mountain States

LODI, CAL.—The installation of conduits and wiring for electroliers on newly paved streets is under consideration. H. Clarke is clerk.

SACRAMENTO, CAL.—The State Water Commission has granted the following permits to appropriate water for power purposes: The Snow Mountain Water & Power Company, to divert 215,000 acre-ft. of water from the South Eel River, a tributary of the Eel River, in Lake and Mendocino Counties; Frank B. Pattee, Samuel Bernhard and J. T. Ross, 130 cu.ft. per second from the north fork of the Stanislaus River in Calaveras and Tuolumne Counties by means of a dam, canal and pipe line to develop 9,600 hp., the cost being estimated at $2,000,000; H. L. Shannon, San Francisco, 150 cu.ft. per second from Deer Creek by means of a dam, 100 ft. long and ditch and flume, 10 miles long, cost estimated at $500,000.

SAN FRANCISCO, CAL.—Application has been made to the Federal Power Commission by the Rich Point Mining Company, 57 Post Street, for preliminary permit to erect a diversion dam in Bear Creek and conduit to power house on the middle fork of the Feather River in Plumas County.

BUTTE, MONT.—The Boston & Montana Development Company has applied to the Federal Power Commission for permission to erect a 32-mile transmission line to its plant at Elkhorn to furnish 2,000 hp. The cost of the work is estimated at $100,000.

THERMOPOLIS, WYO.—The local lighting plant, it is reported, was damaged by fire recently, causing a loss of about $50,000.

CARSON, NEV.—A bill known as Senate Bill No. 61, which authorizes the Board of Commissioners of Mineral County to issue $150,000 in bonds for the purpose of purchasing and extending the Lundy-Hawthorne transmission lines of the Nevada-California Power Company has been passed by the State Legislature. The project includes the erection of transmission lines from the Lundy generating station of the Nevada-California Power Company, situated in the county of Mono, Cal., to the town of Hawthorne, Nev., thence to Simon, via Luning and Mina, Nev., and branches.

Electrical World

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Peace and Harmony Necessary in Iowa

WOE! Woe! Woe! Just as we were about to congratulate the industry on the increasing manifestations of harmony within and good will without, Iowa throws on an overload which blows a fuse. The contractors and central stations there are at sixes and sevens over Governor Kendall's veto of the Springer bill, the utilities charging the contractors with treason. The bill, which bore the indorsement of all water, gas, electric and railway companies of Iowa, had already passed both houses of the Legislature. It provided for a "court of public service" composed of three judges from the district courts of the state to pass judgment on the rates for service fixed by municipalities in cases where appeal to such court was made. Why the contractors should have opposed the measure is not apparent, since the bill did not involve them in any way, and naturally a merry war is in prospect unless saner counsels intervene and prevail. On the foolishness of strife within the industry it is needless to write. Neither do we purpose to hold a post-mortem on the result. What we do insist on, however, is that the contractors and electric light and power interests of Iowa compose their differences quickly and in an amicable manner. There can be no progress in an industry which is divided against itself and which is at the same time partly incapacitated through bickering and strife.

Government Help for Business

THERE is a manifest desire on the part of the government to join hands with business. Heretofore the manufacturer, if he had nothing to fear, attributed his immunity to his honesty rather than to any disposition on the part of Washington to let him alone, and as for expecting assistance from that quarter—he was not given to idle dreams. Now, however, all this is to be changed. The road will still be hard for the crook and the sword of Damocles will still threaten corrupt practices, but the honest business man will find in the Department of Commerce a listening ear, a receptive mind and a helping hand. No attempt will be made to regulate—that is farthest from Secretary Hoover's thoughts. The desire is to encourage foreign and domestic business through the collection and interpretation of statistics, through proper standardization, the elimination of waste, and by means of study and research—in short, to do for the manufacturer what the United States Department of Agriculture now does for the farmer. This is one of the most encouraging signs that have come out of Washington for quite some time.

It Is Not Altogether the Fault of the Daily Press

IT IS a pity that the average newspaper editor knows so little about the central-station business; but it is not his fault. The subject has never been made interesting to him, and he has seldom been told what he ought to know in the way that makes news items. A forceful illustration of the benefits that automatically come from such an understanding and the sympathy that will result was reported in last week's issue, in the case of the San Francisco *Chronicle*. The *Chronicle* is featuring a series of articles showing how the California power shortage is holding back different kinds of business. To correct the situation, it is urging better rates to attract new capital for further hydro-electric development. Think how many interesting stories could and would be told if utility managers would help newspaper editors to see that support for the utilities is constructive service to the whole community. Such publicity would constitute a never-ending good-will campaign.

California's Proposed Hydro-Electric Commission

THE California Electrical Co-operative Campaign has a job cut out for it. In fact, the real test of the efficacy of such a league must soon be made. The state proposes to emulate the example of the Province of Ontario in Canada and establish a hydro-electric power commission. There is no question of the right of the State of California to do that; but the wisdom of such a move is doubtful, and the California Electrical Co-operative Campaign ought to have no difficulty in proving it. In the first place, California possesses no water power comparable to Niagara Falls, from which the Hydro-Electric Power Commission of Ontario receives its chief supply of electricity. At Niagara nature has provided a bountiful supply of water at all times—ten times more than is needed for power purposes. The continuity of this supply of water is assured by mammoth storage basins comprising Lakes Superior, Michigan, Huron and Erie. Moreover, there is a sheer drop at the escarpment at Niagara Falls of about 160 ft. For that reason none of the power companies has had to provide expensive reservoirs, dams, long flumes or even steam reserve stations. If there is a place anywhere where electricity can be generated cheaply, that place is Niagara Falls; but there is no other place like it in the country. Under no circumstances, therefore, is it possible for California to duplicate or even approach what is being done in the Province of Ontario. Existing utilities in California generate and sell electricity very cheaply. The average cost is less than that in any other state and the per capita use is greater. It cannot be claimed that the companies lack enterprise or that

the public is not served adequately, because California utilities are among the most progressive in existence and a larger percentage of people is served with electricity there than elsewhere, even in Canada. Moreover, the state receives in taxes from the electric light and power companies 7.5 per cent of their gross annual revenue. If, therefore, a thorough and impartial investigation were made, California would find it greatly to her disadvantage to embark on any state-owned system of electric generation and distribution, particularly in view of the praises which have recently been heaped on the Railroad Commission and the public utilities act by the Inman legislative committee. That committee, the preconceived ideas of whose members underwent a complete change as a result of its investigation, earnestly commended the public utilities act of the state to the continued favor of the people. It reported that the act has worked well and is working well today and recommended that it be strengthened rather than weakened. Compared with the Ontario system, it should not be hard to show that all that glitters is not gold.

"Engineering English" Should Mean Good English

REFERENCES to "engineering English" are found in the editorial columns of both the technical and the lay press, the term being sometimes used in derision and sometimes seriously as if to denote a kind of writing with rules and usages of its own differing from those that apply to the composition of men not engineers. The best way for technical writers to escape the derision is to disabuse their minds of any idea that they should or properly may adopt a distinctive phraseology or method of construction. Apart, of course, from the inevitable use of the established technical terms of their profession, they should employ, with proper discrimination, the ordinary words of the dictionary, and observe, without pedantry, the accepted rules of English—not of foreign—grammar. A specialized vocabulary has by long prescription come to be considered appropriate for baseball reports and stories of seafaring life, but the engineering writer has no need of one. In committing his ideas to paper he should shun the conversational idioms of his professional pursuits equally with the jargon of commerce, the slang of the workshop and the stark uniformity of the hardware catalog. As to catalogs, there are, of course, useful compositions that must necessarily partake of the character of an inventory, but even in these cases skillful handling and the relegation of details to tables and to the legends under illustrations can do much to dispel the curse of dullness.

Good English is good English, whether the topic be literature, history, politics or engineering. The laws of syntax do not vary with a change of profession. The rules of rhetoric remain the same. Debasement of the noble currency of our mother tongue is much to be deplored. It is true that a mathematical thesis does not lend itself to pathos or a treatise on technology to the play of wit. That only makes it the more necessary that the principle of order, which is the first law of composition as well as of Heaven, and the principle of clarity, which is the second, should pervade them. Descriptive engineering articles, on the other hand, permit a forcefulness of presentation, a vividness of statement, even an occasional flash of imagination or touch of fancy, that they all too seldom display. Frenchmen, to whom the art of expression seems a native gift, have probably best exemplified the possibilities that inhere in engineering as a field for literary skill. To most Englishmen engaged in technical pursuits, and in still greater degree perhaps to most Americans, their work itself is so absorbing, the pressure to excel in action so compelling, that they have no time to learn to write. Graceful historians of the engineering arts are therefore in the English-speaking nations neither born, like poets, nor made, like the purveyors of popular fiction. Hence the records of invention and material achievement seldom rise above the threadbare phraseology and commonplace method of a memorandum book, although the facts related may be as far as possible from the threadbare or the commonplace.

A few engineering writers of rounded intellectual development, fed in their youth perhaps on the great masters of English who nowadays have fallen into such lamentable neglect, have succeeded in informing the books and papers they have written with an interest more widespread than that merely which inheres in the subject matter, just as a few lawyers have made arguments and a few judges have handed down decisions so lucid in their language, so limpid in their construction, and so shot through with eloquence suppressed or soaring, that intricate causes have taken on a general interest which the routine verbiage of the courts could never have bestowed. Such lawyers are rare, and such engineers unfortunately are rarer still. It would doubtless be demanding too much from human talents to expect otherwise. Yet the wish may be pardoned that our technical colleges would so train their students in the practice of writing that no graduate could compose the paragraphs, crude or redundant in form, ambiguous or obscure in meaning, and freely sprinkled with solecisms, that in some minds have come to be meant by engineering English.

Definition of "Navigable Stream" Still Further Confused

A RATHER far-reaching decision governing the construction of power dams in navigable streams was rendered by the United States Supreme Court in the fight of the government to prevent the construction of a dam across the Desplaines River near Joliet, Ill. As reported elsewhere in this issue, the case is that against the Economy Light & Power Company, now controlled by the Public Service Company of Northern Illinois. The Supreme Court in affirming the decisions of the lower courts based its decision largely on the fact that the stream in its natural condition had been navigated by early French explorers, fur traders and settlers in canoes and other light craft. That the stream has not been so used for a century was held of no effect.

While the decision from a power-supply standpoint is not serious to the utility because the power problem has been met by the construction of other plants and the stream has since become a part of the lakes-to-the-Gulf deep-waterway project, the precedent established is extremely important as it seems to extend the meaning of the term "navigable" to a hitherto unthought-of degree. If the fact that a stream has been used by Indians or others for transportation by canoe or other light craft is to be considered as constituting navigability, a serious handicap is imposed upon the American public depending upon future power developments on the streams now under federal control.

International Continental Line Closely Follows American Practice

SOME details of what is the most striking example of high-tension work yet given in France are contained in the current issue. The system is really an international one, with its power station on the River Aar at Goesgen, Switzerland, and the transmission line running north along the border of Alsace and crossing the Vosges Mountains into the Moselle Valley, which it follows to Pouxeux, France. The final voltage of the system is to be 110,000, although, as often happens in our own country, the first rating is 70,000 volts. The equipment is designed for the higher pressure throughout. The line is unusual in Continental practice, being a steel-tower structure with spans up to more than 600 feet, such construction having been selected largely on the entirely correct theory that the insulators are the weak points of the transmission system and the fewer of them the better. The towers themselves are virtually 50 feet to the lowest cross-arm and are set on concrete foundations. Except at dead-ends or angles eight suspension units carry stranded copper cable nearly a half inch in diameter and with a cross-section of about 154,000 circ.mils. Where there are bends in the line a special strain tower of extra solidity is used.

The system, erected about two years ago, has been in successful operation and works in parallel with the steam power station of the Compagnie Lorraine d'Electricité, for the benefit of which the transmission itself was undertaken. Despite the difficulties of the situation —for the construction was started before the armistice —the work was finished in a year and is a fine example of efficient construction, following quite closely American precedents while embodying some interesting variations in design.

Oil Fuel and the Electrical Industry

ACCORDING to figures presented before the American Petroleum Institute, the world's demand for petroleum in the present year will run close to 700,000,000 barrels, of which the United States will produce some 70 per cent and will use an even larger proportion, since we import oil from Mexico to an amount which is likely this year to aggregate 120,000,000 barrels. It is perfectly certain that unless great changes for the better are made and the methods of production improved, the United States will not be able to maintain its present demand for oil without much aid from foreign fields, and these fields are being absorbed by foreign powers as a part of an intelligent and deliberate program of making some future provision for their own national needs. Under these conditions any considerable permanent amount of importation, if accomplished at all, can be accomplished only at high cost, resulting necessarily in increased price of fuel oil here.

The vital question for public utilities depending upon steam generating stations in which plans are being made to use oil is whether the inevitable rise in oil prices will equal or surpass the relative rise in coal. Looking at the situation broadly, the country's coal supply appears to be considerably better from the standpoint of permanence than its oil supply, and considered merely as fuel to be burned under boilers oil appears to be a commodity which will become of dubious value if resorted to by any considerable proportion of the industry. The case is like a good many others in which certain operations are economically possible until the demand rises to serious magnitude, after which there is no saving to be had. Of course, some relief is possible where the Diesel or similar engines are used as prime movers on account of their higher thermodynamic efficiency in the production of power. Such engines are coming into large use for marine work, and operating as they do at fairly steady and nearly full load, their performance has been highly satisfactory.

Offhand, it would seem better, having regard to the general utilization of the world's fuel supply, to employ oil in marine service and for other purposes to which coal as such is not applicable. If there is to be anything like the increase in the use of motor vehicles which seems probable, there will be no considerable oil supply available for central stations. Here and there, as has repeatedly been shown in our columns, instances are encountered where local conditions render the use of oil fuel decidedly advantageous. Such cases will undoubtedly continue to exist even while the oil supply diminishes and demand for other purposes increases. In the main, however, and facing the petroleum situation as it is set forth by those most familiar with it, the conclusion is forced that unless the present situation changes for the better in a way now entirely unexpected the use of oil fuel in central stations, either under the boilers or in internal-combustion engines, will necessarily be of special and local, rather than general, application.

Power Factor and Adequate Rates

THE unusual interest now being shown in the definition of power factor is caused by a realization of existing inadequate rate schedules for power loads rather than by any desire for theoretical accuracy. Present-day conditions, which have made it necessary to analyze closely the costs of various kinds of service, have brought to light the advisability of reconsidering certain long-established customs. Power factor from a purely scientific point of view is and has been exactly defined. What is desired now is a practical definition of a concept based on power factor as a fundamental and which will not only have a definite meaning to both producer and consumer of electrical energy but will also be satisfactory as a basis for establishing rate schedules that will be acceptable to both parties. Moreover, it must also be possible to measure this quantity accurately, so that we must either adapt its definition to our present available meters or else develop new ones to meet the requirements. It is evident that accurate information is required regarding the cost of handling various kinds of power loads, and to obtain it considerable study will be necessary. Investigations from the customer's standpoint must also be made. Further, it must be realized that as our knowledge of these matters increases it is quite possible that any definition now adopted, unless its character is very general and its interpretation flexible, may need to be changed to meet new requirements.

The underlying fundamental that should be sought out is a rate for electrical energy whose application will result in the greatest possible economy or conservation from the standpoint of the people as a whole. Such a rate will naturally be satisfactory to both producer and consumer and can be arrived at only by thorough study of prevailing conditions. The problem is not one of theoretical physics, it is one of application of our present knowledge of equipment and costs to the best possible advantage of all.



George Owen Squier

A soldier-scientist and discoverer of the principle of "wired wireless" and numerous other developments in the art of communication who organized and directed the air and signal services of the American army during the war

THE old question about which branch of the service won the war will probably never be settled. It is true, however, that a war of such magnitude could be waged successfully only when the fighting forces were linked together by an unbroken communications system. It was to Gen. George O. Squier that the task was assigned of keeping this system intact and of perfecting it to meet new conditions. In the realm of science as applied to military activities he has won a high position.

A graduate of West Point, General Squier had all of the fundamental military traditions for a background. His first station at Baltimore enabled him to spend his hours off duty at Johns Hopkins University, where under such renowned scientists as Profs. Henry Rowland, Ira Remsen and Simon Newcomb the young officer laid the foundations for his later career as a physicist. There he secured the degree of doctor of philosophy in physical science and won for himself a fellowship. As a result of his researches, his first important contribution to science, entitled "Electrochemical Effects Due to Magnetism," was published in 1893. Four years later he began to apply physics to military science. From a series of experiments, some of which were conducted in conjunction with Dr. A. C. Crehore of Dartmouth, came a number of important results, among them being a new range and position finder and a synchronograph. The latter invention, which, based on the use of alternating current with the polarizing photochronograph as receiver, marked a great advance in the art of rapid transmission of intelligence, was but the beginning of a long series of improvements in telegraphy and telephony. None perhaps has received so much attention as the discovery of "wired wireless" announced by him in 1911. By means of selective sending and receiving his discovery made it possible to increase greatly the intelligence-carrying capacity of a cable. Although developed for military uses, it has also been applied commercially. His latest contribution to the art of communication was the discovery, announced less than a year ago, of the possibility of multiplex telephony and telegraphy over open-circuit bare wires laid in the earth or sea.

Naturally the General is a member of a number of the better-known scientific and engineering associations, including the Physical Society of London, of which he is a fellow. His polarizing photochronograph won for him the John Scott medal in 1896, his "wired wireless" discovery the Elliott Cresson medal award by Franklin Institute in 1912, and seven years later the Franklin medal was awarded to him by the same institution in recognition of his achievements not only in science but also his war success with the air and signal forces.

It was at Dryden, Mich., March 21, 1865, that General Squier was born.

Rating of Electrical Machinery

Standardization Rules of the American Institute of Electrical Engineers and the Electric Power Club Are Discussed to Compare the 40-Deg. Rated Motor with the 50-Deg. or Continuous-Rated Motor

By FRANCIS B. CROCKER*
Crocker-Wheeler Company, Ampere, N. J.

A SHARP difference of opinion has arisen in recent years regarding the merits of the 50-deg. rating of electric motors, and a fair statement of the case of the 40-deg. rated motor, which represents the attitude of some fifteen motor manufacturers in the United States, is offered in this article. This group adheres to the principle that a factor of safety is as necessary in electrical machinery as in other engineering apparatus. It is also its belief that the small saving in cost effected by the use of a lighter motor is not justified if the reliability of the plant, of which the motor drive is a part, is thereby decreased.

Early Standardization Work of the A. I. E. E.

The original A. I. E. E. Standardization Rules issued in 1899 and all revisions and editions of the same issued up to and including 1911 recommended for electrical "machines in general" a standard ambient temperature of 25 deg. C. and a maximum temperature rise of 50 deg. C. In other words, the maximum observable temperature should not exceed 75 deg. C. The present A. I. E. E. rules permit 50 deg. rise from a standard ambient temperature of 40 deg. C., that is, a maximum observable temperature of 90 deg. This is 15 deg. higher than that recommended in the previous A. I. E. E. rules, which were in existence for seventeen years and under which the electrical industry virtually grew up. "Hottest-spot" temperature and the "conventional allowance" for the difference between that value and the maximum observable temperature were not considered in the A. I. E. E. rules prior to 1916. Hence comparisons must be made of the observable temperatures. This is true today, because temperatures for "hottest spots" and "conventional allowance" are necessarily assumed for all except large or special machines with embedded detectors in their windings.

Before 1916 the A. I. E. E. rules recommended 25 per cent overload capacity for two hours, "with an additional temperature rise not exceeding 15 deg. C. above those specified for rated load." This applied to all direct-current and alternating-current generators and motors. The latter were also recommended to have an overload capacity of 50 per cent for one minute.

The A. I. E. E. rules of 1916 and since do not recommend any overload capacity whatever. Why and how was the maximum observable temperature raised from 75 deg. C. to 90 deg. C. and overload capacity wholly eliminated? The reasons and procedure are far from being clear or satisfactory. According to the published records what happened was as follows:

In 1912 the A. I. E. E. standards committee began to prepare a revision of its rules, especially as to rating of electrical machinery. The midwinter convention in February, 1913, was held under the auspices of the standards committee, and forty-five papers were presented, all relating to this subject. The first two papers, on "Temperature and Electrical Insulation," by C. P. Steinmetz and B. G. Lamme (sub-committee on revision of rules), and "Method of Rating Electrical Apparatus," by W. L. Merrill, W. H. Powell and Charles Robbins (sub-committee on rating), were particularly prominent, being presented by sub-committees of the standards committee and intended to give a basis for the revision of the rules. They are still supposed to be the authority on which the rules were changed as to temperature rise and overload capacity.

Classic Work of Steinmetz and Lamme

Unfortunately these papers have acquired a meaning not at all justified. The Steinmetz and Lamme paper (*Transactions A. I. E. E.*, Vol. XXXII, page 81, April, 1913), referring to fibrous insulation materials such as cotton, silk and paper, treated or impregnated, as ordinarily used in electrical machines, states:

> In Class A the materials appear to have a very long life (or an almost indefinitely long life, aside from mechanical conditions) if subjected to ultimate temperatures which never exceed 90 deg. C. Also they appear to have a comparatively long life even at ultimate temperatures as high as 100 deg. C.

Certainly this statement is no warrant for going beyond this limit, which the A. I. E. E. rules do by permitting 105 deg. C. for Class A insulation. Moreover, Fig. 1 of this A. I. E. E. paper indicates that the life is shortened to about four years at 105 deg. C. Still more significant is Mr. Lamme's statement on page 77, that "this would bring the temperature up to 105 deg. C. on my assumptions, which would be right on the ragged edge."

The Steinmetz and Lamme paper, under "Recommendations," also states:

> That with Class A insulation 90 deg. C. be taken as the ultimate temperature limit, as indicated by conventional methods of measurement, or those which give similar results, and that 100 deg. C. be considered as the maximum ultimate temperature permissible in the insulation, where a comparatively long life is a requirement.

In discussing his paper, Dr. Steinmetz says:

> The room temperature must be limited to a certain maximum of 40 deg. and the maximum insulation temperature must be limited to a definite value, 100 deg. (*Transactions A. I. E. E.*, February, 1913, page 117).

The Steinmetz and Lamme paper is therefore a *warning* not to venture above 100 deg. even in "hottest

*Professor Crocker was chairman of the original standardization Committee of the American Institute of Electrical Engineers, being appointed in 1898 and continuing for about ten years thereafter. He was the A. I. E. E. representative and chairman of the committee of the "conference of electrical, insurance, architectural and allied interests" that formulated the first National Electrical Code in 1897. Dr. C. O. Mailloux and he were the two American delegates to the meeting held in London in 1906 which created the International Electrotechnical Commission. He was president of the Electric Power Club in 1913 and 1914. Since 1886, associated with Dr. S. S. Wheeler he has been continuously engaged in manufacturing electrical machinery.

spots," because surely we should not go even near "the ragged edge." Though often forgotten, it is a fact that a 105-deg. C. permissible temperature will often be exceeded in practical use by variations in voltage, current, frequency, speed and power, as well as by inaccuracies of commercial instruments, peculiarities of individual machines, etc. All of these are inherent in practice, especially with the widely different and often very unfavorable conditions under which electrical machines operate. Indeed, reasonable departures from normal voltage, current, etc., are expressly permitted in practice by the rules of the Electric Power Club and other such codes.

The paper on "Method of Rating Electrical Apparatus," by W. L. Merrill, W. H. Powell and Charles Robbins (sub-committee on rating), contains the following recommendation:

Ultimate Temperature—Cotton, treated cloth, paper and similar substances which may fall in this general classification, maximum ultimate temperature of 90 deg. C.

Evidently, in this case, the 90 deg. C. means the temperature observed by thermometer and apparently justifies a rise of 50 deg. from the 40-deg. room temperature. On the other hand, this paper, as well as that of Steinmetz and Lamme, assumes a "hottest-spot" temperature 10 deg. and not 15 deg. higher than that observed by thermometer, according to the present A. I. E. E. rules. As already pointed out, the words "a maximum ultimate temperature of 90 deg. C." allow nothing for inevitable variations of voltage, frequency, etc. These two papers embody strong arguments against allowing 105 deg. C. as the ultimate "hottest-spot" temperature, because margin surely should be allowed for such variations of current and other working conditions.

Motors Should Have Factor of Safety

Why have these two papers been taken as a basis for permitting 105 deg. C. maximum temperature? Mr. Lamme says this is "right on the ragged edge," with no allowance whatever even for inevitable variations in current supply, etc., and therefore has a minus factor of safety. In all engineering this is the only example of not relying upon our good and tried old friend—factor of safety. The need of it for electrical machinery is as great as for any other kind of machinery. Indeed, it is greater, because heat is generated and stresses are produced by electric and magnetic actions as well as by mechanical, and we have the very uncertain and easily affected matter of insulation.

The Electric Power Club discussed the question of 50-deg. rating at several meetings. Finally, at its meeting of May, 1916, the 50-deg. rating was added as a "recognized departure" (*Bulletin No. 110,* May, 1916, pages 158-9):

1. There may be two ratings for open-type motors and generators with Class A insulation and continuous time ratings, as follows:

(a) A rating giving a 40-deg. temperature rise guarantee under continuous operation with a two-hour 25 per cent overload guarantee at 55 deg. to be designated and known as the 40-deg. rating.

(b) A rating giving a 50-deg. temperature rise guarantee under continuous operation without overload temperature guarantee, to be designated and known as the 50-deg. rating.

2. Machines having 40-deg. ratings are designed for all classes of service, including those in which an overload capacity of 25 per cent for two hours is desired.

3. Machines having 50-deg. ratings are designed for all conditions in which the load requirements are accurately known and under which the motor will not be subjected to load in excess of its rating.

A 50-deg. open-type continuous-duty motor for general purposes as distinguished from a 50-deg. special application motor as described in the above rules is a recognized departure from the standards of the Electric Power Club.

The above statements in the "Handbook of the Electric Power Club" (August, 1920, page 65) are cautionary and not at all reassuring as to 50-deg. general-purpose motors. Evidently we should be very careful in choosing and using such a machine.

A book on "Management of Electrical Machinery," by F. B. Crocker and S. S. Wheeler, the first edition of which appeared in 1892, contains on page 8 the following statements:

Weight: It is a mistake to select a very light machine when it is for stationary use because weight increases strength, stability and durability.

Cost: It is usually an error to select a generator or motor simply because it is cheap, both the materials and workmanship required for the construction of a high-grade electrical machine being costly.

It is a fact, therefore, that twenty-nine years ago Dr. Wheeler and the writer both firmly believed and clearly stated that ample weight in a machine increases its "strength, stability and durability"; also that "it is usually an error to select a generator or motor simply because it is cheap."

Objections to Lighter Motors

The chief characteristics of the 50-deg. machine are lightness and cheapness; indeed, it is not even claimed that it has any other advantage. Its higher temperature limit is a serious defect because it puts the machine "right on the ragged edge."

In the discussion of the papers by Steinmetz and Lamme and by Merrill, Powell and Robbins, Dr. Wheeler began his remarks as follows:

"My interest in keeping up or, if possible, raising the standards for apparatus in this country is so great that I am impelled to say a word or two."

He also said that:

"Electrical apparatus needs plenty of margin or the adherence to a high standard; it is delicate and liable, unlike almost any other kind of apparatus, to approach the breaking point without the fact being visible to the user.

"I think it is very important to keep up the margins or factors of safety."

In the discussion of these papers the writer said:

"Any machine built in accordance with maximum rating must be applied to its work much more carefully than at present. Since it cannot carry any overload it must never be overloaded, and therefore an intimate knowledge of the conditions under which a machine will have to operate during its whole life must be obtained. Even the most careful investigations can only go far enough to apply a motor properly in the first place, but they do not take care of future conditions."

This statement, made three years before the action of the Electric Power Club already quoted, exactly agrees with it and calls attention to what must always be a risky point in the general use of maximum-rated machinery. The writer also said:

"The proposed rating not only fails to provide any margin or factor of safety whatever, but permits insulation to be used at a temperature at which it admit-

tedly suffers permanent and considerable depreciation. Hence the margin is actually a negative quantity.

"It is a violation of the fundamental principles of engineering and nothing short of foolhardy for electrical engineers to attempt to get along without factors of safety."

When the Electric Power Club in May, 1916, added the 50-deg. general-purpose motor as a "recognized departure" from its standards, the Crocker-Wheeler Company made the following statement:

> The Crocker-Wheeler Company wishes to be recorded as acquiescing in, but not approving, this resolution, in so far as it permits a motor that heats to 50 deg. under rated load to be called standard. Such a motor has no reserve for overload or for unfavorable variations in the current supply and is therefore liable to develop trouble and consequently affect the confidence of the public in the reliability of electrical apparatus. (*E. P. C. Bulletin No. 110*, May, 1916, page 159.)

This action was taken as a matter of courtesy on its part because a unanimous vote is required by an unwritten but unbroken Electric Power Club law. Many other member companies disapproved the 50-deg. rating for general purpose-motors but voted for it, not wanting to prevent some companies from using it since they were anxious to do. The disapproval of the Crocker-Wheeler Company was so strong that it recorded the fact in the minutes. The numerous objections to the 50-deg. rating were recently stated by A. C. Bunker,* chief engineer Crocker-Wheeler Company, and are based upon long, varied, intimate experience in designing, installing and operating electrical machinery.

On these four important occasions, twenty-nine years ago, eight years ago, five years ago and one year ago, also at many other times, the Crocker-Wheeler Company strongly opposed lowering the standard for electrical machinery. In the past it has never seen and it does not now see any good reason for changing its attitude.

Confusion and Misuse of Terms

The rating of electrical machinery has been complicated because various names have been used and often misapplied. "Continuous rated" has been appropriated to mean a 50-deg. motor. On the contrary, a 40-deg. machine will run longer and therefore *more continuously*. Hence it is most misleading to distinguish 50-deg. motors as continuous-rated. The word "continuous" should be used only in contradistinction to "short-time," "intermittent," etc., but not to signify a particular temperature rise nor absence of overload capacity.

A 50-deg. machine is maximum-rated. Indeed, its temperature exceeds the limit set by Steinmetz, Lamme, Merrill, Powell and Robbins in their papers. Hence it is over-maximum-rated. Hereafter a spade should be called a spade and not disguised by euphemism.

The term "single rating" has also been identified with the 50-deg. machine. It is single-rated because it has no overload capacity. Any machine, however, is single-rated if only one load or temperature rise is guaranteed. In this case also maximum rating should be designated as such and not camouflaged by terms that do not apply to it any more than to other quite different kinds of machines.

The point often urged that single rating is *simpler* than one including overload capacity is not in itself sufficient reason for adopting it. A single commandment would be simpler than ten commandments. It is far more important to have machines dependable under practical working conditions than it is to have them simply rated.

The most unfortunate confusion of terms is found in the A. I. E. E. Standardization Rules. Under "Temperature Limits" the following statement is made: "Table III gives the limit for the 'hottest-spot' temperatures of insulation. The permissible limits are indicated in column 1 of the table." The title of Table IV is "Permissible Hottest-Spot Temperatures and Limiting Observable Temperature Rises." The word "permissible" should not be linked with "limit." They are really contradictory. From its very nature a *limit* should not be *permitted* in practical matters. For example, the edge of a precipice is a *limit* but should never be *permitted* for the ordinary human being. A reasonable margin is needed to take care of human imperfections—also material imperfections—because even an expert "steeplejack" would not be safe at the limit, as the edge of the precipice might crumble. Common sense demands such margins.

No less than three false steps have been taken in formulating and applying the A. I. E. E. Standardization Rules:

1. The difference between the hottest-spot temperature in the insulation and the maximum observable temperature by thermometer has somehow increased from 10 deg. in the Steinmetz and Lamme paper to 15 deg. in the present A. I. E. E. rules. This raises the permissible hottest-spot temperature from 100 deg., which Steinmetz and Lamme recommend, to 105 deg., which Mr. Lamme says is "right on the ragged edge."

2. An extreme *limit* of temperature is taken as a practical working point for general purposes. This is analogous to taking the breaking load of an elevator cable or the bursting pressure of a boiler as proper working points.

3. The *permissible* temperature limit is taken as *mandatory*. It is bad enough to assume that a limit is permissible, but far worse to interpret the rules to mean that we *must go the limit!* We often hear it said that "the A. I. E. E. rules require" us to allow 50 deg. observable temperature rise!

Real Status of 50-Deg. Rating and Elimination of Overload Capacity

On both sides of the Atlantic it often is asserted that disapproval of 50-deg. rating and of the elimination of overload capacity have already dwindled to insignificance. The opposition is said to be limited to a few conservatives who do not yet "see the error of their ways," but even they are rapidly being "enlightened." The facts are that a large majority of the companies manufacturing electrical machinery in the United States, England and Canada strongly disapprove of allowing 50-deg. temperature rise. At least fifteen American manufacturers are definitely opposed to adopting that change. Moreover, many, if not most, of the electric machinery manufacturers of England favor the retaining of overload capacity. The opposition is not insignificant, dwindling or benighted.

The physical facts, in the opinion of the writer, give no proper engineering basis for permitting the 50-deg. rating of electrical machinery. The data are questionable and seem to have been fallaciously interpreted or changed. It is alleged that improvement in materials and construction enables a machine to be designed

*Electrical World, Jan. 10, 1920.

more closely than was possible when the 40-deg. standard was adopted. The truth is, however, that Class A insulating materials have not been improved substantially and certainly not enough to warrant a 10-deg. increase in temperature rise.

It is virtually impossible to estimate load requirement, operating conditions as to current supply, etc., so closely as to warrant the adoption of maximum rating. Moreover, a 40-deg. motor need not be so carefully selected and therefore has a much wider field of application. Temperature is only one factor causing motor deterioration. Vibration, expansion and contraction, centrifugal force, moisture and other causes also shorten the life of the insulation of electrical machinery. This makes the need of margin all the greater.

Machines manufactured in quantity from the same specifications show differences of several degrees in temperature rise, even under same conditions of test. The 40-deg. rating allows for such individual peculiarities.

A so-called "modern" reason advanced for permitting 50-deg. rise is that now there are more well-trained men engaged in applying motors, so that better selection is made than in the past. This means that every time a motor is bought a well-trained man should be consulted. If there are spare motors, he must be consulted when one of them is applied or any change is made.

It is also said that maximum rating "puts the responsibility on the purchaser." Presumably he knows little about electrical machinery, certainly less than the manufacturer, yet he is expected to know his load requirements "accurately," because the manufacturer gives him no margin to cover conditions that he cannot possibly estimate so closely and that even an expert cannot prophesy.

On the testing bench of its manufacturer under very favorable conditions of attention, ventilation, exactly normal voltage, current, frequency, load, etc., a *new* 50-deg. motor rises that amount in temperature. Surely its temperature rise will be much greater when the machine is old, covered and clogged with dust and dirt, often with unfavorable operating conditions, including voltage above or frequency below normal, little or no attention, etc. The hottest-spot temperature is then likely far to exceed the limit of 100 deg. originally fixed by Steinmetz and Lamme. In these times we should not expect extra care in selecting, installing, operating and cleaning machinery. It is virtually impossible to hire such special care, and if it could be obtained, the extra cost would much more than wipe out any saving in purchase price of the machine.

Conclusions.—The price of the 40-deg. motor is from 10 to 25 per cent more than that of the 50-deg. motor of the same rated horsepower. In the average electrically driven plant the cost of the motors is usually only 2 or 3 per cent and rarely more than 5 or 6 per cent of the total cost of the plant. Hence about 25 per cent of 6 per cent, or 1½ per cent, is the very greatest probable saving. In most cases the saving in total cost of plant would be less than 1 per cent if 50-deg. motors are bought instead of 40-deg. motors. Would an electrical engineer spending his own money be willing to introduce even a question of unreliability into his plant simply to save less than 1 per cent of its cost? For that matter, would any business man make such a mistake—and it would be a mistake—if he knew the facts in the case? Would he have a thousand-dollar or two-thousand-dollar outfit "on the ragged edge" during its whole life simply to save $5, $10, or even much more, in first cost? Fixed charge is still more unfavorable to a 50-deg. machine. The average of many cases under very variable working conditions, the clogging up of ventilating ducts, and in general the extra care demanded by absence of safety factor of the 50-deg. motor, would involve much more expense in time, trouble, attention, repairs, etc., than the slight saving in interest on the investment. This interest and saving is at most only about 6 per cent less than one-sixteenth of 1 per cent on the money invested.

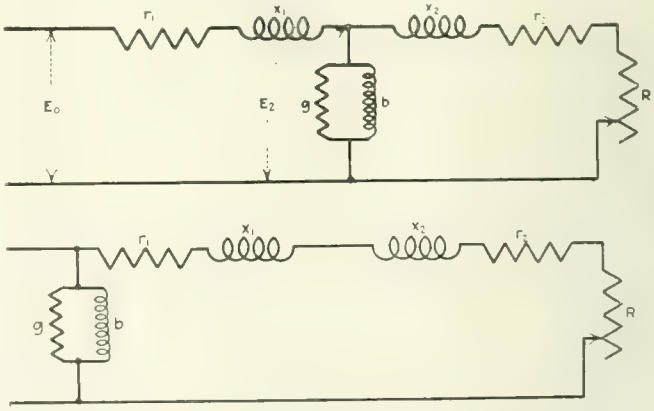
New Viewpoint on Induction Motor Diagram

Effect of Primary Impedance Is to Tilt Circle, but New Interpretation and Test Data Show that Tilting May Be Down as Well as Up

By R. G. Warner
Electrical Engineering Department, Yale University

Perhaps no diagram has been used so widely for the interpretation of induction-motor performance as the circle diagram. Its use is not limited to designers, but electrical engineers in the industries often use it for installation tests and for occasionally checking the performance of motors in service. While the refinement of tilting the circle is not necessary except where accurate results are required, a complete understanding of the possibilities and limitations of the diagram should be of interest to electrical engineers.

In the usual refined treatment of the diagram a consideration of primary impedance has caused an upward tilting only of the circle. In the following development, however, the writer has found that the circle may tilt either up or down, depending on the relative values of the constants in the expression for the primary impedance. This downward tilting of



TOP, ACTUAL EQUIVALENT INDUCTION MOTOR CIRCUIT. LOWER, APPROXIMATE CIRCUIT COMMONLY USED

the circle has not previously been discovered in published treatments of the subject.

The characteristics of the induction motor are commonly shown by the circle diagram corresponding to the approximate equivalent circuit of Fig. 1. It has been shown by K. J. Laurell* that the current locus for the exact equivalent circuit (Fig. 2) is also a circle.

The size of the circle may be determined from test data by the no-load and locked-rotor current vectors, provided that the position of the base line is known.

*"The Exact Circular Current Locus of the Induction Motor," Laurell, Electrical World, July 11, 1908.

By the base line is meant the line drawn from the no-load current vector I_0 on which the center of the circle lies; this base line may be horizontal, or it may point either above or below the horizontal depending on the relative magnitudes of the various motor constants.

The angle ε which this base line makes with the horizontal may be expressed approximately by $\sin \varepsilon = \frac{2I_0}{E_0}(r_1 \sin \theta_0 - x_1 \cos \theta_0)$† where r_1 and x_1 are the primary resistance and reactance and I_0, E_0 and θ_0 are respectively the no-load current, the voltage and the angle between them. This equation is derived in "Appendix."

The equation indicates that the base of the circle may tilt either up when $r_1 \sin \theta_0$ is greater than $x_1 \cos \theta_0$ or down when $x_1 \cos \theta_0$ is greater than $r_1 \sin \theta_0$. Table I illustrates the effect due to variations of primary resistance and reactance when the excitation "constants" (g and b) and the secondary reactance are constant. It will be noted that the numerical value of primary impedance is constant although the proportions of resistance and reactance are varied. Not only is the diameter of the current circle greatly changed, but the base line of the current circle is tilted. A graphical construction would also show that the secondary voltage is shifted.

Case 1 shows the results of constants such that the base is horizontal. It will be noted also that the no load I_0Z_1 drop is in phase with E_0. In case 2 the primary resistance is increased and the reactance reduced to zero, causing the circle to tilt up. In case 3 (see Fig. 3) the primary resistance is reduced to zero and the primary reactance increased, causing the base of the circle to tilt down. The following table summarizes these results:

Case	r_1	x_1	I_0	Coordinates of center	Radius	Sin ε Approximate	Sin ε Actual
1	0.5	1	8.9 $+j$4.45	29.8$+j$ 4.45	20.9	0	0
2	1.12	0	8.88$+j$5.67	47.9$-j$14.02	39.9	0.109	0.209
3	0	1.12	9.2 $+j$4.04	29.2$+j$ 2.01	20.1	—0.091	—0.101

Figs. 4 and 5 show circles of current locus for commercial motors under abnormal conditions to demonstrate the fact that the base line may tilt down as well as up. In each case the motor was run at 50 per cent overspeed, and external resistance and reactance were inserted in the primary leads. This reduced the flux density with small change in core loss and increased the effect of leakage. The test points of current values show close agreement with the circles which are drawn through the values of no-load current, locked rotor current and with the center on base line shown at angle ε. Figs. 4 and 5 show both positive and negative values of angle ε. The motor was loaded by a generator to obtain data for test points. For commercial motors the primary reactance and resistance may be assumed to be one-half the total reactance and resistance.

In actual motors there is great difficulty in obtaining the constants shown in the equivalent circuit because of their inter-relationships for any reading. This difficulty is increased because of the variation of the so-called "constants" with loads and consequent saturation in commercial motors under normal conditions.

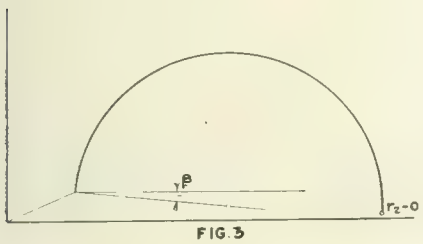


FIG.3

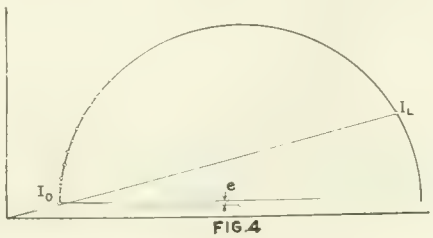


FIG.4

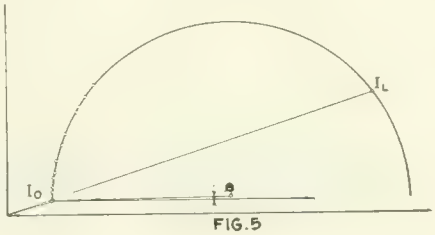


FIG.5

FIGS. 3, 4 AND 5—EXAMPLES OF BOTH UPWARD AND DOWNWARD TILTING OF CIRCLE

Fig. 3—Calculated circle based upon assumed values in Table I. The constants used in this case are $E_0 =$, $r_1 = 0$, $x_1 = 1.12$, $g = 0.05$, $b = 0.1$, $x_2 = 1.0$. Figs. 5 and 6 show actual results by testing motors with selected primary resistance and reactance.

Appendix.—In the following derivation the notation in Laurell's article is used. The equation of the circle is

$$(G - m)^2 + (B - l)^2 = n^2, \quad (1)$$

where G is the equivalent conductance of the motor for any load, B is the equivalent susceptance of the motor for any load.

$$l = \frac{b(x_1 + x_2) + g(r_1 + r_2) + r_1 x_2 y^2}{A}, \quad (2)$$

the abscissa of the circle's center;

$$m = \frac{br_1 + gx_2 + r_1 x_2 y^2}{A}, \quad (3)$$

the ordinate of the circle's center;

$$n = 1/2A, \text{ the radius of the circle} \quad (4)$$

$$A = x_1 x_2 + bZ_1^2 + x_2 y^2 Z_1^2 + 2bx_1 x_2 + 2gr_1 x_2 \quad (5)$$

$$y^2 = g^2 + b^2 \quad (6)$$

The letters correspond to the parts of circuit in Fig. 1. For no load the value of r_2 is infinite and

$$G_0 = (r_1 y^2 + g) D \quad (7)$$

$$B_0 = (x_1 y^2 + b) D \quad (8)$$

where $D = 1 + Z_1^2 y^2 + 2r_1 g + 2x_1 b$. (9)

The values of m, A, G_0 and B_0, by neglecting values of shunted admittance of the second degree, are

$$m = \frac{br_1 + gx_2}{A} \quad (10)$$

$$A = x_1 + x_2 + bZ_1^2 + 2bx_1 x_2 + 2gr_1 x_2 \quad (11)$$

$$G_0 = \frac{g}{1 + 2r_1 g + 2x_1 b} \quad (12)$$

$$B_0 = \frac{b}{1 + 2r_1 g + 2x_1 b} \quad (13)$$

Sin ε equals the difference between the ordinates of the no-load vector and the circle's center divided by the radius, or

$$\sin \varepsilon = (m - G_0)/n \quad (14)$$

$$= 2mA - 2G_0 A, \quad (15)$$

and, substituting the approximate value from (10)

$$\sin \varepsilon = 2br_1 + 2gx_2 - 2G_0 A. \quad (16)$$

Substituting for b and g from equations 12 and 13 and again neglecting terms of second degree of shunted admittance,

$$\sin \varepsilon = 2r_1 B_0 - 2x_1 G_0 \quad (17)$$

or

$$= \frac{2I_0}{E_0}(r_1 \sin \theta_0 - x_1 \cos \theta_0) \quad (18)$$

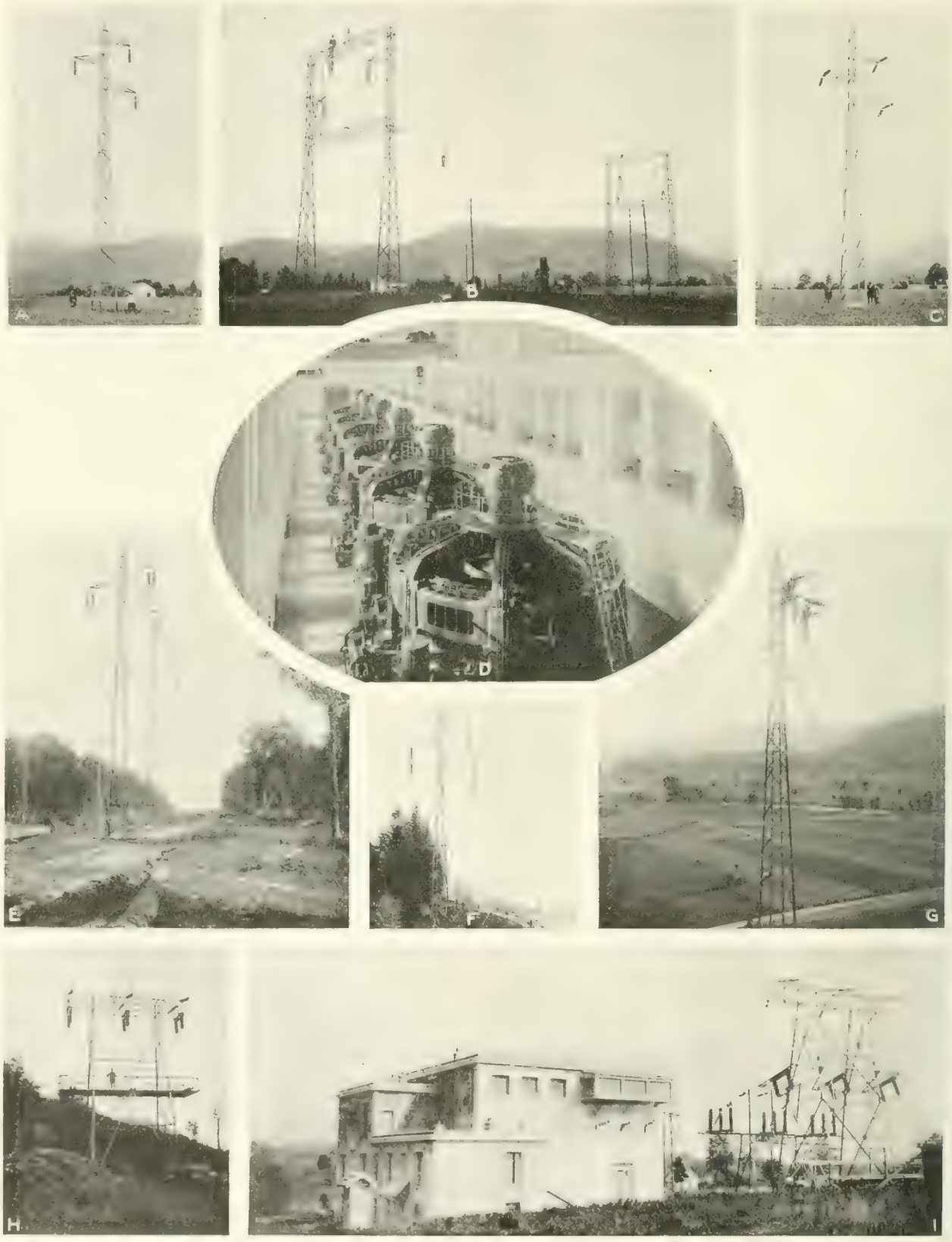
where θ_0 is the angle between I_0 and E_0.

†Heyland gives this value $\sin \varepsilon = 2I_0 R_1 E_0$, which is similar to the first term

Specht gives this value $\tan \varepsilon = \frac{2I_0(r_1 + x_1 + x_2)\cos \theta}{E_0}$

See ELECTRICAL WORLD, Feb. 25, 1905.

110,000-Volt Transmission System Built by the French



A—Standard tower for straight line.
B—Careful construction at railroad crossing.
C—Angle tower construction.
D—Generating plant in Switzerland has six 7,500-hp. units, supplying energy for distribution in France.
E—Crossing a telephone line.
F—Additional insulator strings to prevent swinging.
G—Mounting insulators on angle tower.
H and I—Outdoor switching structure and substation at Delle, where the transmission line enters France.

French Transmission Line for 110 Kv.

Delivers Energy from Hydro-Electric Plant in Switzerland to France—Considerations Which Led to Design Adopted for Transmission Line Over 115 Miles of Mountainous and Wooded Country—Operated at 70 Kv. at Start

By M. A. HENRIOD*
Electrical Engineer, Paris, France

A TRANSMISSION line was erected in 1918 and 1919 between Switzerland and France to permit the Compagnie Lorraine d'Electricité to receive hydro-electric energy from the power station built at Goesgen, Switzerland, on the Aar River by the Société Motor. The distance of 115 miles (185 km.) between the power station and the receiving substation made desirable a transmission voltage of 110,000. The system is operated temporarily at 70,000 volts, but the stations and line are equipped for the final voltage. Information available deals principally with the installation on French territory and gives details on the erection of one of the first transmission lines equipped in France for 110,000 volts. The matter is of particular interest because the actual data and operating considerations upon which the design was based are made available in concise form.

In order to meet the requirements resulting from the war the Compagnie Générale d'Electricité, on the request of the Ministère de l'Armement, was retained at the beginning of 1918 to study the erection of a transmission line, to be put into operation in the shortest time, to carry into France the hydro-electric energy available in Switzerland. The work began in July, 1918, was prosecuted energetically despite the difficulties of the time and was completed in one year, the line being ready for operation on Aug. 10, 1919.

The orders for steel, copper, insulators and other appurtenances for both sections of the line were combined, thus allowing more uniformity in the choice of the material and making better delivery possible.

On account of the long distance and the capacity of the line, which is 20,000 hp., the transmission voltage of 110,000 was chosen; so that with a power factor of 0.8 at the substation of the Compagnie Lorraine d'Electricité at Pouxeux, the ohmic losses are limited to 10 per cent and the voltage drop is not over 15 per cent. It was decided to operate the system at first at 70,000 volts in order to allow immediate connection with the network of the Compagnie Lorraine Electricité already operated at that voltage.

The hydro-electric plant of Goesgen, built between Olten and Aarau, uses the power of the Aar River under a 55-ft. (16.7-m.) head at low water, with an output of 12,360 cu.ft. (350 cu.m.) per second. Of eight units of 7,500 hp., six are now installed and supply three-phase current at 8,000 volts, 50 cycles. The amount of energy to be exported is sent out from a substation in the same building as the power station and equipped for the final voltage of 110,000.

Right-of-Way.—The right-of-way of the line has about the same total length on Swiss and on French territory. It goes through a country of mountains and forests, which made the plotting rather difficult as the route had to be as direct as possible and also easily accessible.

From Goesgen the line proceeds north to near Basle, touches the Bottmingen substation, follows the Alsace border and enters France at Delle, where the connecting and metering substation is provided. Then the line goes on the left of Belfort, crosses the Vosges Mountains at Planches les Mines and Corravilliers and joins the Moselle River at Rupt, following the valley to Pouxeux. The lowest point of the line is near Morvillars at the altitude of 1,112 ft. (339 m.). The highest point is at Belfahy at 2,900 ft. (884 m.). Between Servance and the Mont de Fourche the altitude varies between 1,970 ft. (600 m.) and 2,295 ft. (700 m.), going down suddenly to the Moselle River at 1,395 ft. (425 m.).

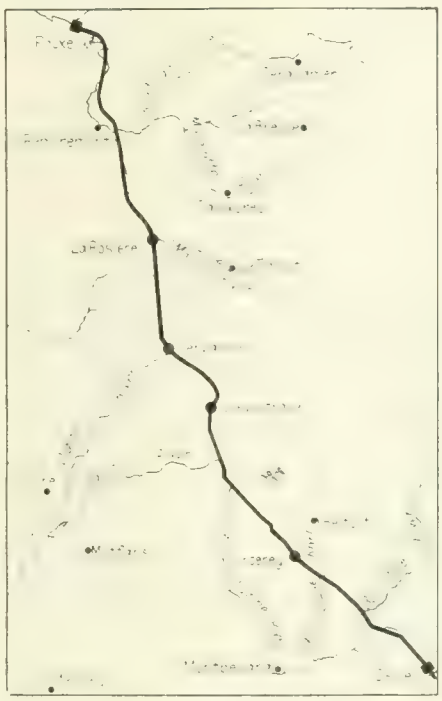


FIG. 1 — PORTION OF TRANSMISSION LINE ON FRENCH TERRITORY

The line is entirely built on steel towers, which support three conductors and one ground wire for the purpose of equalizing the potential of the towers, of which it also completes the grounding, adding a protection against atmospheric disturbances.

On the theory that the insulators are the weak point of any transmission system—it is known that probably 45 per cent of the troubles occur at the insulators—a very long span has been adopted. Owing to the high cost of the insulators and the difficulties in buying them it was advisable to make a careful choice of the special types on the market for high tension.

Considering the characteristics of the line and the price of the material, the economical span has been found to lie between 590 ft. and 650 ft. (180 m. and 200 m). The first figure has been adopted as standard span, but in a few cases, where there was no choice as to location of towers, some spans of 985 ft. (300 m.) have been erected. On the Swiss section there are a few spans of more than 1,600 ft. (490 m.).

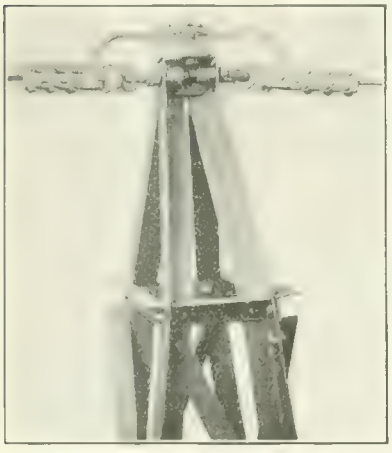
*Translated from article by Paul Meyer in *Revue Générale de l'Electricité*. The translation has been somewhat condensed.

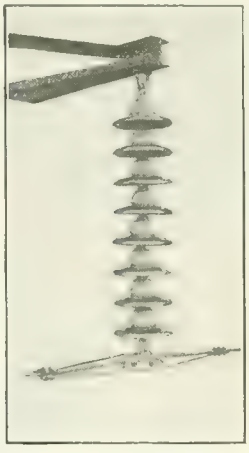
The use of long spans, which is very far from the standard French practice, required long stretches of straight line and the use of high towers. On the other hand, it had the advantage of reducing the number of insulators and also the amount of land to be bought from the farmers. Regarding the question of safety, experience with similar installations in America and Europe has shown perfectly good operation for many years with spans of about 500 ft. (150 m.). Furthermore, with the diameter of the present conductors the danger of mechanical breakdowns is positively offset, as it is known that the overloads due to sleet and snow affect the conductors of large diameter less than those of small diameter.

Two Standard Towers Adopted

In order to realize the standardization of the material there has been an attempt to limit the various types of towers to a minimum. They have been designed in two types which are suitable for any conditions.

The type A for straight line only is designed to carry the load of the conductors, of the insulators and of the wind on a span of 590 ft. (180 m.) with a factor of safety of three. On the road crossings, the towers being closer together, it is easy to obtain the factor of safety of five required by the government reg-





FIGS. 2 AND 3 — DEAD-END OF GROUND WIRE ON ANGLE TOWER AND SUSPENSION STRING WITH SAFETY CLAMP

ulations. The weight of this tower is 2,866 lb. (1,300 kg.), and it is built of three conical sections connected on the field with bolts. The dimensions of the upright angles, which are given in millimeters because they do not correspond to the American standard, follow: First section, 80 x 80 x 8 mm.; second section, 70 x 70 x 7 mm.; third section, 60 x 60 x 6 mm. The width at bottom is 4.2 ft. x 4.2 ft. (128 cm.), and the width at top is 1.3 ft. x 1.3 ft. (40 cm.).

The type B for dead-end is also used on the angles up to 135 deg. This angle has never been exceeded in the setting of the line. As in the case of the straight-line tower, type A, the dead-end tower is built of three sections bolted together. The weight is 5,508 lb. (2,500 kg.). The dimensions of the upright angles are: First section, 100 x 100 x 10 mm.; second section, 90 x 90 x 9 mm.; third section, 80 x 80 x 8 mm. The width at bottom is 4.9 ft. x 4.9 ft. (220 cm.), and the width at top is 1.7 ft. x 1.7 ft. (77 cm.).

The steel used in the construction has an ultimate strength of about 60,000 lb. per square inch (4,200 kg. per sq.cm.) and an extension coefficient of 18 per cent. The height of the tower is 65 ft. (20 m.) above the ground. The height of the lowest cross-arm is 45.9 ft. (14 m.) so that in a span of 590 ft. (180 m.) and with a temperature of 95 deg. Fahr. there is at least 23 ft. (7 m.) between the lowest point of the sag and the ground level.

All the towers are erected on concrete foundations of which the size depends on the kind of ground. In order to prevent rusting, the flanges of the uprights are on the outside so that the water can flow down easily and will not accumulate and stay at the riveting point of the braces.

The three conductors are carried at each corner of a triangle measuring 11 ft. (3.4 m.) on the vertical side and 14.7 ft. to 15.6 ft. (4.5 m. to 4.75 m.) on the two other sides. The length of the shortest cross-arm is such as to prevent any arcing between the conductor and the tower when the swinging of the conductors reaches 40 deg. because of a wind exerting a force of 25 lb. per square foot (0.012 kg. per sq.cm.).

Providing Against Conductor Movement Due to Sleet

The lowest cross-arm is offset 1.8 ft. (55 cm.), so that it will balance the shortening of the space between two phases on the same side when the sleet and snow on the upper conductors produce abnormal stresses due to unbalanced conditions of load. After experience in operation and in the most affected places this shifting may be doubled, and an additional string has been secured on the upper cross-arm in order to pull the upper conductor 1.7 ft. (50 cm.) closer to the tower and thus obtain a space of 3½ ft. (106 cm.) between the vertical planes of the conductors. At the beginning the arrangement of the three wires on a horizontal plane had been considered. The greater weight of the towers, their size and the difficulties of erection in a very rough country have led to the abandonment of this plan, which was after all very much more expensive.

The ground wire is in the center and on the top of the tower, 8 ft. (2.4 m.) above the upper conductor. It is secured to special clamps bolted on the top of the tower with lead sheets inserted between. On the angle towers strain clamps secure the steel wire on each side of the main clamp so that it remains flexible enough to avoid the wearing resulting from the oblique pull. Ground plate of copper of 1.4 ft. x 1 ft. x $\frac{7}{64}$ in. (42 cm. x 30 cm. x 2.8 mm.) is connected to a tinned wire of ¼ in. (6.3 mm.) to provide a perfect ground on each tower.

The crossing of three main railroad lines has required the erection of special steel structures. The three conductors are triple-stranded and secured to double strings of insulators. When crossing the telephone lines some special grounding nets have been provided between the high-tension line and the telephone. In special points the factor of safety has been increased by doubling the strings and by adding wire guards.

Eight Suspension Units in an Insulator String

The strings of insulators are provided with eight porcelain units, as shown in Fig. 3. At strain points or at angles they are provided with nine units.

These units, of the cap-and-pin type, are brown-glazed and connected together by the ball-and-socket arrangement; a suspension eye secures the string on

a link bolted on the cross-arms, and the conductors are supported by clamps, which are, of course, of different designs for strain and for suspension purposes.

Each unit has a diameter of 10 in. (25.4 cm.) and a weight of 7.9 lb. (3.6 kg.), and the length of the complete suspension string is 4 ft. 2 in. (1.27 m.).

The conductors are of electrolytic copper with a resistivity of 10.7 ohms per circular mil-foot at 20 deg. C. and a mechanical ultimate of 51,600 lb. per square inch (3,610 kg. per sq.cm.). They are made up of seven strands, giving a total cross-section of 153,933 circ.mil and a diameter of $\frac{33}{64}$ in. (11.6 mm.).

The sags and tensions have been established so as to limit the tension of the copper to 11,360 lb. per square inch (795 kg. per sq.cm.) except at the special points where a factor of safety of five is required. With the normal span of 590 ft. (180 m.) the sag does not exceed 23 ft. (7 m.) at 95 deg. Fahr. The ground wire is of galvanized steel of 78,940 circ.mil, $\frac{5}{16}$ in. (8 mm.) in diameter, made up of seven strands of a mechanical resistance of 99,300 lb. per square inch (6,950 kg. per sq.cm.). This wire is pulled in order to not exceed 17,000 lb. per square inch (1,190 kg. per sq.cm.).

The splicing of the conductors was done by means of the Schlick connector, which is in bronze with concentric cones, although a copper splicing sleeve twisted around the conductor ends was used in some sections. The mechanical tests showed that the conductors broke before any slipping of the connectors took place.

The unbalanced conditions resulting from the different capacities of the conductors are compensated for by a transposition at Bottmingen and at Delle.

Erection of the Line.—On account of the rolling land the location of each tower required the computation of the graphical curves established in function of the spans for the extreme temperatures of —4 deg. Fahr. and +95 deg. Fahr. (—22 deg. C. to 35 deg. C.).

The strain towers are spaced from 3,300 ft. to 3,950 ft. (1,000 m. to 1,200 m.). They are closer together in the mountainous section, but in their location the profile is always taken into account. In a few special cases where the insulator strings might have been lifted up at low temperature, and also in order to avoid need of erection of a special strain tower, the suspension strings have been provided with an additional string under the conductor to hold it down.

In order to obtain very long stretches of straight line and to reduce the angles, the woods and large forests have been traversed by opening a right-of-way wide enough to prevent falling trees damaging the line.

Towers Partially Assembled Before Transportation

The transportation of the towers was relatively easy on account of their construction in three sections and also because of the arrangement of the angles of the uprights, which permitted one section to be put inside of another. In special cases where the roads were too far from the location of the tower or where the slopes were too heavy the towers were carried to place of erection, each section separately, so as to avoid the handling of pieces heavier than 1,550 lb. (700 kg.) with a maximum length of 25 ft. (7.6 m.). The towers were erected with the aid of a hoist or a pulley.

The conductors, carried on special trucks, were laid by lengths of 3,280 ft. (1,000 m.) and immediately hung on pulleys secured at the same level as the clamps of the string of insulators. The tension and the adjustment of the conductors were checked with a dynamometer.

The erection of the transmission line on French soil required 850 tons of steel, divided among 542 steel towers and structural work segregated as follows: Four hundred and thirty-four suspension towers, ninety strain and angle towers, five canal crossings, six railroad crossings, seven special structures for switches, endings and telephone protection devices. In addition, 440,900 lb. (200,000 kg.) of copper conductors, 63,000 lb. (28,600 kg.) of steel strand, 19,000 insulators and 1,200 tons of cement were used. One hundred and twenty towers erected on rock necessitated blasting, and sixty tower foundations required electric pumping. The erection of this line was started with the help of Kabyle and Moroccan soldiers, and after the armistice it was completed with civilian labor.

Further information concerning the substations at Pouxeux and Delle will appear in an early issue.

Tendencies in Utility Financing

Needs for Soundest Possible Financing Loom Large—Encouragement of Consumer Ownership Will Strengthen the Position of Utilities

By A. N. Kemp
Vice-President Southern California Edison Company

With the tremendous development requirements facing our public utilities it is obvious that in order to keep pace with the growing demands upon them a proper provision for their financing is a subject for most thoughtful consideration. Development of utilities to meet the ordinary growth of business was impeded during the war. Money was diverted into the financing of our military activities. The man power of the country was enrolled in service. Freight embargoes and many other conditions incidental to the all-absorbing purpose of winning the conflict either stopped or curtailed normal development. We therefore face a condition where funds must be provided for the extension of our railroads, the overloaded condition of our telephone system must be relieved, gas utilities must find the funds to extend their facilities—but among the most important of these requirements is the necessity of developing hydro-electric energy.

Greater utilization of electrical energy and the substitution of other forms of power in this post-war era are forcing the electrical utilities to expand their physical properties in order to meet definite requirements for new business. This is particularly true of the hydro-electric companies. Many new uses are being found for electricity, both for domestic and industrial purposes, and demands are being accentuated by the realization of the limitations attached to other forms of power. It appears certain that many of the steam railways of the country will be obliged to electrify within the next few years. This has already been achieved in some of the mountain states, and those railroads are indeed fortunate which operate where water power is available.

While much of the potential energy of the falling water of our mountain streams has heretofore been allowed to go to waste, we have been ruthlessly and extravagantly consuming our natural resources of fuel. Scarcely had it been comprehended that a world war was impending than a shortage of the coal supply be-

came felt. Oceangoing craft were made over to consume oil instead of coal, and this condition became quickly apparent in the shortage of oil and its consequent increase in cost, and scarcity of both coal and oil was again reflected in the expense of producing gas and electrical energy.

Billion Dollars Needed

The capital requirements of public utilities in this country during the next decade will therefore be enormous. Looked at from various points of view, it is estimated that the money to be spent in the development of hydro-electric utilities alone during the next ten years will reach and possibly exceed $1,000,000,000. Facing us is the problem of how the means are to be provided for carrying out these required developments. It is virtually impossible to find actual or prospective owner-stockholders willing or able to provide the total of such a large sum of money. Therefore we must look further afield to the custodians of trust funds, the savings institutions, life insurance companies and other investors requiring a security of a fixed maturity and yield with a large margin of safety, secured by the property of the utilities. This source of funds is reached by the sale of bonds and leaves the remainder to be provided by the utilities' owners or shareholders.

Just as the very foundations of manufacturing, commerce and trade are based on credit, so are the public utilities built on a similar foundation. As the stockholders provide the sufficient margin of equity, investors are to be looked to to provide the remaining wherewithal to carry on the necessary development work. It is an axiom that any utility manager prefers partners to creditors, but the amount involved is so great that utilities perforce must look to the loaning public for a substantial part of their financial requirements.

Ratio of Bonds to Investment

Opinions differ as to the proper ratio of these borrowed moneys to the total investment, but it is generally agreed that a maximum of 75 per cent of the cost of extensions may be so borrowed with propriety and safety, although some contend that 50 per cent as a maximum is a more conservative rate. Considering the discount at which securities are very apt to be sold in these times, with bonds issuable for 75 per cent of the cost of construction, it generally results in not more than 60 or 65 per cent of construction funds being provided by the sale of bonds.

Unlike ordinary business, which is unrestricted by regulation in the handling of its affairs and enabled to make large earnings, regulation of the public utilities has reached the stage where their securities are essentially of a most conservative nature. This not only applies to the mortgage indebtedness upon the property of the utilities, but to its junior securities—debentures and stocks. Many safeguards are being thrown around such securities by regulating bodies.

Public utility commissions derive their authority from the people, and their accountability to the people is reflected in their actions. In order to encourage the investment of capital to permit the development of public utilities their securities are being stabilized to an extent which was unheard of in the days before rates were regulated or the issuance of securities scrutinized by state authority. For instance, public utility commissioners are going on record as favoring a contingency or financial reserve to insure the continuity of dividend payments during years of low operating costs, so that at times when, owing to abnormal conditions, the net earnings of utilities may be reduced invested capital will continue to earn and receive its just wages. Rewards for efficiency have been allowed whereby higher returns have inured to the benefit of the utility owners, and in general it is evident that the regulating bodies have awakened to a realization of the needs of public utility development.

It is conceded that in the interest of the stockholders two-thirds of the invested capital should be provided from the proceeds of bonds, leaving the remaining one-third to be provided by the owners through the sale of preferred or common stocks. Preferred stock should be limited as to dividends, but of a higher rate than the bonds, so as to reach that class of investor desiring a conservative investment with a higher yield. Common stock, being unlimited as to dividends, however, appeals to the partner-stockholder. He is the real owner of the property and is the one to whom the larger returns should go.

Utility Stocks Attractive

Granted a fair return on the invested capital, which the most conservative now place at not less than 8 per cent, and which in the opinion of many financial experts should be from 10 to 15 per cent, utilities may borrow a substantial part of their requirements at a cost somewhat less than the allowed return, so that the remaining difference may be applied to an increase in the return available for the stockholder. In spite of the fact that because of the necessity of building up equities and the maintenance of adequate reserves conservative financing precluded the payment of a utility's entire earnings in dividends, present-day regulation properly permits the payment of dividends on stocks at a rate which, in view of the safety insured by the principles above set forth, makes them most attractive. It is reasonable to assume, therefore, that this development need of our public utilities will be met through the sale of their bonds to investors of one type, preferred stocks to those of another type, and common stocks to those who become their partners.

Now that the people in many sections of the country are coming more and more to regard our public utilities as their own home projects, serving their own necessities, and to realize that upon the growth of such service depend the extension of business and agricultural development, the establishment of manufactures and the general prosperity of their community, they are giving an earnest and sincere co-operation by becoming partner-owners in the properties supplying this service. This form of public ownership is being encouraged by the utilities. As securities are being sold direct in large quantities to consumers and people in the territory served, this sort of co-operative ownership creates a substantial and enduring safeguard to other security holders of the company which increases and broadens the investment market not only for the utility's junior securities but for its bonds as well.

The two leading hydro-electric utilities on the Pacific Coast have been pioneers in this work and have sold many millions of dollars of stock to thousands of their consumers. Individual holdings are small, averaging in the neighborhood of ten shares, but the number of stockholders obtained is considered quite equal in importance to the number of shares sold. These small buyers invest on the theory that their stock will yield a

satisfactory dividend return while their investment will go to the development of their own community. Many purchases of stock are made in such amount as to provide for the payment of lighting or power bills out of dividends. This purchase of securities by consumers is a most healthy indication. When a large percentage of its consumers are security holders a company is indeed built on a rock which cannot be shaken. It is entirely within the range of possibility that the time is not far distant when the position and stability of a public service corporation will, in part at least, be judged by the number of its customer-owners.

Public utility organizations are not made—they grow with the communities which they serve. Under normal conditions existing in a domain which has not yet approached the limitations of population and consequent community wealth, the public service must keep ahead of the demand of the consuming public, because it has been proved by experience and statistics that population and prosperity invariably follow the extension of the public service. It is unquestionably true that a public utility organization is so intimately and absolutely interwoven with the woof and warp of the community that the relation is inseparable and intensely co-operative.

Relay Selection for Large Power Systems

Considerations Governing the Choice of Relay Layout for Generators, Feeders and Tie Lines Generators and Transformers Usually Protected From Internal Trouble by Differential Relays but Not by Overload Relays

By R. F. GOODING
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POSSIBLE short circuits on large power systems, their intensities and ways to limit them, have been dealt with by the writer in previous issues.* It is appropriate, therefore, to go a step farther and see what relay layout such a system would need in order to insure the proper operation of the various circuit breakers. For no matter how carefully the breakers may be selected and applied, they cannot function properly unless the relays have been just as carefully applied. The setting of the relays determines the sequence in which the different breakers will operate, and an incorrect setting on one set of relays only may introduce difficulties in that entire section of the system. This being the case, the question of their application is certainly deserving of serious thought. In general it may be said that generators are commonly protected against internal trouble by differential relays, but not by overload relays, since trouble on lines or feeders should be isolated without disconnecting the generator from the bus. Radial feeders are best protected by overload relays, while the reverse-power relay or directional relay is especially applicable to parallel feeders. Transformers, like generators, are isolated in case of internal trouble by means of differential relays.

The original purpose of relays was to protect the apparatus on any circuit in case of trouble in that circuit. The idea then was to disconnect this apparatus at once in order to prevent its partial or complete destruction. Now, however, relays have a second and even more important mission, that of restoring normal conditions to the system at large in the shortest possible time. To do this they must not only localize the disturbance as much as possible but must also isolate the troubled section from the rest of the system with the least possible disarrangement to the system proper. They must discriminate between overload and reversal of power, function on predetermined unbalance of currents, and, above all, must always operate in their proper time, so that the sequence of operations will not be destroyed.

*ELECTRICAL WORLD, Oct. 18, Nov. 15 and Nov. 22, 1919; also April 3 and April 24, 1920.

In order to determine what relays to apply at various points on such a system, how and when they should operate, etc., it is necessary to make a complete and comprehensive study of the short-circuit possibilities at all points. This can be done as outlined in the previous articles above referred to. Where it is convenient to use a calculating table† this would be simpler

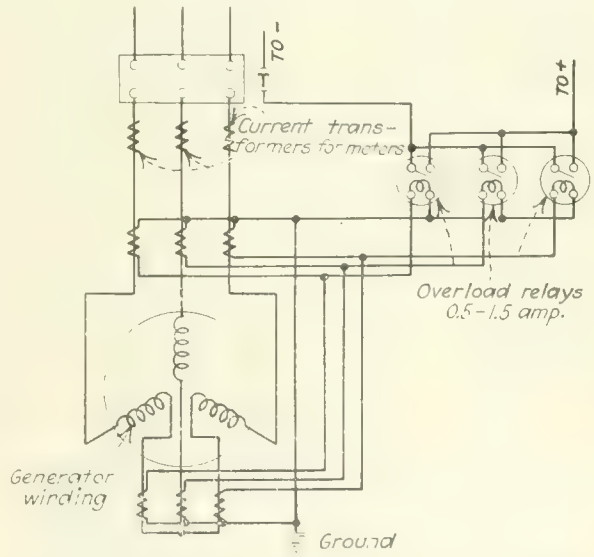


FIG. 1—CONNECTING DIFFERENTIAL RELAYS FOR GENERATOR PROTECTION

than the method outlined. However, if such a table is not to be had the method proposed before will be found to give very good results.

Knowing the short-circuit values at different parts of the system, the engineer is in position to begin the application of relays for each particular point and to determine what settings the different relays should have in order that they may function in just their proper time. No matter how carefully these data have been calculated or how closely the relays have set, there will always be considerable readjustment necessary before

†See ELECTRICAL WORLD, March 27, 1920.

the relay layout on a large system will operate properly under all conditions. It will usually take several months of this work to insure proper functioning at all points. In fact, even after the layout is working satisfactorily a change in the load at one point occasioning different transformer capacity may change the setting for relays on that circuit, and this different setting may in turn be passed on to several other points in that section of the system. Thus the study of relays is one that is never ended.

In dealing with the relays for this supposed system the writer will indicate what arrangements have given the best service to operating companies under conditions similar to those assumed in these articles. Various other combinations could be suggested, but only

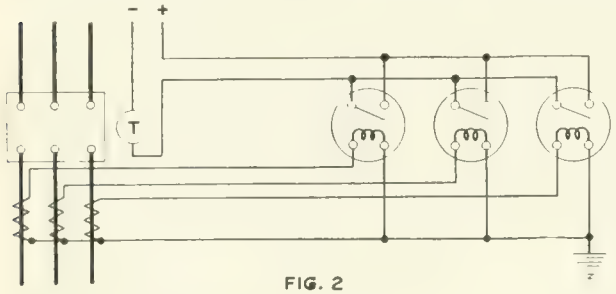


FIG. 2

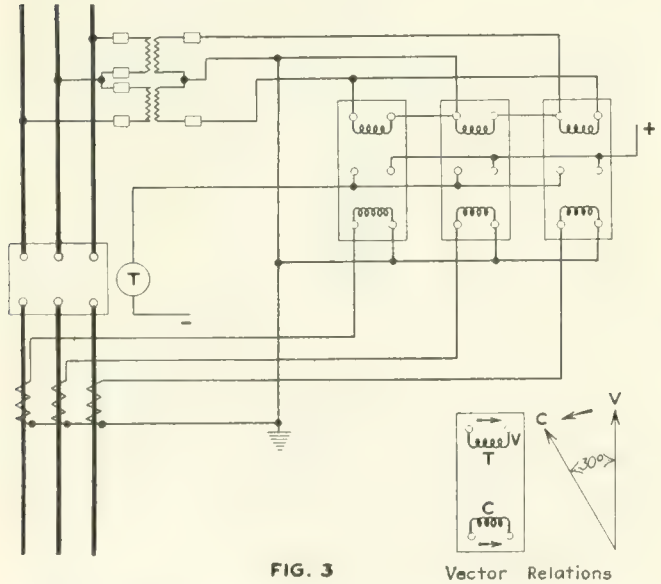


FIG. 3 Vector Relations

FIGS. 2 AND 3—OVERLOAD RELAY DIAGRAM AND REVERSE-POWER RELAY SCHEME COMMONLY APPLIED TO PARALLEL FEEDERS

the ones most widely used for similar systems will be outlined here. The relays will be considered first for the generators and then on through various steps of the transmission and distribution systems.

GENERATOR PROTECTION BY DIFFERENTIAL RELAYS

In modern stations it is customary to have no overload protection for the generators. The generator of today is built in a sufficiently sturdy way to withstand a short circuit at its terminals and therefore does not need the overload protection. Moreover, with overload relays on the generators a severe short circuit close to the bus might trip all of the generators, thus dropping the entire load of the station. This could happen only if the circuit breaker on the damaged circuit should "stick" or should be very sluggish in opening. Rather than drop the entire load it is better to have the generators stay on the bus and, if necessary, let the short circuit burn itself out, which will usually be accomplished in very short order.

If for any reason trouble develops within the generator itself means must be provided which will immediately disconnect the generator from the bus, and this is accomplished by the use of differential relays, as shown in Fig. 1.

RELAYS TRIP GENERATOR BREAKER

In this scheme all the generator leads are brought out of the machine and a current transformer is located on each leg between the armature coil and the neutral. On the line, or load, side a similar transformer is put on each lead between the generator and the bus. The secondaries of each pair of similar transformers are then connected in series, so that the current merely circulates. Across these secondaries is connected an overload relay, usually with 0.5-amp. to 1.5-amp. coils. Under normal conditions the secondary currents are equal and there is no current through the relays. But if part of the generator winding should become short-circuited this will unbalance the currents from the two current transformers on that particular leg, and this unbalanced current will then be forced through the overload relay for that circuit, causing it to close its contacts and trip the circuit breaker. These relays should be set for practically instantaneous operation, at just about 0.5 amp. (unbalanced current). This means that with 0.5 amp. or 10 per cent of unbalanced current the generator will immediately be disconnected from the bus.

Additional wiring (not shown here) should be installed in order that operation of the differential relays shall not only trip the generator breaker but also open the generator field switch, destroying the field and "killing" the generator entirely. Otherwise, even though the generator were isolated from the bus, with the field circuit still closed, it would be generating full voltage and would destroy at least part of its winding with its own power. When using this scheme it is possible to use the relay transformers for meters also, but this is not recommended, the usual practice being to supply separate transformers for metering purposes.

OVERLOAD RELAYS FOR RADIAL FEEDERS

Radial feeders, leaving the power station singly and with only one to a substation, are protected by plain overload relays. This connection, shown in Fig. 2, is probably the best known and most widely used of all of the different relay arrangements. When operating as a grounded system three current transformers and three relays are necessary in order to protect against an overload or ground in any phase. However, if the system is ungrounded the middle transformer and relay may be omitted. As most of the 2,300-volt distribution systems are ungrounded the two-relay scheme is very widely used for this class of work.

Very often there are parallel feeders running from the power station to a substation and then on to additional substations. With this scheme the feeders leaving the power station and successive substations would be equipped with overload relays, and reverse power relays would be placed on the circuits entering the various substations. The standard connection for the reverse power relays is shown in Fig. 3. Three relays are required in all cases, and, as the "vector relations" of Fig. 3 show, the current must lead the

voltage by 30 deg. This particular type of relay is really an overload and reverse power relay combined, or, as the manufacturers style it, a directional relay. Were it not for the overload feature the slightest reversal of power would trip the breakers, but, arranged as it is, it can be set to function at any predetermined amount of reversal. In many cases a reversal of full load (5 amp. secondary current) on the circuit might be permissible, in which event these relays would be set so as to pass this much power in the reverse direction, but to trip on any reversal greater than this. As will be seen later, the reverse power or directional relays play a very important part in the protection of parallel feeders between stations.

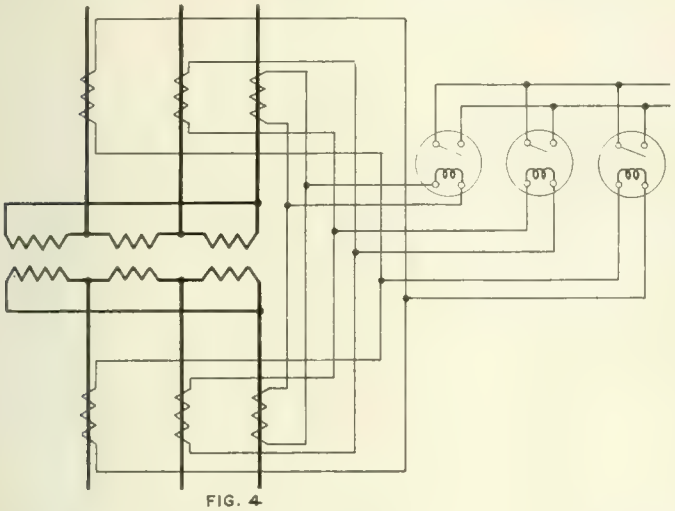


FIG. 4

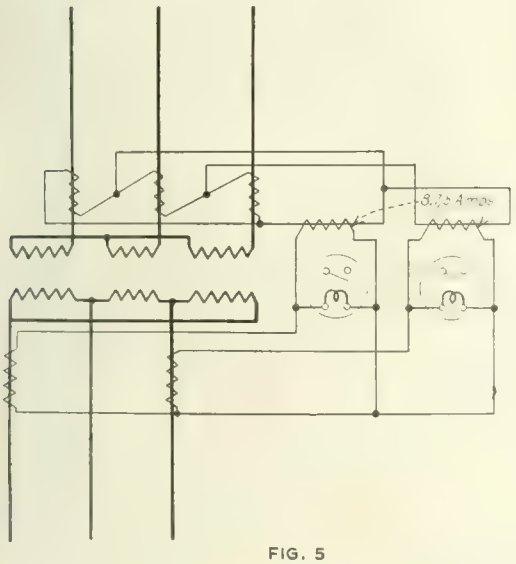


FIG. 5

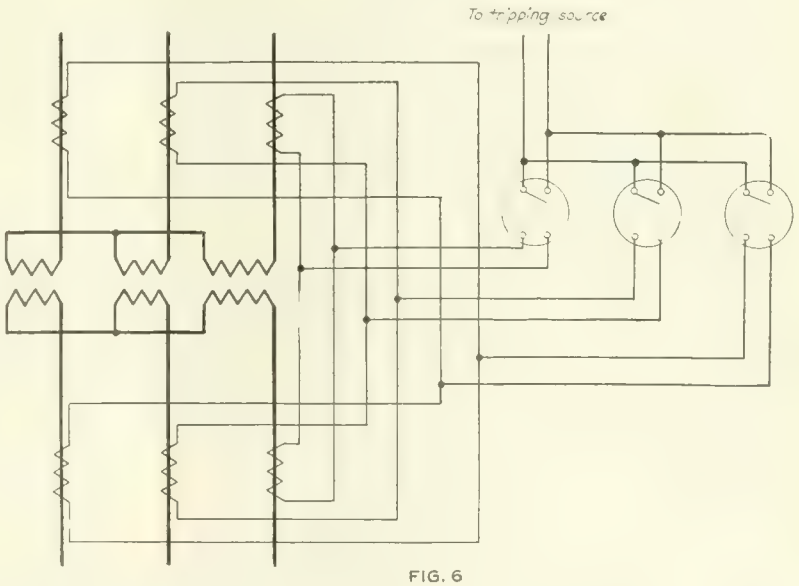


FIG. 6

FIGS. 4, 5 AND 6—APPLYING DIFFERENTIAL RELAY PROTECTION TO TRANSFORMERS CONNECTED DELTA-DELTA, STAR-DELTA AND STAR-STAR

DIFFERENTIAL RELAYS ALSO APPLIED TO TRANSFORMERS

The usual method with transformer banks is to omit overload relays and rely on differential protection, as was done in the case of the generators. Fig. 4 shows such connections for a delta-delta bank, while Fig. 5 is for a delta-star bank and Fig. 6 for a star-star bank. With a delta-star or star-delta bank this scheme requires special ratio transformers and requires considerable extra work, "phasing out," etc. The "phasing out" must, of course, be done with any arrangement, but is easier with delta-delta or star-star than with a combination of delta-star or vice versa.

A new relay has been developed called a polyphase differential power relay which simplifies the "phasing-out" work very much. It consists of two polyphase wattmeter elements on a common shaft and arranged so that their torques are opposing. One of these polyphase elements is connected to the high side of the bank, the other to the low side, care being exercised to have their torques in opposition. Under normal conditions, their torques being equal and in opposite directions, the resultant torque on the shaft will be zero and, of course, there is no tendency to trip the breakers. But if trouble develops in one side of the bank this will immediately unbalance the torques from the two sides of the bank, and when this unbalanced torque reaches a predetermined value the relay contacts will close, tripping both breakers and completely isolating the bank from the line. One big advantage of this relay is that it can be used with equal facility on delta-delta, star-star, delta-star or star-delta banks. Another thing in its favor is that the potential from the low side of the bank may be used for both of the polyphase elements, thus eliminating potential transformers on the high side.

The chief claim for differential protection for transformers is that it will isolate a bank before the internal trouble has had time to develop into a serious short circuit and by lessening the damage done to the windings will make the repair work that much less. Some engineers, however, state that it takes as much work to replace one coil as to replace several, and for this reason they supply straight overload protection on all transformer banks. General practice, however, seems to favor keeping the damage as slight as possible, and for this reason differential protection is very widely used.

In an early issue this discussion will be completed with an analysis of the action of reverse-power relays on parallel feeders and a discussion on the choice of relays for a typical system of stations, lines and substations.

Limitations of Interconnection

Rupturing Capacity of Oil Switches Under Short-Circuit Conditions Limits Interconnection Unless Plants Are Well Distributed

By E. C. Stone
Assistant to General Manager Duquesne Light Company, Pittsburgh, Pa.

INTERCONNECTION by its very nature always means a greater concentration of power at one point under short-circuit conditions, and the entire plant of both interconnecting systems must be mechanically and electrically able to withstand the increased strains. At the present time it is fair to assume that the short-circuit-breaking capacity of the oil circuit breaker marks this limit. The manufacturer's rating of the largest breakers made today indicates a rupturing capacity of approximately 1,500,000 kva., which is high enough by a considerable margin to take care of most systems that can be operated in parallel at the present time. The time does not seem far away, however, when present-day oil circuit breakers will be outgrown, and it may become necessary even to separate the systems of single large companies into parts.

To get an accurate idea of some of the limits the writer has made estimates on the future development of a system similar to the present system of the Duquesne Light Company. It was assumed that the various generating units of the power plants would be operated through individual transformer banks in parallel on the 66,000-volt bus only, and that the entire transmission system, operating at 66,000 volts, would be connected in parallel. Thus connected each 60,000-kw. unit would be able to deliver into a short circuit at the high-tension bus an instantaneous current of 3,400 amp.

Under these conditions the largest oil circuit breakers now built would just about break the short-circuit current of 240,000 kw. of generating capacity. If, however, this generating capacity could be divided equally between two power plants 60 miles (96 km.) apart and tied together by ample line capacity the combined capacity of the two plants could be 360,000 kw. without the maximum short circuit exceeding the capacity of the circuit breaker.

Safe Parallel Operation Dependent on Load Concentration

In other words, the maximum amount of generating capacity that can be operated in parallel on a given system depends to a considerable degree on the concentration of the load. Although 240,000 kw. is the maximum capacity that can be operated in parallel on a single bus, it might be perfectly practicable to operate three or four times that capacity in parallel if it were located in several plants separated over a distance of 150 miles or 200 miles (278 km. to 370 km.).

Assuming a system of this type consisting of two power plants of 180,000 kw. each, connected in parallel through 60 miles of transmission, if synchronous condensers were installed at the substations along the transmission line of sufficient capacity to increase the power factor of the load from 80 per cent to 90 per cent these synchronous condensers would cause an increase of 25 per cent or 30 per cent in the maximum instantaneous short-circuit current which could develop on the system.

A major element in determining the magnitude of short circuit which can develop is the reactance of the system. From this point of view alone the higher the reactance the better the condition. Very high reactance, however, introduces problems of voltage regulation, power factor and synchronizing power. In this connection, however, it is interesting to consider what would happen if the natural reactance of this system were doubled. The favorable effect would, of course, be to cut the maximum short-circuit current in half. The undesirable effect would be to increase seriously the voltage regulation of the system and introduce an additional reactive component into the load at the power stations. If, however, synchronous condenser capacity sufficient to raise the power factor of the load to unity could be installed the original voltage regulation would be restored and the power factor of the system sufficiently improved more than to offset the additional wattless component due to the high line reactance. The maximum short-circuit current, including that due to the increased synchronous condenser capacity, would be about 75 per cent of what it was before the reactance was increased.

In order that power plants may operate satisfactorily in parallel when tied together through a transmission system the synchronizing power of this system must be adequate; that is, the capacity of the transmission lines must be sufficient to permit of a free flow of corrective current between plants great enough to hold them solidly in step.

In general, the larger the capacity of an interconnected system the greater will be the ratio of peak load that can be safely carried to the installed generating capacity and the nearer will be the ratio of the average load on the machines actually in service from hour to hour to their rated capacity. Both of these facts make for economy.

Interconnection for Switching Purposes

So far interconnection has been discussed from the point of view of permanent parallel operation. Where this is not practicable because of the presence of some of the limitations referred to already, or for other reasons, temporary parallel operation for switching purposes sometimes proves very desirable. For instance, where the necessary synchronizing power is not available for permanent parallel operation it is possible for a few moments to parallel in the two systems and to switch over desired load from one system to the other without interruption. It is surprising how successfully this can be done on strings of line with an almost negligible synchronizing power. In almost any case the two systems will stay together for the comparatively short time necessary to complete the transfer of the load. They should then be immediately cut apart. For this sort of operation the question of the capacity of oil switches over the system in general is less important, since the chance of a short circuit developing at the moment when the two plants are in parallel is quite remote. However, the switches at the particular points where paralleling is to be done and the load transfer effected should be adequate. Elsewhere it is probably safe to provide switches only large enough to handle the short circuits of the generating capacity permanently back of them.

Where interconnection of a major to a minor power system is considered the minor system will presumably be connected to the major system through a bank of step-down transformers. These transformers must not only be of sufficient capacity to handle the load to be

taken from the major system but must be large enough for their reactance to be sufficiently low to permit of ample synchronizing power to hold the local generators in step with the major system. This last factor will require consideration, particularly when the amount of power to be taken from the major system is small compared with the capacity of the local plant. The possibility of the connection with the high-voltage system transiently raising the voltages of the local system must also be considered. Where the ratio of transformation is high, from say 66,000 volts to 11,000 volts or possibly 2,300 volts, it is probably necessary as a protective measure to ground the neutral of the transformers on one side or the other. The greatest safety, of course, is obtained when the ground is on the low-voltage side.

Voltage Regulation Is Important

The effect of the voltage regulation of the major system must also be considered, and it must be remembered that this will be added to the voltage regulation of the local system. This may necessitate the introduction of some sort of additional local voltage regulation, which may be accomplished by the installation of synchronous condensers at the step-down transformers or by the use of induction regulators on the various feeders, or by a combination of both of these methods.

The present tendency in the use of electric power is toward more refined equipment which requires closer voltage regulation. This is true in the fields of both power and heating apparatus as well as in lighting. The question of voltage regulation is thus becoming more and more important, and too much emphasis cannot be laid on the necessity of providing uniformly good voltage for all users of central-station power.

Due consideration must be given to the rupturing capacity of oil circuit breakers on the local system. Even though the capacity of the feeding transformer bank is no greater than the capacity of the generating plant shut down, the lower reactance of the transformers will probably permit much heavier short-circuit currents to develop. If the circuit breakers installed are not adequate a large amount of very annoying trouble is bound to develop.

In operating a small power plant on a major power system considerable attention can properly be given to governor setting. It the governor is properly adjusted the smaller plant will run along on an almost constant load, leaving the larger system to handle the swings. This will materially improve the local boiler operation.

In running a small plant in parallel with a larger system it is quite essential that the voltage regulation of the larger system be fairly good; otherwise there will be a tendency to hunting due to sudden changes in phase displacement caused by the poor regulation of the major system.

The interconnection of a major to a minor system when the minor system does not generate is much simpler than the preceding case, since the problems of parallel operation of the smaller plant do not need to be considered.

In this case the essential points are the proper protection of the system from high-tension disturbances through grounding of the neutral, the proper solution of the voltage problem by the use of synchronous condensers and induction regulators, and the installation of circuit breakers of adequate rupturing capacity to take care of the conditions arising from being connected to the larger systems.

It will not always be found necessary to ground the neutral at the point of connection with the major system, but conditions should always be studied in regard to this point and the protection of the grounded neutral should be provided when found necessary.

There is already in operation in the New England States an interconnected system embracing a considerable number of power plants varying over a considerable range of capacity and including both steam and hydraulic. On this system a distinct saving in plant capacity required to handle the load and in costs of producing energy is made by parallel operation. If the superpower project for the Eastern district is carried out as contemplated all of these stations and many others will, of course, be tied in to the superpower system.

This subject was also discussed at a recent meeting of the Transmission and Distribution Section, Ohio Electric Light Association.

Electrification of the Upper Rhone District

NATIONAL and complete hydro-electric development of the Upper Rhone, which now serves two Swiss plants rated at 18,000 hp. and three French plants, of which the largest, at Lyons, is of 30,000 hp., while a plant of the same rating as the last named is being erected to transmit power to Le Creusot at 130,000 volts, has for a considerable time been the concern of the French authorities. The difficulties, says the French Commission in the United States, have been principally those of the choice of the right place to build barrages. A joint agreement with Switzerland for the use of Lake Geneva as a regulator for the Rhone has been made. The increase in the level of Lake Geneva brought about in 1918 has added 63,000,000 kw.-hr. to France's power supply and 13,500,000 kw.-hr. to Switzerland's.

Switzerland, which wishes to see the Rhone open to navigation and which cannot undertake the expenditure necessary to the regulation of the lake to permit this, has been more than willing to enter into any agreement proposed.

An electrical engineer employed by the French government to examine water-power possibilities of the Upper Rhone, estimated that the fall of 69 m. at Frontière Génissiat would make available 200,000 hp.; that the fall of Eilloux, of 7 m., would make available 164,000 hp.; that the fall at Boursin-Maty, of 19 m., would make available 53,000 hp.; that the fall at Chanar-Brens, of 19 m., would make available 24,500 hp.; that the fall of Tremurs-Groslée, of 12 m., would make available 297,000 hp.; that the fall of Sault-Villette d'Authon, of 12 m., would make available 29,700 hp., a grand total available of 395,000 hp.

This total would make available 4,000,000,000 kw.-hr. per annum, which would equal a saving in coal of 4,000,000 or 5,000,000 tons per annum.

Concessions for the construction of plants at all of the falls mentioned above have been obtained from the French government and the work of construction has actually started on the first four. Plants, the French authorities say, will have been constructed at all of the falls by the end of 1925, and the whole of the great industrial region in the neighborhood of the Upper Rhone will then be served with a comparatively cheap electric power.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Co-operation of Technical and Practical Men in Industry

To the Editor of the ELECTRICAL WORLD:

SIR: During these days of industrial readjustment there is an opportunity to give more careful consideration to the problem of the relation of the technically trained man to the man following a trade. Many considerations in the past months have brought this matter into the foreground. Readjustments of wages, salaries and working conditions to meet the high cost of living have injected increased interest into the situation as to whether proper recognition has been made of the relative value of these two groups of men.

During the past year, on convention platforms as well as on graduating platforms, the old skeleton of the "white collar versus the overalls" has been dragged out, and after rattling it a few times it has been left without any real diagnosis being made or any verdict rendered. There would seem to be no ground for believing that the relation of the technical graduate to the man who has mastered his trade in the shop is one of antagonism, or that it should be. Both men are needed today in solving the great problems of development and conserving our resources, and both will find opportunity to serve in these days of "super-achievement" as industry launches out into a new era of activity. The two men are called to work in different atmospheres, but both must have constructive minds.

That there has been more or less misunderstanding between these two groups is evident. I recently heard an address given by a man skilled in construction work in which he said that college graduates in his employ did not know how to light a blowtorch. How many schools today would draw a large enrollment if they put on a course on "blowtorch engineering"? The cartoonist takes delight in picturing the agricultural college graduate trying to milk a cow on the wrong side and in similar gibes at college men. Such things are not a criterion of the standards by which to measure a technical graduate. The existence of the blowtorch has only been made possible by careful and patient investigation of the laws that govern combustible material and how they may be controlled. Such investigation, accompanied many times by sacrifice, has been carried out by the technically trained man. The problem of a new supply of energy to take the place of our coal as its quantity becomes limited will be left to the technical man to solve.

If the man in the shop looks at the college-trained man as a sort of an overgrown mushroom and in return the graduate looks at the shopman as a mere machine, then both are wrong. It is easy to overestimate one's self and underestimate the other fellow. Organizations have reported that recent graduates have applied for situations and have expressed their willingness to work for salaries ranging from $8,000 to $10,000 a year! Both groups should feel that their training is not a mark of complete fitness for being useful, but rather the laying of a cornerstone for building upon, through co-operation, in order to produce more efficiently that which satisfies the needs of mankind.

How can this spirit of co-operation be fostered? I know of a large electrical manufacturing company—and it is perhaps only one of many—that pays cash prizes to the men at the bench for such suggestions as are of value in the making of a machine part. Under such a plan the machinist develops the power of constructive thinking, becomes more valuable to his employer and lays the foundation for greater recognition in directing the particular industry in which he is engaged. Some of our colleges are working hand in hand with the manufacturers in adopting a program which gives the student alternate training in the classroom and in the shop. The student gets a better appreciation of the atmosphere that surrounds the man in the factory and prepares the way for cordial relations in the future as he graduates and enters his chosen profession.

The discussions, then, of our convention speakers, of the classroom instructors and of the press should not only be along the line of evaluating men according to the work which they select as their chosen vocation, but also should emphasize that the work of planning is equal in importance with the work of executing the plans, and that to insure the success of either there must be the friendliest co-operation between the two classes of workers.

HOWARD D. MATTHEWS,
Head of Electrical Design Department.
School of Engineering of Milwaukee,
Milwaukee, Wis.

Refilling Fuses Is Hazardous

To the Editor of the ELECTRICAL WORLD:

SIR: In the issue of the ELECTRICAL WORLD dated April 9 an article by H. S. Rich describes "methods for refilling inclosed fuses," and the apparent assumption is that by following the practices set forth a correct and safe fuse can be insured. This illustrates a too common misapprehension regarding the character and requirements of fuses, many people believing that any fuse is good enough if it is anywhere near the supposed current capacity rating. The research work in the development of fuses by standard manufacturers would have been wasted effort if this were true. The very definite requirements for the construction and safe operation of fuses as demanded by the Underwriters' Code and Underwriters' Laboratories' standards are based upon the knowledge that a proper fuse cannot be produced without careful manufacture and testing.

These rules are the result of years of study and experience which have shown fuse making to be both an art and a fairly exact science. Equivalent results cannot be obtained by the rough-and-ready means described by Mr. Rich, and as a fuse is essentially a protective device and usually the only one in a circuit, the unwisdom of attempting to refill fuses with so-called "fuse wire" should be self-evident. It is unfortunate that this fuse wire is sold as it is, marked, for instance, "tested 10-amp. fuse wire." Whether such wire will fuse at more or less than 10 amp. depends upon the length of the piece employed, the man-

ner of attachment to its terminals, the mass and surface of those terminals and the packing or filler, if any, surrounding it, to mention only the more important items. The performance on short circuit of a fuse refilled with such fuse wire or with other home-made elements is exceedingly doubtful. Experience has shown that changes in the fusible element far less radical than this will very often wholly alter the operation of a fuse and make it unsafe and unreliable.

In listing non-renewable fuses (one-time fuses) the Underwriters' Laboratories states that the manufacturers are prepared to refill them, marking and guaranteeing them as to ratings and operation upon the same basis as new fuses. Recognition of refilled fuses extends only to fuses thus refilled by their original manufacturers. Renewable fuses are approved only when used with renewal links made by the fuse manufacturer for his own particular casings. These limitations are made not to give business to the listed fuse makers, but because fuses refilled by others than real fuse experts are almost certainly hazardous.

The abuse of fuses constitutes perhaps the greatest evil and hazard in the present use of electricity and one which underwriters and municipal inspectors are unable to control with any great success. It is most unfortunate that the public, already too prone to disregard safety rules, should be encouraged by advice like that offered by Mr. Rich to practice a false economy at the expense of all reliability in the operation of fuses and at the risk of destroying the value of the sole protective device in electrical circuits.

Those who are disturbed by the reported large number of electrical fires and the resulting losses may well ask whether the abuse of fuses is not one of the prime causes and whether it is not very probable that fuses refilled as described in the article referred to are frequent causes of fire.

DANA PIERCE,
Vice-President.
Underwriters' Laboratories,
New York City.

[The ELECTRICAL WORLD agrees with Mr. Pierce's contention that safety is a paramount consideration in the fusing of circuits and welcomes the opportunity to say that it does not indorse the practice of refilling non-renewable fuses except under expert supervision such as is afforded by the fuse manufacturers.—EDITOR.]

Effect of Static Discharge on Telephone, Telegraph and Power Circuits

To the Editor of the ELECTRICAL WORLD:

SIR: On March 5, during an ordinary electrical storm, a violent electrical aërial discharge occurred at Kendalls, Wis. It had the results and characteristics of an explosion of dynamite or some other high explosive. At first it was thought a store of dynamite had exploded, but upon investigating it was found that the occurrence was entirely an electrical phenomenon. Unlike an ordinary electrical discharge, it was not concentrated at any point, but was distributed over quite an area. The concussion was so severe that in nearly every business building from two to sixteen window panes were shattered. A window was completely blown out of the Chicago & Northwestern depot.

Overhead circuits, such as telephone, telegraph and power lines, were nearly all affected. The telegraph circuits routed along the Chicago & Northwestern right-of-way were all grounded in air-gap protectors in the Northwestern station. The insulated copper ground wire between the protectors and ground connections was fused, several holes were blown through the insulation, and the molten copper metal was completely blown out of the insulating covering. Isolated parts of the telephone equipment used for train dispatching were burned and destroyed. The bottom of the cable box at the open-wire terminal, which is about 150 ft. from the station, was completely blown out, but otherwise box and equipment were uninjured.

Virtually all telephone circuits at Kendalls and its immediate vicinity were put out of service by this storm. The relays controlling the crossing bells on the Chicago & Northwestern Railway were burned so that the bells rang continuously, which added to the confusion. In the power house supplying electrical energy for the city of Kendalls the switches on the power board were twisted into irregular shapes and forms.

CHARLES T. REISZ.
Western Union Telegraph Company,
Chicago, Ill.

Influence of Iron on the Temperature Coefficient of Manganin

To the Editor of the ELECTRICAL WORLD:

SIR: The important bearing of iron on the temperature coefficient of manganin was first pointed out, so far as I am aware, by M. A. Hunter and J. W. Bacon.* Recently Dr. E. B. Rosa of the Bureau of Standards reported in this journal† that manganese between the limits from 9 to 13 per cent has no effect on the temperature coefficient of resistance, but that the presence of iron affects it to a considerable degree and up to 1 per cent improves the temperature coefficient of the resulting alloy.

The serious shortage of manganin caused by the war has caused great progress in the manufacture of manganin in Japan, and recently I have had opportunities to test several home-made samples. As the tested samples contain iron in much wider range than those reported by Dr. Rosa, it may be of interest to give a short account of my results.

To measure the temperature coefficient the wire was wound on a crossed mica frame and, after being thoroughly coated with shellac, was annealed by heating in an electric oven at 150 deg. C. for a period of fifteen hours. This process of annealing was found to be indispensable in order to obtain consistent temperature-resistance relations.

No parallelism between the iron content and the temperature coefficient of resistance was observed. This seems to be due to the influence of the larger amounts of nickel and manganese contained in the tested samples. It was found, however, that the presence of iron to an extent more than 1.5 per cent is harmful to the resulting alloy.

Commercially pure nickel and manganese, even the best samples, are rarely free from iron, so that there is little danger that the resulting alloy will contain too small an amount of iron. Hence in making manganin special care should be taken to make the iron content less than the amount just stated.

Owing to the large amount of nickel, the tested samples showed high thermo-electromotive force against copper, and the thermo-emf. is approximately proportional to the amount of nickel.

DR. JUICHI OBATA.
Electrotechnical Laboratory,
Department of Communications, Tokyo.

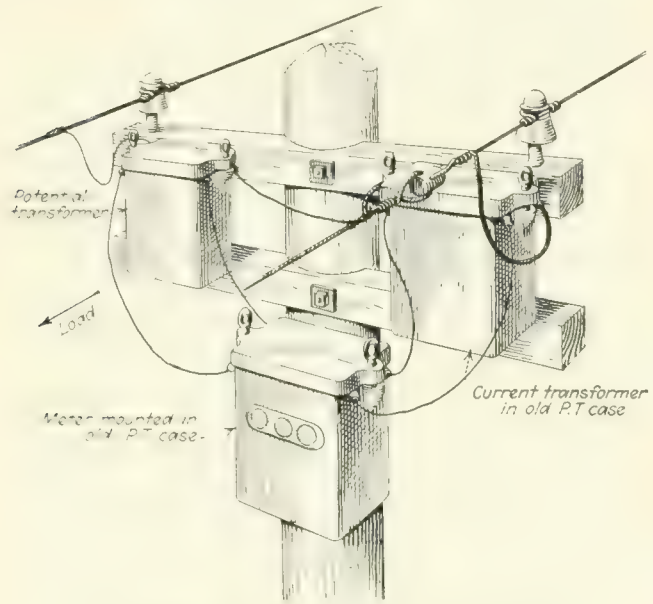
**Chemical and Metallurgical Engineering.* Vol. 21 (1919), p. 520.
†ELECTRICAL WORLD, Vol. 75 (1920), page 941.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

An Outdoor Meter Installation for Suburban Customers

SOME small, serviceable and inexpensive outdoor meter installations for single-phase, 2,300-volt lines were required recently by the meter department of the Empire District Electric Company at Joplin, Mo. City primaries had been extended at different points to supply suburban farmhouses, the farm consumers agreeing to stand the line and transformer losses by being metered at the town border. The following method was used with success:



INEXPENSIVE OUTDOOR METERING INSTALLATION

The cases and covers were obtained from two 2,000/100-volt discarded potential transformers. In front of one case and near the center a space equal approximately in size to that of a meter dial was drilled out and sealed with a glass plate from the inside. A 5-amp., 110-volt meter was prepared by removing the busbar on the middle terminals and then calibrating, particular care being taken with the light-load adjustment. This meter with the current and potential leads attached was fastened in the case by means of a bolt through the back of the case in such a position that the dial was opposite the glass-covered opening and thus could easily be read. The current leads were brought out of the case on one side through the original bushings, and the potential leads on the other side. In the second transformer case a 10-amp. to 5-amp. current transformer was placed with the primary leads entering the original primary bushings and the secondary leads coming out of the secondary bushings.

These cases with the addition of a 2,000/100-volt potential transformer were mounted on a pole top, as shown in the sketch. The potential transformer was placed on one side of the pole and the primary leads were tapped to the line wires. The case containing the current transformer was mounted on the opposite end of the same cross-arm, a guy (strain) insulator was inserted in the line wire on that side and the line was looped around it through the current transformer. The case with the meter was mounted in the center, and the current and potential leads attached thereto were connected to the proper secondaries leading from the potential and current transformers. Primary cut-outs are not shown in the sketch, but they were placed on the line side of the installation on the meter pole or on the preceding pole.

S. E. EVANS,
Foreman Meter Department.
Empire District Electric Company,
Joplin, Mo.

How a Boiler Room Can Improve Quality of Service

QUALITY of service from the consumer's viewpoint is judged by the outward physical signs of constant brilliancy of lamps, constant speed of motors, and freedom from interruption. The boiler room must do its share toward maintaining this quality. The first two conditions indicate constant voltage and unvarying speed of the prime mover—the former greatly dependent on the latter. Variation in speed of the prime mover—excluding that due to overload—may be due to several causes, all of which indicate inefficiency in operation. The cause may be governor trouble, and if so, can be easily remedied. In many cases it is due to fluctuating steam pressure. Assuming that boiler capacity is ample for the load to be carried, fluctuation in steam pressure may be due to poor firing, to improper regulation of air supply or to uneven supply of boiler-feed water. The first two causes are often the more difficult to remedy because of the poor grade of labor available for fire-room service. For this reason a greater responsibility for the economical use of fuel rests on those in charge of plant operation and makes closer boiler-room supervision imperative. The uneven supply of feed water can be remedied by the installation of feed-water regulators, of which there are many good types. An even supply of feed water results in feed water of even temperature, which means higher efficiency in boiler operation and more economical use of exhaust steam for heating the water, and in the case of condensing plants equipped with surface condensers avoids waste of condensate. The installation of a feed-water regulator is sometimes objected to because the fireman becomes dependent on it and its failure to work may result in damage. However, like every other boiler-plant auxiliary, the feed-water regulator needs careful attention for good operation.

The plant auxiliaries are little things on which the continuity of service often depends, and they should receive the same careful and frequent inspection as is

given to the main units. The exciters, boiler-feed pumps and hot-well pumps deserve careful consideration if continuous service is to be rendered. Their location in the plant is also of great importance; they should be easy of excess and whenever possible should be in plain view. If they are in dark or relatively inaccessible places, they will be neglected and may fail to operate at a critical moment.

C. A. GREENIDGE,
Chief Engineer.

J. G. White Management Corporation,
New York City.

Short Cut for Estimating Power of Waterwheel

A SHORT cut for determining approximately the horsepower developed by a waterwheel is the use of the formula Hp. $= qh/10$, where q is cubic feet of water per second and h is effective head in feet. In figuring possible power from waterwheels it is customary to use the formula: Hp. $= 62.5\ qhe/550$, in which 62.5 = weight in pounds of 1 cu.ft. of water; e = efficiency of wheel in per cent; 550 = foot-pounds per second necessary to produce 1 hp., and q and h are the same as in the first formula.

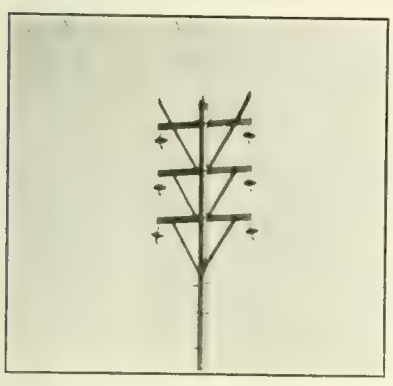
A few years ago efficiencies of 75 to 80 per cent were considered good, but today waterwheel manufacturers will guarantee 85, 90 and even 92 per cent, depending on conditions. Taking 88 per cent as a fair average, we can reduce the formula to Hp. $= qh/10$, which is shorter and simpler to use.

Thus for quick estimating simply multiply the flow by the head and point off one place. One setting on a slide rule will give a direct reading.

Berlin, N. H. RALPH MCKINNEY.

Extensions on Cross-Arm Braces Support Ground Wires

TO CONSTRUCT a distribution line requiring three overhead ground wires most cheaply, the Inspiration Copper Company, Inspiration, Ariz., makes use of an extension of the cross-arm braces supporting the upper cross-arm to carry two of the ground wires. As shown in the illustration, one of the ground wires is supported on the tops of the steel poles. The other two are placed almost directly above the line wires. More than one ground wire is needed in this installation because of the severity of the lightning, which occurs nearly every afternoon in summer time, and because the service from the generating station to the mine and mill can be allowed to suffer no preventable interruption. Although the line is operated at but 6,600 volts, yet it is insulated with standard suspension-type insulators rated at a much higher line voltage.



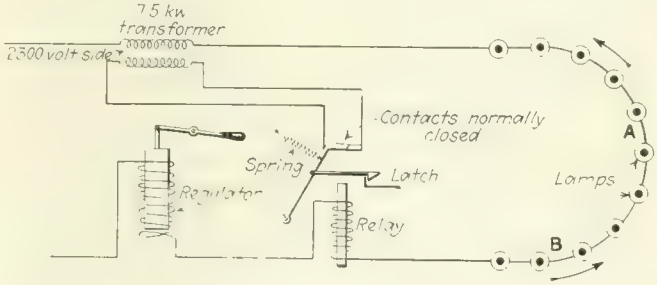
THREE GROUND WIRES MOUNTED IN AN ECONOMICAL MANNER

A. N. VOSS,
Electrical Engineer.

Inspiration Copper Company,
Inspiration, Ariz.

Street-Lamp Burn-Outs Prevented by Relay Scheme

AN INSTALLATION which has saved a large number of street incandescent lamps is in operation at a substation of the North Carolina Public Service Company, Salisbury, N. C. By this arrangement the 2,300-volt side of a transformer with the low side open is connected in series with the lamps when excessive current flows in the circuit. The necessity for this installation was brought about by the burning out of the street series lamps on one of the circuits controlled from this station, the circuit in question containing about 15 miles of No. 6 wire feeding twenty 100-cp., forty-one 80-cp. and fifty-six 60-cp. incandescent 6.6-amp. series lamps. No arc lamps are on this circuit. The station equipment consists of a regulator rated at twenty-five lights



WHEN CURRENT IN LAMP CIRCUIT BECOMES EXCESSIVE TRANSFORMER SECONDARY IS OPENED

(meaning arc lamps) and switchboard as shown by the diagram. On one occasion a cross with the secondary of a lighting transformer occurred at the point A and every lamp on the circuit from A back to the station in the direction shown by the arrow was burned out. On another occasion a cross occurred at B with the same result, this time all the lamps in the circuit from B back to the station in the direction of the arrow being burned out.

An analysis of the conditions showed that if this trouble was to be avoided in the future it was necessary to arrange to insert some high reactance in the line at the station in case of a cross or ground, whereas under normal operation this reactance would be cut out. It was decided to use for this reactance a 7½-kw. transformer rated at 2,300 volts primary and 350 volts secondary which had lain idle for several years. Recognizing the fact that the reactance of the primary of a transformer is high with the secondary open and low with short-circuited secondary, the transformer was installed with the primary in series with the arc line and the secondary wires were connected to the contact points of a home-made relay. This relay consists of a pull-up coil connected directly in the arc line, an armature and two contact points to which are connected the secondary leads of the transformer. Under normal current, which is 6.6 amp., the armature of the pull-up coil floats within the coil, guide rods having been arranged to hold it in place. With a sudden increase of current, say to 7 amp., this armature is quickly pulled up, tripping a latch which holds the contact points together and allowing the contacts to be separated by a spring, opening the secondary of the transformer and automatically inserting the high reactance of the primary in the arc line, thereby reducing the current to approximately 1 amp. When this happens the substation operator tries the line a second and third time and if trouble still exists the trouble department is notified.

The contacts have to be closed by hand, of course, this insuring that the operator shall know of any trouble.

In order to prove that the apparatus would take care of an extreme condition, the following test was made: With the circuit operating under normal conditions, with approximately 1,600 volts on the arc line, the entire external circuit with the exception of two lamps which operate normally on about 64 volts was shunted out, throwing the voltage of the entire circuit on these two lamps. The relay operated so quickly that they were not damaged in any way.

The credit for the design of this apparatus should be given to F. L. Bunker, Westinghouse Electric & Manufacturing Company, who supervised the construction. No trouble has been experienced from burned-out lamps due to crosses or grounds since the installation of the relay.

J. H. ROBERTSON,
Manager.
North Carolina Public Service Co.,
Salisbury, N. C.

Curves Showing Men Employed and Labor Cost Aid Management

FOR checking up the number of men employed to handle work in progress, correcting tendencies toward an oversupply or undersupply of workmen and showing at a glance the cost of labor, curves such as are shown herewith have been plotted by the Worcester (Mass.) Electric Light Company's distribution department. These curves, which are plotted from the weekly payroll, show the variation of the total cost of labor, the fluctuations in the labor employed by the company and in the labor of contractors, and also the number of employees in the department of the company concerned. If certain work is to be planned for the future, the number of men required and approximate cost can be estimated by consulting the chart records for such work done in the past.

The charts are used for aiding the management of this company in a number of ways. Some of them have



CURVES OF LABOR AND COST USEFUL FOR PLANNING FUTURE WORK

already been published in the ELECTRICAL WORLD (see issues for April 9, 16 and 23, 1921, and more will be published in issues to follow.

GEORGE M. HARDY,
Superintendent.
Worcester Electric Light Co.,
Worcester, Mass.

Corner Poles Placed So They Do Not Obstruct Sidewalk

NOT wishing to place a pole directly on the curb line on a busy corner in Phoenix, Ariz., the Central Arizona Power Company has made use of the corner construction illustrated herewith. The pole at the right is not at the curb line but some distance back from the corner. The one on the left is placed on the curb and building lines and is the dead-end pole of the line extending to the right. Thus neither of the poles interferes with the free use of the sidewalks. The two suspension-type insulators in each line wire were made up in the span before stringing, and the junction taps are placed on either side of the insulators.



SIDEWALK OBSTRUCTION AVOIDED BY USE OF AN EXTRA POLE

FIELD EDITOR ELECTRICAL WORLD.
San Francisco, Cal.

Current Leakages Detected by Receiver Connected to Metal Shoes

A DEVICE developed by a German firm for locating leakages from electric circuits consists of a couple of metal sandals, to which a telephone receiver is connected. The workman equipped with these sandals and walking over the ground with them in the vicinity of a leakage will notice a noise in the telephone on account of the difference of voltage within the circle of radiation of the ground current. The device is based upon the fact that the stray current radiates from the point of leakage, or, in the case of overhead lines, from the pole through which the ground circuit is produced. The device allows the workman to ascertain not only the direction but also the intensity of such stray currents, and by following the direction to which the increasing intensity points the location of the leakage can be found. Only when both feet rest on circles of equal voltage will the noise cease, a case which will hardly happen in practice. From the intensity of the noise the operator can also estimate the extent of the leakage. As the ground currents can attain a very considerable intensity in the case of high-tension lines, a rheostat may be inserted in the telephone circuit.

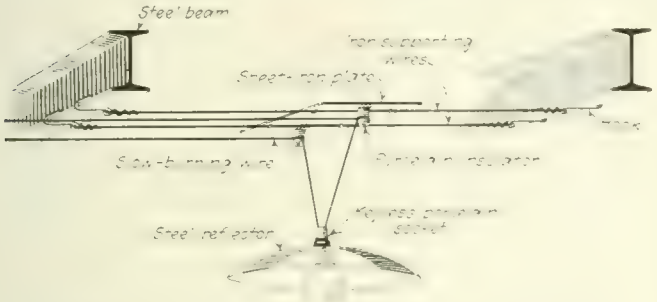
Berlin, Germany. H. O. HERZOG.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Lamp Mounting Which Withstands High Temperature

FOR placing a lamp over a hot furnace or in other positions where the temperature is high a special construction must be used. In one foundry where it was necessary to mount a lamp over a long malleable-iron furnace the problem was solved by stretching two strong iron wires across overhead from one steel beam to another. In the middle of the span a thin sheet-iron



HEAT-PROOF CONSTRUCTION USED ABOVE A MALLEABLE-IRON FURNACE

plate 12 in. square was securely bolted. On this plate were fastened two porcelain insulators carrying the line of slow-burning wire, and a few inches below was suspended a porcelain keyless socket into which the slow-burning wire was connected. A 15-in. steel reflector was used with a 100-watt nitrogen lamp. The whole installation is proof against high temperature. It affords excellent illumination over the top of the furnace, which is charged and closed up early every morning and is opened after each day's work. H. S. RICH.

East Berlin, Conn.

Too Small a Pulley Caused Bearing to Burn Out

RECENTLY a case of repeated burn-outs of bearings on a motor was found after investigation to be caused by the use of a pulley with too small a diameter. The user was puzzled because the motor drove a shaft at the correct speed and the power delivered was under 30 hp., the motor rating. Moreover, the motor did not overheat, fail to start or misbehave itself in any of the usual ways. It did, however, burn out its bearings regularly about once a month. An investigation disclosed the fact that the pulley on the motor was 7 in. in diameter and the belt was 8 in. wide, while the speed of the motor given on the nameplate was 1,800 r.p.m. A reference to the rules of the Power Club and to manufacturers' bulletins showed that the standard diameter size of a pulley for a 30-hp., 1,800-r.p.m. motor is 9 in. and that the belt should be 7 in. wide.

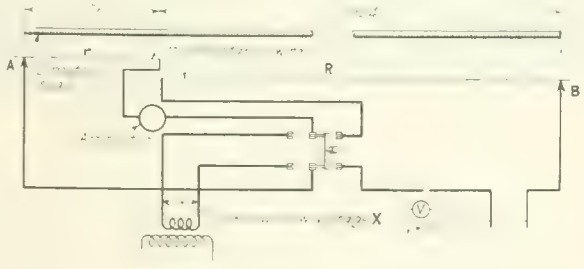
The cause of the trouble was of course apparent at once. The diameter of the pulley was too small. It is obvious that if the diameter of the pulley is reduced the speed of the belt will be less. This means that the net pull upon the belt must be increased in the same proportion so that the product of the speed and the pull will be constant. In this case the net tension of the belt was necessarily 30 per cent above the normal pull, and consequently the bearing was working under a continuous overload of 30 per cent. Actually the condition was much worse than this would indicate. Since the belt was insufficient for the service, it was necessary to stretch it very tightly in an attempt to prevent excessive slip.

Moreover, the line of pull of the belt was farther from the center of the bearings than it should have been, owing to the increased width of the belt. The actual overload on the bearings was nearly 50 per cent. The obvious cure was to use the proper size of pulley, which was a diameter of 9 in. with a belt 7 in. wide. This was impossible in this case since it would have been necessary to use a much larger pulley on the countershaft and there was not sufficient clearance between the shaft and the ceiling for the larger pulley. The only remedy was to replace the motor with one of the same horsepower operating at 1,200 r.p.m.

Howell Electric Motors Company, Howell, Mich. B. F. BAILEY, Chief Engineer.

Shop Method for Low-Voltage Measurement

IN AN industrial laboratory where 60-cycle alternating current is used it was necessary recently to measure accurately the low voltage obtained from small induction apparatus. As no low-reading alternating-current voltmeter to indicate from 1 volt to 10 volts was available, a shop method was developed. A circuit as shown in the diagram served for the purpose. *R*



ARRANGEMENT FOR MEASURING LOW VOLTAGE WITHOUT USING LOW-READING VOLTMETER

and *r* stand for variable resistances made up of carefully straightened nichrome wire, which is placed alongside a two-meter scale divided in centimeters. Using a low-reading ammeter and sliding contacts *A* and *B*, the apparatus is carefully adjusted, so as to

have the same amperage upon closing the switch to either side.

When the switch is to the right the voltage across r is to the line voltage (V) as the length of r is to the length of $(r + R)$ (as they are in series), or $x/V = r/(r + R)$, where x is the unknown voltage. Now, if the switch is thrown to the left and the same current flows as before, then the voltage across r is the same as before. Consequently this voltage may be calculated from the formula just given. As a numerical example, suppose $V = 110$, $R = 192.4$ and $r = 7.6$. Then $x/110 = 7.6/200$, and, solving, $x = 4.18$ volts.

When the resistance wire is No. 32 B. & S. gage from 0.2 amp. to 0.3 amp. is the necessary current. As the tie wires are made up of comparatively large cord with soldered terminals, they have negligible resistance in comparison with the nichrome wire. As both resistors are of the same cross-section and at the same temperature, the resistance of each is proportional to its length.

Lima, Peru. V. M. ARANA,
Consulting Electrical Engineer.

Locating Battery Troubles with High-Rate Discharge Test

TO PICK out those cells of a battery which require treatment or repairs a high-rate discharge test is very valuable for application to the closed type of lead storage battery. The test consists of discharging the batteries at a fairly high rate and taking a voltage reading of each cell while discharging. A suitable current rate for this test is about nine times the four-hour rate of discharge, if the battery is rated for four hours, or sixteen times the eight-hour rate, if it is rated for eight-hour discharge. If the nameplate gives any other time of discharge, the current may be figured by comparison with the four-hour or eight-hour rate given. This current is held for about fifteen seconds, and then voltage readings are taken on individual cells with the current still flowing.

It is best to take a hydrometer reading of each cell before making the test. If the readings are within fifty points of each other and all are below 1,200, the battery probably needs a bench charge with adjustment of the strength of solution. If the readings are above 1.200 or one cell differs from the others by fifty points or more, the discharge test should be made. If the voltage readings on the test are within 0.1 volt of each other, the battery needs a charge with an adjustment of the strength of solutions, or maybe there is a leaky jar which should be replaced. If the voltage readings differ by 0.1 volt and the battery is pretty well charged, there is something internally wrong with the cell showing the low reading, provided that it has not been short-circuited while in service. This cell should be opened and examined. However, if the battery is discharged

TABLE II—CONDITION OF BATTERY AS INDICATED BY HYDROMETER READINGS

Hydrometer Readings	Condition of Battery
1.300 to 1.270	Fully charged
1.270 to 1.200	Above half charge
1.200 to 1.150	Below half charge
1.150 or less	Discharged

TABLE I—HIGH-RATE DISCHARGE TEST FOR LOCATING TROUBLES ON STORAGE BATTERIES

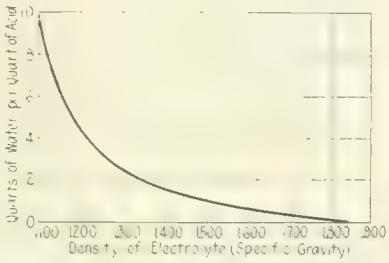
Gravity is read on each cell before starting discharge. Voltage is read while battery is discharging at a high rate, about nine times the four-hour rate or sixteen times the eight-hour rate. Current should flow fifteen seconds before taking voltage and should be flowing while readings are being taken.

Gravity Readings		Voltage Readings		Condition	Treatment
All readings within 50 points of each other	Above 1.300	Do not take....		Electrolyte has probably been added	I. Give "water treatment," and then test. For water treatment empty electrolyte and fill cell with water. Charge at two-thirds normal four-hour rate or three-eighths of eight-hour rate, until gravity remains between 1.270 and 1.310 for three hours. If between 1.300 and 1.310 adjust strength of electrolyte to between 1.270 and 1.300. If gravity rises above 1.310, repeat the water treatment.
	1.270 to 1.300	All cells within 0.1 volt of each other	All above 1.75 volts	Good	II. None required.
			Highest below 1.75 volts	Electrolyte has probably been added	III. Give "water treatment" and test again. (See I.)
		One cell at least 0.1 volt lower than others	Any cell above 1.75 volts	Cell with low voltage has been externally short-circuited or is in internal trouble....	IV. If cell has not been externally short-circuited, it should be opened and trouble removed.
			Highest below 1.75 volts	Entire battery needs charge or else is in internal trouble	V. Charge, test again, and, if same result, examine and remove trouble. For this charge remove cell from battery and charge at one-third of normal four-hour rate or one-fifth of eight-hour rate, until gravity reading is constant for three hours.
	Below 1.270*	Do not take....		Probably not fully charged	VI. Charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300, and then test. (See V.)
One cell at least 50 points lower than others	Highest above 1.300	Do not take		Electrolyte has probably been added	VII. Give "water treatment," and then test. (See III.)
	Highest 1.270 to 1.300	Do not take		Leaky jar, electrolyte spilled from low cell, low cell been externally short-circuited, or low cell is in trouble	VIII. Replace jar, if it leaks. Otherwise charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300 and then test. (See V.)
	Highest below 1.270	Do not take....		Probably not fully charged	IX. Charge to maximum gravity and voltage, adjust gravity to between 1.270 and 1.300 and then test. (See V.)

* An experienced man can make the voltage test with specific gravity as low as 1.200, using the same indications as given in this table for 1.270 to 1.300 gravity. Under 1.270 gravity, however, the 0.1-volt limit may become greater and the 1.75-volt limit may become lower, depending largely upon the state of charge. Only experience can guide, so it is deemed best to omit this condition from table.

the difference in voltage may be greater than 0.1 and yet not indicate any internal trouble. If there is any question, the battery should be put upon a bench charge and charged to maximum gravity and voltage and then for several hours more.

A bench charge is made at about one-third of the four-hour discharge rate. It is continued at this rate until all cells are gassing or bubbling freely and evenly and until the hydrometer readings and voltage are constant for five hours. The gravity on each cell should be between 1.270 and 1.300, for motive-power batteries and for batteries in starting, lighting and ignition service in temperate climates. In tropical climates "Exide" batteries in the latter service are specified to be operated with gravity about seventy points lower, *i.e.*, 1.200 to 1.230, fully charged. This gives better life and service with high temperatures. By tropical climates are meant those where freezing of water never occurs. If in this charge the hydrometer readings of any cells continue to rise above 1.310 give the "water treatment" as shown in Table I. In making this charge keep the temperature of the solution below 110 deg. Fahr., interrupting the charge if necessary.



PROPORTIONS OF WATER TO ACID OF 1.835 SPECIFIC GRAVITY FOR ELECTROLYTE OF DIFFERENT DENSITIES

For proportion by weight divide the above amounts of water by 1.835.

After making this charge the battery should have another high-discharge test and the voltage should be read on each cell. The accompanying table shows what conditions of voltage and gravity may be met and indicates what troubles are present, if any, and how to remedy those troubles.

If it is necessary to change the density of electrolyte, acid stronger than 1.300 should not be added directly to the cells. The electrolyte should be mixed in glass, earthenware or rubber vessels. In mixing, the water should be poured in first and the acid added in order to prevent danger of the acid heating excessively and being thrown out of the vessel. Extreme care should be taken that no impurities get into the electrolyte and that it does not come in contact with metal surfaces. The proportions of acid and water to mix for different densities of electrolyte are shown in the curve reproduced herewith. For a gravity of 1.280, which is the value usually employed for filling charged cells, 2.75 quarts of water must be used to 1 quart of acid of 1.835 specific gravity.

Electric Storage Battery Co., Philadelphia, Pa. RALPH W. RITTER, Engineer, Operating Department.

Enlarging Air Gaps for Heavy-Duty Motors

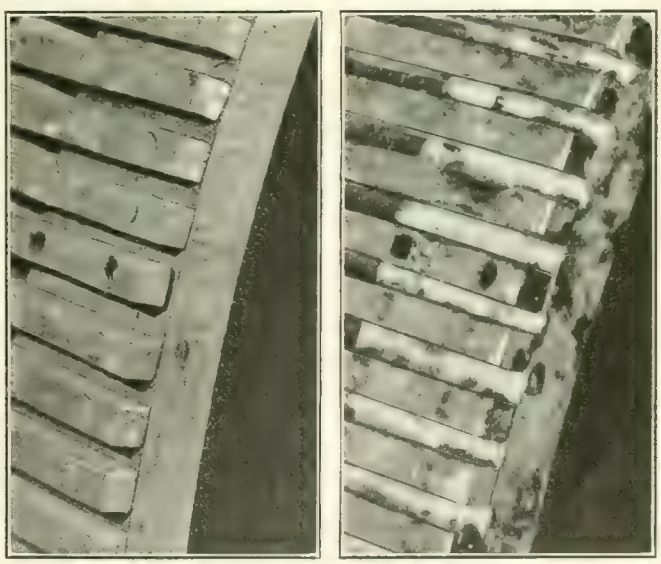
IN HEAVY-DUTY service in some of the copper mines and mills of Arizona it has been found desirable to enlarge the air gaps of induction motors to give considerably greater clearance between the rotors and the stators. In one particular case the air gap of a 500-hp., 440-volt induction motor had its rotor turned down so as to increase the air gap approximately 0.05 in.

Bearings of motors in such service generally receive a daily inspection and oiling. Often each motor is blown out daily, but, as the dust conditions are severe in the extreme, it is very difficult to keep the dust out of the bearings. This causes rapid wear. Although it is customary in the better supervised installations to gage the rotors weekly, yet service requirements sometimes prevent rebabbitting until damage has been done by rubbing between rotor and stator. No marked effect on the performance of the motors has been reported as a result of turning-down the rotors.

FIELD EDITOR ELECTRICAL WORLD.
San Francisco, Cal.

Welding Loose End Rings on Squirrel-Cage Rotors

FOR repairing defective rotors of squirrel-cage motors of the older types the latest reliable practice consists in welding the bars to the rings without reinsulating. This makes a permanent job and is a quick method for remedying a trouble frequently met, one which occurs in nearly all of the earlier designs of rotors. In one familiar type the bars are insulated and are secured to the end rings with bolts, nuts and lock washers. Another old type, familiar especially to repair-shop men, also has insulated bars, and the end rings are made up of a number of plates which are pressed on the ends of the bars and soldered. There are numerous other types which are similar in construction, on all of which considerable trouble has been experienced. Heavy loads heat up the end rings sufficiently to cause the metal of the bars and rings to expand, and when the load is removed or the motor is shut down contraction takes place. During the periods of expansion and contraction of the bolted-bar type oxidation takes place at the point of contact and the steel lock washers lose their temper, causing the bolts to loosen. This creates very poor contact between the bars and rings, raising the temperature of the latter



WELDING THE END RINGS OF A ROTOR GIVES A QUICK AND LASTING JOB

Left — Rotor for a 150-hp., 2,300-volt, three-phase, 60-cycle, 435-r.p.m. motor, showing the screws missing in one bar and the bar raised up from the ring.

Right—Defective bar is firmly welded to the ring. It was not found necessary to cement this rotor, owing to the fact that the cage winding was sufficiently tight in the slots not to be affected by vibration in service, as is very often the case with the larger-sized rotors.

to such an extent that the fishpaper insulation around the bars becomes charred and brittle, finally breaking off and flying out of the slots, leaving the bars bare and causing the complete cage winding to become loose in the slots, with a tendency to rattle while the motor is in service. In the rotor with pressed-on end rings temperature rise due to overload and similar conditions causes the solder to melt and be thrown out by centrifugal force.

When trouble of this character develops, the welding method makes a good and everlasting job. First, all excess grease and dirt is cleaned from the bars and rings at the point of contact and the under side of the ring is preheated to a bright red heat by a gas flame with forced air pressure. The bars are then welded on by melting a $\frac{5}{16}$-in. stick of "Tobin" bronze dipped in special brazing flux on the spot to be brazed by means of an oxyacetylene flame. A fillet weld is made between the bars and the ring.

The person doing the job should be careful not to deposit more metal than is necessary to secure the bars firmly to the rings. The result will be less metal to remove from the ring after the job is finished and incidentally less waste.

This method applies only to end rings with a good mixture of copper or other metal which has a fairly high melting point. In the case of rotors with high-resistance end rings, used for elevator service, etc., bronze brazing must not be attempted on account of the low melting point of this metal, as it actually fuses in some cases before the proper preheating temperature can be reached. A very good job is made on this type of rotor by soldering with silver alloy dipped in borax and applying just enough heat to cause the alloy to run freely in and around all crevices between the bars and rings.

Owing to the heat, virtually no insulation is left around the bars, which leaves the cage grounded to the core. No effort is made to clear the ground, as it has been found that insulation is not necessary, the current induced in the winding naturally following the path of least resistance. The winding is made of a much better conducting material than iron and has sufficient cross-section to take care of the proper distribution of the secondary current.

Since there is no insulation left around the bars, the cage winding is free to vibrate in the slots. This is remedied by the application of a suitable cement immediately after welding and while the core is still hot. The cement is mixed to a consistency such that when it is applied with a putty knife it can easily work its way well down in the slot along both sides of the bars. When cold the cement hardens so that the winding is firmly secured. The cement is not affected by moisture or oil, but in the course of a year or so recementing may be necessary owing to expansion and contraction of the bars. If recementing is again found necessary—and it is a very simple and inexpensive job—the time required to put the rotor back in service is reduced to a minimum as compared with the older method of reinsulating, etc.

After cementing the end rings are trued up in a lathe to remove any excess welding or soldering metal prior to placing the rotor in the motor frame. The motor should then receive a free running test, being started in the regular way and a close watch made to ascertain the time required to reach full speed. If full speed is not attained in a reasonable length of time, then the starting torque has been decreased owing to an increase in cross-section of the end rings caused by depositing too much welding metal. To remedy this the rotor is placed in a lathe and a cut taken off the outside end of each ring, the amount of metal to be removed depending upon how much the resistance was decreased. Through experience on several jobs and good judgment the operator will be capable of doing the work with such a degree of accuracy that only one finished cut will be necessary to make the rotor ready for operating service.

E. R. Debman.

East Orange, N. J.

Distributing Power Costs in a Pulp Mill Using 1,500 Hp.

By carefully compiling a monthly cost sheet showing the power distribution it has been found feasible to apply the cost of energy to the cost per ton of finished product, as well as the cost for various departments, in the pulp mill of the Provincial Paper Mills at Port Arthur, Ontario. While the mill manufactures only one product, sulphite pulp, and while the cost of power is really charged to one article, it is not charged as overhead, as is often the case in many plants, but is distributed between the different departments as a part of the manufacturing cost. There are, however, three different grades of pulp made, and the costs of power are carried to the point where electrical energy consumption can be applied to each of these different processes.

POWER COSTS FOR A TYPICAL MONTH

Previously estimated maximum demand, 945 kw. = 1,265 hp.
Minimum, 75 per cent, or 708 kw. = 948 hp.

Power service for the month of February:	
Maximum demand, kw.	925
Transformer losses, kw.	15
Total maximum demand, kw.	940
Present meter reading, kw.-hr.	22,700
Previous meter reading, kw.-hr.	469,100
Consumption, kw.-hr.	353,600
Transformer losses, kw.-hr.	6,720
Total consumption, kw.-hr.	360,320
Service rate, $1 per month per hp, or 1,260 hp =	$1,260.00
Consumption rates:	
(1) All consumption up to the first fifty hour monthly, 940 × 50 = 47,000 kw.-hr., at 1.75 cents.	822 50
(2) All additional consumption up to the second fifty hours monthly, 940 × 50 47,000 kw.-hr., at 1 cent.	470 00
(3) For all excess consumption, 360,320 — 47,000 — 47,000 = 266,320 kw.-hr. at 1 cent.	266 32
Total.	$2 818 82
High-tension discount, 15 per cent.	422.82
Balance.	$2,396.00
Prompt payment discount of 10 per cent.	239.60
Balance.	$2,156.40

*Equivalent to 1,260 hp.

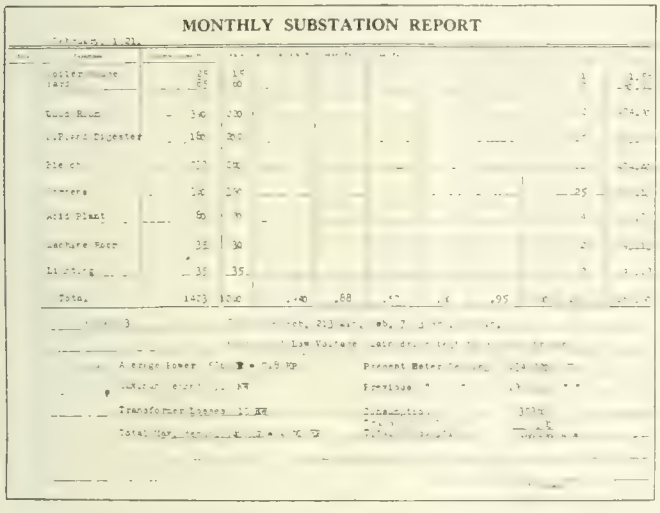
Power is purchased on a basis of $1 per horsepower per month and figured on the maximum ten-minute demand, including transformer losses. The energy charge is on a sliding scale, the first fifty hours of the total maximum demand being charged for at the rate of $1\frac{3}{4}$ cents per kilowatt-hour, the second fifty hours of the total maximum demand being at the rate of 1 cent per kilowatt-hour, while all in excess of these two rates is charged for at 0.1 cent per kilowatt-hour. As this company owns its substation apparatus a high-tension discount of 15 per cent is allowed, and an additional 10 per cent, as is quite frequently the case in power contracts, is allowed for prompt payment. The rate for the succeeding months is not charged at the previous month's maximum demand, but is 75 per cent of it.

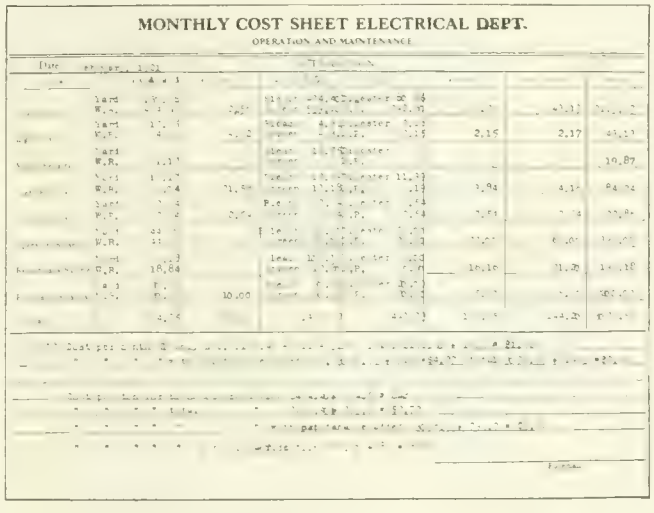
The connected load in this mill is about 1,500 hp.

and divided into eight main departments.* Each of these departments is fed from a separate panel in the substation, equipped with an ammeter the readings of which are taken every hour. The average of these readings taken for the month and the percentage of the total consumption is kept in the station log and transferred to the monthly substation report, as shown in the accompanying illustration.

The method of distributing the actual cost to the various departments is to determine first the total kilowatt-hour consumption, which is taken from the integrating kilowatt-hour meter, and then determine the maximum demand from the graphic wattmeter. The total power bill for the month of February, 1921, figured on this general basis, is shown in accompanying table on page 1000.

It will be noted that the total bill amounted to $2,156.40. By referring to the departmental percentages on the monthly substation report it is possible to divide this total up and apply the power costs to the individual departments. By using the general percentages given on the monthly substation report the


MONTHLY SUBSTATION REPORT


MONTHLY COST SHEET ELECTRICAL DEPT.
OPERATION AND MAINTENANCE

POWER DISTRIBUTION RECORDS THAT FURNISH AN ACCURATE CHECK ON DEPARTMENTAL AND PRODUCTION COSTS

costs are further subdivided and analyzed on the monthly cost sheet for the electrical department. On this record the cost of operation and maintenance are also added, so that the total cost of operating the electrical department may be determined. From these figures it will be noted that the cost per horsepower for the average load was $1.56 without including maintenance, while with maintenance added the cost was $2.16. The cost per ton for the bleached production was 84 cents, while the cost for the total production was $2.72 per ton. With maintenance added the cost per ton for the total production becomes $3.88.

A copy of all of these reports is sent to the accounting department each month, and at the end of the year the records are all placed on a yearly chart (not shown) which indicates the maximum demand for each day. Another chart is also kept which covers the monthly maximum demand, the monthly connected loads, the average monthly power and the average yearly power. In addition the various costs are shown.

This method of charging costs has been entirely satisfactory, as it is possible to determine any unusual departmental condition or production expenses at a glance. The annual load charts show the monthly variations of conditions.

H. E. STAFFORD,
Electrical Engineer.
Provincial Paper Mills, Ltd.,
Port Arthur, Ont.

*The load requirements for this mill were analyzed in an article in the Jan. 29 issue of the ELECTRICAL WORLD, page 265.

Obtaining Good Performance from Electric Drills

IN OBTAINING the best performance from an electric drill the feed pressure is a very important factor. The feed pressure required for drilling in steel to the full capacity of the tool is greater than can be exerted by hand for all except the smallest sizes, and even in the small sizes made by the leaders of the industry there is enough power to operate the drill under all the pressure a heavy man can exert. A pressure of 500 lb. is seldom too much for a ½-in. machine drilling in steel. A feed screw is therefore usually supplied with the larger sizes. All reputable tools of this type have enough power to prevent stalling except under accidental circumstances. When this does happen through bending a drill or other accident the power should be cut off as soon as possible. Momentary stalling of this kind will not injure a well-designed machine. The part most apt to fail under these circumstances is the switch, which must then act like a circuit breaker.

Sometimes when drilling sheet metal the lip of the drill will catch as it breaks through, stalling the machine. This trouble can be prevented by grinding the drill especially for this work. The angle of the point should be reduced to give a longer point—59 deg. is the standard angle—and the sharp angle at the cutting edge should be ground off slightly to give the same result as a smaller angle of the spiral flute to the axis of the drill. This latter procedure alone may also help to prevent "grabbing" in soft material and will allow high-feed pressures without chipping the cutting edges in very hard material. For drilling in wood the type of drill will depend upon the condition and kind of wood and the depth of the hole. Very deep holes require the ship auger. When drilling green wood the hole should be cleared several times if the depth of the hole is many times the diameter. Choosing and conditioning the drill is important and can best be solved by the mechanic on the job.

E. L. CONNELL,
Chief Engineer.
Van Dorn Electric Tool Company,
Cleveland, Ohio.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

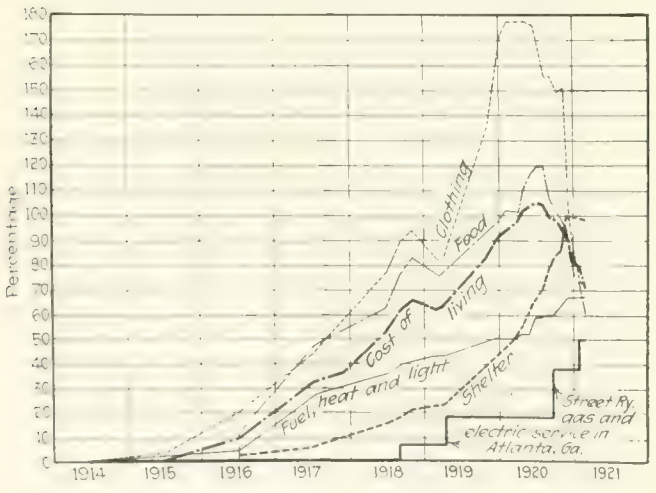
Profitable Increase in Business of Small Utility

AN INCREASE of slightly more than 20 per cent in the number of customers of the Albuquerque (N. M.) Gas & Electric Company was achieved in 1920. At the beginning of the year the total number of customers was 3,159. To these were added 678. This was done at a very low cost by soliciting business only along existing lines. The total average cost per consumer, including the sales expense, which was small, equaled almost exactly $50. An additional gross revenue of $9,168 resulted. At the beginning of the year the 1,725-kw. steam generating plant was carrying a load of 1,250 kw. At the end of the year the peak load was 1,500 kw. The output for the year was 4,684,000 kw.-hr., an increase of 849,700 kw.-hr. over 1919.

Increased Cost of Living Compared with Public Utility Rates

SHOWING that the increases in rates for electric, street railway and gas service have been extremely small compared with the increases of other items in the cost of living, the Georgia Railway & Power Company, Atlanta, Ga., recently inclosed an interesting folder with the monthly bills sent to over 40,000 of its customers. Attention was called to the comparison as follows:

"The accompanying chart shows the percentages of



COMPARISON OF PUBLIC UTILITY RATES AND COST OF LIVING

increase over pre-war levels in the price of the various items in the family budget. The combined effect of these items represents the 'cost of living' as indicated by the 'cost of living' curve on the chart.

"The percentages of increase in the combined cost of street-railway, gas and electric service has been insignificant compared to a great many items, and less than any other item in the family budget. It has remained at the bottom of the list.

"Prior to Sept. 1, 1918, notwithstanding that the price of practically everything else had soared and was still soaring, there had been no increase whatever in the charge for services furnished by the Georgia Railway & Power Company, although there had been a very great increase in the cost to the power company of furnishing such services."

Communities Are Judged by Their Utilities

FOLLOWING up the national campaign for public utility good will the Arkansas Light & Power Company of Pine Bluff, Ark., is running a series of advertisements in eleven local newspapers published in the thirty-three different communities served by the company. Showing how closely related are the interests of the community and the utility one of the advertisements placed the company's problem before the public in the following manner:

"Every community is known and judged by its utilities, and the public's attitude toward them. Good lights, abundant power, good transportation tell a stranger within the gates more about a city than can the spoken word. And the attitude of the public toward the utilities impresses the stranger favorably or unfavorably, because he realizes that a city is no better than its utilities. For, after all, the responsibility is with the people. If they are fair toward utilities, they enjoy good service; if unfair, the utilities cannot serve properly.

"Where the service of utilities is not efficient, experience warrants the deduction that some influence is at work which lessens the desirability of that community as a place of residence and occupation; a good place not to invest money; a good place to stay away from. For the stranger appreciates that a utility, like any other business, has its incentive to develop in the fact that it is prosperous.

"The electric light and power, telephone and telegraph, and electric railway services originated from the minds of inventive Americans. Here they have made greatest progress in development, American public services being the envy of the world.

"Although the public utilities have come into general usage within the life-time of the man still in his forties, they have become everyday necessities of modern life. Weaken them or derange them, and the whole nation is thrown out of gear. Wherever electric railway, electric light and power, and other public service has been suspended because of inadequate rates or other reason, social, commercial and industrial activities first slacken and then stop. And then decay sets in.

"If it is necessary for this property to be expanded—electric and power lines to be extended, street car lines to be built—in order to meet the public demand for service, the same thing must be done as when sidewalks are built or sewers installed.

"The utility must go out and get the money to buy the material and pay for the labor. This is because the utility is not permitted to earn enough to put aside a reserve for building extensions. It is in the same position as the city which goes into a bank to borrow money. If its credit is good it gets a loan; if it isn't it doesn't. It is just the same with the utility. If new additions to plant and extension of facilities are required to keep pace with the city's growth, the utility has to go out and sell securities. If it cannot show that it is entitled to credit because of its financial soundness, or because the public it serves is inclined to be unfair by trying to get service below cost and by mulcting the utility at every opportunity, then the utility doesn't get the money. The result is the extension isn't built, some people are deprived of service and community growth is stifled."

Breaking of Rate Contracts with Municipalities Justified

A PAMPHLET on "Rate Contracts Between Municipalities and Utilities," prepared by Walter A. Shaw, until recently a member of the Illinois State Utilities Commission, and giving an exhaustive review of the situation as it exists in Illinois, is being distributed by the Illinois Committee on Public Utility Information. In his booklet Mr. Shaw justifies the practice of state utility commissions in breaking contracts between municipalities and utilities wherever such action is necessary to establish fair and reasonable rates.

"The fact," Mr. Shaw says, "is that state commissions were created for the very purpose of breaking so-called contract ordinances. That part of the public which now accuses the commission of being 'contract breakers' is responsible for obtaining decisions from various state courts and the United States courts that rates prescribed in these ordinances must be set aside when it is determined that those so fixed are unjust, unreasonable, insufficient or excessive. The cities were the first 'contract breakers.' "

Using Illinois examples solely, Mr. Shaw reaches the conclusion that, inasmuch as municipalities began as far back as 1882 to invoke the courts in order to set aside alleged unfair contract ordinances and were upheld in their stand, they now can have no ground on which to resort to the courts in an effort to uphold contract ordinances when the advantage is on the other side. Another conclusion at which he arrives is that at no time were municipalities in Illinois either explicitly or implicitly given the power by the state to make a valid contract concerning rates to be charged by a public utility. He points out that Illinois was the first state to settle this question and that that decision has since been upheld by a United States court, which declared that such power of regulation of public utilities was inherent only in the state.

In distributing the pamphlet, the Committee on Public Utility Information calls attention to the fact that utility operators generally know the truth of the situation, but that the public is ignorant of it and must to a great extent rely upon the utterance of some agitator, either misinformed or purposely deceitful. To correct this condition the committee has suggested that the utility men call the pamphlet to the attention of mayors, councilmen, commercial clubs, city attorneys, judges and civic leaders, and others who attempt the discussion of rate contracts or commission regulation.

Achievements of Illinois Committee on Public Utility Information

TWO years' intensive effort on the part of the Illinois Committee on Public Utility Information to cultivate public good will for the industry has produced some surprising results. The committee closed its second year of activity this month, and even the most casual survey of its activities reveals amazing evidence of what can be done in this field by intelligent, practical planning consistently and persistently followed up under the direction of experts.

The purpose of the committee from its inception, to use its own words, has been "to conduct a systematic campaign for informing the public on the fundamentals, and particularly the economics, of the public utility industry, and thereby endeavor to cultivate a public opinion friendlier both to the industry and to the individual electric, gas, street railway and telephone companies." It utilizes all possible agencies for getting the case of the utilities before the public. It relies mainly upon newspapers, but it has also developed systematic utilization of other agencies, including public speakers, pamphlet literature and the public schools.

The committee celebrates its second anniversary by passing the five-million mark in pieces of literature distributed. These 5,000,000 pieces of literature have not been merely scattered broadcast, but have been definitely placed—each piece—in somebody's hands; and each piece was specially prepared or selected and approved by hard-headed practical utility men to be helpful to the utility industry.

This literature has gone to the general public by republication in newspapers and by other usual channels. Special pieces of it have gone directly into the hands of customers of public utilities, business men (members of chambers of commerce and other associations), bankers, lawyers, employers (for their employees), teachers, preachers, librarians, students in colleges and high schools, mayors, members of city councils and village boards, public officials of all kinds and candidates for public office.

An Incentive to Other States

The scope and effects of what the Illinois committee has done and is doing are by no means confined to Illinois. It has helped organize and start similar educational campaigns in nine other states—Indiana, Kentucky, Ohio, Nebraska, Missouri, Oklahoma, Arkansas, Wisconsin and Michigan—and has inspired the preliminary steps in Iowa, Texas, California, New York, Kansas, Oregon and Georgia. Its newspaper material and all of its literature are available for use in other states for the asking or the taking and are extensively so used. Its speakers' bulletins, school pamphlets and other publications have been circulated from coast to coast.

In addition to its directly educational work, the committee has established and standardized itself as an information committee. Its informational help is constantly sought—and from all parts of the country—by newspapers wanting data pertinent to current news, by high school and college students facing a debate or a thesis, by lecturers wanting to freshen up platform material, by writers of circular, publicity and advertising matter for investment houses, and so on. Even members and employees of the state public utilities commission have drawn upon the committee's resources.

A noteworthy fact is that the committee has not once been seriously accused, by newspaper, politician or utility baiter, of trying to "propagandize" the public. This absence of hostility, as well as much of the committee's success in getting its educational matter accepted and printed, is attributed to its strictness in living up to the "information" part of its name.

AVERTING "HOME RULE"

In the summer of 1920 Chicago and Illinois politicians seized upon the rate increases granted by the public utilities commission as vote catchers. Violent anti-utility proposals were made in the campaign for the nomination and election of the present state administration. Repeal of the public utilities law, abolition of the commission and reversion to "home rule" regulation were threatened and were recommended in the Governor's inaugural address. Citizens and civic bodies then began to take notice. The Illinois Chamber of Commerce (a federation of chambers of commerce in the leading cities) conducted a referendum on the subject, and business men of the state declared for retention of the public utilities law and the commission by a vote of 21,825 to 1,039—a ratio of twenty-one to one. Talk of abolishing the commission or seriously changing the utilities law has declined.

While it is impossible here to record a full account of all that the Illinois Committee on Public Utility Information has done, the "high spots" in its routine may be summarized as follows:

A weekly news bulletin goes regularly to the 900 newspapers in the state—about 125 dailies. Special bulletins go to the dailies and press associations when news warrants it. This news service is intended to be informative rather than argumentative, to avoid the political and the controversial, to carry matter that is at once helpful to the utilities and interesting enough to be printed for its own sake.

FRIENDLY ATTITUDE OF PRESS

Use of this matter by the state press averages about 5,000 column-inches per month, equivalent to considerably more than 250 newspaper columns per month—more than 3,000 columns per year. Newspapers that were unfriendly have become friendly. Helpful editorials have appeared in the state press, literally by hundreds, where formerly there were hostile ones or none.

Speakers' bulletins have been issued, each devoted to some phase of the utility industry, as, for example, the nature, development and service of public utilities, the prosperity of communities and of public utilities, the history and philosophy of regulation by state commission, utility service rate making, and so on. These furnish any intelligent person with ample material for sound talks, and as a further guide each bulletin carries one or two sample speeches.

ENGAGEMENTS FOR PUBLIC SPEAKERS

A bureau is operated to find engagements, before clubs, civic associations, and so on, for dependable speakers on utility subjects. The bureau is also organizing local utility managers, city by city, into local committees to promote discussion of utility subjects in public meetings and otherwise. Local managers have been thus brought together for definite co-operation in nearly a hundred communities.

More than 800 Illinois high schools use specially prepared utility industry literature in classrooms, in theme work and in debating societies. This literature is, of course, 100 per cent informative, not one-sided propaganda, and is sent to high-school principals and teachers only on request.

All local managers of gas, electric, telephone and traction companies are on the committee's mailing list. By letter, by discussion at association meetings and by reminders from higher executives local managers are constantly asked to co-operate with one another and with the committee in all possible ways and particularly as follows:

1. To familiarize themselves with each weekly news bulletin (which they receive one day earlier than editors do), to discuss the contents of the bulletin with the local editor on every opportune occasion and to point out the application of general information in the bulletins to some local situation or question.
2. To get utility subjects discussed before clubs and civic organizations by themselves or other dependable speakers, the speakers' bulletins aforementioned being always available for speech material.
3. To tie in with the committee's work in the schools by getting high-school classes to visit utility company plants, by stimulating debates and essay-writing competition, and so on.
4. To guide the committee in systematic distribution of helpful literature in their respective communities, with a view to getting maximum benefit from it.

ORGANIZATION OF THE COMMITTEE'S PERSONNEL

Samuel Insull is the "author" of the Illinois Committee on Public Utility Information. He conceived the general scheme and told a group of "Insull" company executives to "get something started." Thus it was that, with the co-operation of both Bell and independent telephone interests, the original membership of the committee in April, 1919, came to be as follows: John F. Gilchrist (chairman), vice-president Commonwealth Edison Company; Martin J. Insull, vice-president Middle West Utilities Company (now president of N. E. L. A.); Charles A. Munroe, vice-president Public Service Company of Northern Illinois and People's Gas Light & Coke Company (now president of American Gas Association); Britton I. Budd, president Chicago Elevated Railways (now vice-president American Electric Railway Association); Bernard J. Mullaney, manager public relations department, People's Gas Light & Coke Company; Clifford Arrick, publicity manager Chicago (now Illinois Bell) Telephone Company, and W. S. Vivian, secretary-treasurer United States Independent Telephone Association. Virtually every electric, gas, electric railway and telephone company in the state is now co-operating and is represented on the enlarged committee through members designated by the several state electric, gas, electric railway and telephone associations.

The committee's work was organized and is still guided by Mr. Mullaney as director and H. M. Lytle, former financial editor of the Chicago *Record-Herald*, as associate director. Out of the experience of all concerned in this Illinois campaign have come certain definite conclusions in relation to work of this character, among them the conviction that two important factors in the committee's success have been (1) the careful way in which its work is done so that no accusation may lie against it of trying to mislead the public, and (2) the motive power supplied by the weekly meetings of the committee and the facilities of the committee members for getting close to local managers and spurring them to co-operative action.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Progress in the Manufacture of High-Voltage Alternating-Current Windings.—W. ZEDERBOHM.—A detailed, well-illustrated description of the development of high-voltage motor, generator and regulator windings during the last twenty years. It was recognized early that round wires, wound at random, do not withstand overvoltage stress as well as rectangular conductors which fill out a given slot without leaving any dangerous air pockets. The author points to the great danger resulting from slow discharges, beginning at about 1,400 volts and destroying rapidly cotton covering which is not specially treated. Asphalt treatment and inclosing the coils in sleeves of "Mikanite" improve conditions materially. This method was standardized by the Siemens-Schuckert Works for all machines above 30 kw. and 1,200 volts. The entrance and exit slot coils now receive heavier insulation than all the other coils of the same winding (about 10 per cent of the number of turns are reinforced) to withstand line surges. Coils are wound on adjustable mandrels, are bent to the desired shape and smoothed out in steam-heated presses. If slots are wide enough the finished coils are laid in and the slots are closed by wedges. For machines with narrow openings of the slots the formed and finished coils are cut open again, straightened out at one end and threaded through the slots. By means of a small portable welding transformer the open ends are then closed again.—*Siemens Zeitschrift*, February, 1921.

Number of Bars and Torque of Squirrel-Cage Armatures.—W. STIEL.—Very elaborate tests were made to determine the influence of the number of copper bars in a cage armature upon the torque. One three-phase, four-pole, 1-hp. stator was successively tested with eleven different rotors, each having a different number of bars, varying from eighteen to forty-two. A spring dynamometer was used to trace out the torque curve, the motor driving a flywheel in all cases. The results showed that it is always advisable to have fewer slots in the rotor than in the stator, but that the difference should be small. The number of rotor slots should be even and divisible by the number of poles. The tests proved further that one may find in literature on this subject many statements contrary to practical experience. The influence of the form factor of the feeding voltage and the overfield caused by the staircase form of the field curve are usually overestimated, while the influence of the change of the field due to the slots in the stator and rotor laminations is generally underestimated. The latter fact especially is of great importance.—*Zeitschrift des Vereines deutscher Ingenieure*, Feb. 5, 1921.

Mercury-Arc Rectifiers for Large Output.—M. GIROZ.—This article describes the present status of large-output mercury-arc rectifiers. All mechanical difficulties of building metallic containers holding a high vacuum are said to have been overcome. Rectifiers up to 900 amp. direct current or up to 2,000 volts direct current are in successful operation. At 1,500 volts direct current an efficiency of about 98.7 per cent has been reached, and it is of interest to note that the efficiency is the same, regardless of load. The alternating-current input power factor may be kept around 0.97, the voltage regulation at 3 per cent. In several Swiss and French substations the 600-volt trolley service is fed from such rectifiers with excellent results. As main advantages are claimed: (1) High efficiency, (2) quiet operation, (3) small floor space, (4) small amount of necessary attendance, (5) capability to stand overloads, and (6) no foundation required. —*Bulletin de la Société Française des Électriciens*, Vol. X, No. 93, page 375.

Generation, Transmission and Distribution

Distribution of Voltage Along Disk-Type Insulator Chains.—CH. DACHARY and P. GORCE.—A study was made to investigate the voltage distribution along chains of disk-type high-voltage insulators. Two types of disks were investigated—the Hewlett type and the disk with metal cap and cemented short rod. It is shown that a very high stress exists on the disk next to the line. With metal cap disks, when all disks are alike, the disk next to the line has to withstand up to 45 per cent of the line voltage. This figure may be reduced to about 17 per cent if double the capacity of the rest of the units is given to the last two disks, which may be done by enlarging the metal surface. For Hewlett-type disks a metallization is recommended, and for this the Schoop metal spray process proved very satisfactory. A great many curves of actual measurements of different chains under operating condition are given. —*Bulletin de la Société Française des Électriciens*, Vol. X, No. 93, page 345.

Removing Gases in Water by the Kestner System.—PERDRIZET.—Recognizing that the principal cause of deterioration of boilers is the gases in solution in the boiler-feed water and that the oxygen is by far the most detrimental of these, the author describes an apparatus by which the oxygen is removed from the water by chemical process.—*Revue Générale de l'Electricité*, Feb. 5, 1921.

Mechanical Construction of High-Voltage Transmission Lines.—H. KYSER.—The article deals in detail with the most suitable construction for supporting structures for high-voltage lines, taking up in turn wooden poles, fabricated-steel poles, reinforced-concrete poles, steel towers, towers for very long river crossings and their respective accessories and hardware. Simple, treated wood poles are recommended for all straight lines up to about 15,000 volts. Double poles and "A" poles should be used for angles, crossings and branch points. An interesting "lyra" steel arm for a three-wire line is described and illustrated which will hold and safely separate the lines even in case the top of the pole should break off. To avoid trouble from birds perching upon the cross-arms slanted steel arms are

recommended. For higher voltages and longer spans structural steel poles are more economical, and may be used up to about 60,000 volts. Above that rating towers will be cheaper, as they permit longer spans. As examples of river crossings nine spans, ranging from 223 m. to 739 m., are tabulated with all their details. The article is well illustrated.—*Siemens Zeitschrift*, February, 1921.

Traction

Arc Welding and Motor Maintenance.—A discussion of arc welding applied to electric railway equipment and a general consideration of motor repairs for this type of service.—*Electric Railway Journal*, March 19, 1921.

Electrification of Main-Line Railways in Relation to Traffic Working.—Philip Nash.—The writer asserts that one of the principal difficulties in forming a fair judgment of the advantages of electrification lies in obtaining true comparisons between steam and electric operation from actual results. He says that in many of the figures available the performance of new up-to-date electrical equipment is compared with steam locomotives designed many years ago. Nearly all electrification, he continues, can be shown to effect a direct saving in money over steam operation, though only in special cases will the direct savings be sufficient to pay interest and depreciation charges on the capital involved and leave any surplus profit. It is thus necessary to depend largely upon the collateral savings and benefits to justify the expenditure involved, and such collateral savings do not invariably accrue to a sufficiently important extent in main-line electrification.—London *Electrician*, March 4, 1921.

Installations, Systems and Appliances

Electric Arc Welding with Two Arcs in Series.—C. A. Bourgeois.—This article outlines a scheme by means of which it is feasible to connect two welding places in series, both being fed from one direct-current generator. Two contactor relays and two substitute resistances are necessary to permit the two welders to operate independently of each other. In case one of the arcs goes out the relays cut into the circuit the substitute resistance, which is short-circuited when both arcs are in play. It is obvious that the two welders must operate their respective arcs with the same current density. Not counting the cost of the generator, the author gives the cost of the complete equipment for two welding places as 2,000 francs.—*L'Electricien*, Feb. 1, 1921.

A New Gas Turbine.—Tests have been resumed at the works of Thyssen & Company with the gas turbine invented by H. Holzwarth, which was built in 1914. The vertical unit, it has been found, will be improved by horizontal construction. Four tests of a 500-hp. turbine of the horizontal type yielded the following results:

Test Number	1	2	3	4
Quantity of gas at 0 deg. C., 760 mm. mercury, meters per hour	300	400	550	660
Quantity of heat admitted, calories per hour	1,150,000	1,530,000	2,110,000	2,415,000
Useful horsepower	77	251	724	984
Heat consumption	16,430	6,090	2,915	2,450
Efficiency, per cent	3.9	10.4	21.8	26

—London *Engineer*, Feb. 11, 1921.

Use of Small Electrically Driven Rock-Drilling Machines.—Theo. Hauber.—The article describes the successful use of a 1-hp. electric rock drill in a tunnel 1,280 m. long. The motor is of the squirrel-cage type, operating over a slip clutch a drill with 500 impulses per minute. Two of these drills were used at a time on one front, power being furnished from a 6-kva., three-phase generator driven by steam.—*Elektrotechnik und Maschinenbau*, Feb. 13, 1921.

Electric Trucks and Industrial Locomotives.—Attention is called to the usefulness of small electric trucks in manufacturing work of all kinds, and the article states that railway companies are utilizing these trucks to an increasing extent for carrying freight on station platforms. Small electric locomotives are employed frequently for the heavier class of service in steel works and similar industries, as well as for haulage work in connection with contracting jobs such as building and drainage. British experience with these devices is dealt with.—London *Engineer*, March 4, 1921.

Electric Melting in Non-Ferrous Industry.—Edwin F. Cone.—Data showing the distribution of electric furnaces of each make according to location, number of furnaces, type of furnaces, capacity in kilowatts, and the character of product. The table gives the results

DATA ON ELECTRIC FURNACE DISTRIBUTION

Type of furnace	No. of Furnaces March 1, 1921	No. of Furnaces March 1, 1920
Ajax-Wyatt	178	118
Baily	82	61
Detroit rocking	57	44
Booth rotating	40	20
Rennerfelt	13	9
H. & H. electric reverberatory	1	..
Snyder	4	7
Von Schlegell	11	..
General Electric	8	..
Ajax-Northrup	11	..
Weeks	1	1
Ludlum	1	1
Greves-Etchells	1	..
Total	408	261

of this analysis, showing the increase in the number of furnaces in use March 1, 1921, compared with March 1, 1920.—*Iron Age*, March 24, 1921.

Electrophysics and Magnetism

Deleterious Effect of Fibers on the Electric Insulating Power of Oils.—Thomas A. McLaughlin.—This article deals with research showing the very serious effect on the insulating value of transformer oil of the presence of fibers from cotton rags or waste used in cleaning containing vessels or otherwise introduced into the apparatus contained in the oil. The author finds the effects to be as serious as those previously reported by Japanese investigators.—London *Electrician*, March 18, 1921.

Structure of the Helium Atom.—Irving Langmuir.—From a study of models for the helium atom the author concludes that Bohr's model is unsatisfactory because it gives too great a value for the ionizing potential and is not in accord with the optical and magnetic properties of helium. The chemical evidence suggests that each electron in an atom has its own separate orbit and that these orbits are closely inter-related. Accordingly two new models are considered: (1) In the double circle model the two electrons are assumed to move in two separate, parallel, circular orbits; (2) in the semicircular model each electron is assumed to oscillate back and forth along an approximately semicircular path in accord with classical mechanics, each being brought to rest at the end of its path by the repulsion of the other. The absolute dimensions of the

model were computed. The total energy comes out less than for the Bohr model, and the ionizing potential, 25.62 volts, agrees closely with the experimental value. —*Physical Review*, March, 1921.

Electrochemistry and Batteries

Copper-Nickel Alloys.—PAUL D. MERICA.—A study of the structure and properties of alloys used for driving bands, condenser tubes and coinage.—*Chemical and Metallurgical Engineering*, March 30, 1921.

Recent Work on Chromium-Tungsten-Steel Methods of Magnetic Analysis.—A description of the methods of magnetic analysis extensively utilized. The work of Japanese investigators is particularly considered. This is the first of a series of articles reviewing the literature on chromium-tungsten steels.—*Chemical and Metallurgical Engineering*, March 30, 1921.

Cost of Nitrogen Fixation in Norway.—T. C. HAGEMANN.—It is said that the object of the paper is not to make an accurate calculation of the cost of construction and working expenses of a plant for the manufacture of nitrates by the electrical oxidation of air, but, taking into consideration the market price of the products, to show that this process is profitable in Norway. For a medium-sized factory of, say, 40,000 kw. the output is estimated at 20,000 tons of HNO_3, the equivalent of 4,500 tons of nitrogen in the form of 29,000 tons Norwegian saltpeter with 13 per cent N and 4,400 tons sodium nitrate with 16.5 per cent N. The raw materials required will be 15,000 tons limestone, 500 tons lime and 2,500 tons soda. For the economical calculation the writer uses Norwegian kroner (1 kr. at normal exchange or parity equals $0.268, at present market $0.18). The market price of the nitrogen as required above is about 3,000 kr. per ton. Total selling price for 4,500 tons is 13,500,000 kr. Approximate running expenses, in kronen, are: Power, 40,000 kw., at 100 kr., 4,000,000; administration and wages, 1,500,000; raw and other materials, 1,100,000; packing, 1,000,000; sundries, 400,000; total, 8,000,000. Balance: 13,500,000 kr. — 8,000,000 kr. = 5,500,000 kr. The investment is estimated to be about 20,000,000 kr., and taking 7½ per cent, or 1,500,000 kr., for amortization, the profit will be about 4,000,000 kr. The cost of energy represents about one-half the total running expenses.—*Chemical and Metallurgical Engineering*, March 23, 1921.

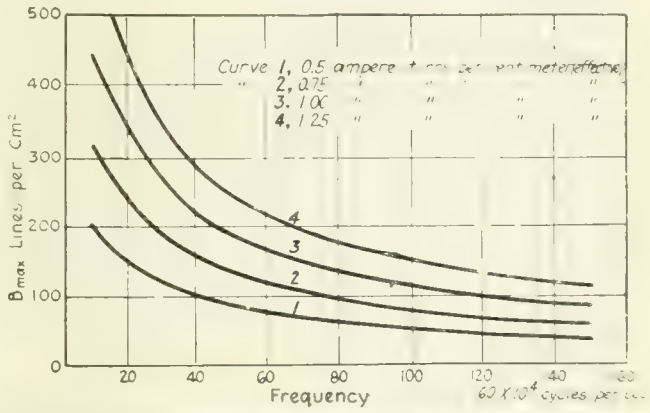
Units, Measurements and Instruments

Measuring Condenser Losses with Electrometer.—M. THIELERS.—In measuring power at a very low power factor—for instance, in determining condenser losses at high voltages—the electrometer may be advantageously employed as a wattmeter. For this purpose the condenser may be connected to the high-tension terminals of a transformer through a standard pure resistor. The midpoint of the transformer secondary is taken to the electrometer needle and the two pairs of quadrants are connected to the terminals of the standard resistance. But for certain terms of correction the deflection of the electrometer then is proportional to the condenser losses. The corrections may be made to vanish by introducing a balancing resistor symmetrically placed with respect to the standard resistor and by connecting the needle to the exact electrical midpoint of the transformer. If certain conditions are not fulfilled and if there is too high a capacity or too high losses in the electrometer considerable errors may enter into the results. After discussing the method, the author states that the electrostatic wattmeter has been successfully used for measurements of condenser losses up to 60,000 volts.—*Teknisk Tidskrift, Elektroteknik*, Vol. L, page 181.

Measuring of Power Factor by a Double Instrument. —W. FUHRMANN.—A kilowattmeter and an ammeter are combined in one instrument so that the pointers of the two cross each other. A number of curves have been drawn between the two scales, and the cross point of the two pointers indicates directly the power factor on the curve nearest to this point. A similar result may be obtained by combining two wattmeters. The instruments are being built by Hartmann and Braun.—*Elektrotechnische Zeitschrift*, Feb. 17, 1921.

Telegraphy, Telephony and Signals

Magnetic Behavior of Iron in Alternating Fields of Frequencies Between 100,000 and 1,500,000 Cycles.—LEON T. WILSON.—Mild steel ribbon, 0.002 in. (0.5 mm.) in thickness, was tested at various radio frequencies between 100,000 and 1,500,000 cycles per second for the relation between ampere-turns per centimeter and flux density and for core loss in watts per cubic



MAGNETIZATION CURVES FOR STEEL AT VERY HIGH FREQUENCY

centimeter at the various frequencies. A vacuum-tube oscillator supplied the necessary current for magnetizing the ring samples of steel. The method of measurement required the development of a precision radio-frequency voltmeter, which is described in detail. Some of the results are shown in the curves.—*Proceedings Institute of Radio Engineers*, February, 1921.

Development of Printing Telegraphy.—J. O. CARR.—The writer gives the historical development of printing telegraphy from the beginning, but confines himself to those systems which have had an influence on the development of systems in use in the United States.—*Journal Western Society of Engineers*, March, 1921.

Miscellaneous

Errors Involved in Solving for Constants of Fourier's Series by Calculation Method.—WARREN MASON.—The author considers (1) sources of error due to measurement of wave forms and due to higher harmonics, (2) error due to formulation of equations, and (3) error due to the assumption that no harmonics above the mth exist. —*Physical Review*, March, 1921.

Federal Power Commission Issues Rules and Regulations.—The first Federal Power Commission, just before relinquishing office, approved twenty rules and regulations to govern the granting of permits and licenses for the development of water power. These are given in full.—*Water Power*, March, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Contractors Blamed for Veto of Iowa Utility Court Bill

AFTER it had passed both houses of the State Legislature, the Governor of Iowa has vetoed the bill providing for a public utility court of appeal. The electric utilities of the state hold the electrical contractors primarily responsible and have threatened to withdraw their support from the contractor-dealer association. This bill, which had the approval of the utilities of the state, created what was called a "court of public service," but which to all intents and purposes was a state utility commission. At the office in New York of the National Association of Electrical Contractors and Dealers it was stated that no information had been received of any action taken by the Iowa State Association.

Under the bill utilities and cities were authorized to fix rates, but in case of disagreement the matter was to be laid before a court of public service consisting of three judges of the Iowa District Court, selected by the Chief Justice of the Supreme Court.

The court was to be empowered to determine on appeal the justness of rates fixed by municipal authorities, and in the event of failure of the city to fix just and reasonable rates was to be empowered to enter an order directing proper action.

In an action brought by a city the court was to be empowered to annul any indeterminate franchise—under which type of charter all utilities were to operate had the bill been signed—when public necessity should require. Either side could appeal from any order of the court to the Supreme Court of Iowa.

Power Commission Proposed for California

THERE is at present in the hands of the committee on government efficiency of the State Senate of California a bill creating a hydro-electric power commission and defining its powers. The proposed commission would not be much unlike the Hydro-Electric Power Commission of Ontario in its powers and would consist of three commissioners, two appointed by the governor and a third, who would be chairman, elected by the municipalities joining in the scheme.

According to the provisions of the act as amended in the California Senate the commission may acquire by purchase, lease or otherwise land, waters, water privileges, water powers, works, machinery, plant, transmission lines and appurtenances and all things necessary for the generation, transmission, storage and distribution of electricity. It may construct, maintain and operate works for that purpose and exercise the power of eminent domain in the name of the state.

The commission is empowered to apply for and obtain in the name of the State of California permits and licenses from the United States under the federal water power act and may enter into an agreement with the United States or with any other state respecting the use and conservation of interstate waters. It may also purchase electricity for distribution and resale.

The act provides for the supply of electricity to municipalities by contract and for the formation of rural syndicates which may also contract for service. The commission shall fix a monthly rate which may be changed at the end of six months, and provision is made for a readjustment of rates each year.

For the purposes of the act the commission is empowered to appoint a secretary and employ engineers, accountants, counsel and necessary assistants. It may also standardize accounting systems, methods, etc. It is felt by some power interests that the act has a chance of passage.

Northwest Superpower Survey Committee Organized

A STUDY of plans for guiding the economic power development of the Northwest, including the hydro-electric resources, is being undertaken by a Superpower Survey committee, which held its organization meeting in Portland, Ore., April 20. The committee plans not to confine its work to any one particular phase of the superpower project, but (a) to make a study and compile data to be available to the public, to capital, to existing and future operating companies, to industry in general and to commercial and legislative bodies, and (b) to further industrial development by an attempt to forecast and indicate such methods of power expansion, development and interconnection as will ultimately prove sound.

The conference had its inception in the Oregon Technical Council, where the need for such a study was keenly realized, and a representative committee has been appointed to undertake the work. Various subcommittees have been appointed to carry out its many phases, and these committees will report to the general committee, which will meet from time to time.

The personnel of the general committee is as follows: D. C. Henny, chairman, and J. C. Stevens, first vice-chairman, Spalding Building, Portland; Prof. C. E. Magnusson, second vice-chairman, University of Washington, Seattle; F. H. Murphy, secretary, Electric Building, Portland; R. M. Boykin, North Coast Power Company, Portland; R. Beeuwkes, Chicago, Milwaukee & St. Paul Railway, Seattle; W. H. Crawford, Portland Chamber of Commerce; E. R. Cunningham, Oregon Electric Railway Company, Portland; Prof. R. H. Dearborn, Oregon Agricultural College, Corvallis, Ore.; J. B. Fisken, Washington Water Power Company, Spokane; J. P. Growden, Skagit River Project, Seattle; F. F. Henshaw, United States Geological Survey, Portland; R. M. Jennings, Douglas County Light & Water Company, Roseburg, Ore.; E. W. Lazell, consulting engineer, Portland; L. T. Merwin, Northwestern Electric Company, Portland; C. P. Osborne, Portland Railway, Light &

Power Company; G. L. Parker, United States Geological Survey, Tacoma; W. M. Shepard, California-Oregon Power Company, San Francisco; G. E. Quinan, Puget Sound Power & Light Company, Seattle; H. H. Schoolfield, Pacific Power & Light Company, Portland; R. U. Steelquist, Mountain States Power Company, Albany, Ore.; W. R. Putnam, Idaho Power Company, Boise, and R. B. Childs, Intermountain Power Company, Seattle.

Georgia Electrical Interests Plan Co-operation

PLANS for a closer organization of and co-operation between the electrical interests of Georgia were discussed at the annual meeting of the Georgia Association of Electrical Contractors and Dealers, held in Atlanta April 22. A special meeting will be held in Macon on May 9 and 10, to which all branches of the electrical industry of the state are invited.

Addresses were made at the meeting by several of the jobbers relative to the need of more aggressive activity on the part of the electrical dealers and of employing experienced salesmen for the purpose of meeting the keen competition from the hardware, department and drug stores that is evidencing itself.

Ohio Public Utilities to Spend Half a Billion During 1921

INDICATIONS so far this year point to further investment of close to half a billion dollars being necessary for the utility companies of Ohio during 1921 to meet the growing demands for additional service made in almost every section of the state. To obtain part of this new capital many companies are encouraging customer ownership.

Ohio public utility companies during 1920 requested the State Public Utilities Commission to authorize them to sell $222,868,000 worth of new securities for the purpose of extending and improving their services to the people of the state, according to figures gathered by the Ohio Committee on Public Utility Information. Of this amount the commission sanctioned the sale of $218,441,134 of new securities.

Big Problems of Business Are Outlined by Commerce Chamber Head

THE ninth annual meeting of the United States Chamber of Commerce started on Wednesday at Atlantic City. President Joseph H. Defrees outlined the various important problems facing industry as a whole, the greatest of which, he stated, was the transportation problem.

Mr. Defrees took occasion to put on record the labor position of the chamber. The organization, he said, has no relation to the open-shop movement. It does, however, stand for the "principle of the open shop in its true integrity." Adequate attention must be given to foreign trade, the speaker said, before the employment problem, or for that matter the entire business situation, can be satisfactorily straightened out.

Other matters touched on were the tariff, which Mr. Defrees asked the chamber to consider in the light of the creditor position of the nation; federal taxation, "government in business," housing, education and immigration.

Larger Construction Program for Byllesby Properties

PLANS have been laid by the Standard Gas & Electric Company, the holding company for the H. M. Byllesby properties, to enter upon a somewhat larger construction program during 1921 than has prevailed in the last few years, all construction work in the recent past having been held down to a minimum. The growth of business in certain communities, the company says in its annual report for 1920, so urgently demands increased plant capacity that it is proposed to develop one hydro-electric station on the Pacific Coast and to enlarge the generating plants in certain other communities. Financial asrangements to cover the enlarged construction program are, it is stated, in the process of consummation.

Gross earnings of the company's subsidiaries amounted in 1920 to $32,352,232, an increase during the year of slightly more than five million dollars. Net earnings amounted to $11,230,741, which is an increase over 1919 of about a million and a quarter.

A. I. E. E. Annual Convention Program

DETAILS of the tentative program of the annual convention of the American Institute of Electrical Engineers, to be held at Salt Lake City, Utah, June 21, 22, 23 and 24, are announced this week as follows:

TUESDAY, JUNE 21.

President's address, by Arthur W. Berresford; technical committee reports; "Hydro-Electric Developments at Niagara Falls," by J. L. Harper, Niagara Falls Power Company; "Modern Developments in Waterwheels," by W. M. White, Allis-Chalmers Company.

WEDNESDAY, JUNE 22

"Economic and Engineering Problems of the 220-Kv. Transmission," by L. E. Imlay, Superpower Survey, New York; "Voltage and Power-Factor Control of 66,000-Volt Transmission Lines Connecting Two Generating Stations," by Raymond Bailey, Philadelphia Electric Company; symposium on long-distance transmission systems, by F. G. Baum, consulting hydro-electric engineer, San Francisco; W. W. Lewis, General Electric Company, Schenectady, N. Y., and L. L. Elden, Edison Electric Illuminating Company of Boston; "Modern Production of Suspension Insulators," by E. H. Fritz, Pittsburgh High-Voltage Insulator Company, and G. I. Gilchrest, Westinghouse Electric & Manufacturing Company.

THURSDAY, JUNE 23

"Voltage and Current Harmonics Caused by Corona," by F. W. Peek, Jr., General Electric Company, Pittsfield, Mass.; "A Solution of the Porcelain Insulator Problem," by E. E. F. Creighton, General Electric Company, Schenectady, N. Y., and F. L. Hunt, Turner's Falls Power & Electric Company; "Transformers for Interconnecting High-Voltage Systems or for Feeding Synchronous Condensers from a Tertiary Winding," by J. F. Peters and M. E. Skinner, both of Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; "Electric Strength of Air Under Continuous Potentials and as Influenced by Temperature," by J. B. Whitehead and F. W. Lee, both of Johns Hopkins University, Baltimore.

FRIDAY, JUNE 24

"Synchronous Motors for Ship Propulsion," by E. S. Henningsen, General Electric Company, Schenectady, N. Y.; "Magnetic Properties of Compressed Powdered Iron," by Buckner Speed and G. W. Elmen, both of Western Electric Company, New York; "Heat Losses in Conductors in Alternating-Current Machines," by W. V. Lyon, Massachusetts Institute of Technology.

Philadelphia Electric to Issue $5,000,000 More Preferred Stock

HOLDERS of common stock of the Philadelphia Electric Company will have an opportunity to subscribe to $5,000,000 of 8 per cent preferred stock at par. This is part of the $15,000,000 authorized last September, $6,000,000 of which has already been issued.

President McCall in his annual report for 1920, issued last week, said that there are now 12,731 holders of the company's common stock, 6,668 preferred stock holders and 12,738 bond and note holders.

The company's 1920 operating revenue amounted to $19,734,234.57, as compared with $16,014,256.65 in 1919. Expenses, however, were sufficient to absorb virtually all of this increase, for the 1920 operating income was $5,066,095.35, against $4,979,082.13 in 1919.

Municipal Ownership Inquiry at Boston

UPON motion of Councilor Watson, the Boston City Council voted Monday to authorize an investigation by its executive committee of the feasibility of the establishment by the city of a gas or an electric lighting plant. Very little popular interest in the matter is apparent at present, and the movement is chiefly sponsored by the sensational press. The Cambridge (Mass.) City Council has passed a vote favorable to the taking over by the city of the local electric lighting supply, but the vote has slight significance in view of similar action having been taken at odd times in the past apparently for its effect on the political fortune of the members of the Council. Under the Massachusetts law, to bring about municipal ownership a favorable vote must be had in two consecutive years and followed by a popular referendum, and unless all three steps are taken in order, municipal ownership cannot be instituted in a city or town already served by a utility.

Program for Contractor-Dealers' Convention July 18-23

FOR the twenty-first annual meeting of the National Association of Electrical Contractors and Dealers, to be held in Buffalo, N. Y., July 18 to 23, at the Lafayette Hotel, the following tentative program is announced:

Monday, July 18.—National executive committee meetings at 10 a.m. and 2 p.m., registration bureau opens at 4 p.m.

Tuesday, July 19.—National executive committee meeting at 10 a.m. and 2 p.m.

Wednesday, July 20.—Convention sessions at 10 a.m. and 2 p.m. in ballroom; opening address, E. D. McCarthy, Buffalo, chairman local convention committee; address of welcome, Mayor of Buffalo; response, James R. Strong, New York City, chairman National Association; historical address, Charles L. Eidlitz, New York City, first president of National Association; address, "The Business Outlook," speaker to be announced later; reception and dance at 8 p.m. in ballroom.

Thursday, July 21.—Convention sessions at 10 a.m. and 2 p.m.; "What a Trade Association Can Do and What Some Are Doing," by Charles S. Estey, Chicago; "Cost Data on Installation Work," by Kenneth A. McIntyre, Trenton; "Capitalizing Your Opportunities," by W. L. Goodwin, New York; annual dinner at 8 p.m.

Friday, July 22.—Convention session at 10 a.m.; "Financing for the Contractor Dealer," by Alfred J. Martin, South Bend, Ind.; "The Conduct of a Contracting Business," by M. H. Johnson, Utica, N. Y.; trip to Niagara Falls in special trolley cars at 2 p.m.; trip over Gorge Route at Niagara Falls and visit to power house.

Saturday, July 23.—Meeting of national executive committee at 10 a.m.

Full details of the entertainment for ladies accompanying delegates are not completed. An automobile trip and a river trip have, however, been arranged.

New Interpretation Given to the Term "Navigable Streams"

A DECISION that has possibilities of affecting future development of water powers or streams not now thought of as navigable was made by the United States Supreme Court in the fight of the federal government to prevent the Economy Light & Power Company, now controlled by the Public Service Company of Northern Illinois, from constructing a dam across the Desplaines River near Joliet, Ill. The construction of the dam was undertaken and was resisted by the government. The Supreme Court in affirming the decisions of the lower courts based its finding largely on the fact that the stream in its natural condition had been navigated by early French explorers, fur traders and settlers in canoes and other light craft. That the stream has not been so used for a century was held as of no effect. The decision says in part: "We concur in the opinion of the Circuit Court of Appeals that a river having actual navigable capacity in its natural state and capable of carrying commerce among the states is within the power of Congress to preserve for purposes of future transportation, even though it be not at present used for such commerce and be incapable of such use according to present methods either by reason of changed conditions or because of artificial obstruction.

"We agree that the provisions of Section 9 of the act of 1899 apply to such a stream. The act in terms applies to any navigable river or other navigable water of the United States, and without doing violence to its manifest purpose we cannot limit its prohibition to such navigable waters as were at the time of its passage or are now actually open for use.

The Desplaines River after being of practical service as a highway of commerce for a century and a half fell into disuse partly through changes in its own condition, partly as a result of artificial obstructions. In consequence it has been out of use for one hundred years, but one hundred years is a brief space in the life of a nation; improvements in the methods of water transportation or increased cost in other methods of transportation may restore the usefulness of this stream.

New York Legislature Authorizes Fight on Federal Water-Power Control

BEFORE adjournment the New York State Legislature passed the following resolution, which is expected to bring before the courts for review the question of states' rights in connection with the federal water-power law:

Whereas the federal government has by the act of Aug. 8, 1917, assumed jurisdiction over the water powers of this state in common with other states and is now assuming to act in relation to the disposition of the same for national purposes to the exclusion of the state; and

Whereas such water power belongs to the State of New York and to its citizens, subject only to the right of the federal government to control navigation, and the federal government is not vested by the Constitution with any right or power to control over water power; and

Whereas such water power and the right of control over the same are of great value to the people of the state for public use for heat and power as a course of commercial

development and revenue to the state, of which they will be deprived under said law by the action of the federal government;

Now therefore be it resolved, That the Attorney-General of this state be and he hereby is authorized to take such action as he may be advised in the premises for the effectual protection of the interests of this state and that he is further authorized to co-operate with the duly constituted authorities of other states to the same end.

New York State Water-Power Measure Passed by Legislature

NEW YORK'S water-power measure, providing for the development of the state's water-power resources, was passed by the Legislature and is now before Governor Miller for his signature. That the bill will become a law seems certain as it had the Governor's approval and support when introduced.

This bill provides, as stated in the ELECTRICAL WORLD of March 26, page 728, for a commission of five to have charge of the leasing of the state's water power along the lines of the federal water-power bill. Licenses will be granted by the commission to permit of the diversion and use for power or other purposes of the waters of the state in which the state has a proprietary right or of boundary waters over which the state has jurisdiction. The commission will have power to issue a license for a period of fifty years and is to accord preference to the applicant whose plans are best adapted properly to develop, conserve and utilize the water power of the watershed, stream or locality.

Line Extension Rules for Northwest Being Formulated

THE governing committees of the commercial and technical sections of the Northwest Electric Light & Power Association held a joint meeting in Portland, Ore., on April 22 for the purpose of formulating a set of standard rules and regulations to govern line extensions to be adopted by the electrical utilities in the Northwest. It is not expected that the committee will make a report of its findings before the convention of the association, which will be held in Portland in June.

Kansas City Electrical Show Successful

WITH a total of nearly 75,000 admissions, Kansas City closed its electrical show on Saturday night last. There were 115 exhibitors. The exhibits covered not only household and similar appliances, but power equipment for industrial uses, transmission and distribution line equipment and virtually every device except heavy electrical equipment and that for power-house purposes.

A notable feature was the exhibit from the trade and domestic science departments of the public schools. In the trade section electrically driven woodworking, printing and wireless-telegraph equipment installed by the students was in constant operation. The domestic science department had ranges, refrigeration and other kitchen equipment and a complete sewing room in operation.

The general illumination of the convention hall area was a feature that attracted a great deal of comment. This lighting, for which Manager Furst was responsible, was laid out for 15 foot-candles on the lighting plane and 16 foot-candles was actually secured. Eighty 1,000-watt "tip-up burning" lamps were used in inverted-bowl reflectors to provide the illumination, which was indirect.

The Kansas City Power & Light Company had a booth that attracted a great deal of attention and presented a display valuable from an educational standpoint. A number of novel electrical "stunts" helped to entertain the spectators. These were placed against a background of all sorts of electrical equipment, including meters, line materials, a section of 33-kv. line construction and a large oil circuit breaker, equipped for operation and used for demonstration purposes. Household and industrial appliances were avoided, and the exhibit was confined to equipment used in rendering service.

One feature of the show was the absence of the commercial concessions ordinarily seen. Even the giving away of advertising novelties or anything of a like nature was forbidden. The show was conducted in cooperation by the electrical interests of Kansas City. The management gave its services voluntarily.

Italian Commission Here to Study Railway and Industrial Electrification

THE Italian Commission on American Railway and Industrial Electrification arrived on the steamship Lorraine Monday, April 25. The commission consists of Guido Semenza, consulting engineer and past-president of the Associazione Elettrotecnica Italiana and



THE ITALIAN MISSION JUST BEFORE DISEMBARKING, READING LEFT TO RIGHT, PROF. G. G. PONTI, G. SEMENZA, MRS. PONTI AND COL. C. SCARELLI

honorary secretary of the American Institute of Electrical Engineers, as chairman; G. G. Ponti, professor at Turin University and general manager of the Società Idroelettrica Piemonte ed Elettricita Alta Italia, and Col. Cesare Scarelli, delegate from the Italian War Office. Two other members are expected, Marquis F. Cusani, delegate from Italian industries, and a delegate from electric traction services, Italian State Railways.

Italy is planning to electrify about 5,000 miles of her railways, and the commission has been sent to America to study the systems of railway electrification here. It is the intention of the commission to visit the more important developments in this country, including power generation and transmission, railway electrification and application of electricity to industries. The commission will remain in the United States for about two and a half months and will cover the principal towns of the Eastern, Central and Western States.

Pennsylvania Power & Light to Add 20,000-Kw. Unit

ADDITIONAL generating capacity will be added by the Pennsylvania Power & Light Company by the installation of a new 20,000-kw. unit at its Hauto plant. Plans are also under consideration for increasing the capacity of this company's Harwood plant by replacing a 4,000-kw. unit with one rated at 12,500 kw. Work on the new unit at the Hauto plant will be started at once and if possible completed within the present year. This installation, together with that of 12,500 kw. at the Harwood plant, if made, will give the Pennsylvania Power & Light Company a total generating capacity of 112,150 kw.

For the past few years this company has been unable to keep pace with the demand for power in its territory. The additional capacity is expected to meet only the requests for power which the company has formerly been compelled to refuse and does not provide any surplus of unsold capacity.

Missouri Convention Discusses Valuation

PRESENT-DAY value as a basis for rate making was the subject of considerable difference of opinion before the Missouri Association of Public Utilities at Kansas City on Thursday of last week. R. A. Brown, attorney for the St. Joseph Railway, Light, Heat & Power Company, presented a review of court decisions and an argument for the present-day cost basis. The difference of opinion was less in evidence in the formal discussion than in the comment exchanged informally among those in attendance after the session in which the paper was presented. This informal discussion brought out a very strong feeling that before the problem could be solved some other basis of valuation and return that would recognize other factors essential to the success of the utility business must be recognized.

The rural-service problem came in for the usual share of attention when N. T. Wilcox of Keokuk, Iowa, presented a strong statement of the cost of service, showing that in some cases this cost could run as high as $50 per month. This possibility exists in a territory where the farms average about 160 acres and small communities are not included in the service. The importance of putting the business on a basis where good service could be rendered and the necessity of substantial line construction were strongly stressed by Mr. Wilcox. Mr. Wilcox asserted that the mistake made by the average company is lack of appreciation that the service has a definite value as one that must be sold on a service and not a kilowatt-hour basis.

H. H. Kahn of Kansas City discussed the "Concentration of Generating Equipment at Centers of Economical Production and Transmission," pointing out the possibility of a superpower district including Missouri, Kansas and Arkansas.

Dean McCaustland of the School of Engineering, University of Missouri, discussed the relation of engineering education to industry, citing engineering education as the foundation stone of American industry.

President Martin J. Insull of the National Electric Light Association addressed the joint meeting of the Kansas and Missouri associations on Thursday, outlining the work of his association and urging the necessity of creating better public relations.

The officers for the coming year are: President, H. Spoehrer, St. Louis; first vice-president, E. R. Locke, Mexico; second vice-president, E. C. Deal, Springfield; third vice-president, H. C. Blackwell, Kansas City; secretary and treasurer, F. D. Beardslee, St. Louis; executive committee, L. P. Andrews of Sedalia, J. D. Von Maur of St. Louis and L. B. Landman of Jefferson City.

Those in attendance were taken through the 75,000-kva. Northeast powerhouse of the Kansas City Power & Light Company on Saturday.

"Build Business for the Long Run," Says L. H. Parker

THAT the present is a time to lay firm foundations for future business both in this country and abroad is the opinion of L. H. Parker, president Spray Engineering Company, Boston, who has recently returned from an eleven weeks' trip to the British Isles, France, Italy, Switzerland, Belgium and Holland. The object of Mr. Parker's trip was to investigate the overseas situation as regards the marketing of his company's products. Six weeks were spent in London and Paris.



LEE H. PARKER

To a representative of the ELECTRICAL WORLD Mr. Parker declared that the deflation process resulting from the war appears to be making steady progress throughout both Europe and America, and that as this is gradually accomplished business conditions must improve. The resumption of better business in Europe hinges largely upon Germany's paying the reparations demanded.

The building of trade for the long run instead of for immediate quick profits is receiving much attention on the other side, and Mr. Parker said that the pursuance of the former policy to a greater extent in this country would be most wise. Contrary to press reports, Mr. Parker found popular sentiment very friendly to America in the countries visited, and a better understanding of America's international position and aims appears to be gaining ground. At all times, he feels, it is a good plan to undertake preliminary work looking toward the development of export trade from the United States. Considerable interest in steam railroad electrification is being manifested in Italy, France and Holland, and large purchases of electrical and allied apparatus seem destined to be made.

The outlook for this country, Mr. Parker stated, is optimistic. Deflation has made good progress since he left for Europe late in December, and a better feeling in trade is now apparent. The people in the foreign countries visited are tired of fighting and revolutionary agitation, and ex-service men overseas as well as here are exerting a stabilizing influence. Disturbing as is the exchange situation, it is gradually yielding to the

deflation process. The great natural resources of the United States, the readiness of its factories for mass production, our ample supply of man power, the high intelligence of our population and our far greater use of modern methods augur well for the future development of the country, gradual though the resumption of normal conditions must be because of the immense burdens imposed by the war.

Theoretical Engineer Has Important Function, New York Men Hold

THAT there is an important place in the profession for the "theoretical" or research type of engineer appeared to be the consensus of opinion brought out at a joint meeting of the New York Section, A. I. E. E., and the Metropolitan Section, A. S. M. E., held on April 22. Regarding the training of these men who are chiefly responsible for the revolutionary developments in the science of engineering, however, there appeared to be considerable difference of opinion.

Prof. Comfort A. Adams, chairman Engineering Division, National Research Council, presided, and in introducing the speakers indicated the two general schemes of engineering education in which (1) the fundamentals are emphasized and (2) a large number of facts are given. Teaching of fundamentals he considered right and the other method superficial. Prof. Walter Rautenstrauch of Columbia University believed that progress would be relatively slow were it not for the engineer of high theoretical attainments In engineering teaching he believed that quality should be emphasized and that students should be encouraged to express themselves in clear English rather than by formula.

Dean Frederic L. Bishop, University of Pittsburgh, said that no university in the country is adequately equipped to train the theoretical engineer, although several of them are developing research work to an encouraging extent. He quoted data that have recently been gathered showing that high scholastic standing is of greater importance to the engineering student than has commonly been acknowledged. Records show that most eminent engineers of today stood high in scholarship as undergraduates. C. R. Dooley, manager personnel and training Standard Oil Company of New Jersey, believed that the best results can be obtained by encouraging whatever talents engineering students possess.

It was announced at this meeting that Farley Osgood, vice-president and general manager Public Service Electric Company of New Jersey, had been elected section chairman and Harlan A. Pratt secretary.

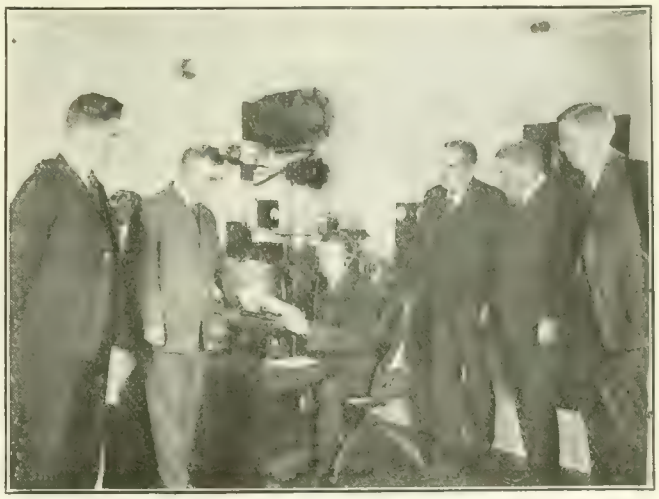
President of Houston Company Proposes Guaranty Fund and Lower Rates

THE president of the Houston (Tex.) Lighting & Power Company, Edwin B Parker, has publicly declared in favor of a plan by which the surplus profits now divided between the city and the company will be devoted to the creation of a guaranty fund, to be followed by the reduction of rates as far as practicable to yield an 8 per cent return on the company's investment, any deficiency to be made up from the fund. Mr. Parker said that since 1914 the company had paid out nearly $2,000,000 in cash in additions and betterments to keep pace with Houston's growth. This, he said, had been made possible by passing the dividends of the company and devoting these sums, together with the company's share of the surplus earnings, to such betterments and additions, while continuing to pay the city its share of profits under the agreement.

Business Conditions Getting Better

BUSINESS conditions throughout the country are getting better. This is indicated by a distinct gain for March over February in the volume of distribution by jobbers and retailers, according to Archer Wall Douglas, chairman of the committee on statistics and standards of the Chamber of Commerce of the United States. The whole tone of Mr. Douglas' report is optimistic. He points out many signs as indicative of an improvement in the situation and as tending to foreshadow a return to more settled and stable conditions. Among these signs are a resumption of operations in a modest way by some automobile factories which were shut down but which now have orders in hand, a better demand for lumber and prepared roofing and paint because of somewhat more building and construction, the unusually fine crop conditions of winter wheat, and the fact that the farmer, while economizing on some things, is also buying somewhat more freely, especially in the grain region, which Mr. Douglas holds to be a healthy sign, for the genuine beginning of better times is likely to come in agricultural rather than industrial life.

Department Heads Send First Messages from New Post Office Radio Station



THE big new radio station in the Post Office Department to be used in connection with the air-mail service was formally opened April 22 in the presence of Postmaster-General Hays, Secretary of Agriculture Wallace and officials of the Post Office and Agricultural Departments. These two departments will co-operate in the distribution of a national radio marketgram service by the use of the various air-mail radio stations. The air-mail service has major raido stations at Washington, D. C.; Bellefonte, Pa.; St. Louis, Mo., and Omaha, Neb. With these stations and the fifteen minor radio stations operated by the service, together with more than 6,000 licensed amateur operators almost every farmer will be able to receive each day market reports.

Those in the picture, reading left to right, are J. C. Edgerton, chief of the air-mail radio service; Secretary of Agriculture Wallace, Postmaster-General Hays, Charles F. Marvin, chief of the Weather Bureau; Dr. S W Stratton, Bureau of Standards, and W. A. Wheeler, director of markets.

Revised Edition of "Electrical Salesman's Handbook" Soon Ready

INSTEAD of being issued at one time as a complete loose-leaf book, the N. E. L. A. "Electrical Salesman's Handbook" is being thoroughly revised and each section will be published in a separate flexible card cover. Two of these sections, one on "Industrial Lighting" and the other on "Lamp Equipment for Commercial and Industrial Lighting," are now on the press and can be ordered.

The revised handbooks are to be sold instead of given away. However, the prices, it is stated, will only cover the cost of printing and distributing. The price of the sections now being printed is 50 cents a copy.

Electrochemical Society Forms Division on Electrothermics

AT THE thirty-ninth general meeting of the American Electrochemical Society held in Atlantic City April 21 to 23 there were three technical sessions, one on "Arc Welding and Electric Furnaces," another on "Electrolytic Products and Cells," and a third on "Corrosion."

O. H. Escholz presented a detailed account of a study of the "Phenomena of Arc Welding," which was illustrated by lantern slides. In the discussion of this paper the importance of protecting the operator was emphasized and the use of automatic welders wherever possible in order to eliminate the personal factor was recommended.

In a paper, "Electric Furnaces for Non-Ferrous Metals," H. W. Gillett of the United States Bureau of Mines gave a detailed summary of all the electric furnaces in operation in the United States melting nonferrous metals. It was brought out that electrometallurgy has made great strides in the last five years and the electric furnace has been firmly established in th brass and bronze industries.

Dr. Carl Hering in a paper, the "Electro-Dynamic Forces in Electric Furnaces," described the various "effects" met with in the operation of electric furnaces.

Dr. E. F. Northrup presented a paper on "Recent Progress in High Frequency Inductive Heating," pointing out that so far only star connection was found practicable as the delta connection does not work properly. In this type of furnace he stated that he has melted fairly large quantities of very high melting alloy composed of tungsten, osmium and a little nickel.

"Regulation of Electric Steel Arc Furnaces Using Movable Electrodes" was the topic of a paper by W. G. Mylius. B. S. Cushman presented a paper by T. W. Case on the "Photo-Electric Effect in Audion Bulbs of the Oxide Coated Filament Type."

At the business session on Thursday of the society the board of directors sanctioned the formation of a division on electrothermics which will include all those members interested in electric furnaces, electric steel, electric brass refractories, electrodes, regulators, heat treating apparatus, etc. Acheson Smith is chairman of the new division. Regarding the formation of a division on electrodeposition a committee of three, consisting of William Blum, George B. Hogaboom and H. S. Lukens, was appointed to ascertain whether such a division would meet with the necessary support and encouragement.

At the annual business meeting on Friday the following officers were elected: President, Acheson Smith; vice-presidents, Charles L. Burgess, C. G. Schluederberg and E. L. Crosby; managers, Carl Hering, J. V. N. Dorr, F. A. J. Fitzgerald, and secretary, Joseph W. Richards.

The place of meeting in the fall was definitely fixed as Lake Placid, N. Y., Sept. 28 to Oct. 1, at which time a session on Non-Ferrous Electro-Metallurgy and a session on Electrodeposition will be held. At the spring meeting, 1922, a session will be devoted to Electric Furnace Cast Iron.

Arkansas Utility Men Arrange Program

PLANS have been completed for the holding of the convention of the Arkansas Utilities Association at Hot Springs, Ark., May 11 and 12. The program as tentatively arranged is as follows:

WEDNESDAY, MAY 11

Morning Session.—Registration; address of welcome, Mayor, Hot Springs National Park; response, H. C. Couch, president Arkansas Light & Power Company, Pine Bluff; address of president, C. J. Griffith, Little Rock; report of secretary and treasurer, W. J. Tharp, Little Rock; report of executive committee, C. J. Griffith, Little Rock; report of committee on taxation.

Afternoon Session.—Paper by representative of telephone company; "Efficient Fuel Combustion," by W. G. Shurgar, combustion engineer Little Rock Railway & Electric Company.

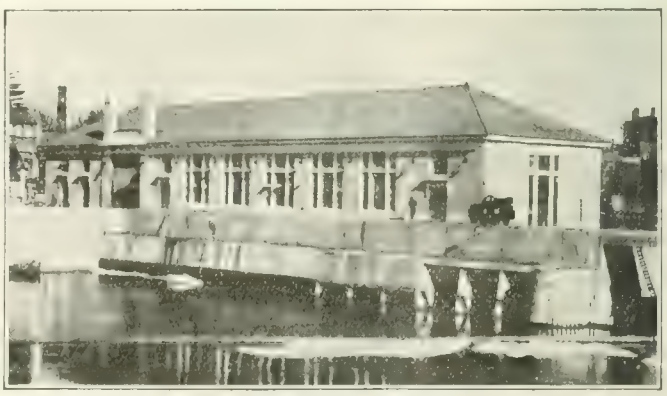
THURSDAY, MAY 12

Morning Session.—"The Value of Pure Water," by M. J. Blair, chief sanitary engineer State Board of Health, Little Rock; "Publicity," by A. G. Whidden, advertising manager Arkansas Light & Power Company, Pine Bluff; "Inductive Interference," by W. J. Canada, engineer National Electric Light Association.

Afternoon Session.—Joint meeting class A and class B members; "Merchandising," paper by a class B member.

The convention will be immediately followed by that of the Southwestern Geographic Division of the N. E. L. A., to be held May 13 and 14 at Hot Springs.

Central Maine Power Completes New Hydro Plant



IN THIRTEEN months from the time it was started the Skowhegan hydro-electric plant of the Central Maine Power Company was completed. The plant operates under a 32-ft. head and has an initial installation of three 4,250-hp. units.

There is room in the plant for another similar unit, and provision is made for extending the plant in case a fifth unit is desired

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Hydro-Electric Development in North Carolina.—Eight hydro-electric plants, developing a total of more than 3,000 hp., have been placed in operation or will be running inside of ninety days in the neighborhood of Hickory, N. C., according to the president of the construction company, as quoted in the *Manufacturers' Record*. Two plants are now being completed in Alexander County, and in Little River, 10 miles from Hickory, one of the largest of the light plants is nearly finished. Lower down on the same river the North State Cotton Mills Company is building a 200-hp. plant. Other developments in the near future are contemplated in Burke and Catawba Counties.

Idaho Power Company Rates.—Valuation proceedings in order to fix rates for the Idaho Power Company have opened before the Idaho Public Utilities Commission at Boise. The report presented by the company's valuation engineer fills thirty-seven large volumes, and an indefinite continuation of the case was taken to give the commission time to examine it. A recent order of the commission authorized the power company to pay to the city in yearly installments the sum of $35,594.73, being the amount of the franchise tax due on account of the Beaver Dam Light & Power Company. The order also allowed the company to file a schedule of rates with the commission to reimburse it for this tax. The city has agreed to an extension of the time within which the company must comply with this order, but it objects to the filing of new rates.

The Radio Megaphone.—Interesting facts concerning the radio megaphone developed and arranged by Prof. Alfred N. Goldsmith of the College of the City of New York are printed in the *Wireless Age*, which says this instrument is the result of fourteen years of diligent research in the college's department of electrical engineering, no claim to invention of the apparatus being made by Professor Goldsmith. The new amplifier, the *Wireless Age* says, is distinguished from others by its extreme sensitiveness, its reliability, the high power of its amplification, the evenness and clearness of its tones and its ability to receive from long distances. With it messages passing between Nauen, Germany, and New Brunswick, N. J., Stavanger, Norway, and Marion, Mass., Lyons, France, and Tuckerton, N. J., Carnarvon, Wales, and New Brunswick, N. J., are heard at the college station with great distinctness. A commercial advantage of the apparatus is that by its use the cumbersome head harness worn by wireless operators becomes unnecessary.

"Hydro Municipalities" in Ontario.—In this department on April 16 a list of the "hydro municipalities" of the Province of Ontario was given with what purported to be the horsepower output of each. The engineering department of the Hydro-Electric Power Commission of Ontario calls attention to the fact that the figures as printed were erroneous, they being population figures and having no relation to either domestic consumers or power supplied.

Prospects of Railroad Electrification in England.—It is reported on what the *Electrical Times* of London says looks like good authority that the North Eastern Railway of England is about to start a long-projected electrification of its main line between Newcastle and Darlington, a distance of about 35 miles. Uncertainty of the action that may be taken by Parliament holds back virtually all schemes for railroad electrification in Great Britain, but the North Eastern line is said to be in a particularly favorable condition as regards absence of competition and relatively dense traffic, nor is it threatened with serious interference by "grouping" proposals.

Electric Iron Smelting in Sweden Gets Setback.—A serious blow has, according to London *Engineering*, been dealt to the electric iron smelting industry in Sweden by the stoppage of the Porjus iron works. They were started in 1916 and from a technical point of view had been entirely successful, the cost of production being reduced. The expenditure for plant extensions, however, far exceeded the estimates and the capital proved insufficient, while prices of the product fell and demand dwindled. Last year's output of pig iron was only 12,500 tons, despite a large foreign market. A department for alloys which had been in operation only a short period had employed a staff of expert engineers.

The Queenston Hydro-Electric Plant.—It has now been officially announced that the Queenston-Chippawa development of the Ontario Hydro-Electric Power Commission will undoubtedly be ready to deliver power by next September. This power will probably be sold upon a basis of approximately $10 per horsepower at the generating station. The government's estimate that the total cost of the development will be about $55,000,000 is figured on the basis of 500,000 hp., or $110 per horsepower. It will be necessary for Canada to obtain permission to divert more water from Niagara Falls in order to operate the Queenston plant to full capacity if the other plants on the Canadian side of the Niagara River are also to be operated, and to this end negotiations will have to be opened with the United States. Estimates for capital expenditures by the Ontario Hydro-Electric Power Commission for the current year total $36,937,000, of which $26,700,000 is for the Queenston-Chippawa plant.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New Orleans Electrical Men Organize.—A hundred representatives of the electrical industry in New Orleans met recently and organized an association for the advancement of electrical interests in that city. Leo Hirsch, president and general manager of the Electrical Supply Company, was chosen president; T. V. Sharp was made vice-president, and F. H. Ames, secretary and treasurer of the Gulf States Electrical Company, was elected secretary-treasurer.

O. E. L A. Holds Meter Conference.—A meter conference under the auspices of the Ohio Electric Light Association was held at Cincinnati on April 22 and 23. Problems in power-factor measurement were discussed by B. F. Cleaves of Altoona, Pa.; J. C. Langdell of Jackson, Mich., and Mr. Currier of Philadelphia. Meter department activities were dealt with by C. M. Goldberg of Cincinnati. A. S. Yard and J. R. West told of interconnection metering on the Windsor system, D. J. Angus discussed the design of graphic instruments, and William Hubbell presented a paper on meter-board construction.

Coming Meetings of Electrical and Other Technical Societies

A. I. E. E. Section Meeting—Vancouver, B. C., May 6.

A. I. and S. E. E. Section Meetings—Philadelphia, May 7; Cleveland, May 9.

American Association of Engineers—Buffalo, May 9-11.

Society for Electrical Development Annual Meeting—New York, May 10.

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

A. I. E. E. Annual Meeting—New York, May 20.

American Society of Mechanical Engineers—Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

California State Association of Electrical Contractors and Dealers—Santa Cruz June 16-18.

A. I. E. E. Annual Convention—Salt Lak City, June 20-25.

National District Heating Association—Cedar Point, Ohio, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Toronto, June 28.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Reproduction Cost New Not Now a Reasonable Basis for Rates.—Fixing the rate base of the Southern California Edison Company at $94,075,000, the California Railroad Commission said: "Without question, to construct the plants now in existence under conditions of labor and material costs during the past year would result in a much greater figure than the investment. The commission, however, does not hesitate to state that reproduction cost new or reproduction cost depreciated based upon price conditions existing during 1919, 1920 and 1921 is not a reasonable basis for rate-fixing purposes except in so far as it applies to those portions of the properties that were of necessity constructed during the period of high prices."

Montana Commission Holds that Tide Has Turned.—A recent pronouncement from the Montana Public Service Commission declaring that while the policy of granting rate increases had already justified itself by preserving intact for better times services which must have been exhausted without this relief went on to say: "There is a most definite turn in the tide of financial affairs today, however, a turn consequent on the general effort at reconstruction, and we should fail in our duty if we did not recognize it now. The solution of fundamental problems can no longer be deferred, nor the demands of patient but weary consumers further ignored. Reconstruction has as definite an application to public utility affairs as it has to any other incidents of commercial or industrial life."

Every Division of a Joint Public Service Company Must Stand on Its Own Feet.—The principle that the owners of a utility furnishing more than one kind of service must not make up a deficiency in one branch by revenues derived from another received further indorsement when, in applying it to the Elmira Water, Light & Railway Company, the New York Public Service Commission for the Second District said: "The city very well argues that if the rule contended for by the company were in force a paying utility in any community might acquire another utility of a different nature which was non-remunerative and on account only of a combination of ownership become entitled to place upon the customers of the prosperous utility the burden of paying the cost of operation and also yielding a profit upon the unsuccessful utility, in which they might have little or no interest."

Emergency Relief Not Always Justified.—According to views expressed by the Public Utilities Commission of Connecticut in hearing a complaint made by the city of Meriden against the Meriden Gas Light Company, a public utility company which has declared extra dividends and has paid a large return on the value of the property during prosperous years and has set aside a substantial depreciation reserve fund and accumulated a large surplus account will not be allowed emergency relief in that state until after it has drawn upon such surplus to meet deficiencies in current operating revenue. The commission refused to accept the theory that surplus accumulated from operating revenues has no bearing on the question of rates and that patrons have no interest in the surplus or in surplus earnings.

Return to Normal Water Conditions Brings Reduction in Agricultural Rates.—The California Railroad Commission has made a temporary order, pending valuation proceedings, which will, it is estimated, result in an average reduction of approximately 5 per cent in the San Joaquin Light & Power Corporation's revenue from agricultural service, based on what the commission holds to be a return to virtually normal water conditions on the company's system. The new schedule is a combination of an energy and a demand-and-energy rate, and by it consumers who use energy for short periods only will pay increased rates, while those operating continuously from eight to twelve months will pay rates materially less than they have been doing. The commission disagreed with the contention that a reduction in earnings would prevent the flotation of additional bonds and thus put a stop to the company's construction work.

Relation Between Rates and the Ability to Command New Capital.—In its decision on the rates to be allowed the Southern California Edison Company (see issue for April 16, page 898) the California Railroad Commission said: "The commission fully appreciates the interrelation between the earnings of a utility and its ability to command new capital from investors to provide the facilities required by the growing demands of its business and its obligation to the public. This does not mean, however, that the commission will permit applicant or any other utility to charge in excess of a reasonable rate in order that additional capital can be secured. No measure of earnings can be approved by a body such as this commission, charged with the protection of the public interest, which does not result, for equal benefits, in a rate as low as or lower than the rate which would be fixed upon the standard accepted basis of a fair return upon the reasonable value of the utility properties. In this, therefore, as in other rate-fixing proceedings, the primary consideration is a fair return upon the properties used and useful in the public service."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Only Condition Under Which Commission's Findings of Fact May Be Set Aside.—Findings of fact by the Public Service Commission, declared the New York Supreme Court, Appellate Division in People ex rel. New York Central Railroad Company vs. New York Public Service Commission, Second District, cannot be disturbed by the court in proceedings to review an order of the commission unless the finding is such as in a case tried or triable by a jury would be set aside by a court as against the weight of evidence. (187 N. Y. S. 24.)*

District of Columbia Consumers Cannot Claim Equal Treatment with Government.—A bill in equity filed in the United States Supreme Court (Hollis vs. Kutz) sought to have an increase in gas rates to consumers in the District of Columbia declared void, the main contention being that in raising rates the Public Utilities Commission had not applied the increase to the United States government and the District administration. This contention was declared without merit by the court, the government having the power to fix the price for its own needs as a condition to allowing the establishment of the business in the District of Columbia. (41 S. C. R. 371.)

City May Proceed Under Public Utilities Law Instead of Under Franchise Provisions in Acquiring Plant.—The city of Superior, Wis., having determined to take over the waterworks of the Superior Water, Light & Power Company pursuant to franchise provisions, the company named brought suit against the city for not proceeding in the manner specified in the contract instead of under the provisions of the public utility law in arriving at a just compensation. The Wisconsin Supreme Court has refused to entertain the plea, holding that the method followed by the city is proper, all property being held subject to the right of the state to acquire it for public purposes whenever it may see fit to do so; that the law under which the city is proceeding assures the water company adequate compensation, and that it is to be assumed that that is all a valuation according to the provisions of the contract would give it. If the contrary were assumed, the question would arise whether a court of equity should decree the specific performance of the agreement. (181 N. W. 113.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

E. P. Edwards, who has been assistant manager of the lighting department of the General Electric Company for a number of years, has been made responsible for the radio activities of the company. His duties will include immediate supervision of radio engineering, manufacturing and selling, negotiations with the Radio Corporation of America and other companies and general directing of the efforts of the company in the field of radio communication. Mr. Edwards has been connected with the General Electric Company since 1899. He was born in Louisville, Ky., and after graduation from the Rose Polytechnic Institute, Terre Haute, Ind., in 1899, was first employed in the electrical department of the Ohio Steel Company, Youngstown, Ohio, from which he resigned to become connected with the General Electric Company. After completing the test course he entered the meter, instrument and switchboard department and later the lighting department. Mr. Edwards first became interested in radio communication through association with Prof. R. A. Fessenden in connection with the latter's early activities with the National Electric Signaling Company. It was during this period that the General Electric Company designed and manufactured the first Alexanderson high-frequency alternator, which was used by Prof. Fessenden in his experimental station at Brant Rock, Mass.



E. P. EDWARDS

J. I. Banash, formerly of the Underwriters' Laboratories, Chicago, has opened a consulting engineering office at 3642 Jasper Place, Chicago.

Thomas H. S. Andrews, heretofore connected with the engineering staff of the J. G. White Engineering Corporation, New York City, has become affiliated with the E. G. Long Company of the same city as secretary.

S. Jacobs, for the last six years a member of the staff of the California Railroad Commission, acting in that time as assistant chief engineer of the gas and electric division, resigned recently. Mr. Jacobs will enter private practice, specializing as a consulting engineer in the gas and electric field. During his connection with the commission he took part in many important cases.

E. W. Lewis has resigned as assistant general manager of the Iowa Railway & Light Company and has entered the business field for himself, forming the firm of E. W. Lewis & Company, wholesalers of electrical supplies. Mr. Lewis first entered the electrical industry with the Onondaga Dynamo Company at Syracuse, N. Y. After seven years with that company he resigned to take the apprentice course with the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa. He was later transferred to the Baltimore office of that company. In 1908 he took charge of the electrical department of C. E. Fawcett, manufacturer of mill supplies at Cedar Rapids, Iowa.



E. W. LEWIS

Three years later he became connected with the Iowa Railway & Light Company as superintendent of transmission lines, and he also held other positions with that company before becoming assistant general manager, the office he has just resigned.

Frank L. Dame, vice-president of the North American Company and associated with the Harrison Williams organization, has been elected president of the Wisconsin Edison Company, Inc., which is controlled by the North American Company. Mr. Dame is also president of the Central States Electric Company, which controls the Cleveland (Ohio) Electric Illuminating Company, and a vice-president of the Cleveland Electric Illuminating Company and the Union Electric Light & Power Company, St. Louis, Mo. From 1909 to Jan. 1, 1913, he was vice-president of the Electric Bond & Share Company in charge of its operating department. His early connections with the industry were with the General Electric Company in the Pacific Northwest. Later he became general manager of the Union Electric Company, Dubuque, Iowa, after which he was appointed engineer for the Electrical Securities Corporation soon after its formation in 1904. He continued in that position until his election as a vice-president of the Electric Bond & Share Company in the fall of 1909, which position he resigned to become president of the Central States Electric Corporation.



F. L. DAME

A. E. Dyment, who has been elected president of the Canadian General Electric Company, Ltd., succeeding Senator Frederic Nicholls, who has become chairman of the board of directors, as announced on page 920 of last week's issue, is well known among Toronto financial men. For some years he has been a member of the stock brockerage house of Dyment, Cassels & Company. That connection he has given up, however, and he will make his headquarters at the offices of the Canadian General Electric Company. Mr. Dyment was formerly vice-president of the organization. He is also a director of the Royal Bank of Canada, director of the Mercantile Trust Company, director of the Dominion Sugar Company, vice-president of the Maritime Coal, Railways & Power Company and president of the Dyment Securities, Loan & Savings Company.

R. E. Fisher, who was recently placed in charge of the commercial department of the Pacific Gas & Electric Company, San Francisco, has for years been active in developing the use of electrical energy in the agricultural district of central and northern California. In addition to his regular duties, Mr. Fisher has found time materially to assist in the co-operative efforts between the several branches of the industry. His broad experience has well fitted him for the position of chairman of the Commercial Division of the Pacific Coast Section of the N. E. L. A., which he now holds. Mr. Fisher was born in Kansas in 1882, being taken as a child to Idaho, where, after completing high school, he began his electrical career. In 1902 he went to California, where he completed his technical education. After two years spent in operating a small station he became a salesman for the General Electric Company. Two



R. E. FISHER

years later he entered the electrical contracting business under the name of the Kurtz-Fisher Company. In 1909 he entered the newly formed Pacific States Electric Company, where he assisted in the organization and the development of sales policy. In 1911 he was employed by the Pacific Gas & Electric Company, and he had remained with that company to the present time. Mr. Fisher has been active for years in N. E. L. A. work and has served a term as president of the San Francisco Electric Development League, in addition to broad activities in civic bodies.

John F. Layng, for many years connected with the railway and traction engineering department of the General Electric Company, Schenectady, N. Y., has entered the consulting engineering field as a partner in the firm of Hemphill & Wells of New York City. Mr. Layng has been engaged in the electric railway business since 1889, having been at various times connected with operating companies, as well as with the General Electric Company and the Westinghouse Electric & Manufacturing Company. During the war he was engineer with the United States Fuel Administration in Washington, D. C., in charge of the electric railway fuel saving for the entire country. It was largely due to his efforts that the skip stop was so generally used.

Shiras Morris, president of the Hart & Hegeman Manufacturing Company, Hartford, Conn., has been elected president of the Johns-Pratt Company of that city to succeed the late Edward B. Hatch. Mr. Morris has been a director of the Johns-Pratt Company for a number of years. A brief biography of him appeared in the April 16, 1921, issue of the ELECTRICAL WORLD in connection with his election as president of the Associated Manufacturers of Electrical Supplies.

Arthur W. Fox, assistant treasurer of the Johns-Pratt Company, Hartford, Conn., has been appointed secretary of that company, to succeed Robert C. Buell, who has resigned to enter the stock brokerage business. No successor to Mr. Fox has been chosen.

Philip K. Murdock has been appointed export sales manager of the Bryant Electric Company, Bridgeport, Conn. Mr. Murdock was graduated from Dartmouth College in 1915, and after spending a year in the purchasing department of the Locomobile Company of America entered the Bryant organization as assistant to the sales service engineer. During the war he served in the First Separate Brigade of Coast Artillery, and upon returning to America he represented the Bryant interests in the metropolitan district and later in the South Atlantic seaboard states, with headquarters in Atlanta.

Lawrence P. Crecelius and **Victor B. Phillips** have announced the organization of the firm of Crecelius & Phillips, consulting, constructing and operating engineers, with offices in Cleveland. At the present time this firm is undertaking extensive work for large coal-mining interests which operate mines in Ohio, Pennsylvania and West Virginia. It is also acting as engineering counsel for a number of electric railways and other public utilities. Until recently Mr. Crecelius was electrical engineer and superintendent of power of the Cleveland Railway Company. He is a past-president of the American Electric Railway Engineering Association, a member of the American committee on electrolysis, of the committee on standards of the American Electric Railway Engineering Association and of a number of other engineering committees. Mr. Phillips has also until recently been associated with the Cleveland Railway Company, both as assistant to the vice-president and as acting superintendent of power. During the war he served with the 113th Engineers with the rank of captain. Subsequently he was attached to the American peace commission, being employed in the valuation of war damages, and later to the United States liquidation commission in charge of sales of surplus army stocks to Spain. Mr. Phillips is serving in the capacity of expert on the American committee on electrolysis. He is a member of the engineering executive committee of the National Safety Council.

J. P. Pulliam, in charge of the operation of the properties of the Wisconsin Securities Company, has been elected president of the Wisconsin Electrical Association. Mr. Pulliam has been connected with Wisconsin utilities for the last fourteen years. He is a native of Louisville, Ky., and for a time was connected with the Southern Railway at Louisville and with the Grand Rapids, Grand Haven & Muskegon Railway Company at Fruitport, Mich., as trainmaster. In 1907 he became superintendent of the Winnebago Traction Company, Oshkosh, Wis., and as the result of a reorganization his duties were extended to cover the operation of the Eastern Wisconsin Railway & Light Company, operator of the electric, gas and street-railway properties at Fond du Lac, with an interurban line to Oshkosh. When these properties were sold in April, 1917, Mr. Pulliam resigned and became affiliated with the



J. P. PULLIAM

Wisconsin Securities Company, Milwaukee. For six months in 1917 he was stationed at Green Bay as general manager of the Wisconsin Public Service Company. On Jan. 1, 1918, he assumed his present responsibilities.

Obituary

Lester Gray French, for thirteen years editor and manager of *Mechanical Engineering*, official journal of the American Society of Mechanical Engineers, of which he was assistant secretary, died April 18 at the French Hospital, New York City, after an operation. Mr. French was born in Keene, N. H., and was graduated from the Massachusetts Institute of Technology in 1891. He began his career as a draftsman with the Cranston Printing Trust Company and later was identified with engineering education. In 1897 he became editor-in-chief of *Machinery*, resigning in 1906 to publish technical books. He wrote one of the earliest American treatises on the steam turbine.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Slight Improvement in Interest in Electrical Sheets

AS THE year advances reports from manufacturers of electrical sheets show that the volume of inquiries is better now than it was last month, and that although the size of the orders is very small the number coming through is not so much below normal. Here and there an order is placed which is big enough to be remembered, but for the most part just enough sheet business is being placed to keep the electrical apparatus manufacturers working along on their reduced schedules of production.

There is plenty of the material that can be made available for quick delivery and no tendency to stock is noticeable on the part of manufacturers, jobbers or consumers. With the recent reduction in price on sheets by the Steel Corporation the price on electrical sheets for delivery up to July 1 is now generally on an even level for both corporation and independents. Certain mills that were below the general level came up to it when the corporation lowered its price. At this time it is impossible to predict the course of prices for delivery over the last six months of the year, and it will probably be late May or June before any price policy is made known. The opinion in the trade seems to be that electrical sheet business will have picked up considerably by fall.

Electrical Exports in March Total $9,782,045

ALTHOUGH the exports of electrical material and apparatus for the month of March showed a falling off to $9,782,045, this figure is nearly a million above that of a year ago March and brings the total for the first quarter of 1921 to $38,747,478. This shows an increase over the first quarter of 1920 of 73 per cent. Three items alone brought larger returns in March than in January or February—arc lamps, carbon-filament lamps and telegraph apparatus.

In spite of the optimistic feeling right along that electrical goods were leaving this country in satisfactory volume it is not surprising to find a recession in this volume from the extremely high values which have been shipped during the past five months. Current orders from beyond the borders are low in all classes of commodities, and consequently it would be rather unexpected if these high figures were even approached in the near future.

	March		Three Months Ended March	
	1920	1921	1920	1921
Batteries	$ 99 8 6	$412,019	$1,592,568	$1,519,487
Carbons	128,531	51,583	344,757	184,743
Dynamos and generators	4 4 178	550,562	1,240,811	1,954,630
Fans	115 069	179,939	224,436	847,756
Heating and cooking apparatus	135,450	180,693	389,289	853,981
Insulated wire and cable	543,545	721,647	1,772,424	4,293,174
Interior wiring supplies	230,315	200,096	594,718	999,651
Arc lamps	1,088	2,878	1,351	5,542
Carbon-filament lamps	19,986	20,435	36,865	44,314
Metal-filament lamps	427,348	296,177	1,002,436	1,514,528
Magnetos, spark plugs, etc.	444,240	112,534	957,658	575,947
Meters and measuring instruments	207,655	254,029	615,242	1,028,612
Motors	1,247,806	1,571,601	2,807,355	6,062,458
Rheostats and controllers	72,896	87,649	177,936	363,137
Switches and accessories	356,631	429,118	1,031,870	1,889,930
Telegraph apparatus	61,530	352,714	261,684	508,456
Telephones	414,451	499,072	898,094	1,978,247
Transformers	347,195	765,564	992,744	3,011,417
All others	2,966,103	3,093,735	6,863,312	11,111,468
Total	$8,874,884	$9,782,045	$21,805,549	$38,747,478

One of the main reasons for this feeling is that the value paid for electrical goods has decreased since last fall so that even with a continuance of orders the amount would be lower for the same volume. Furthermore, it was last summer and fall when domestic business began to drop off. Manufacturers then were able to concentrate production on foreign orders, and shipments out of the country improved materially. This increase was noticed very markedly in the electrical exports from October on through February, the highest months on record.

Looking forward, it is known that there are developments in Italy, Sweden, Switzerland and other European states which will be put under way this year, while, on the other hand, there are some which will not come through in 1921. Japan and other Far Eastern countries have projects which probably will be let this year. There is no doubt that the present lull in export buying is only temporary, but although the future is bright it will mean real selling efforts to overcome foreign competition.

Some Trends in Lighting Fixture Design

IN THE design and execution of lighting fixtures, especially for residential and hotel use, there is a very noticeable trend toward certain rather distinctive features. This is particularly true of the higher class of fixtures and was borne out strongly at the fixture convention in Buffalo in February. Although many manufacturers of these fixtures will not admit it, there certainly appears to be a decided leaning toward fixtures using exposed round-type lamps and candelabra effects with or without shades. In the cheaper class of fixture the employment of glassware is still adhered to strongly.

Color and decorative effect predominate. In the last year there have been developed many new finishes for the metals, and these are being used in matching general color designs of the rooms. Some colored pottery vase effects are being worked in to the fixture proper. There are also colored flowers and drops attached or hung here and there. Sometimes these are of glass and sometimes of metal. Crystal and prisms seem to be quite popular in the highest grade of residential and hotel fixtures.

Where glassware is used it is gradually tending to be of higher quality and is taking on a more decorative effect.

Demand for Line Materials Slow in Materializing

IN SPITE of the admittedly low price of copper and the varying reductions which lately have gone into effect on other materials entering into line construction, reports come from the Mid-West that the season of the year which usually sees the heaviest purchasing of these materials is passing without much being done. Construction by central stations is being pared down to pressing needs.

There are several angles to this problem, two of the most prominent being the high price of money and the high price of materials. It is useless to expect central-station operators to pay 8 per cent for money to put into electric utility property, the value of which in the process of readjustment is apt to be lowered 20 to 30 per cent in the next three years. A large part of the extension work done in the past has been done because the community needed the service and not because the central-station company expected an immediate return on its investment; but in the present money market ample returns must be assured before it is wise or even possible to obtain capital for a new line. Nor is this

a situation which may be expected to mend quickly, according to the heads of some of the largest utilities in the Middle West. It is their opinion that the old reservoir of capital, the money minority, has been tapped almost to the limit and that from now on the public as a whole must be educated to support the utilities. This means a long, slow, painful process.

One hope for getting the tremendous construction program started is for prices to recede to the point where it will be reasonable to expect central-station companies to put 8 per cent money into generating plants and transmission and distribution lines. Or else money must go lower. It is the average opinion that, with the exception of copper, prices have not reached the low point yet. Copper today is below its pre-war price, but the demand for it is so enmeshed with the demand for other materials that this fact has not induced much buying.

What some central-station companies are expecting in the way of reduced prices may be seen from a comparison of the line costs of one large utility company in the Middle West for the years 1917, 1918, 1919, 1920 and the first three months of 1921. Taking the costs for 1917 as a base, with a value of 100 per cent, these figures show that in 1918 materials went up to 106½ per cent, labor up to 101¼ per cent and the total cost of construction, excluding right-of-way, up to 105¼ per cent. In 1919 materials increased to 140 per cent, labor to 121 per cent and total cost to 134 per cent. In the peak year, 1920, materials had risen to 156 per cent, labor to 172½ per cent and total cost to 160¼ per cent. At present materials are down to 132 per cent, a reduction of 15 per cent from 1920, and total cost has receded to 142 per cent, or an 11⅛ per cent reduction from the preceding year, while labor continues at its 1920 level.

Labor cost at present amounts to 30 per cent of the total against 25 per cent in 1917. There is a probability that wages will be reduced a trifle, but the main desire of the utilities is that material costs be reduced approximately 25 per cent further, bringing them to about the 1917 level. Whether manufacturers can afford this at present is another problem. On the average line in 1917 copper formed about 50 per cent of the total material cost, while at present it forms only about 30 per cent. Were this item to regain its 1917 level other materials would have to drop about 45 per cent to equalize matters. So far copper has borne most of the burden of deflation, a condition that is neither economically just nor safe. To remedy it means an immediate sacrifice, but an ultimate greater benefit to the whole industry. Against this is balanced the possibility of getting cheaper money, and in the solution there may be a compromise whereby materials and money will find lowered costs.

Appliance Sales Responding to Aggressive Merchandising in Southwest

THE experiences of several central stations in the Southwest seem to point out that a good market for appliances still exists there, provided that the proper merchandising methods are applied. Sales of appliances of all sorts fell off somewhat during January, February and the first half of March as compared with the same period in 1920, but this drop in sales has not been so marked in the case of companies employing aggressive sales methods as it has been in other instances. Again, the further into the Southwest the investigation was carried the better were the conditions found.

One central station in the far Southwest reports that during January sales of appliances totaled 50 per cent more than in January, 1920, and that February sales ran slightly ahead of those for February, 1920. At least 90 per cent of their sales, according to the manager of appliance sales, can be attributed to the fact that salesmen impressed the "household necessity" idea upon each customer and put forth an effort to sell appliances instead of merely taking orders as has been done for the last couple of years. Other companies have had similar experiences. In the more eastern section of the territory agricultural and industrial conditions have affected sales to a greater extent, decreases from the like period in 1920 running from 15 per cent to 50 per cent.

Discarding the dollar sales value of the various appliances and taking into consideration only the number of items sold the following seems to be an average ranking: Domestic irons, cleaners, washing machines, percolators, portable heaters, grills, curling irons, toasters, heating pads and sewing machines. It is reported from some districts that washing-machine sales are running ahead of those of vacuum cleaners.

Price inducements have been tried occasionally with good results. Some tendency to balk at price has been shown by the public, and where in conjunction with aggressive merchandising a slight concession has been made sales have increased largely. One central station by using these methods in a washing-machine campaign increased its sales for the three-week period of the campaign 650 per cent over the same period in 1920.

Survey Shows Use of Socket Appliances in Canada

IN THE matter of distribution of socket appliances in Canada, a summary of the electrical needs of more than 250 Canadian towns and cities distributed from coast to coast, according to the *Electrical News*, Toronto, Canada, indicates only 7.3 per cent saturation on the average. The sales opportunities here are pointed out very definitely.

Houses wired showed 74.9 per cent, but the degree of utilization of socket devices seemed remarkably low. Flatirons showed 45.7 per cent, toasters 18.2, washing machines 5.9, fans 5.4, vacuum cleaners 5, air heaters 4.8, percolaters 3.7, ranges 3.1, water heaters 1.3, sewing-machine motors 1.2, ironing machines 0.14, dishwashers 0.07 and refrigerators 0.06 per cent.

The Metal Market Situation

THE best that can be said for the copper market is that large producers are still maintaining their prices. Buying interest in general is lacking despite occasional orders that stand out, such as that of the Western Union Telegraph Company for 3,000,000 lb. last week. Japan has come into the market again for the first time in many months, but orders from that quarter are not important as yet.

As the statistical position of copper continues to improve producers are hopeful that in about two months more the commercial position will open up too, but right now consumers, including wire producers and manufacturers of brass products, show little interest. Continued slack demand has had the effect of making some of the smaller interests willing to shade the asking price of 12.75 cents per pound for prompt shipment, and reports persist that as low as 12.50 cents has been quoted on small lots. The majority of producers continue to ask from 12.75 to 13 cents over the second quarter, however. In the outside market there is very little copper available, and virtually none at all under 12.75 cents delivered.

Demand for lead is not especially large, but the market is firm at the "official" price of 4.35 cents per pound. Galvanizers have been buying zinc recently, and consequently there has been an advance during the week, though surplus stocks are still too large. The scrap-metals market is quiet.

NEW YORK METAL MARKET PRICE

	April 19, 1921	April 26, 1921
	£ s d	£ s d
Copper		
London, standard spot	69 15 0	70 5 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	12 75—13 00
Electrolytic	12 75	12 75
Casting	11 75—12 00	11 62½
Wire base	14 50—15 00	14 50—15 00
Lead, trust price	4 25	4 35
Antimony	5 12	5 25
Nickel, Ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 20	5 45
Tin	30 75	32 00
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9 50—10 25	9 50—10 25
Brass, heavy	5 50— 5 75	5 50— 5 75
Brass, light	3 75— 4 00	3 75— 4 00
Lead, heavy	3 50— 3 75	3 50— 3 75
Zinc, old scrap	2 87½— 3 00	2 87½— 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WHILE there is little marked improvement in general supply business there is, however, that steadily though gradually increasing tone to the market which points to a healthy condition of trading when it shall have progressed somewhat further. New England business is holding up reasonably well, and central stations and traction companies are a little more active. Midwest business is unchanged, and in Chicago the building labor deadlock is holding up construction projects. In the South Central States there are small increases in sales and better railroad buying. An effort is being made there to stimulate Mexican business.

Small-residence building in the South Atlantic States is fair, and farmers are releasing cotton and other products in rural districts. Building is good in the Intermountain territory and manufacturers' agencies report better business there. Northwest lumbering is a little more active and some otner industries are waking up a little. Building is poor. Collections are improved on the West Coast.

A threatened marine tie-up may still further hamper shipments out of this country; general transportation is good, however.

NEW YORK

There is not much increase in the total volume of sales of jobbers. These would like to report better business if they could, and hence the majority are optimistic, but truth compels the acknowledgment of the present quiet state of affairs. There is a barely perceptible improvement in some quarters, and by July, it is generally hoped, business will be on its feet again. Just now attention is devoted to cutting down overhead. This has been accomplished by releasing chiefly office help and in some cases a few salesmen where the latter are not on a commission basis, and also in a couple of instances by wage cuts.

Lower prices are reported on outlet boxes, and there is also a slight drop on armored cable. Price decreases are little or no stimulus to trade, however.

Conduit—There is some fairly steady demand in very small lots that seems to indicate a maintenance call, but the bulk of the good stocks that are held is not moving. Many jobbers as yet have not changed prices very materially since the recent manufacturers' drop, quotations this week on 2,500 ft. being as follows: ½-in. black, $63.50 to $68; ½-in. galvanized, $68.70 to $78; 1-in. black, $123.75 to $129; 1-in. galvanized, $134 to $139 per 1,000 ft.

Cast-Iron Bodies.—A full assortment of condulets, etc., is generally carried, but supplies are not moving well. In standard-package quantities 15 per cent off list is quoted on condulets.

Flexible Armored Conductor.—Demand is small, with good stocks on hand. A leading manufacturer this week reduced the Pittsburgh base price of double-strip $2 per 1,000 ft. to the same level as single-strip material, or $55. Jobbers sell 1,000 ft. of No. 14, two-wire, double-strip, at $59 to $65.

Porcelain.—Prices cover a wide range, representative quotations this week being $25.20 to $30 on "Nail-it" knobs, $10.35 to $12 on 3-in. x ⅝-in. tubes and $15 to $26 on two-wire unglazed cleats, all in barrel lots per thousand. The market is stagnant, with fairly small stocks held.

Outlet Boxes.—Following the corporation drop in steel prices manufacturers have generally reduced stamped-steel boxes by increasing the discount allowed on both black and galvanized ten points. The drop is effective on varying dates, ranging from April 21 to 25 in several instances. Previous discounts quoted by jobbers ranged from 35 to 40 per cent on black and 30 to 35 per cent on galvanized in lots of 100. Demand is slow, with fair stocks held.

Lead-Covered Wire.—Little or no call is received for this product, so only small stocks are carried. No. 14 duplex in 1,000-ft. lots brings from $35 to $42 per 1,000 ft.

Schedule Material.—Demand is poor and jobbers are still in some cases replenishing stocks from one another rather than from manufacturers.

Fans.—The market is spotty, as some jobbers report a pretty fair demand and a good increase in sales in view of present warm weather; some say demand is just starting to show improvement, while others report no activity at all as yet. The general fan policy this year, it seems, will be to let the manufacturer "hold the bag."

Flashlights.—Jobbers report no activity in expectation of a vacation demand as yet; in fact the market is quiet, with fair stocks on hand.

CHICAGO

The immediate future of construction in this territory remains uncertain for, following the rejection by the unions of the newly offered scale carrying a reduction of from 20 to 30 per cent, the employers' associations have issued an ultimatum to labor. Their position is that unless the unions reconsider and sign up at the new scale a lockout on all construction work will go into immediate effect.

Business is virtually unchanged. Insulated wire is lower in price because it was too high in comparison with prices of bare copper and bar copper. Western cedar poles are down considerably below Northerns and little business is reported in either kind. Black conduit, following steel, is off a little, building inactivity continuing to act as a brake on sales.

Bare Copper Wire.—The momentary strength shown a week ago has been entirely dissipated. The larger distributers have made no change in price for several weeks, and the passing upward tendency was noted only in less willingness to shade prices by some smaller interests.

Insulated Copper Wire.—An effect of the long-continued low price of copper has been to cause another reduction in insulated wire. No. 14 rubber-covered in 10,000-ft. lots is now quoted at $7 per 1,000 ft. No. 6 triple-braid weatherproof is 17 cents per pound in quantities of 1,000 lb. These reductions are in line with lower insulating materials.

Flexible Armored Conductor.—This commodity holds firm, ample in supply and with demand light. It is stated that present prices have anticipated recent reductions in production costs. No. 14, two-wire, in 5,000-ft. lots, is quoted at $62 per 1,000 ft.

Black Conduit.—Reductions in steel have induced new lists showing a slight cut. Beginning April 25 a price of $62 per 1,000 ft. is quoted on ½-in. in 5,000-lb. lots. Demand is very quiet.

Poles.—In line with lowered producing costs on the Western coast and with readjusted freight charges new lists on Western cedar poles are in preparation. Reductions are expected to average 15 per cent. Northern poles remain unchanged in price. Producers claim that the season's short production precludes any thought of a cut. Business is light.

Line Hardware.—Recent changes in the price of raw materials have not caused any changes in hardware lists. Lowered steel costs were anticipated when the current lists were in preparation.

Hollow Ware.—Retailers still complain that prices are too high. Their sales in most cases are scarce, and as a result jobbers report business as poor.

Toasters and Flatirons.—Flatirons remain the one fairly steady item in the retail stores. As an indication that price has little effect on the trade it is noted that a ten-dollar iron is selling more rapidly than other makes which are priced from $1.50 to $2 cheaper. Toasters have retained a portion of their popularity, but are moving much slower than the trade would like.

BOSTON

Business held up reasonably well last week, and the contracts placed in New England building and engineering operations for the week ended April 18 totaled $4,409,200, compared with $4,724,000 for the same period last year. Jobbers and retailers continue to buy from hand to mouth, but increased sales of wiring material are anticipated before long. Central stations are coming more actively into the market for pole-line material, and some inquiries are being made by electric railways with resultant small orders. The open-shop movement appears to be gaining headway. Collections are being sharply watched. Stocks are ample for present needs, and the only long deliveries are on high-tension insulators. Prices show a tendency to weaken in flexible armored conductor and rigid conduit.

Flexible Armored Conductor.—Prices are unsteady in competitive sales, ranging from $60 to $65 in typical cases on No. 14 double-strip, per 1,000 ft., in 5,000-ft. lots. Sales are not active, however, and the desire to move stocks is apparently behind these price variations.

Rigid Conduit.—Stocks are plentiful and an abundance of all sizes is in evidence. Prices are settling into the new levels announced last week, and in 5,000-lb. orders the following are typical: Black pipe, ½-in., $67.30, galvanized, $72.40 per 1,000 ft.; black, 1-in., $131.20, and galvanized, 1-in., $141.40. Movement is quiet.

Sockets.—Steady prices feature the market with ample stocks for current requirements. These are still moderate. Pulls in case lots bring 47½ cents net, and keys and keyless 27 and 26 to 25 cents.

Wire.—Rubber-covered No. 14 is selling at $7.50 per 1,000 ft. on 5,000-ft. orders. Weatherproof is selling on from 16 to 17 cents base, with ample stocks. Bare copper wire is being marketed on base prices ranging from 14¾ to 15½ cents. Central-station buying accounts for some business.

Non-Metallic Flexible Conduit.—As yet this material shows no acceleration in general sales movement.

Friction Tape.—Prices are showing some variation, depending largely on the qualities marketed. In 100-lb lots good grades bring from 45 to 50 cents per pound, ¾-in. black and job lots sell around 30 cents. The demand is very sluggish.

Motors.—An excess of motors appears to be the usual situation in distributing circles. Some new power business is being taken on by central stations and a good many motors are being sold when it is realized that the business is spread out very thinly.

Industrial Heating.—Interest in this class of equipment is growing steadily, and intensified efforts to develop a broader market are being planned for early pushing by manufacturing and central-station interests. Missionary work is beginning to bear fruit in selective sales.

Appliances.—Popular interest and trade are being stimulated by marketing a good many designs of substantial but not the latest type at low prices in retail stores. In purchasing these the public seems to accept higher quotations on the most advanced designs with less objection than where only the latest products are shown. Interest in irons, washers and cleaners continues active.

Knobs and Tubes.—In barrel lots "Nail-it" knobs sell for $27 per 1,000 and 3-in. tubes for $9.50 per 1,000. Light demand is reported.

ATLANTA

Business in this section as a whole might be said to be rather quiet, though one or two of the more fortunate centers report conditions holding up fairly well. The principal activity reported seems to be that resulting from the purchase of material required for electrical installations in small residences, repairs caused by fire damage and improvements urgently needed to existing industrial plants. The municipal activity, which a few weeks ago was fairly good, has again become dormant and few orders for pole-line material and allied lines are being received. Retail electrical dealers seem very slow to replace depleted stocks of household appliances, largely on account of their difficulty in interesting the buying public in this line of goods. Fans, however, continue to live up to dealers' expectations.

There is a noticeable tendency on the part of the rural population to release their farm products, particularly cotton, which is beginning to move much more freely, with the result that Southern banks are able to reduce materially the amount of outstanding loans. This should serve to make money easier for industrial and commercial activities. Building permits in Atlanta continue to hold up fairly well, there being a noticeable increase in the number of permits taken out for small residential construction. Jobbers report their collections slightly improved over those a month ago.

Wire.—A further reduction in the price of wire is reported this week, rubber-covered No. 14 being quoted at $8 per 1,000 ft. and No. 12 at $10. The rubber-covered seems to be moving more satisfactorily than weatherprooof, orders for the latter variety being small in volume. Stocks are reported in excellent condition.

Storage Batteries.—These have not responded to the seasonal movement. Distributers have heavy stocks on hand in virtually all sizes.

Schedule Material.—The construction of small residences and repairs to damaged buildings has served to accelerate the movement of this line. Stocks are in good shape. "Nail-it" knobs, standard packages, are $2.83 per 100; porcelain tubes, $\frac{5}{16}$ in. x 3 in., are $1.08 per 100; pendent key sockets are 28 cents each; single-pole snap switches are 27 cents each, and push-button switches, single-pole, 29 cents.

Washing Machines.—The movement is not by any means satisfactory. Like other lines of household appliances the market is very dull. Heavy stocks are reported on hand by nearly all jobbing firms.

Outlet and Switch Boxes.—The demand is reported as above the average, while stocks continue to be maintained in good condition, with no price change to be noted.

Interphones and Call Systems.—Considerable activity is reported, the construction of an unusual number of hospitals being responsible for the brisk movement in call systems, while interphones are going into apartment houses nearing completion. Stocks of interphones are quite satisfactory, with shipments on call systems good.

Printing-Press Apparatus.—A quite widespread activity is noted throughout the entire line of electrical equipment for printing establishments, the principal demand being for small to medium-size units. Local stocks are somewhat spotty and shipments range from stock to eight weeks.

Industrial Motors.—Interest is showing a slight improvement over prior weeks, though orders approximate only 30 per cent of the normal four-year average. The three-phase, 220-volt type seems to be the most popular. Stocks are in fair condition, with single-phase motors being reported again as having returned to normal stock basis.

ST. LOUIS

No deviation in the progress toward better business was observed this week. Sales are gradually increasing in volume, and business, while by no means normal, has generally a better tone. More confidence in the future is manifest. Two of the largest stove factories in St. Louis reopened this week after shutdowns of four months. No large orders are now on the books, but preparations are being made for the fall demand, which is expected to be at least 50 per cent of normal. The railroads have been doing more buying lately than for several months previously. Some new construction work has been started, but only a small portion of this is industrial. A number of industrial plants are making inquiries, however, and it is expected that industrial building will show improvement by fall. Very few industrial plants are entirely closed down, and the average operation is on a four-day-per-week basis. In special cases, as in manufacturing women's shoes, the plants are running on full basis.

Active efforts are being made by St. Louis concerns to stimulate business. Delegations have been sent to Mexico and Mexican delegations have visited here to foster better business relations. There is an attractive amount of trade

with Mexico, and it is felt that the recent conferences will increase it. To stimulate building, particularly of residences, the "Own Your Home" Exposition opened April 25 for one week.

Collections are still on an average basis of sixty days, but electrical jobbers have their obligations well in hand, so that the time required for collections is giving no material concern. The tendency is to stop price cutting except where replacement prices are reduced, as it is found that lower prices have no material effect upon buying.

Poles and Crossarms.—The reduction in prices announced last week has not yet resulted in an appreciable increase in orders, but inquiries are numerous and attractive orders are expected before long. Local stocks are in good condition.

Porcelain Insulators.—Prices are firm and deliveries are much improved. Factory shipments in some kinds can be made immediately and the other kinds can be shipped in not exceeding thirty days.

Dry Cells.—Sales are reported to be on a normal basis and local stocks are in good condition. Immediate factory shipment is available. In barrel lots the regular cell sells at 38 cents each and the igniter sells at 39 cents each.

Wire.—Rubber-covered continues to have a competitive market and No. 14 is the leader. The price on No. 14 varies from $7 to $8 per 1,000 ft., depending upon how badly the individual jobber wishes to reduce his inventory. The larger sizes are moving quite slowly. Only a small demand is found for bare and weatherproof.

Knobs and Tubes.—"Nail-it" knobs are selling from $23.80 to $28 per 1,000, and 2½-in. tubes at $8 to $8.75 per 1,000. The demand is quite low and the stocks heavy.

Vacuum Cleaners.—Improvement in demand is noticed, due to the usual spring requirements. Intensive sales efforts are being applied which are resulting in sales not far from normal for residential requirements. The demand for cleaners in office buildings and apartments is very quiet.

Flexible Armored Conductor.—Slight improvement in demand for the week is reported, but sales are still low and stocks are somewhat heavy. No. 14 double-strip is quoted as a rule at $65 per 1,000 ft. in 5,000-ft. lots, but some quotations are made as high as $80.

SAN FRANCISCO

Collections are better than those of a month ago, particularly in the larger cities. Country dealers, however, are still running slower than those in the city. They are being helpfully followed, although as a rule the credit situation is rather tighter than it was last year, with small encouragement offered new enterprises unless they are gilt-edged.

During the recent highly successful San Francisco market week, in which the dealers from all over the Pacific Coast were induced to visit San Francisco to inspect new stocks, orders to the value of several million dollars were placed. While the electrical industry did not participate directly, it will benefit from the general prosperity of the community.

Rail shipments are coming through from Eastern factories in very good time, carload shipments requiring about twenty days and less-than-carload shipments thirty days. It is estimated that the present volume of freight received is about 70 per cent of that of 1920.

Household Devices.—Beginning with the middle of March the growing business of household appliances was seriously affected by the indifference of the buying public, who are either jaded by present soliciting methods or are confidently expecting much lower prices. Dealers are cutting their stocks to a minimum and are particularly retrenching on conditions of purchase affecting their turnover rate, such as unusual quantities and parallel makes. One of the jobbers (Pacific States Electric Company) is instituting a series of merchandising conferences to be effective along the entire Pacific Coast during May, to which the electrical merchandising fraternity is invited. Washers are particularly slow, and vacuum cleaners, except those sold through large department-store campaigns, are hardly better. On the other hand, such comparatively new lines as ironers and dishwashers are showing a pretty good movement.

SEATTLE—PORTLAND

Trade and industry in the Seattle and Portland fields, according to recent reports and present indications, do not reflect any marked changes from last reports, but there are enough signs of improvement in basic conditions to rob the general showing of some of its hitherto rather depressing atmosphere. Industry, particularly lumbering, is a trifle more active, but it is more or less depressed owing to slack buying and unstable prices. Camp and mill activities are still on a 50 per cent basis as regards numbers in operation and nearly all are operating on a reduced-capacity basis. The employment situation is improving from week to week, and the demand for construction, building and general laborers during the past week showed excellent improvement. Manufacturers state that there seems to be a feeling of a little more confidence abroad at present, although it is no more than barely perceptible. Business continues about the same.

There have been no recent price changes of note and stocks of all kinds are in good shape. Jobbers throughout the district, as a whole, state there is a continued increase in business, although it is still not of very great value. There is no improvement in collections, particularly in the Portland field, and it is expected that the next two or three months may record several liquidations of smaller organizations that are operating on an unsound financial basis. Those operating on a sound basis, but temporarily embarrassed, are having time extensions granted them. Contracting business in both Seattle and Portland is active in small work, but there is practically nothing in the way of larger contracts. In Portland residence fixture business is active, but in Seattle it is only fair.

Insulated Wire.—Very light business is reported in inside wire in Seattle, but the Portland field reports increasing sales volumes. Stocks of all sizes are ample and prices are subject to some variation.

Lamps.—Jobbers and dealers report present demand is not far from normal for this time of year.

Motors.—Inquiries are light but are on the increase and some small sales are being handled. Considerable interest is being shown in motor application, and it is believed that this interest will develop into orders of consequence later in the year.

Distribution Transformers.—Accompanying the movement of pole-line material, transformer sales are reported increasing, smaller municipalities, especially, doing considerable buying. Stocks are in good condition

Safety Switches.—Demand continues comparatively brisk, stocks, generally speaking, are in good shape and replenishments are coming through satisfactorily.

Conduit.—Demand, particularly in the Portland field, is showing an increase, with residence building on the upward trend. In Seattle the demand shows slight improvement.

SALT LAKE CITY—DENVER

Much building activity is reported in the territory of Denver and $15,000,000 worth of buildings is now projected for the year 1921. These structures include several large office buildings. This activity in the Denver territory is about typical of the general building status in the Intermountain region. Several large manufacturers' agencies report business better at the present time than in the corresponding period of 1919.

A co-operative league movement has been launched in Denver, taking in twenty-five manufacturers, forty dealers, several jobbers and the central stations. The movement is well under way and is characterized by much enthusiasm. The backward spring is holding up building operations to some extent and is having a similar depressing effect on business generally. Farmers are a little behind schedule in planting their crops. They report labor both cheap and plentiful. The employment situation is not much changed. There are perhaps more men unemployed at the present time than at any period during the siege of non-employment. Indications, however, point to early alleviation of this difficulty. Collections are still slow.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Driver-Harris Bonds for Expansion

Of an authorized $2,000,000 of these bonds the Driver-Harris Company, Harrison, N. J., has placed on the market $1,250,000 of first mortgage 8 per cent gold bonds, due April 1, 1931. The price is 99½ and interest, denominations are $500 and $1,000, and they are redeemable at the company's option at from 107 to 104, plus accrued interest, depending on the year in which they may be taken up from 1921 to 1931.

The purpose of the issue, according to Frank L. Driver, president, is for the erection and equipment of a new hot-rolling mill and for additional working capital required by the steadily increasing business of the company. Besides its holdings in this country the company has found it necessary to erect plants in Canada, England and France.

Vacuum-Cleaner Maker Adds Furnace Plant

The Ramey Manufacturing Company, Columbus, Ohio, has purchased the F. B. Zieg Manufacturing Company, Fredericktown, Ohio, its heater-furnace business and equipment, and has moved this plant to Columbus, where it will be operated together with the company's vacuum-cleaner business at 175-179 West Fulton Street.

Change in Name to Brunt Porcelain Company

Having discontinued the manufacture of tile, the Brunt Porcelain Company is successor to the Brunt Tile & Porcelain Company, Columbus, Ohio. The company specializes on knobs, tubes and cleats and about the first of the year added two new kilns and three new buildings, giving a total floor space now occupied of 70,766 sq.ft. Building depression just now, of course, is making the porcelain industry quiet, but the company is receiving a healthy proportion of business.

Ohio Brass Insulator Business Holds Up Strongly

The Ohio Brass Company, Mansfield, Ohio, reports that new orders for high-tension insulators hold up surprisingly well in view of the quiet condition of the general electrical market. Foreign shipments the first quarter of this year were exceptionally large, it is stated, and new business from abroad continues in good volume. In general, the company is still sixty to ninety days behind on orders, though the insulator plant is running at full capacity with an undiminished labor force. Pin-type insulators and bushings are in the worst shape as regards delivery, while a fair reserve supply of suspension units is reported to be on hand. One of the most recent orders of the company is that just placed by the Ohio Power Company for 8,000 suspension units covering a 15-mile line at 66,000 volts. Shipment of these insulators will start within the next two weeks.

Western Electric's Dealer Help in Power and Light Plant Sales

In going out after the six and one-half million farms in the United States and Canada, of which about one-half million have electric service from central-station and farm plants, the Western Electric Company has just issued a special advertising manual for its power and light dealers. Contained in this "Business Builders for 1921" is a special 104-page booklet designed to assist dealers in the development of their local newspaper advertising. News stories and advertisements are tied up together for each week in the year.

Appleton Electric Buys Nicholson Connector

The Appleton Electric Company, 1701-13 Wellington Avenue, Chicago, has purchased all patents, machinery, etc., for manufacturing the box connector for metallic flexible conduit formerly made by the Nicholson Electric Fittings Company, Wilkes-Barre, Pa.

Standardization to Be Discussed by Gear Manufacturers

The fifth annual meeting of the American Gear Manufacturers' Association is being held in the Hotel Sinton, Cincinnati, Ohio, April 27, 28, 29 and 30. Standardization and uniform cost accounting will be among the subjects discussed, and important action is expected by the association tending toward the establishment of a more complete standardization of the products of the gear industry.

According to the program that has been prepared G. M. Bartlett of the Diamond Chain & Manufacturing Company will discuss "The Ideal Chain and Sprocket Drive"; A. R. Mitchell of the Andrews Steel Company will speak on "Industrial Gears from the User's Standpoint"; J. B. Foote, president Foote Brothers' Gear & Machine Company, has been assigned "Worm Gearing," and J. B. Doan, president American Tool Works, has an unannounced subject.

Maintenance Company Moves to Larger Building

The Maintenance Company has moved from 417 Canal Street, New York City, to the building at 449-453 West Forty-second Street, where it has about double the room it formerly had to carry on its electrical contracting, retailing of supplies, repair and maintenance of power and lighting equipment and systems. The building is 60 ft. x 90 ft., and the company now is using the basement, ground and first floors. Number 455, next door, has just been purchased by the company and will be rented out for the time being.

Sager Electrical Takes Over J. W. Poole & Company

The Sager Electrical Supply Company has been organized at Boston to take over the business and distributing agencies handled by James W. Poole & Company, Inc., with offices and stockrooms at 201 Congress Street. Joseph E. Sager is president and treasurer of the company, George Lloyd being sales manager and W. M. Fyffe purchasing agent. The Poole company was one of the older jobbers of New England and the Sager interests acquired the business following the death of the late James W. Poole.

Rome Wire's New Weatherproof Wire Mill in Operation

The Rome Wire Company, Rome, N. Y., has added weatherproof wire to its manufacturing schedule, and its new weatherproof wire mill is now completed and in operation. This plant is two stories in height, 125 ft. x 325 ft., with floor space of 81,250 sq.ft., bringing the company's total floor space to 15½ acres. The new product rounds out the company's line of copper rods, bare and tinned copper wire, stranded cables, rubber-covered wires, magnet wires and weatherproof wires. It is the intention to carry large stocks of rubber-covered and weatherproof wires in the Rome warehouses at all times.

American Di-Electrics Enlarging Quarters and Distribution

American Di-Electrics, Ltd., New York City, manufacturers and engineers in the field of insulation, are moving to larger quarters at 71-73 West Broadway on May 1. John P. Rockwood, metropolitan distributer, is also moving to the same address. The change will enable the company to enlarge its lines and deal in all kinds of insulation in addition to those produced in its own factories. The company's Pittsburgh agent, the Electrical Engineering & Manufacturing Company, has also recently moved to larger quarters at 907-909 Penn Avenue, Pittsburgh.

Surf Washer Taken Over by Sunbeam Domestic

The Surf Manufacturing Company, manufacturer of the Surf electric clothes washers, has been taken over by the Sunbeam Domestic Appliance Company of Evansville, Ind., and will move into its new daylight factory in Evansville some time in May. The new company will retain the trade name of "surf" and will be under the active management of O. F. Fischedick, formerly of the Surf Manufacturing Company.

It is announced that the change will enable the new company to manufacture its product under more favorable conditions both as to additional capital and lower labor costs.

Franco Electric Moving Into Larger Quarters

The Franco Electric Corporation, manufacturer of flashlights, flashlight batteries, Christmas-tree outfits and novelties, is now moving from its former location on South Fourth Street to its new factory and office building at Tillary and Pearl Streets, Brooklyn, N. Y. This new "Franco" building is of six stories and basement and contains 120,000 sq.ft., whereas the former location provided only 75,000 sq.ft. of space. Occupancy is expected to be completed by May 15.

On advices from the company, business for the first quarter of this year amounted to 15 to 20 per cent more than that of the same period of 1920, and, except for the break caused by moving, the volume of present business is very satisfactory. Full capacity is expected by August.

Cancellations Reduced Through Active Production

In a message to employees of the Lynn (Mass.) works of the General Electric Company Manager Richard H. Rice points out that at no time in the history of the plant has close co-operation between the management and the employees been so necessary as it is today and that the response of the employees to a previous suggestion that increased vigor of production would enable deliveries to be maintained and minimize cancellations has been heartening. "The Lynn works has been singularly favored," said Mr. Rice, "in being able to keep on with the force reduced only a small percentage from the maximum and with most departments running full time. We still have considerable volumes of unfilled orders on our books, and the same process of intensified production on these orders is necessary if we are to keep our customers. While it is true that we have had large cancellations of orders, these cancellations have been insignificant in amount as compared with those which we would have had if we had greatly delayed the shipment of our apparatus."

In referring to the efforts being made by the management to minimize layoffs Mr. Rice points out that the number of employees absent from the plant on Saturday mornings all through 1920 was virtually equal to the number now laid off for lack of work. This large absentee list, he said, indicated a serious failure to realize the necessities of either the plant or of individual thrift. Through co-operation, it is believed, the present depression can be faced with confidence.

Motor Plant Begins Operation in Louisville

Electric motors and generators and other electric machinery are now being manufactured by the Louisville Electric Company, Louisville, Ky. The company was organized by Charles E. Willey, president, and James F. Willey. It has been incorporated and recently completed its new factory at Thirty-first and Magazine Streets. This is 65 ft. x 150 ft.

The company, while manufacturing motors, generators and electric-driven tools, will make a specialty of repairing electric machinery.

Jobber Urges Divorce of Dealer and Contractor

The results of the electric range demonstration held by the Piedmont Electric Company, Asheville, N. C., in March have been pleasingly evidenced through the company's retail department, according to William Farr, president and general manager, and hardly a day goes by but that some lady who attended the demonstration orders a range.

The dealers, however, are found neglectful of the opportunity to stir up business in their own towns. This Mr. Farr considers to be the weak link in the selling chain at present, and he is convinced that before any real results are obtained in the sale of electrical merchandise through the dealer he will have to separate his business from contracting. Even in the small towns Mr. Farr thinks there is room for two men to devote their entire time to the merchandising of electrical goods, others to do contracting and installation of such equipment.

Stoker Producers' Annual Meeting Date Changed

Because of conflicting dates with meetings of other societies, the Stoker Manufacturers' Association, J. G. Worker secretary, Phoenix Manufacturing Company, Eau Claire, Wis., has changed the date of its annual conference to June 14, 15 and 16 at the Red Lion Inn, Stockbridge, Mass. The program is not yet in a completed stage.

The British-American Metals Company, Inc., will move its general offices from 52 Vanderbilt Avenue to larger quarters at 200 Broadway, New York City, about May 2.

The Green Fuel Economizer Company about May 1 will move its general sales office and engineering department from 90 West Street, New York City, to the factory at Beacon, N. Y. The New York sales office will remain at 90 West Street, and Mr. Brinkerhoff will continue in charge.

The Esterline Company, Indianapolis, manufacturer of graphic recording instruments, announces the appointment of Walter W. Gaskill, 141 Milk street, Boston, as New England representative of the company.

The Bryant Electric Company, Bridgeport, Conn., announces the removal of its New York office to larger quarters in the Canadian Pacific Building, 342 Madison Avenue. George H. Williams will continue in charge.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, announces that its Atlanta branch office is now at 1508 Candler Building, where Thomas W. Peters, branch manager for the Southern territory, will make his headquarters.

The Diamond Electric Specialties Corporation, Newark, N. J., announces the removal of its Chicago office on May 4 to 43-45 South Wells Street. This change is made necessary owing to the need of additional space to take care of its increasing Western business and to permit carrying a greatly enlarged stock of Diamond flashlights and batteries.

The National X-Ray Reflector Company, Chicago, announces the appointment of Walter Hall as resident engineer for Indiana and southern Illinois, with offices at 305 Merchants' Bank Building, Indianapolis, Ind.

The Advance Electric Company, St. Louis, announces that it has completed arrangements for a sales agency and office with the Direct Equipment & Engineering Corporation, 50 Church Street, New York City.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, announces that its New York branch office, formerly at 141 Broadway, is now in the Printing Crafts Building, Eighth Avenue and Thirty-third Street. In order to co-operate more closely with its jobbers in this territory a service station has been established at the same address, where a complete stock of parts will be carried. C. R. Lundane is manager of the New York territory. The Detroit branch office has been removed from 19 Selden Avenue to 27 Watson Street. C. G. Odell is in charge of the Detroit district.

The National Wiring & Protective Company, 801 Flushing Avenue, Brooklyn, N. Y., has filed notice of increase in capital stock from $6,000 to $50,000.

The Thomas & Holben Electrical Repair Company, Allentown, Pa., recently incorporated, is planning to establish a plant at 1035 Hamilton Street for the repair of electrical equipment, armature rewinding, repairing machinery, etc. W. F. Holben is president.

The Baker R & L Company has removed its Cleveland office from the Leader-News Building to 2180 West Twenty-fifth Street.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number

A trading corporation in France (No. 34,750) desires to secure an agency on commission for the sale of electrical and other industrial supplies.

An engineer in the Netherlands (No. 34,751) desires to purchase a quantity of copper cable for double electric tram lines of about 60 kw., etc.

Foreign Trade Notes

ELECTRIC STEEL MILL FOR BRAZIL. —A decree authorizing the Federal Minister of Agriculture, Industry and Commerce to enter into a contract with the Brazilian Electric-Metallurgical Company for the construction of a steel mill equipped with electric furnaces was published in the *Official Gazette* of March 5, 1921. The importation of materials, such as machines, motors, furnaces, etc., will be free of duty for a period of thirty years, and permission is granted for the use of waterfalls belonging to the federal government.

USE OF INTERNAL-COMBUSTION ENGINES in BELGIUM.—According to advices from the American Consulate at Antwerp, there is a large use of internal-combustion engines in Belgium. The Diesel engines are used extensively for ship propulsion and sometimes for foundries and lighting purposes, most of the importations coming from Sweden, Germany and England. At the same time, there is a tendency toward the increase of electric drive for smaller plants.

WATER-POWER RESOURCES OF GREECE.—In a report to the Bureau of Commerce, William P. George, Vice-Consul at Athens, Greece, states that in 1917 the Greek government expropriated conditionally all rights connected with the use of water-power in the kingdom. A tentative estimate of the water-power resources of the country has placed the horsepower available at 497,500. The government, it is understood, is open to any reasonable offer by foreign capital to exploit these resources. Such capital will receive assistance from local banks or otherwise.

THE NATIONAL FOREIGN TRADE COUNCIL, 1 Hanover Square, New York City, has issued a pamphlet entitled "Commercial Possibilities of the Union of South Africa." This publication is a survey of the recent industrial expansion and the mineral and agricultural resources of a market presenting great possibilities for American enterprise. A copy may be obtained on request to O. K. Davis, secretary, 1 Hanover Square, New York City.

ELECTRIFICATION OF RAILWAY BETWEEN RIGA AND KEMMERN LATVIA, PROPOSED.—According to reports to the Bureau of Commerce, a group of foreign capitalists has begun negotiations with the Town Council of Riga Strand and the Ministry of Communications regarding the electrification of the railway between Riga and Kemmern (the seaside). It is proposed to utilize the present tracks and run storage-battery trains, the only equipment needed to be ordered from abroad. The Railway Administration contemplates equipping the Libau station and depots for electrical operation, energy to be obtained from the Libau naval port. The cost is estimated at 6,000,000 German marks.

EXTENSION TO WATER-POWER DEVELOPMENT IN CATALONIAN PYRENEES. The Sociedad Productora de Fuerzas Motrices, which was organized to develop the water power of the falls in the Catalonian Pyrenees in Spain to generate electricity on a large scale, according to the *Electrical Industries*, London, England, is issuing 10,000 7 per cent bonds of 500 pesetas each ($96.50 in United States money). The proceeds are to be used mainly for the extension of the works at Pobla de Segur Falls and the completion of those at the Cledes Falls.

NEW ELECTRIC PROJECT IN TAIWAN, CHINA.—Consul Dooman, Taihoku, Taiwan, China, reports that a company to be known as the Taiwan Electrical & Industrial Company, Ltd., is to be organized with a paid-up capital of 6,000,000 yen. The company proposes to supply energy from its hydro-electric plant at Giran to the Taiwan Electric Power Company, which has the sole right to distribute electricity for lamps and motors in Taiwan. Later it plans to undertake the production of cement, lumber, pulp and other commodities which would utilize electricity to operate the works

New Apparatus and Publications

INDUSTRIAL TRACTOR.—The Elwell-Parker Electric Company, Cleveland, has a new electrically propelled tractor for the market.

PUMPS.—"Ten Years' Progress in Water Works Pumps" is a 100-page publication of the De Laval Steam Turbine Company, Trenton, N. J.

OUTDOOR SWITCHING. — "The Skeet Switch and Skeet Transformer Station," an eighteen-page publication, has been issued by T. J. Johnson, Jr., Electric and Gas Building, Atlanta, Ga.

BRITISH HANDBOOK — "The Electrician' Electrical Trades Directory and Handbook for 1921" has been published by Benn Brothers, Ltd., 8 Bouverie Street, London E. C. 4.

HYDRAULIC VALVES.—Bulletin No. 52 has been issued by the Wellman-Seaver-Morgan Company, Cleveland, entitled "The W-S-M Balanced Plunger Hydraulic Valve," a new product developed by the company.

STOKERS.—The Files Engineering Company, Inc., Providence, R. I., is distributing a sixteen-page booklet covering its hand-operated Files stokers.

ELECTRIC RANGE.—Landers, Frary & Clark, New Britain, Conn., has issued a four-page leaflet describing its new Universal electric range.

ELECTRIC FANS.—The Knapp Electric & Novelty Company, 511-513 West Fifty-first Street, New York City, is distributing a four-page leaflet describing its new "Limo-Sedan" fan.

STEAM TURBINES.—Bulletin No. 42,201-B has been issued by the General Electric Company, Schenectady, N. Y., entitled "Curtis Steam Turbines" and describing these turbines of 100 kw. to 3,500 kw. capacity.

METERS.—Bulletin 55 of the Sangamo Electric Company, Springfield, Ill., describes new types of current and potential transformers for use with their alternating-current watt-hour meters and new developments in the company's rotating standard.

FURNACES. — The Electric Furnace Company, Alliance, Ohio, is distributing a seventy-page booklet of its Baily electric furnaces.

FITTINGS.—The Appleton Electric Company, 1701 Wellington Avenue, Chicago, has brought out a line of outlet-box covers with swivel fixture joints, a "Unilet" swivel fixture joint and a combination hickey and swivel fixture joint. A bulletin is in preparation.

THE BLEADON-DUNN COMPANY, Chicago, has issued a bulletin describing its newest product, a small-size violet-ray machine.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, is distributing price book No 52, applying to Emerson small motors, effective April 15. No price changes are listed, the book containing only revised data, latest-type designations and late information on stock types.

SOLENOIDS.—"C-H Iron-Clad Solenoids" is the title of a new leaflet being distributed by the Cutler-Hammer Manufacturing Company, Milwaukee, describing electric solenoids for operating breaks, etc.

BURN DRESSING. — The Industrial Products Company, Philadelphia, has recently placed on the market an instantaneous dressing for burns and scalds of all kinds.

SURGE ARRESTER.—The Electro Service Company, Marietta, Ga., is distributing bulletin No. 3-D, covering the Bennett surge arresters.

SUPERHEATERS. — The Superheater Company, 17 E. Forty-second Street, New York, is distributing bulletin No. T-7, entitled "Superheaters for Stationary Power Plants."

ELECTRICAL SUPPLIES. — The Wetmore-Savage Company, 76 Pearl Street, Boston, has just received its new 1921 general supply catalog of 1,500 pages for distribution to the trade in New England only.

MOTOR STARTERS. — The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1,114, entitled "Type 'R' Potential Starters for Squirrel-Cage Induction Motors."

BATTERY AND SERVICE STATION EQUIPMENT. — The H. B. Shontz Company, Inc., 161-167 West Sixty-fourth Street, New York City, factory distributer of supplies and equipment for storage-battery service stations and auto electrical repair men, is distributing its 1921 catalog, covering its battery and electrical service station supplies.

REFRIGERATION.—The Clothel Company, 61 Broadway, New York City, has issued a forty-eight-page booklet describing the "Clothel" system of mechanical refrigeration.

New Companies

THE J-E BATTERY & SUPPLY COMPANY, Pittsburgh, Pa., has been incorporated by J. W. Daniels, W. H. Virgin, D. A. Mahoney and Austin L. George, 1,110 Park Building, to manufacture storage batteries, etc.

LONDON MOTORS, LTD., London, Can., has been incorporated with a capital stock of $1,000,000 by Thomas H. Griffith, W. R. Stansell and T. A. Conley. The company proposes to manufacture motors, engines, etc.

THE GLOBE ELECTRICAL FIXTURE MANUFACTURING COMPANY, Newark, N. J., has been incorporated with a capital stock of $10,000 by Pemberton Dudley, Fred Wilson and William H. Freeman. The company proposes to manufacture electric fixtures and other electrical equipment.

THE JOHN A. STANDISH MANUFACTURING COMPANY, Bloomfield, N. J., has been incorporated by Charles J. Flessa, Edward Maguire and Howard I. Edge, 134 South Oxford Street, Brooklyn, N. Y. The company is capitalized at $5,000 and proposes to manufacture electrical equipment.

THE SUNSET FIXTURE COMPANY, New York, N. Y., has been incorporated by A. C. Mandel, J. J. Lazaroe and E. Goodman, 1480 Washington Avenue, Bronx. The company is capitalized at $20,000 and proposes to manufacture lighting fixtures and other electrical products.

THE BEDFORD LAMP WORKS, Brooklyn, N. Y., has been incorporated with a capital stock of $15,000 to manufacture incandescent electric lamps. The incorporators are S. E. Gertler, C. G. Katz and A. Adler, 411 Bedford Avenue.

THE NATIONAL ELECTRICAL CORPORATION, Whitman, Mass., has been incorporated by Harold B. Huntley, Harry G. Barnes and J. M. Hathaway. The company is capitalized at $5,000 and proposes to manufacture electrical equipment.

THE JAMAICA ELECTRIC SERVICE & EQUIPMENT CORPORATION, Jamaica, N. Y., has been incorporated with a capital stock of $10,000 by P. and P. J. and K. Guthy. The company proposes to manufacture electrical appliances and equipment.

GEORGE B. BANKS, INC., New Rochelle, N. Y., has been incorporated by F. G Schrenkeisen and A. D. and G. B. Banks, 320 Fifth Avenue. The company is capitalized at $100,000 and proposes to manufacture electrical machinery.

THE AMERICAN LIGHTING & MANUFACTURING COMPANY, 800 Sibley Street, Chicago, Ill., has been incorporated with a capital stock of $100,000 by W. J. Davis, F. E. Davis and W. O. Turtle, 811 Sheridan Road. The company proposes to manufacture electric lighting equipment and appliances

THE CARMEAN ELECTRIC COMPANY, Kansas City, Mo., has been incorporated to manufacture an electrical heater which can also be used as a ventilating fan. S. M. Carmean is president, W. H. Nance vice-president, Edward E. Naber secretary and H. P. Bowman treasurer.

THE SMITH ELECTRIC COMPANY, LTD., Sarnia, Ont., has been incorporated by Harry Smith, Leonard H. Darbyshire, Sarnia; Frank O. Smith, Petrolea, and others. The company is capitalized at $40,000 and proposes to manufacture electrical machinery, equipment, etc.

Record of Electrical Patents

Notes on United States Patents

(Issued April 5, 1921)

1,373,928. REGULATOR FOR ELECTRIC GENERATORS; Fred H. Winter, Schenectady, N. Y. App. filed Sept. 11, 1918. Vibratory type.

1,373,931. RADIO RECEIVING SYSTEM; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed June 5, 1919. Continuous wave signals.

1,373,951. STORAGE-BATTERY INDICATING DEVICE; Clare C. Cox and George W. Lentz, Indianapolis, Ind. App. filed March 11, 1918. Graphic hydrometer.

1,374,003. RECLAIMING DRY BATTERIES; Carleton Ellis and Alfred A. Wells, Montclair, N. J. App. filed Sept. 29, 1917. Leclanché type.

1,374,041. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Dec. 18, 1917. Lighting of railway cars.

1,374,042. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Jan. 25, 1917. Car lighting.

1,374,043. SYSTEM OF ELECTRICAL DISTRIBUTION; William A. Turbayne, Niagara Falls, N. Y. App. filed Jan. 27, 1917. Lighting of railway cars.

1,374,047. TROLLEY POLE; Martin D. Watrous, Ansonia, Conn. App. filed Jan. 17, 1921. Trolley-wheel support free to rotate to limited extent.

1,374,076. PROCESS OF MAKING STORAGE-BATTERY PLATES; William H. Grimditch, Philadelphia, Pa. App. filed July 24, 1920. Positive plates of uniform composition.

1,374,080. ELECTRIC CURRENT GENERATOR FOR ARC CIRCUITS; Joseph A. Holifield, Mobile, Ala. App. filed Feb. 17, 1920. For electric welding and motion-picture machines.

1,374,091. DEVICE FOR HEATING BY ELECTRICITY; Antonangelo Negromanti, Milan, Italy. App. filed Oct. 4, 1920. Circulating fluid.

1,374,117. TROLLEY CONSTRUCTION FOR BARBERS' ELECTRICAL EQUIPMENT; Joseph A. Shelton, Henderson, Ky. App. filed Aug. 14, 1919. Current supplied to any chair.

1,374,119. PROCESS OF CATALYSIS; Elbridge W. Stevens, Baltimore, Md. App. filed March 18, 1920. Maintaining clean surfaces and effective catalytic action.

1,374,122. PROCESS FOR DYEING AND WATERPROOFING; Alfred O. Tate, New York, N. Y. App. filed April 20, 1920. Aniline dyeing.

1,374,123. PANELBOARD FITTING; George B. Thomas, Bridgeport, Conn. App. filed Dec. 12, 1917. Protective cover.

1,374,152. TELEGRAPH TRANSMITTER; Charles L. Krum and Howard L. Krum, Chicago, Ill. App. filed Nov. 29, 1909. Improved transmitter.

1,374,165. POTENTIAL-REGULATING SYSTEM; Harry L. Tanner, Brooklyn, N. Y. App. filed Nov. 2, 1915. Gyroscopic compass.

1,374,168. CORRUGATED DRY-BATTERY CUP; Adolph C. Recker, Oakville, Conn. App. filed Sept. 20, 1919.

1,374,170. GENERATING SYSTEM FOR ELECTRIC CURRENTS; August J. Kloneck, New York, N. Y. App. filed March 27, 1916. Oscillations of high frequency.

(Issued April 12, 1921)

1,374,171. ELECTRIC MOTOR; George W. Amann, Jr., Little Black, Wis. App. filed Dec. 21, 1917. Reciprocating.

1,374,179. TELEMOTOR; Melvin B. Benson, Superior, Wis. App. filed Dec. 27, 1916. Steering gear for vessels.

1,374,180. TELEMOTOR; Melvin B. Benson, Superior, Wis. App. filed Dec. 29, 1916. Steering gear for vessels.

1,374,184. TELEPHONE SYSTEM; Ernest C. Britton, New York, N. Y. App. filed July 9, 1917. Machine switching.

1,374,188. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed May 11, 1918. Trunk-line circuits.

1,374,192. SELECTIVE SYSTEM; Almos F. Dixon, Newark, N. J. App. filed July 2, 1917. Printing telegraphy.

1,374,201. SELECTOR; John A. Hall, Bayside, N. Y. App. filed Sept. 19, 1919. Automatic telephone.

1,374,202. HEATING UNIT FOR WASHING MACHINES; Irvin H. Harris, Evanston, Wyoming. App. filed Jan. 14, 1920.

1,374,219. COMPOSITE TRANSMISSION SYSTEM; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraph signals over same conductors.

1,374,220. COMPOSITE SIGNALING SYSTEM; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraph communication over same conductors.

1,374,221. COMPOSITE PHANTOM CIRCUITS; Harold S. Osborne, New York, N. Y. App. filed Feb. 12, 1919. Telephone and telegraphic communication over same conductors.

1,374,230. TEMPERATURE CONTROLLER; Fred J. Petrovics, Chicago, Ill. App. filed July 17, 1920. For sadirons, curling irons, etc.

1,374,235. X-RAY PHOTOGRAPHING APPLIANCE; Gordon E. Richards, Toronto, Ontario, Canada. App. filed June 20, 1919.

1,374,237. ELECTRIC GAS GENERATOR; Rudolf Rosner, Chicago, Ill. App. filed June 17, 1920. For killing germs.

1,374,241. RHEOSTAT; William Schwagermann, Yonkers, N. Y. App. filed June 27, 1917. Dial type.

1,374,260. GENERATING SYSTEM; Charles White, East Orange, N. J. App. filed Oct. 23, 1918. Telephone system.

1,374,285. ELECTRIC REGULATOR; Rhys Davies, Fort Wayne, Ind. App. filed May 9, 1919. Socket rheostat.

1,374,293. WIRELESS DIRECTION FINDER; Reginald A. Fessenden, Chestnut Hill, Mass. App. filed July 28, 1919.

1,374,317. PROCESS AND APPARATUS FOR THE MANUFACTURE OF CARBIDES AND DERIVATIVES THEREOF; Fred E. Norton, Worcester, Mass. App. filed April 1, 1918. Electric furnace.

1,374,332. RHEOSTAT; Clarence C. Stirling, Hartford, Conn. App. filed Jan. 14, 1920. Compression.

1,374,366. TELEPHONE SWITCH; George W. Dickerson, Galion, Ohio. App. filed June 26, 1916. Telephone exchange.

1,374,381. CONNECTING RAILS; John C. H. Lubken, Westmont Borough, Pa. App filed Dec. 12, 1919. Bonding.

1,734,404. AUTOMATIC ARC REGULATOR; James E. Soons, New York, N. Y. App. filed Nov. 15, 1919. Will maintain uniform length of arc.

1,374,411. FLASHLIGHT; George V. C. Vreeland, East Orange, N. J. App. filed Nov. 22, 1919. Switch mechanism.

1,374,414. ELECTROMEDICAL BRUSH; Henry Weiss, New York, N. Y. App. filed July 25, 1919.

1,374,453. ELECTRIC RIVET HEATER; Frederick T. Kitt, Seattle, Wash. App. filed Aug. 26, 1919. Jaws receive rivets of different lengths.

1,374,477. STORAGE-BATTERY PLATE OR ELECTRODE; Edward W. Smith, Philadelphia, Pa. App. filed Sept. 4, 1918. Metallic rods surrounded by active material.

1,374,521. SYSTEM OF CONTROL; Laurence M. Perkins, Swissvale, Pa. App. filed Nov. 16, 1917. Single-phase commutator machines.

1,374,529. CONNECTOR PLUG; Frank L. Simmons, Woonsocket, R. I. App. filed Feb. 1, 1918. For use with magnetic chucks.

1,374,534. CIRCUIT-INTERRUPTING DEVICE; Norman W. Storer, Pittsburgh, Pa. App filed Jan. 6, 1917. No movable parts.

1,374,535. SYSTEM OF CONTROL; Norman W. Storer, Pittsburgh, Pa. App. filed Sept. 28, 1917. High-voltage railway.

1,374,537. STRUCTURE FOR TROLLEY-WIRE FITTINGS; Nils J. A. Wahlberg, Pittsburgh, Pa. App. filed Aug. 7, 1917. Splicers, frogs, strain supporters, etc.

1,374,541. ELECTROLYTIC PROCESS; Frederick S. Woodward, Richmond Hill, N. Y. App. filed July 25, 1919. Copper deposition.

1,374,557. ARC-WELDING SYSTEM; Otto H. Eschholz, Wilkinsburg, Pa. App. filed Feb. 15, 1919. Alternating current.

1,374,558. ELECTRIC RANGE; Frank F. Forshee, Flint, Mich. App. filed Sept. 25, 1919. Thermostat mounted in oven door.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

ALBANY, N. Y.—Plans have been prepared for the construction of a one-story power house at the local works of Swetzer & Bainbridge, Inc., Tivoli Street.

BATAVIA, N. Y.—Plans are under way for the extension of the lines of the Genesee Light & Power Company to furnish electrical service in Alexander and Pembroke.

BROOKLYN, N. Y.—The Brooklyn Edison Company has been authorized to issue $750,000 in bonds for the construction of a generating plant on Marshall Street near the Brooklyn Navy Yard.

LITTLE FALLS, N. Y.—The installation of an ornamental lighting system on part of Main Street is under consideration.

GLOUCESTER, N. J.—Plans are under way for the reconstruction of the municipal waterworks system at a cost of about $170,000. Plans provide for the installation of electrically operated equipment, including two high-pressure-type pumps and two of low pressure, and the construction of a filtration plant.

SEA ISLE CITY, N. J.—The Board of Public Utility Commissioners has approved the sale of the plant of the Electric Light & Power Company of Sea Isle City to the municipality for $67,000.

TRENTON, N. J.—All bids received for lighting Upper Stacy Park have been rejected by the City Commission, and new bids will be asked. Commissioner Fell is in charge.

HAZLETON, PA. — The Pennsylvania Power & Light Company, Allentown, plans to extend its lines to connect with the system of the Lehigh Traction Company with which it has an agreement to supply power. Service will be furnished from the Harwood plant.

MIDDLEBURG, PA. — The Middleburg Light, Heat & Power Company has filed notice of $40,000 increase in its capital stock.

PHILADELPHIA, PA.—The Department of Public Works is having plans prepared for the construction of a switchboard department and motor building at Lycoming and O Streets.

HUNTINGTON, W. VA.—Arrangements are being made by the Consolidated Light, Heat & Power Company for an increase in its capital stock from $530,000 to $865,000 to provide for proposed extensions, improvements, etc. W. W. Perkins is secretary.

BUCHANAN, VA.—The Buchanan Light & Water Company contemplates the construction of a steam power plant, 38 ft. x 75 ft., including a flight conveyor-type coal hoist, installation of a 1,200-hp. boiler, etc. L. Hudson, Wabash Building, Pittsburgh, Pa., is engineer.

EDINBORO, VA.—Plans are under way for the construction of a power house to cost about $50,000, at the State Normal School. Cody, Hicks & Davidson, Ariol Building, Erie, Pa., are architects and engineers.

HALIFAX, VA.—Work is under way on the construction of a hydro-electric plant on the Bannister River by the Halifax Power Company, to develop 1,350 hp. for service in Halifax and South Boston. Present plans provide for an increase of from 8-ft. head of water to 25-ft. The cost of the work is estimated at $350,000. W. C. Whitney & Company, Richmond, are consulting engineers and contractors.

North Central States

HOLLAND, MICH.—The installation of ornamental lamps is under consideration by merchants on Eighth and River Streets.

LANSING, MICH.—Plans are being prepared for the proposed new municipal electrical plant, 150 ft. x 245 ft., to cost about $500,000. The initial installation will pro-

vide for about 55,000 kw. Woodwell & Resler, 501 Fifth Avenue, New York City, are engineers.

BOWLING GREEN, OHIO.—The installation of a cluster lighting system in Bowling Green has been recommended to the Council by the Kiwanis Club.

CINCINNATI, OHIO. — The Cincinnati Traction Company has applied to William C. Culkins, director of street railways, for approval of an expenditure of $380,000, preparatory to purchasing energy from the Union Gas & Electric Company. The plans include the equipment of seven transformer stations in different parts of the city. Three of the stations will work automatically. The contract for the purchase of power goes into effect in September.

GALION, OHIO.—Improvements to the municipal electric light plant are contemplated.

LOUISVILLE, KY. — Plans are under consideration by the Louisville Gas & Electric Company for the construction of another power plant at the waterside station, to cost between $2,500,000 and $3,000,000.

SULLIVAN, IND.—The Community Club has appointed a committee to confer with the Wabash Electric Company regarding improvements to the lighting service in Sullivan. It is proposed to replace the arc lamps now in use with modern lamps and install cluster lamps in the business section of the city.

JACKSON, MINN.—The question of issuing $13,500 in bonds for the installation of an ornamental lighting system in Jackson is under consideration.

DENISON, IOWA.—The citizens of Dow City and Arion have petitioned the Council to extend the municipal electric lighting service to those towns.

DELPHOS, KAN.—Bonds to the amount of $30,000 have been voted for municipal lighting purposes.

ELLINWOOD, KAN. — Bonds to the amount of $40,000 have been voted for improvements to the municipal light and water plant.

Southern States

ALBOSKIE, N. C.—The Council is considering an issue of $40,000 of electric light and water bonds.

CORNELIUS, N. C.—Arrangements are being made for an issue of electric light bonds to the amount of $1,000.

RANDLEMAN, N. C.—Arrangements are being made by the Council for an issue of bonds for the purchase of the plant of the Randolph Power Company. Extensions and improvements are contemplated.

MARIANNA, FLA.—G. M. Thomas contemplates the construction of a hydro-electric plant to develop 200-hp. The plans provide for the erection of transmission lines, installation of generators and waterwheels. The Albany Electro Company, Albany, Ga., is engineer.

SAFETY HARBOR, FLA.—The Borough Council is considering an issue of $10,000 in bonds for an electric lighting plant.

SEBRING, FLA.—Bonds to the amount of $250,000 have been voted for improvements to the electric light plant and waterworks, etc.

BIRMINGHAM, ALA.—The board of directors of the Civic Association has adopted resolutions approving the installation of an ornamental lighting system on Fifth Avenue.

BELZONI, MISS.—At an election to be held in May the proposal to issue $25,000 in bonds for improvements to the municipal light and water plant will be submitted to the voters.

BILLINGS, OKLA.—Contract has been let to the Oklahoma Gas & Electric Company to furnish electricity for lamps and motors in Billings.

CHEROKEE, OKLA.—Bonds have been voted for the construction of a transmission line from the municipal electric plant in Cherokee to supply electricity to the towns of Jet and Nash.

LAWTON, OKLA.—The Lawton Railway & Lighting Company contemplates extending its line from Fort Sill to Medicine Park, a distance of 9 miles. The cost is estimated at $300,000.

PADEN, OKLA.—Bonds to the amount of $8,200 have been voted for improvements to the electric light plant.

YALE, OKLA.—Plans are under way for the installation of an ornamental lighting system in Yale.

SAN ANGELO, TEX.—The San Angelo Water, Light & Power Company plans to double the output of its plant, including the installation of a 500-hp. engine and generator, to cost about $70,000. The company also plans to construct a transmission line to the State Tuberculosis Sanitarium and into Concho and Colorado River Valleys to supply electricity to operate irrigation pumps.

EDINBURG, TEX.—The City Commissioners have voted to submit to the people a proposal to issue $100,000 in bonds for electric lamps, improvements to waterworks, etc.

Pacific and Mountain States

PULLMAN, WASH. — Bids will be received soon, it is understood, for the installation of a new boiler and generators for the heating system of the new gymnasium at the Washington State College.

SPOKANE, WASH.—Investigation of the power possibilities of Kettle Falls on the Columbia River in Stevens County, 72 miles north of Spokane, is being made by the Washington Water Power Company with a view to purchasing a power site.

SPOKANE, WASH.—A contract has been let by the Chelan Falls Power Company for the construction of a 30-ft. dam across the Chelan River at its narrowest point for $40,000. The plans provide for an initial installation of 1,250 hp.

TACOMA, WASH.—Preliminary investigations have been started, of the rock gorge at the Lake Cushman power site, where the city proposes to locate the great impounding dam of the project.

TACOMA, WASH.—Investigation is being made of the possibility of supplying electricity to residents of Spanaway, Brookdale and vicinity. Ira S. Davisson is commissioner of the light department.

VANCOUVER, WASH.—The City Council has granted the Northwestern Electric Company a fifty-year franchise to install and operate a distribution system in Vancouver and surrounding territory. The company is now installing an 11,000-volt, three-phase cable on the S. P. & S. Railroad bridge, which will tap one of the overhead distribution lines of its Portland system. The transmission line from the company's hydro-electric plant on the White Salmon River will be extended from Camas to Vancouver to tie in with the new system there. A distribution system will be installed as soon as possible within the city.

WENATCHEE, WASH. — Norwood W. Brockett of Seattle has applied for a franchise to erect electric power lines in Wenatchee and over all roads of Chelan County.

LOS ANGELES, CAL.—Application has been made by the Green River Power Company, Pacific Electric Building, to the Federal Power Commission for a preliminary permit to develop all the water power in Green River from a point near Green River, Wyo., to its junction with Grand River in Utah, for public utility purposes.

LOS GATOS, CAL.—The installation of a new lighting system in Los Gatos is under consideration.

SAN FRANCISCO, CAL.—Roy C. Hackley has applied to the State Water Commission for 500 cu.ft. per second direct diversion, 50,000 acre-ft. per annum for storage from Middle Fork of Feather River, tributary to Feather River, Butte County, for power purposes. The plans provide for the development of about 23,984 hp. Diversion will be made by means of a concrete dam. The cost is estimated at $1,500,000.

VENICE, CAL. — The Pacific Electric Railway Company, Los Angeles, is considering the construction of a subway or elevated railway through Venice, Ocean Park and Santa Monica.

LOGAN, UTAH.—The City Commission is considering the advisability of installing meters to replace the present flat-rate system.

PANGUITCH, UTAH.—The city officials are considering the purchase of the 100-hp. plant of the Telluride Power Company on Panguitch Creek, from which the municipality is supplied with electrical service.

PAYSON, UTAH. — The City Council is considering the extension of the municipal lighting system to Spring Lake. Electrical service is also being sought by other suburban sections of Payson.

SALT LAKE CITY, UTAH.—The Utah Copper Company contemplates the construction of an electric generating plant to supply electricity for its local properties. The initial installation will have a capacity of 55,000 kw.

GRANGEVILLE, IDAHO — Application has been made to the Federal Power Commission by the Grangeville Electric Light & Power Company for license to construct a dam, conduit and power house in the south fork of the Clearwater River for public utility purposes.

IDAHO FALLS, IDAHO.—Contract has been awarded to the Wellman, Seaver & Morgan Company, Cleveland, for two 500-kw. generating units for the municipal electric plant, at $34,950.

Canada

ST. JOHN, N. B.—The New Brunswick Electric Power Commission, it is reported, will receive new bids for the construction of the power house in connection with the Mushquash development.



THE BOWL AND PITCHER RAPIDS, THREE MILES BELOW SPOKANE

Eight years ago the Spokane Valley Power Company was organized and obtained the necessary rights and areas for dam and building site at this point, together with the lands covered by the overflow. Plans have since been prepared for a 65-ft. dam. A lake 3 miles long will be formed, and as this will cover a section of the area comprising Fort George Wright it was necessary to have federal legislative permission. This has now been accomplished, and it is expected that a definite move toward the erection of the power plant will be taken shortly. The accompanying view of the rapids has not hitherto been published.

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A Business Man's Defense of Public Utilities

EDWARD N. HURLEY'S speech before the Chamber of Commerce of the United States of America at Atlantic City last week was most excellent and salutary. While he spoke as a business man to business men, no operator could have presented the public utility case better or added much to the vigor of the argument; and it is certainly a matter of congratulation that the electrical industry has so stanch a friend and supporter as Mr. Hurley. As former head of the Federal Trade Commission and of the United States Shipping Board, Mr. Hurley's testimony on the efficacy of government ownership and operation was as frank as his strictures were damning. In his estimation there should be erected across all roads leading to government ownership danger signs reading, "This way leads to inefficiency and failure." Mr. Hurley has little patience with those who on account of misunderstanding or of the shortcomings of utilities advocate municipal ownership, because he is convinced that municipal or governmental ownership will not give the relief desired. Hence his plea that unless the public, the state commissions and the utility corporations work together and create that measure of confidence which will influence people to invest in utility securities further development of electrical utilities by private initiative will be arrested to the detriment of the entire country. But, while asking for justice for the utilities, Mr. Hurley is just as insistent that the utilities give service that will merit fair or better treatment, and we trust that this part of his utterance will not fall on deaf ears.

Plans of the Colorado River Commission

THE electrical utilities of the Southwestern States have a most vital concern with the actions and plans of the newly formed Colorado River Commission, and they should not delay in making this plain. This commission has been fostered by the League of the Southwest, which is composed of representatives of the seven states in which the Colorado River basin lies, and, as now constituted, it consists of the state engineers of these states and engineers from the Reclamation Service. It is proposed, and perhaps rightly, that the further development of the Colorado be primarily for irrigation purposes, the generation of power to come after all the requirements entailed by the control of a stream for irrigation have been taken care of. The director of the Reclamation Service has stated that the division of power developed will be made in the following order: First, for pumping of irrigation water on the projects; second, for municipal uses by towns in the projects; third, for the use of other municipalities, and, fourth, for sale to industries, etc. In the plans thus far contemplated by the commission the generation of power will be the last thing considered. But it is not the last thing which should be considered. In California particularly the power available from the Colorado River will in years to come be the mainstay of industrial progress. The undeveloped hydro-electric power in that state is not unlimited. At present rates of growth the larger sites will have been well developed in fifteen years, and recourse must then be had to the power of the Colorado. It is not reasonable to infer that at that time the supply of electrical service to the industries and farms of the state will be turned over to the municipalities for further exploitation. It therefore is urgent that the utilities, perhaps through the National Electric Light Association, be ably represented upon the Colorado River Commission and see to it that the needs of the electrical industry shall receive due consideration from the standpoints of adequate electric service and the upbuilding of industries and communities depending upon that service.

Central-Station Profits that Stay Afloat

THERE is a lingering thought in the fact that the selling of appliances by central-station companies is a business that floats on the tide. Costs may rise and fall, but a margin of profit remains. No inflexible rate schedule strangles profit when expenses are abnormal. As costs go up prices proportionately advance and the business still pays as it should, and in times of stress added effort in this department may retrieve much ill fortune. Surely this is something to be carefully considered. Sales department policies and appropriations should be shaped not alone on experience purely local but with a mind to future needs and proved possibilities elsewhere. Electric labor-saving household appliances are fast becoming staples in the homes of every city. A prosperous store that stimulates the demand is a help in building revenue and defining service in a practical way.

Conservatism Marks English Plans for Power Supply

PLANS for consolidating the power supply in England, which include the building of superpower stations and the shutting down of inefficient sources, have been progressing somewhat deliberately, but nevertheless to good purpose, and the latest advices show that they are measurably near to producing results. For convenience there will be two general stages of operations. Under the first stage, while superpower stations are being built, there will be merely the opportunity to shut down thirty-four conspicuously inefficient plants, supplying the necessary output by wholesale purchase from the

remaining plants. When the superpower stations come along twenty-six more plants of lesser commercial efficiency will follow the first group, leaving seventeen of a higher type temporarily to continue. Gradually, as superpower stations come into full action, part even of this number will be dispensed with, only a few remaining to serve as auxiliaries to the greater project. Existing stations for railway purposes will be continued, although new electrifications will be carried out from the general power supply. The whole question of railway electrification is in so unsettled a condition that it is a material obstacle in the unification of electrical supply.

The existence of a large bulk of power supply which ultimately must be in the form of direct current of indeterminate voltage must be dealt with as an existing fact. This introduces a somewhat troublesome economic factor in any consideration of superpower projects, which must in the long run have much to do with railway electrification.

Improper Fusing of Fuse Plugs

JUDGING from the following incident, there is need for some popular education in safe uses of electricity. Apparently the bridging of fuses with copper coins is quite common, so common in fact that some means ought to be found to check the practice. "One morning last week," writes an inspector, "I took some time off and inspected one block of the business district just to see how the electrical work is, and from a financial standpoint I did very well, having gathered twenty-three pennies from the back of plug fuses to say nothing of pieces of copper." Sitting on the safety valve ought to be a penal offense, but the great difficulty is to prove the crime. It is hard to attribute the practice to ignorance. We can believe that a woman will connect to a lamp socket a device which will overload it because she doesn't know any better, or leave a flatiron in circuit on a table through carelessness, but any one putting a cent in a fuse plug knows what he is doing and why. He is an enemy to society in that he willfully makes non-effective safety devices installed for public protection. Such a person should be incarcerated. No other punishment fits the crime.

Working with the Metallurgical Engineer

IN MANY respects procedure in the various branches of the engineering profession runs along parallel lines. In dealing with specialized applications, however, there is an overlapping of fields, and the division of work among specialists is not always clear. Such a relation exists between the metallurgical and the electrical engineer where electric furnace problems are involved. Beginning as a metallurgical problem, the electric furnace has by the very magnitude of its application become a problem for the electrical engineer as well. Producing a metal with certain qualities is undoubtedly the work of an engineer who devotes his efforts to such investigation; but where the means of production depends upon a source of power such as electricity, it is natural that the electrical engineer, who is responsible for continuous production through this application, should be vitally interested.

To use the electric furnace successfully is very definitely an electrical problem as well as a metallurgical one. This is clearly shown by the marked interest taken in furnace development by the industrial electrical engineers of the country. Probably no engineering group has made a more comprehensive study of furnace characteristics than that made by the electrical engineers connected with the steel industry. Such study has overlapped the metallurgical field only far enough to determine the production methods affecting the electrical apparatus used, energy consumption and so forth. For example, the nature of material handled, the rate of production, the size of the unit or units needed to produce this output and the location of units with respect to the source of power and with relation to the production department are subjects for the mutual consideration of both the metallurgical and the electrical engineer.

It is often contended that even these subjects are in the field of the production department, but when one stops to consider the extent to which the use of the electric furnace adds new duties to the electrical department it is evident that the electrical engineer charged with the responsibility of electrical operation and maintenance of a large industry becomes a vital element of the production organization. In the past the production department too frequently selected electrical equipment on the basis of apparent production needs without much consultation with the electrical engineer. As a result machines were sometimes obsolete electrically before they had served their normal life from a production standpoint. Where a piece of apparatus as important as the electric furnace is involved, such questions as type of equipment to use, nature of installation and method of operation should be jointly answered by electrical and metallurgical engineers, and mutual responsibility should exist from the time the problem is first considered rather than start when the problem of operation to secure economical production is faced.

Regular Inspection Schedules a Necessity

MAINTENANCE that will prevent trouble rather than cure it is a money saver, both directly in preventing loss due to service interruptions and indirectly because of the confidence that good service gives to consumers. In too many plants, particularly the smaller ones, original designs are so worked out that it is impossible to inspect oil switches, buses and other parts of the installation without serious interruption to service. Inspection in these cases is usually of the sporadic, "when-we-can-get-to-it" type. It is expensive and generally is postponed until forced by a serious breakdown. Much of such maintenance work is relegated to the low-load hours after midnight or to Sunday, and it is done so hurriedly that it lacks effectiveness.

Inspection schedules such as that of the Syracuse Lighting Company, described elsewhere in this issue, are needed in every plant. While original design may make such schedules difficult, it is well to remember that there is opportunity from time to time, when heavy maintenance work must be carried out, to rearrange plant equipment in such a way as to permit better routine inspection and maintenance. Such arrangement does not always or even usually mean heavy investment in duplicate items like oil switches, buses and transformers. An air-break switch arranged to shunt an oil switch

for inspection purposes can be cheaply installed where duplicate switches are unwarranted. Proper sectionalization of buses, with light transfer buses to care for circuits while bus sections are cut out for inspection and maintenance, are cheap and usually easy to arrange. One spare transformer can be made to serve for two or more banks.

Every plant should have its routine inspection and maintenance system, and if inspection is difficult to carry out because of the manner in which the plant is designed, the responsible head should seize opportunities for inspection and maintenance as from time to time changes become necessary.

Maintaining Permanent Test Conditions

THERE is always supposed to be a very material difference between the everyday working condition of a plant and that maintained when it is undergoing tests. This difference means one of two things—either the conditions of an efficiency test cannot be practically maintained over considerable periods or else the plant is normally allowed to get into a more or less slovenly condition. However, it is possible to keep plant operation somewhere nearly up to the standards set in an acceptance test, and furthermore it pays to do so. The chief factor in keeping the whole plant tuned up is the maintenance of day-by-day records of just what every part of the plant is doing.

Reserved Police Power and "Scraps of Paper"

OVER and over again have state courts held, and over and over again have federal courts sustained them in so holding, that the reserved police power of the state delegated to a public service commission gives to that commission the power to alter contracts between public utilities and municipalities or between public utilities and private customers when the terms become unjust to either of the parties they were meant to bind, no possible infringement of the constitutional prohibition of legislation impairing contracts being involved. This is an outstanding fact in public utility jurisprudence that puts it, so to speak, in a class by itself.

It is unfortunate that the doctrine, which in its essence was reaffirmed at Washington a week or two ago by the highest court in the land, is so little understood by the people at large. The average man can readily see that justice is served when statutory rates which have become confiscatory are upset under the Fourteenth Amendment as the cause of deprivation of property without due process of law; but why fixed-term contracts entered into deliberately and duly signed, sealed and delivered should not have to run their term is beyond his comprehension. He demands to know why the Prussian doctrine of scraps of paper should be applied to such agreements and hotly asks what a breach of faith is if this be not one.

In the interest of good public relations, every utility in whose interest this police power is successfully invoked should issue a statement to every customer affected by the increased rate explaining the legal doctrine under which the contract has been changed, dwelling on the fact that this doctrine works both ways, and making it clear that in the interest of the customers themselves rates must be high enough to insure proper service and that to attempt to force individuals or stockholders to supply such service at a loss, under contracts based on beliefs which have since been proved fallacious, would be not only a futile but itself an unethical proceeding.

Just One Example of What Can Be Done with Electric Trucks

WHEN it is realized that one electric truck of about two tons capacity will handle the work formerly requiring five hand trucks, will do it more quickly, greatly facilitating prompt loading, and at singularly moderate expense, it becomes clear that a great change for the better has taken place. According to the experience at the Grand Central Terminal, New York, related on page 1041, not the least of the advantages of the electric truck is that the men who handle the baggage piled upon it are not exhausted by a sprint for the baggage car, but get there much more quickly than in the old days and fresh for the task of loading. The mere ability to get mails and baggage aboard at the last minute owing to the speed with which mechanical haulage does the work is a great convenience to the railways and to the public as well.

One remarkable feature of the situation is the way in which the trucks endure in service and the modest expense of operating them, considering the benefits gained. The first truck placed in operation at the Grand Central Terminal ten years ago is still in good condition on its daily job. There are now forty-six of the regular baggage trucks in operation besides five freight trucks of similar capacity. They are all two-ton trucks driven by a 2½-hp. motor, fed from a battery of nearly 200 ampere-hours capacity. All batteries are interchangeable and all are charged separately, none ever being out of commission waiting for a new battery. A truck is merely run up to the charging station, the old battery removed and a new battery is put in on a definite schedule.

Every month or so each truck receives an inspection in the maintenance repair shop, where necessary small repairs are made, the brakes, steering gear and control in particular being tuned up so that the machine will work with the utmost facility. About every two years a complete overhauling is given at the central shop, where machine tools are at hand and all the apparatus can be taken down for repair or renewal. The average life of the batteries has proved to be about twenty-seven months, and for the fifty-one trucks in use seventeen spare sets are kept at hand. Through all the service careful check is kept on the cost so that the expense of mechanical and electrical maintenance work is thoroughly well known. It amounted in 1919 to 26.3 cents per truck-mile, a little more than one-third of the total operating expense for the same year. All told this amounted to 72 cents per truck-mile. The mechanical and electrical maintenance costs are about the same, while the battery repairs and renewals and charging energy altogether foot up to about 6½ cents per truck-mile, plainly demonstrating that the battery costs are by no means a forbidding item.

What has been done in the Grand Central Terminal by small industrial trucks can be done in many places other than railway stations. It is merely a question of picking out the right truck for the job and giving it proper care.



Charles William Holtzer

Electrical manufacturer whose forty-six years of service, marked by executive ability, technical insight and sympathetic appreciation of honest effort, have built, besides a successful business, the loyal co-operation and affection of fellow workers

FROM the experiences of those pioneer workers in the electrical industry who have applied their energies to the working out of original tasks there has been established a source of inspiration of lasting value to those who are now responsible for the solution of newer and more complex problems. Among those who have steadily worked behind the scenes from the very beginning of the electrical industry, with no desire for public acclaim of their significant accomplishments, is Charles William Holtzer, founder and president of the Holtzer-Cabot Electric Company, Boston. Born in Karlsruhe, Baden, Germany, in 1848, and coming to the United States eighteen years later, after receiving a thorough classical education, Mr. Holtzer was for two years engaged in experimental work in the manufacture of heavy ammunition. Shortly afterward he became associated with E. S. Ritchie & Sons, Brookline, Mass., makers of philosophical instruments, and continued there until 1875. Meanwhile he had become interested in electrical development and, realizing the enormous possibilities in the manufacture of electrical apparatus, he went into business at Brookline in his own name in 1875, years before the first central station, producing batteries, bells, switches, etc.

In 1880 he took a contract to operate a telephone exchange of thirteen subscribers at Brookline, the first in the Boston suburban district. The manufacture of lamp fittings and telephone repair work were added, with the manufacture of magnetos, and subsequently of motors, generators, signal equipment, etc. In 1887 Mr. Holtzer formed a partnership with George E. Cabot, and in 1889 the Holtzer-Cabot Electric Company was incorporated. The business was successful from the outset, and it has grown in variety of products, number of employees and output until it now occupies a six-story factory in Roxbury, representing an investment of about three-quarters of a million dollars. During the war over 90 per cent of the output was for the United States government. In 1891 Mr. Holtzer built what is believed to have been the first electric automobile operated in the country, and in 1892 he built with William Stanley two electric motors of pioneer design.

Throughout his long career Mr. Holtzer has displayed the keenest interest in manufacturing problems and the executive aspects of production. His business sagacity, executive ability, technical insight and deep concern for the welfare of his employees have carried him to a commanding position in the manufacturing world. Recently 179 employees, ranging in terms of employment from ten to forty-four years, in expressing their appreciation of Mr. Holtzer's leadership, summed up his accomplishments by saying: "Our factory is a monument to thrift and honest industry and a memorial to merited success."

Essential Design Data for Choosing Synchronous Machines

Broad Principles from Which Engineers May Study Effect of Kva. Rating and Speed on Weight and Efficiency of Synchronous Machines—Important to Those Applying Machines as Well as to Designers

By THEO. SCHOU
Chief Engineer the Ideal Electric & Manufacturing Company

ALTHOUGH the design of electrical apparatus is an art more than a science, certain fundamental laws apply which can be represented as mathematical curves characteristic of the line of equipment in question. The curves which represent design-constants* are just one example of this fact, and others can be plotted which give relations between performance, effective weights of material involved, ratings, speeds, etc. It is to analyze these relations and submit them in the form of curves that this discussion is written.

Among the advantages of the method and curves to be presented, is the elimination of much of the usual cut-and-try work. They should also be useful to engineers who have to select and apply electrical machinery because they give an understanding of the effect of speed, kva. rating and other factors on efficiency, weight and consequently cost. Although the data given are approximate, they are based on experience and may therefore be used by operating and industrial engineers for estimating purposes. The weights of effective material are also helpful in comparing the suitability of different machines intended for the same operating conditions. Use has even been made of such data for calculating salvage value of equipment.

It should be borne in mind that the line under discussion involves 60-cycle alternators and motors which will operate at full kva. rating at 80 per cent power factor with a temperature rise not exceeding 50 deg. C. in any part of the machine. The stators are wound for standard voltages up to and including 2,400 volts, for two-phase and three-phase, with the excitation based on 125 volts.

Constants Upon Which Design Is Based

Whereas design-constant curves give information as to the relation of dimensions, an "armature-strength (*A-S*) curve," designating effective ampere-conductors per linear inch of armature surface, may be derived which will give information as to the electrical and magnetic properties. The *A-S* constant is defined by the equation:

$$A\text{-}S = (I \times N \times f_{ch})/(\pi \times D_g) \qquad (1)$$

where:

I = current per terminal,
N = total effective conductors in the stator slots,
f_{ch} = chord factor, or factor depending upon the throw of the stator coils, and
D_g = gap bore, or inside diameter of the stator in a revolving-field machine.

According to the previously mentioned article, it was found that

$$D \times L = [(D_g^2 \times l \times \text{r.p.m.}) \text{ kva.}] \times \Sigma K_1 \qquad (2)$$

where:

$D \times L$ = design constant,
D_g = gap bore,
l = length of stator core including ducts,
r.p.m. = synchronous speed in r.p.m.,
kva. = normal 50-deg. rating,
ΣK_1 = constants varying as to phase and design details.

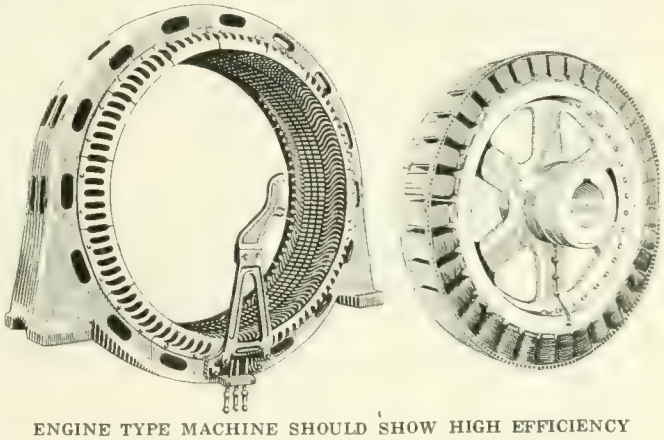
In a similar way:

$$A\text{-}S = [\text{kva.}/(D_g^2 \times l \times \text{r.p.m.})] \times \Sigma K_2 \qquad (3)$$

Or, by substituting:

$$A\text{-}S = [1 \div (D \times L)] \times \Sigma K \qquad (4)$$

Therefore, if a line of symmetrically designed machines is investigated as to these constants, and the kva. and speed are plotted on plain co-ordinate paper, we would obtain curves like those in Fig. 1, indicating clearly that the *A-S* curves are the reciprocals of the $D \times L$ curves.†



ENGINE TYPE MACHINE SHOULD SHOW HIGH EFFICIENCY BECAUSE FRICTION AND WINDAGE ARE CHARGED TO PRIME MOVER

When the *A-S* curves are given it is possible to derive from them several other characteristic curves relating to performance, design and weights. For example, from the equation (1):

$$N = (\pi \times D_g \times A\text{-}S) \div (I \times f_{ch}) \qquad (5)$$

Thus the total number of effective stator conductors may be computed.

If the current density per square inch in the stator copper be designated by A, and the cross-section of the conductor in square inches by q, then:

$$A = I/q, \text{ or } I = A \times q.$$

The current density A varies considerably, depending upon capacity and speed, and is, from a designer's

*"Analysis of Design-Constant Curves," ELECTRICAL WORLD, July 21, 1917, page 103.

†In Fig. 1 D represents the back bore, or the outside diameter, of the stator punchings.

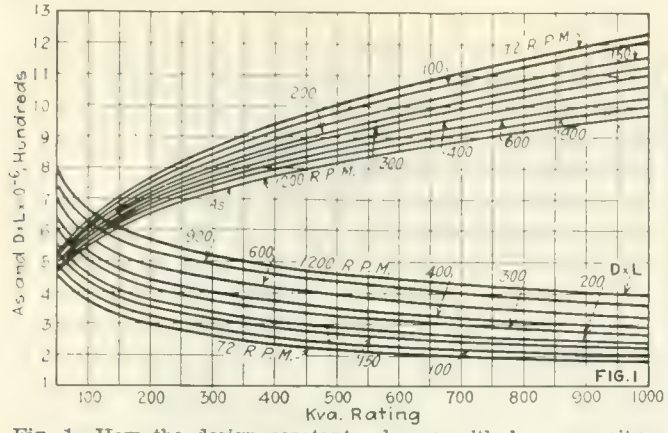


Fig. 1—How the design constants change with kva. capacity and speed for symmetrically designed machines. These curves as well as those which follow refer to 60-cycle machines.

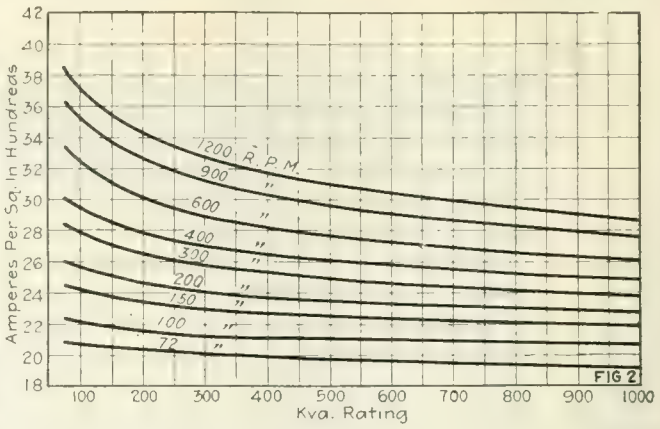


Fig. 2—Armature current density may be higher with high speed for same kva.; also, for same speed, current density may be higher in small kva. ratings.

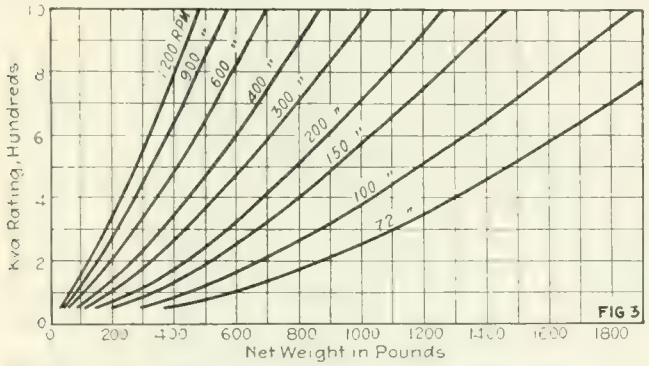


Fig. 3—Armature copper weight depends upon speed and kva.

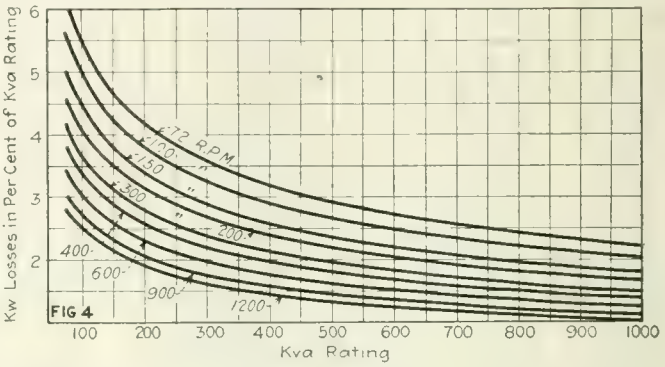


Fig. 4—Armature copper loss curve derived from Figs. 2 and 3.

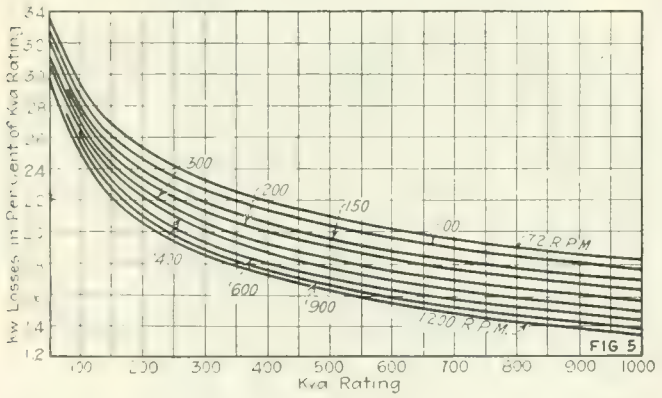


Fig. 5—Percentage of core loss for kva. rating and speed variation. Curves are somewhat pessimistic.

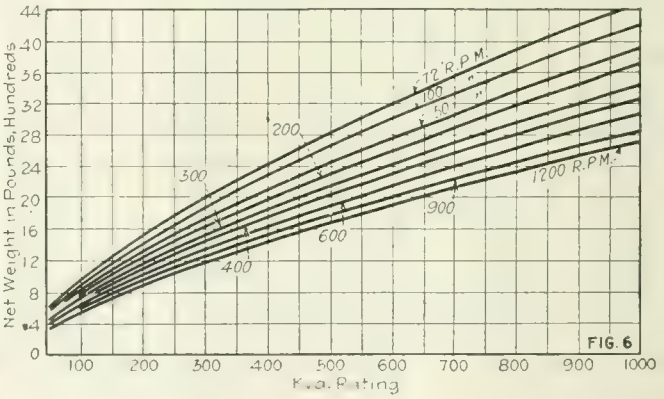


Fig. 6—Weight of stator iron required for synchronous machines, showing economy in high speed and high ratings.

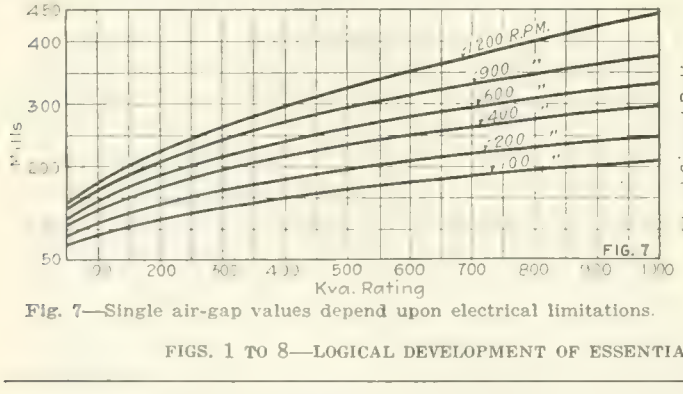


Fig. 7—Single air-gap values depend upon electrical limitations.

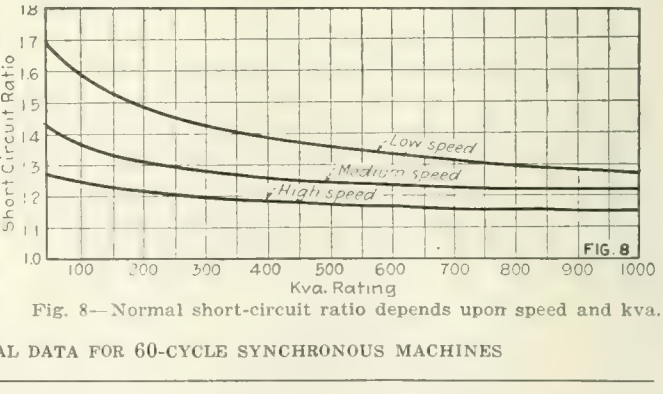


Fig. 8—Normal short-circuit ratio depends upon speed and kva.

FIGS. 1 TO 8—LOGICAL DEVELOPMENT OF ESSENTIAL DATA FOR 60-CYCLE SYNCHRONOUS MACHINES

viewpoint, determined by giving due consideration to heating, efficiency, ohmic drop and economy of actual copper. In high-speed machines the heating is largely the limiting feature; in low-speed machinery the efficiency and ohmic drop come more into consideration.

There exists a simple law or relation between current density, net copper weight and stator copper loss, as follows: If the total net weight of the bare stator copper (G) and also the current density in amperes per square inch of effective conductor (A) are known, then the stator copper losses (W), in watts, at 50 deg. C. rise of temperature may be determined:

$$W = 2.56 \times A^2 \times G \times 10^{-6}. \qquad (6)$$

This simple and convenient formula (6) is derived

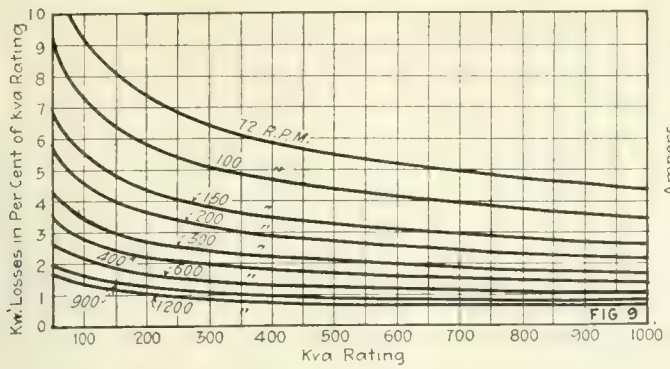


FIG. 9—EXCITATION LOSSES AT 80 PER CENT POWER FACTOR, INDICATING SIZE OF EXCITER REQUIRED

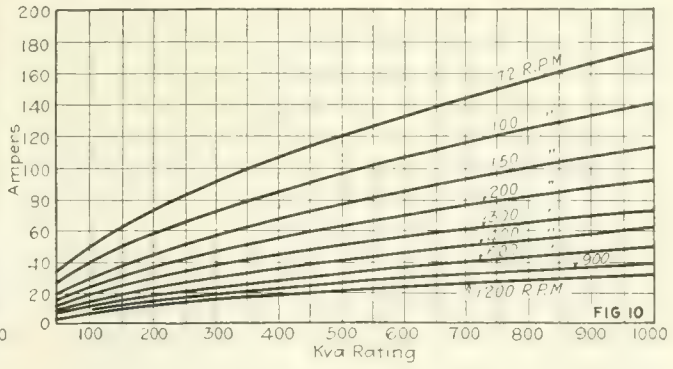


FIG. 10—NO-LOAD FIELD CURRENT TO OVERCOME RELUCTANCE OF AIR GAPS AND MAGNETIC CIRCUIT

as follows: If l is the total length in inches of effective stator conductors, and q the area in square inches of effective conductor, then the resistance in ohms at 25 deg. C. is:

$$R = l/(q \times 1.45 \times 10^6).$$

If I denotes current in the conductor (in case of a three-phase, Y-connected or two-phase open-type winding, also "current per terminal"), then:

$$I = A \times q, \quad \text{and by substitution:}$$
$$W = I^2 \times R$$
$$= A^2 \times [(l \times q) \ (1.45 \times 10^6)] \text{ watts.}$$

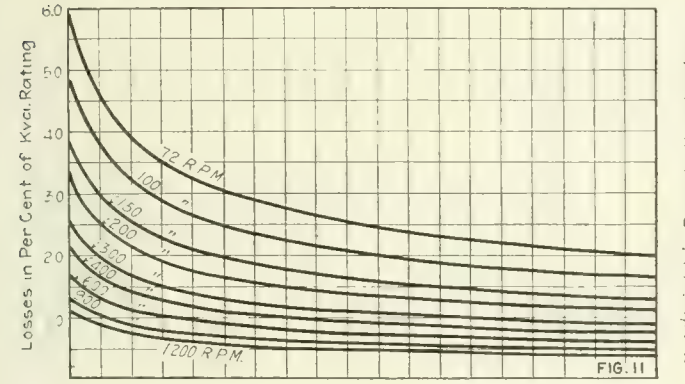
Since the total net stator copper weight is:

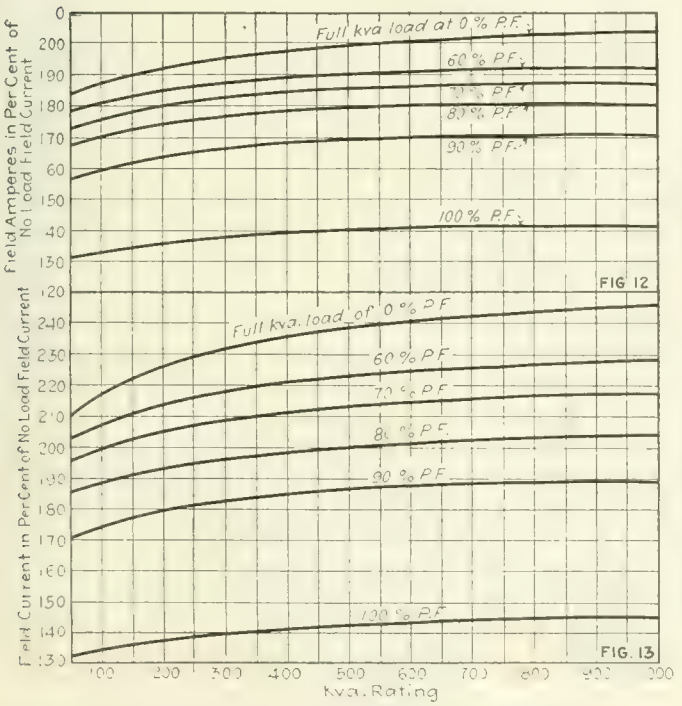
$$G = l \times q \times 0.32,$$
$$W = A^2 \times G \ (1.45 \times 0.32 \times 10^6)$$
$$= 2.16 \times A^2 \times G \times 10^{-6} \text{ watts.}$$

at 25 deg. C. temperature, or at 50 deg. C. temperature we obtain:

$$W = 1.19 \times 2.16 \times A^2 \times G \times 10^{-6} \text{ watts,}$$
$$= 2.56 \times A^2 \times G \times 10^{-6} \text{ watts.}$$

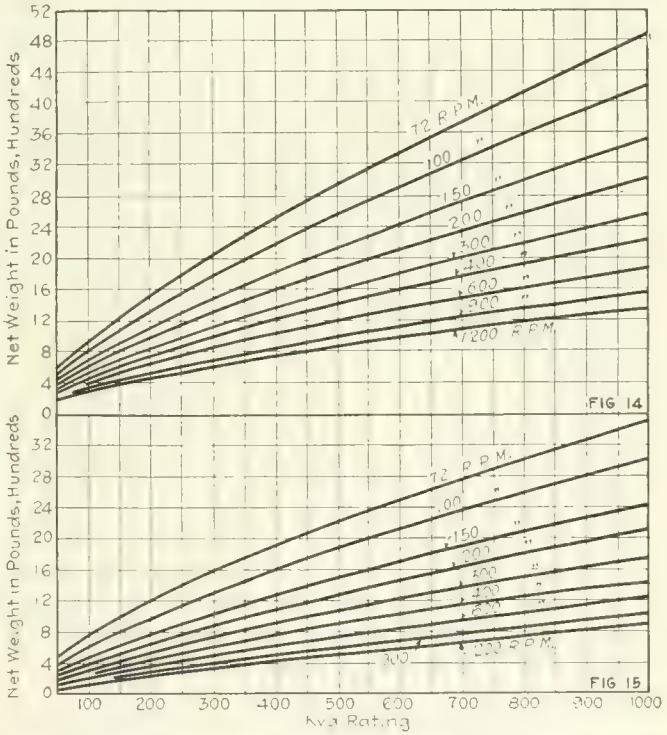
The efficiency of a certain line necessarily depends

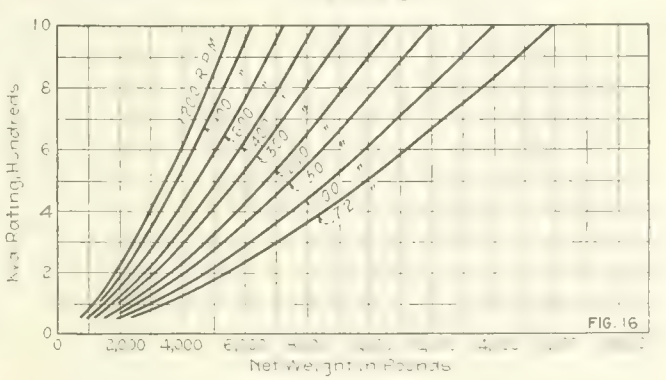




FIELD LOSSES AND EXCITATION CHARACTERISTICS

Fig. 11—Field losses at 100 per cent power factor.
Figs. 12 and 13—Excitation at various lagging power factors for machines at high (Fig. 12) and low (Fig. 13) speeds.





CALCULATING EFFECTIVE IRON AND COPPER WEIGHTS

Fig. 14—Weight of field pole punchings.
Fig. 15—Net weight of field copper.
Fig. 16—Total effective iron and copper weights.

upon the losses, which in the case of synchronous machines consists of (1) stator or armature copper losses, (2) rotor or field copper losses, (3) core or iron losses, and (4) friction and windage losses.

Stator Copper Losses.—In order to compute the stator copper losses it is necesssary to fix the current density and weight of bare stator copper, or, if the stator losses are fixed and the current density known, the amount of bare stator copper may be computed.

Fig. 2 gives approximate values for stator current densities for a certain line of synchronous machines of various capacities and speeds. Fig. 3 gives the net stator copper weight, and from these curves we obtain the stator copper losses as shown in Fig. 4. It is interesting to note that for a 100-kva. rated machine, the stator copper losses will vary from 5.5 kw. at 72 r.p.m. to 2.5 kw. at 1,200 r.p.m. The values for stator copper losses, however, as expressed in percentage of normal kva. rating, are decreasing as the kva. capacity is increasing; but the rate of decrease becomes less the larger the capacity, as indicated in Fig. 4.

Core or Iron Losses.—The iron losses (hysteresis and eddy-current losses) depend upon the frequency and the magnetic density in the different parts of the magnetic path, also upon the type of construction and workmanship. As a rule, the magnetic densities for a certain line do not change much with the speed or rating, although this may be said: that whereas in high-speed machines the magnetic densities in the teeth and back of the teeth—or in the core proper—are approximately the same, the densities for low-speed machines are rather low back of the teeth and almost limited for mechanical reasons, as a too shallow iron depth below the slots complicates the construction and makes the punchings difficult to handle from a production standpoint. The densities in the teeth, however, are, on the other hand, chosen rather high.

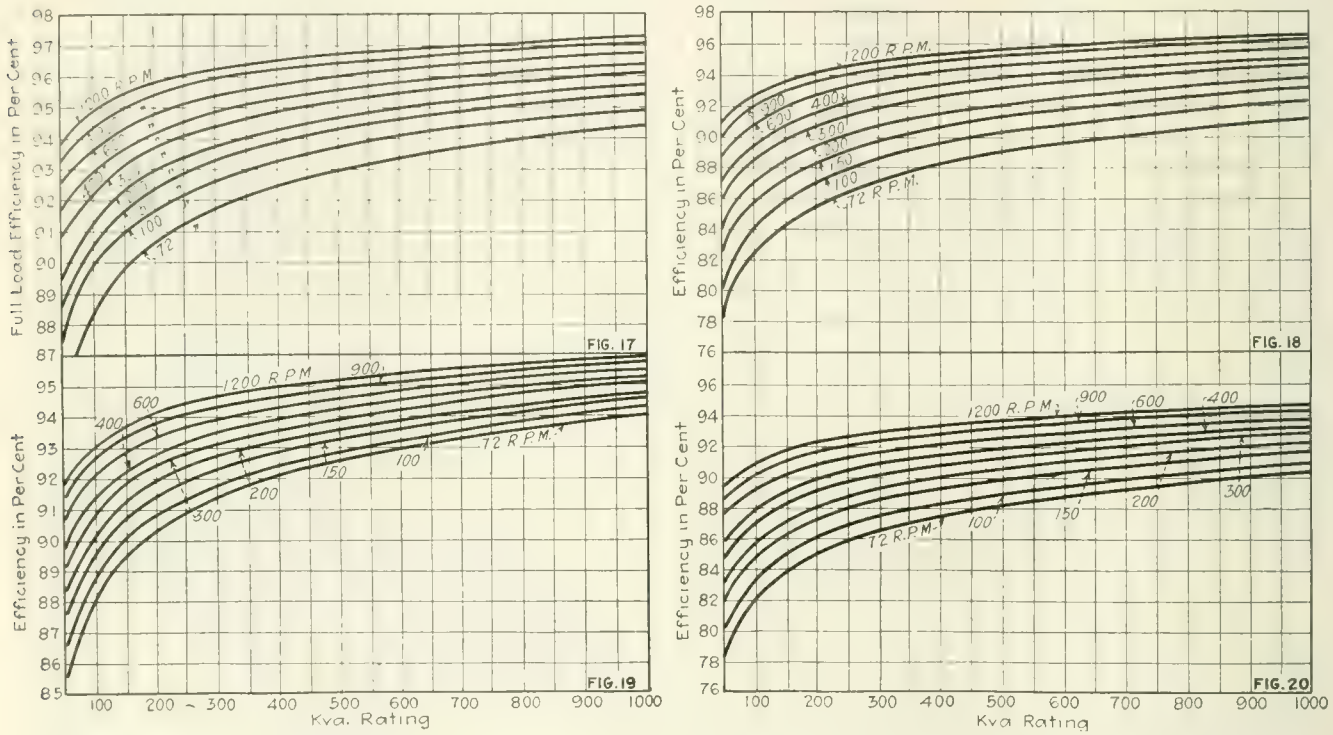
If the magnetic densities for different frequencies are replotted in watts per cubic inch or watts per pound—then, knowing the volume or weight of the iron, the core losses may be found for various speeds and capacities.

In general, the curves used for computing core losses are, or should be, based on test results of actual machines, rather than on magnetic densities based on laboratory research and tests of certain grades of iron. Time and again it has been proved that the shop methods of handling and building the cores—*i.e.*, punching the segments, insulating and drying them, and assembling—play a very important part in the useful magnetic curves for computing core losses.

It is, therefore, true that every factory has or should have, so to say, its own set of curves based on their own methods and construction. In connection with this it is well to mention that excessive, or even moderate, filing of stator slots will vary the core losses considerably. It is, therefore, a very bad policy to design slots too closely in this respect, because it does not better conditions, but, on the other hand, throws hardships on the shop and the production, besides getting an inferior machine as far as core loss and core heating and voltage breakdown are concerned.

Fig. 5 gives rather pessimistic values for core losses expressed in per cent of the kva. rating. These curves are based on No. 26 gage iron, not annealed, but insulated with one coat of core-insulating compound.

Field or Excitation Losses.—At no load the field excitation has only to compensate for the ampere-turns necessary to overcome the reluctance of the air gap and the magnetic circuit. At loads the synchronous reaction enters and calls for additional excitation.‡



FIGS. 17, 18, 19 AND 20—EFFICIENCY OF ENGINE TYPE AND TWO-BEARING TYPE OF SYNCHRONOUS MACHINES AT FULL LOAD

Figs. 17 and 18—Engine-type, not including friction and windage, for 100 (Fig. 17) and 80 per cent power factor.

Figs. 19 and 20—Two-bearing-type for 100 (Fig. 19) and 80 per cent power factor. Low power factor lowers efficiency.

‡A detailed discussion of this was published by the writer, "The Excitation of Synchronous Machines," ELECTRICAL WORLD, Feb. 12, 1916.

As the air gap of a synchronous machine is electrically limited, and not, as is the case with induction motors, mechanically limited, the air gap varies over a wide range, depending upon capacity and speed.

The field design in most cases will have to adapt itself to mechanical limitations and the necessary margin as to heating limits. More turns mean more copper and heavier field coils, but again a smaller exciter and a cooler field. The arrangement of turns and layers and the cross-section of the coil also enters into consideration. For a given line of synchronous machines it is usually more difficult to meet conditions involved with high speed than the characteristics of low-speed machines.

Fig. 9 gives the values for necessary exciter capacities, expressed in percentage of the kva. rating for the line under discussion, and may serve as a fair estimate concerning the size of exciter required.

Figs. 12 and 13 give the approximate field excitation expressed in percentage of no-load field amperes at various lagging power factors of high-speed and low-speed synchronous machines, but it should be kept in mind that exciter capacities as given in Fig. 9 refer to operation at full load, 80 per cent power factor only.

Fig. 14 shows approximate net weight of the field iron, that is, the net weight of the pole punchings, and Fig. 15 the approximate net weight of field copper. Total copper weights may readily be derived by adding data from Figs. 3 and 15, while total iron weights may likewise be obtained from Figs. 6 and 14. Fig. 16 represents the total weight of effective material, that is, total weight of armature and field punchings and copper.

For engine-type machines all losses are included with the exception of windage and friction losses. For other types of machines—that is, other than engine-type—friction and windage are usually included in the total losses for computing the efficiencies.

The total weights of machines may be estimated by adding weights of parts for different types to the weights of effective materials. This matter will be discussed in an early issue.

Arrested Development of Public Utilities

Part Which Electric Power Must Play in Bringing About Renewed Industrial Progress in the Nation—Necessity for State Regulation—Financial Problems Awaiting Solution

By EDWARD N. HURLEY*
Chairman of the Board, Hurley Machine Company

AMERICA today is at the crossroads of electrical development. It is a question whether we are to go forward or stand still. At this very moment the electrical industry is suffering from arrested development. The industry is awaiting the verdict of the American people. I have taken the electrical industry as my topic because I believe that there is no question, save the daily problem of food, clothing and shelter, which is so vital to the welfare of the American people. Upon the development of the electrical industry depend the extension of means of communication, further facilities for lighting and household conveniences, the spread of education, and the further progress of civilization.

We like to think of ourselves here in America as the pioneers in the science of electricity. We have been the pioneers, but the job we started has not been half done. There are still 14,000,000 homes in the United States without electric service and which eventually will have it. It is authentically stated that if the present problem of housing the population is to be met, the United States needs 1,500,000 additional homes, 500,000 additional factories, 5,000 public schools, 5,000 churches, 60,000 apartment buildings and 15,000 theaters. These, too, mean electric service. There are 150,000 pending applications for power by existing or new industrial plants desirous of utilizing electricity.

We have come to think of electric light as the normal lighting for every home. We like to think that the women of the nation are no longer compelled to do the drudgery of the home—that electric power has taken a large part of the load from their backs. The fact is that the vast majority of people in the United States are still without the aid of electric energy. There are literally millions who still read under smoky oil lamps. There are many industries burning coal and generating their own power which, more economically, could utilize electricity from the electric light and power plant and at the same time decrease the drain upon the nation's coal pile.

"Do it electrically" is a slogan which has been much in use lately, but it cannot reach its full meaning until a way has been found to provide the enormous amount of money necessary to build additions to old plants and for the construction of new ones which will provide light and power for the homes and factories still in semi-darkness and lacking in the economical facilities for operation afforded by electric power.

Electric Power an Interstate Problem

The electrical industry, if it is to be operated economically, must be operated in large units—the larger the unit the greater the economy. Existing small units serving individual communities must be physically interconnected to permit of more economical use of present generating capacity and with the ultimate purpose of building a single great unit to replace the smaller ones as they become obsolescent. And unless these great stations at the very beginning are built with a realization of what will be required of them ten and twenty years hence, much of the machinery will have to be torn out and replaced, and, perhaps, even, buildings will have to be remodeled or replaced at tremendous expense as the years go on.

Electric power has ceased to be a local problem. It has become a state-wide and even an interstate problem. Steam and hydro-electric plants built in large

*Address delivered before the Chamber of Commerce of the United States at Atlantic City, N. J., April 29; slightly condensed.

units now provide service over a radius of 100 miles or more, and in many cases their lines extend far beyond state boundaries.

The old method of financing has no bearing whatever upon the utility questions of today. Under modern methods of regulation, as provided by the utility laws of most of our states, overcapitalization and watered stock are practically obsolete terms. Capitalization has nothing to do with the rates paid by the customers of utility companies. Capitalization is not even considered when state public service commissions make the rates.

It is true that the rates of the electrical industry are regulated by law. The returns on the capital invested are thus limited. Frequently they are not sufficient to encourage capital to go in. Those who complain on this score against state regulatory bodies are simply leveling their shafts at the wrong target.

Public Officials Responsive to Public Opinion

Public officials are usually responsive to public opinion. This is a democratic country and it is governed democratically. Appointed officials as well as those who are elected take it for granted that the public has common sense as well as a sense of fairness. And the public is always fair when it has full information. When the public takes an unfair attitude toward an industry it is almost invariably because accurate information is lacking. It behooves the electrical industry everywhere to take the public into its confidence. No company official has the right to sit behind closed doors and complain about unfair treatment. The public will not understand the difficulties of the industry unless the industry throws open the doors and tells the truth about itself plainly and without fear. The newspapers like to get their information from the head of a corporation—the man who is really responsible. If the captains in the electrical industry would make themselves more available, there would be less misunderstanding of their troubles and their plans for development.

If the proper encouragement is given to the electric light and power industry, the industry will spring forward in the next decade faster even than in the past decade. The result unquestionably will be a lowering of the cost of living and the conservation of national resources which cannot fail to benefit the whole population. I think it will be agreed that upon the development and application of electrical energy, more than upon any other one thing, are dependent both the speeding up of production and the conservation of our natural resources.

The almost unlimited water power of the nation cannot be harnessed for the benefit of the public without enormous capital investment. Already there are 1,450,000 thrifty American citizens who have put their savings into the securities of the electric light and power industry, and there are millions more who may be listed as indirect investors through the banks and insurance companies. They already have invested five billion dollars, and billions more must be forthcoming if the complete job of the electrical industry is to be done.

It is not merely in the cities but on the farms that more progress must be made. There are 6,500,000 families living on "farms" in this country. The lives of 2,000,000 of these families have been made less burdensome by the introduction of electricity, but the convenience must still be extended to the vast majority which remains unserved.

In reviewing the development of electricity there are very few of us who really appreciate the wonderful work done by that great inventor who has accomplished so much not only for the industrial world but for mankind generally, Thomas A. Edison; by C. A. Coffin, chairman of the board of the General Electric Company, who co-operated with Edison in developing the manufacture of electrical devices; by George Westinghouse, whose vision and foresight built the Westinghouse Electric & Manufacturing Company, or by Samuel Insull, former associate of Thomas A. Edison and recognized today as the foremost leader in the central-station field in America. These men and others have shown what brains, vision and courage can do in expanding a great industry, with the result that America today uses more electricity than all the rest of the world combined, and many times as much per capita.

The Development of Electricity

In the early and competitive development of the electrical industry methods were employed by some managers which were not consistent with good business ethics. In some cases more attention was given to the selfish interest of the corporations than to public needs, with the result that in a number of communities a chaotic condition developed. Local politics and prejudices often entered into the settlement of utility questions, and expert advice on engineering, valuation, accounting, rates and service counted for little. This condition left the service-using public helpless against poor and inadequate service and against unjust rates. This method of control, like any commercial project not based on costs, resulted in poor service where rates were too low and in extravagance and corruption where rates were too high. In either case the public failed to get what is now looked upon as an essential—good and adequate service at a fair rate. Cities and villages found that if, individually, they attempted to regulate rates of service, each necessarily would be forced to create staffs of highly skilled and highly paid experts and that there would ensue constant conflict of practices and principles between the expert staffs of the various municipalities.

In the absence of proper regulation there are some communities even today in which utility companies are attempting to ride roughshod over their patrons and the public, or where the public, through lack of understanding of its own self-interest in the prosperity and well-being of the utilities, is refusing them fair treatment, or even endeavoring to wreck them.

Not all the companies really understand what service means—real service—using the word in its broadest sense. Such real service commences at the top of the company and works down and percolates through to the outer edges of the corporation, so that all points of contact are guarded and all methods of intercourse are watched, and the consumer is considered in the manner which makes him believe he is regarded as an individual with rights and desires which the company recognizes and respects.

The system of state regulation by commissions now in effect in forty-two states is the natural and logical outgrowth of the attempt to remedy the obvious and unbearable faults of the old system. Statistical data have been compiled by the commissions regarding the capital invested in the electric lighting and street-

railway companies. All questions of valuations, depreciation, etc., are under their control. They have at hand every detail as to how the properties are financed and what the earnings are. Every fact and figure is before them. Is there any valid reason why a definite policy should not be outlined for the many electric light and street-railway companies that are being seriously delayed in obtaining permission to expand and to improve their service to the public? The large majority of the state commissions consist of men with courage and a knowledge of the public's requirements. But in a few states there are members of commissions who are still resorting to the old political methods of handling cases brought before them. The public should be the first to rebuke such policies, as it is the public which always suffers as a result.

In the early days of the electrical industry and in the absence of collective facts, unwarranted attacks upon a public utility might be overlooked. But today, with all the necessary data before both the people and the state commissions, it is impossible to expect progress where charges are made with ulterior motives.

Financial Problems

The financial standing of a well-managed street railway, gas or electric lighting plant is as vital to the life and development of a community as its banks, and should be protected against unfair attacks so that customers and the investing public will have confidence in the properties, resulting in a desire to purchase utility securities when offered. The American people must realize that confidence in public utility securities cannot be had by constant, unjust criticism. If the same kind of public attack should be made upon national and state banks in the same communities where members of state commissions and other public officials are now bitterly assailing the central stations and street-railway companies, the public would lose confidence and in a very short period these banks would be forced to close their doors.

No public utility corporation subject to regulation can finance its requirements out of earnings. For each dollar of additional annual gross revenue from the sale of electrical energy by a light and power company it is necessary to provide additional facilities involving an investment of from $4 to $6. Thus a company with a gross revenue of, say, $1,000,000 per year, to provide for a growth of 10 per cent per annum ($100,000), which is a very moderate rate, would have to spend $400,000 to $600,000 for additional generating capacity and distribution facilities. With earnings limited by commission regulation to 8 per cent on the invested property value, which is below the actual cost of obtaining capital, it will be readily seen that additional capital must be secured if the facilities are to be provided to enable the growing service requirements of the community to be met, and such capital can be obtained only if a reasonable, permanent return is assured to the public utility concerned.

Therefore, adequate facilities for the transportation, lighting and industrial requirements of a growing community can be made available only if the attitude of the public and of the commission authorities toward the electric enterprise is such as to encourage the necessary capital investment and to afford it the security as to principal and return without which the investor will refuse to become interested in the situation. When financing, companies are compelled to make provisions for ample reservations, so that today public utility securities with substantial reserves are gilt-edged.

The "public be damned" policy in public utility companies has been virtually eliminated. We may find some of the old methods in force in certain rural towns, but modern managers now "sell" the public needs to their employees when those employees first enter the service, and then keep them informed as to anticipated requirements. This is good business. The public is entitled to 100 per cent service, and we have hundreds of public utility organizations that are giving it; but unfortunately the public is reluctant to commend their efforts, since the people find difficulty in differentiating between the many good companies that give adequate service and those that are inefficient and indifferent.

Unless the public, the state commissions and the utility corporations work together and create that confidence which will influence people to invest in utility securities, I am convinced that the nation within three years will fall so far behind in electrical development that it will be without sufficient electricity to provide for electrical home labor-saving devices, for unless capital investment can be encouraged through the creation of this confidence, the expansion of our industries will be seriously retarded.

Government Ownership or Private Ownership

Although at one time sympathetic toward government ownership, I am certain, after a number of years in government service, that no community can receive the industrial service to which it is entitled under municipal or governmental management. It is not humanly possible to obtain the same effort or interest from managers or men employed in industrial government service that exists in competitive private ownership, and as a result, if the advocates of government ownership investigate the facts carefully and impartially, they will find that government operation in industrial service is a flat failure from a "service to the public" standpoint. This is true not only in America but it is a proved fact throughout the world.

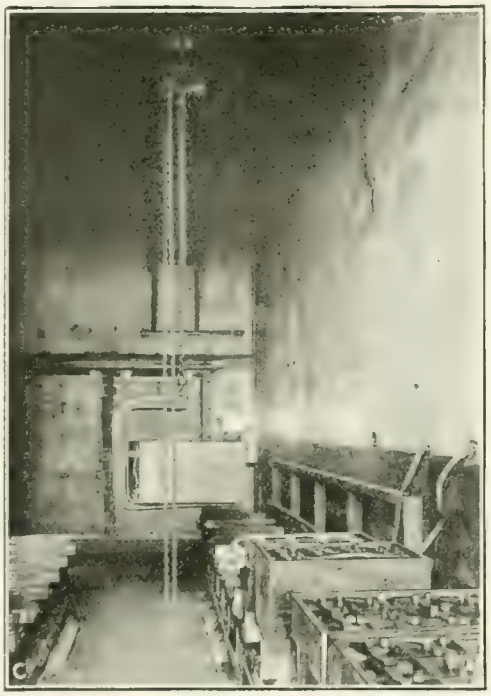
The public has difficulty in unraveling the bookkeeping through which the actual deficits in municipal operations are finally placed upon the people through the medium of the tax rates themselves. It is therefore of primary importance to the taxpayer, where municipal operation of the public utility is suggested, that such a bookkeeping system shall be set up as will give the taxpayer a true picture of the actual operation and cost thereof. When this is done, I am convinced that it will be found that the lack of personal efficiency under municipal or governmental industrial ownership spells financial failure for the enterprise.

If the members of the Chamber of Commerce of the United States of America, with their great power and influence, were to take a keen personal interest in public utilities in their respective states, insisting that justice be given the public and the utilities, a permanent step toward solving this most important problem would be taken.

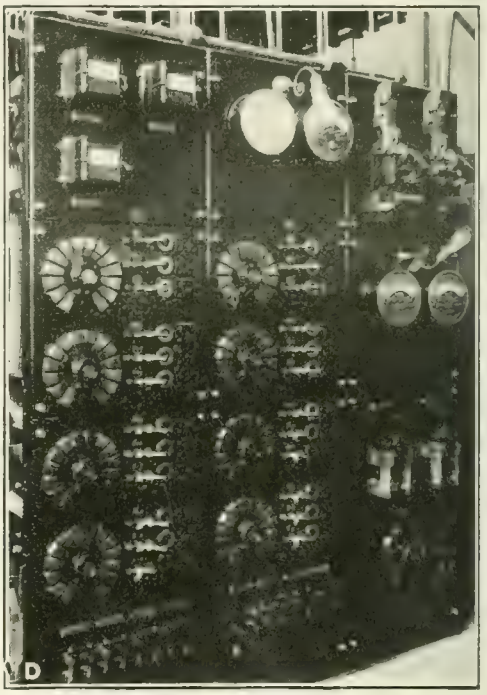
When public utilities realize what high-grade service means and what effect such a service in its operation has upon its customers and the public, then the question of municipal or governmental ownership will gradually drop into the background and the public recognition of the difficulties and the need for encouragement and liberality will quickly aid in the solution of this national problem.

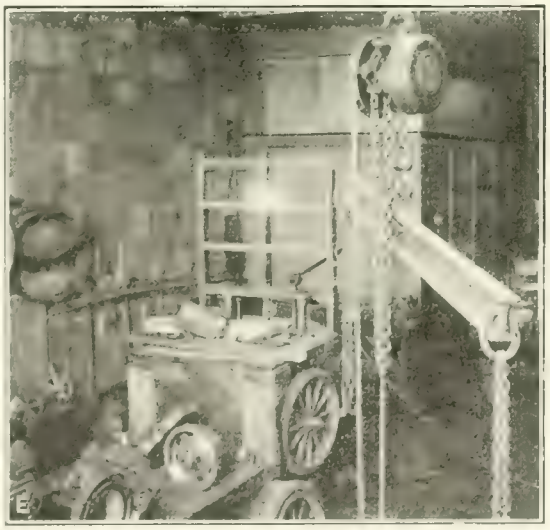






Industrial Trucks Handle Baggage at Low Cost







A—Drop-frame industrial truck used for hauling baggage to and from the trains.

B—Smaller type of truck for hauling baggage between the incoming and outgoing baggage rooms.

C—A special type of sling is used for taking the batteries out of the trucks and placing them on the charging bench.

D—The batteries are charged three in series and a variable resistance permits regulating the charging current. If any one battery comes up to charge before the others, it may be cut out and an equivalent resistance inserted.

E—A corner of the maintenance repair shop where the trucks are run in monthly for inspection and minor repairs.

F—After the truck has been in operation for two years it is entirely overhauled at the main repair shop.

Electric Trucks Prove Indispensable in Handling Baggage

Work at Grand Central Terminal Is Done at Low Cost with Industrial Trucks—Methods of Operating and Maintaining Equipment—Batteries Are Changed Instead of Holding Trucks for Charging—Costs per Truck-Mile and Truck-Month

FROM the experience which the New York Central Railroad has had with industrial electric trucks for handling baggage, mail and express in the Grand Central Terminal, New York City, it has been found that one truck of this type will handle work that formerly required five hand trucks. Besides the actual decrease in the cost of handling material, many other advantages have been found in the use of this equipment. For instance, avoidance of congestion is an important item, since more than 200 hand trucks would be required for the work now handled by about forty electric trucks. In addition, increased speed of operation has not only reduced the labor cost but has permitted moving the baggage and mail more closely in conformity with the scheduled departure of trains. Rush work, such as the placing of late baggage or mail on a train, can also be taken care of to much better advantage than with hand equipment. Another rather important point has been the increased efficiency of labor for unloading purposes due to the reduction of the physical exertion required in the moving of material. When a loaded truck arrives at its destination the operator is not fatigued, as was formerly the case, and is able to remove the load at a higher rate of speed. Taking everything into consideration, it is doubtful if the terminal could be operated as efficiently or as smoothly by the former method, regardless of the number of men employed.

The first electric trucks were placed in operation at this terminal early in 1911, and it is rather interesting to note that these trucks are still in good condition and operating daily. One unit of this original equipment was recently placed on exhibition at the New York Edison Electric Vehicle Show to indicate the results which may be expected if proper care is taken of such apparatus. Owing to the good results which were shown by this initial installation, it was decided to add more trucks, and in April, 1911, there were ten units in operation. In 1912 there were twenty trucks in regular operation, and in 1913 the fleet had been increased to thirty.

A study of the operating results over this period of years showed that the total cost of labor and other items had risen 12.8 per cent, while the volume of baggage and mail handled had increased 46.5 per cent. The cost of handling material was, however, reduced 23.1 per cent. These figures took into consideration all items which should be charged to the electric truck, such as maintenance and overhead. As the years went by and more trucks were added, and labor and other costs rapidly increased, the results were even more marked, until at the present time the method of handling is considered indispensable.

There are now forty-six trucks of the drop-frame type in operation. They are rated at 4,000 lb. (1,814 kg.) capacity, with a motor rating of 2½ hp. and a twelve-cell, fifteen-plate, 196-amp.-hr. vehicle-type lead battery. There are also five freight-type trucks of the same capacity and using the same battery and motor equipment. Although several makes of batteries are used, they are interchangeable.

The drop-frame-type trucks are used for carrying baggage to and from trains, while the smaller or freight-type trucks are used to handle baggage between the incoming and outgoing baggage rooms. The usual number of pieces of baggage handled every twenty-four hours is 6,000, although the maximum has been as high as 12,000. Besides this baggage-handling work, there is also mail and miscellaneous package work. As elevators are used for moving the trucks to the different levels, the service, as far as grades are concerned, is not severe.

Before a man is classed as a truck operator, he is instructed in the operating details, such as steering, starting and stopping, by one of the experienced men. The new operator is also instructed that if anything appears to be in poor operating condition, the truck is to be turned into the maintenance repair shop. Before the new operator is finally intrusted with a truck, one of the baggage foremen goes with him on several trips and then passes on his competency.

Proper Maintenance Work Considered Very Important

To get the maximum working value out of the industrial trucks, as in any other piece of equipment, it is necessary that their operation be looked after very carefully. This is particularly true at the Grand Central Terminal, where trucks are operated on a twenty-four-hour basis and are not laid up for charging. Instead of bringing the truck in and keeping it out of service for charging, the battery is removed and a fully charged battery substituted.

For the purpose of maintaining the equipment in good operating condition the trucks are called in periodically for a close inspection. This is usually done monthly in what is known as the maintenance repair shop. As shown in the accompanying illustration, this is a small shop accommodating about three trucks at a time and equipped only for comparatively minor repairs. There are a workbench, a hoist and the usual assortment of bench tools. When a truck is brought in it is raised and placed on wooden horses so that all parts can be easily inspected.

The particular points in this inspection are to see that there is no lost motion in the brakes, steering gear or control. Brakes are tightened up at this time and brake bands renewed if necessary. It has been found that the lining must be renewed about every four or five years. If oil gets into the brake housing, however, the bands require renewing more frequently. As the

differential is packed with grease, there is not apt to be much trouble experienced from this source. However, in time the grease reaches a condition very nearly of the fluidity of oil and is then apt to give trouble.

As the drop-frame trucks have double-end control, there is likely to be some lost motion in the mechanism owing to the length of the rods and wearing of pins. This play is taken up at the time of inspection. The controller is also gone over carefully, and any lost motion is taken up and fingers that may be in bad condition are renewed. Occasionally it is necessary to replace a broken floor board, and this can be attended to at the same time. A log book of these inspections and repairs is kept by the inspector.

Heavy Repairs Are Taken Care of at Central Shop

It has been found a good operating practice to overhaul the trucks completely every two years, and this is done at a central shop where machine tools are available. The truck is entirely dismantled and all loose rivets are removed and new ones replaced. The frames are straightened, if necessary, and all moving parts are overhauled or renewed. A very careful inspection of the motors takes place, and armatures are thoroughly cleaned, receive a coat of baking varnish and are thoroughly baked. The field coils are also treated in the same way.

COST PER TRUCK-MILE FOR MAINTENANCE

	1918	1919
Mechanical labor and material	$0 0721	$0 0939
Electrical labor and material	.0810	.0956
Wood repairs and painting, labor and material	0162	.0180
Charging current	0182	0138
Battery repairs and renewals	0657	.0419
Total	$0 2532	$0 2632

SUMMARY

	1919	1918	1914
Truck-months for year	516	516	421.5
Truck-miles for year	98425.8	64457.4	62412.6
Cost per truck-month	$50.22	$41.46	$21.73
Cost per truck-mile	$0 263	$0.253	$0.147
Charging current, kw.-hr.	73,453.	89,539.	70,742

FIXED CHARGES, MAINTENANCE AND OPERATION

	Cost per Truck-Mile			Cost per Truck-Month		
	1919	1918	1914	1919	1918	1914
Fixed charges	$0 139	$0 162	$0 180	$26 60	$26.60	$26 60
Maintenance and charging current	263	253	147	50 22	41 46	21 73
Operator	318	370	255	.	.	. .
Total	$0 720	$0 785	$0 582	$76 82*	$68 06*	$48 33*

*Without operator charge.

Batteries Are Changed Instead of Holding Trucks for Charging

As previously mentioned, the trucks are not kept out of service during the time required for charging the batteries, but instead a fully charged battery replaces the one which is depleted. This changing of batteries is done on a definite scheduled basis, each truck having its battery renewed every forty-eight hours. While it is evident that all batteries would not be equally discharged, nevertheless it has been found good practice to handle the work in this way rather than to renew a battery when an ampere-hour meter shows that it is very nearly discharged. As the operators are not especially skilled, it has been found that better results can be obtained by changing the batteries on a definite schedule than by leaving the proper time to their judgment. No instruments are used on these trucks with the exception of an odometer for recording mileage. There are fifty-one trucks in operation, and the work is so divided that twelve or thirteen batteries are changed every twelve hours.

As the available energy supply for charging is a 240-volt, three-wire system, the batteries are charged on two racks, three in series on each leg. By this arrangement a 120-volt supply is available for each leg, and as the three batteries in series require 31 volts each, or a total of 93 volts at full charge, the balance must be taken up in a variable resistance. The normal battery voltage is 24. It is possible by an arrangement of individual switches on the battery-charging panel to cut out any battery from the charging circuit and substitute an equivalent resistance. Such an arrangement allows the removal of a battery from the set of three being charged, if one of them requires less charging than the others. A charging rate of 40 amp. is used at the start, while the finishing rate is 15 amp.

Only minor repairs are made in the battery room, as all batteries are sent to the various manufacturers for overhauling. However, at least once a year the batteries are thoroughly cleaned and put in new crates. Several makes of batteries are in use, but the average life has been found to be twenty-seven months for this service. Seventeen spare sets are provided for handling the changing of batteries for the fifty-one trucks. A record of each battery is kept in the battery room by the individual number, which is given it on receipt of a battery. Records which are kept are "date new," "date cleaned," "date discarded" and a record of charging.

As shown in the accompanying illustration, the changing of batteries is facilitated by the use of a chain hoist with a special lifting hook. When a truck is run into the charging room the old battery is lifted out onto the charging rack and a fully charged battery is placed in the truck. Six men are required for the battery-room work, two being used on each eight-hour shift.

Cost Records Are Carefully Maintained

As shown in the table, the operating cost for this equipment is very carefully kept. The costs are divided into three main groups, namely, fixed charge, maintenance and operation. For comparative purposes it has also been found advisable to finally reduce cost figures to a basis of truck-miles and truck-months. Costs per truck-mile are arrived at by dividing the various three divisions of costs by the miles operated. In arriving at the cost per truck-month the total truck-months are divided into the total cost for the three main items.

Fixed charges are made up of the usual items which enter into this cost, such as interest, insurance, taxes, depreciation on trucks and depreciation on charging facilities. The cost of tires and batteries is not, however, included in the fixed charges, but in maintenance.

It will be noted from the table that the fixed charges per truck per month have remained the same during the years 1914, 1918 and 1919, owing to the fact that virtually all of the trucks were purchased previous to the year 1914 and the various items were charged off at the same rate. The fixed charges on a basis of truck-miles, however, have decreased quite materially because of the fact that each year has seen the number of truck miles increase while the fixed charges remained the same. Maintenance costs are divided into five main divisions, namely, mechanical, electrical, wood repairs, charging current, battery renewals and repairs. For the year 1919 the maintenance cost was 26.3 cents per

truck-mile. The various items are still further subdivided in the records to show the actual cost of labor and of material for these various items. For instance, in 1919 the mechanical work was divided into a labor charge of $0.0805 and material $0.0134, making a total as shown in the table of $0.0939. A further division of the electrical work shows a labor charge of $0.0774 and a material charge of $0.0182, making a total of $0.0956. Wood repairs are made up of such items as replacing broken floor boards and repairs on the truck bodies. This item for the year 1919 was divided into a labor charge of $0.0152 and a material charge of $0.0028, making a total of $0.0180. There is, of course, no further subdivision of current and battery repairs and renewal charges. It will be noted that the cost of electrical labor is slightly lower than that of mechanical.

On a percentage basis these various items divided themselves as follows: Mechanical, 35.7 per cent; electrical, 36.4 per cent; wood repairs, 6.8 per cent; current, 5.2 per cent; battery repairs and renewals, 15.9 per cent.

Summarizing all of the costs, it may be said that the cost of operation was 72 cents per truck-mile for the year 1919, including every charge which could logically be placed against the equipment. In 1914 the same charge was 58.2 cents per truck-mile, showing in a very marked way the effect of present-day higher cost of operation due to increases in both material and labor expenses. Without any charge for the operator the cost of operating the trucks was $76.82 per month for each truck during the year 1919. In 1914 this same comparative expense was $48.33.

Inspection Placed on Scheduled Basis*

A Number Is Given to Each Job, and Inspections Are Scheduled Daily, Semi-weekly, Weekly, Triweekly, Monthly, Bimonthly, Trimonthly and Semi-annually According to Nature of Equipment

CONSIDERABLE attention has been given the subject of inspection and maintenance by the Syracuse (N. Y.) Lighting Company with a view toward placing this work on a definite basis. The inspection methods described have now been in successful operation several years on a system consisting of a steam station, a high-tension step-down substation and five distributing substations. The schedule includes inspections varying in their frequency from daily to semi-annually and covers virtually all apparatus in the stations.

As shown in Table I, a number is given to each job and identified by serial letter. The daily jobs carry the serial letter "D," the weekly jobs "W," triweekly jobs "T.W.," etc., and each station has its own series of numbers. The steam-station numbers are between 100 and 199, Fayette Street substation between 200 and 299, Solvay substation between 300 and 399, etc. For instance, "D-109" is a daily inspection at Fulton Street station, "W-201" is a weekly inspection at Fayette Street substation.

The charts are so arranged that the inspector can tell what he is to do each day. At the completion of his day's work a report (Fig. 1) is made out which indicates the inspections made and the defects noted. This report is turned in daily and the defects noted are indicated on the card shown. On the reverse side of the card shown in Fig. 1 are noted the repairs and replacements when completed. One or more of these cards are carried in a numerical file for each job in connection with which defects have been discovered. Inspections which show no defects are recorded only on the daily report sheet. If a job has been overlooked, a white slip is filled out calling attention to the omission and giving date when the inspection must be up to schedule, even should overtime be required to accomplish it. By this means the inspections are rarely more than twenty-four hours behind the schedule. In order to insure that the inspections occurring at infrequent intervals are not omitted, it has been found convenient to date them ahead in a year book which may be referred to from day to day.

It may be interesting to note that in 1918 and 1919 113 repairs were made at the time of inspection in cases where if the repairs had gone undone serious interruptions would probably have resulted. These defects were caught before grave trouble developed, and it is safe to say that without careful inspection a large percentage would not have been detected in time to prevent the failure of some particular piece of apparatus.

Previous to the introduction of the inspection work the night station troubleman was called on an average of two nights a week. The average number of calls in 1919 was approximately one every eleven nights. In other words, only one-third as many night trouble calls were recorded last year under periodic inspection.

Each central station requires its own scheme of inspection, but it is not going too far to state that systematic and regular inspection at stated intervals of time is a general principle at the foundation of good operating practice, for, like the proverbial ounce of prevention, it is more than worth the pound of cure. Periodic inspection of station and substation is good insurance.

Practice has generally leaned toward caring for only the pressing needs of each day. Inspection has been "incidental" and more often only "accidental" to the daily round. Much has been taken for granted as to the condition of equipment. Symptoms indicating the early stages of trouble are easily overlooked, and if discovered, repairs have been delayed until a more convenient time. Many such repairs have been classed as so-called "rainy-day-jobs," and under such operating conditions the men have frequently been compelled to drop regular work in order to repair a failure which might have been avoided by proper inspection. Even extensive use of reserve apparatus would not to any considerable extent reduce the number of interruptions under such conditions, and it is manifestly impossible to maintain spare equipment for all emergencies. To foresee is to forestall. The old lack of system should be

*This information was worked up in part by G. M. Parsons, now deceased, of the Syracuse Lighting Company, and is presented by courtesy of W. C. Pearce, superintendent of the electrical department of that company.

Table I—Arrangement of Inspection Schedules Designed to Facilitate Work and Prevent Overlooking Small Jobs

Week	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
First	D100-D101-D102- D103-D104*-D105 D106-D107-D108- D109-D100-W111- SW100 Janitor M107-M108-M117 SA100 January and July SA105 June and December	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W106 M101-M109-M400	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W101-W102-W106 M102-M111-M400	D100-D101-D102- D103-D104**-D105- D106-D107-D108- D109- SW100 Janitor W103-W104-W113 M106-M112-M400	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W107-W108	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W105-W109-W110- W112	TW100 See last inspection SA101 June and December SA102 February and August SA301 May and October
Second	D100-D101-D102- D103-D104*-D105 D106-D107-D108- D109 SW100 Janitor W100-W111 M100 SA104 January and July	D100-D101-D102- D103-D104-D105- D106-D107-D108- D109 W106 M101-M110	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W101-W102-W106 M103	D100-D101-D102- D103-D104**- D105-D106-D107- D108-D109 SW100 Janitor W103-W104-W113 M106 SA103 January and July	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W107-W108 SA400 January and July	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W105-W109-W110- W112 TM103 January, April, etc. TM303 January, April, etc.	TW100 See last inspection
Third	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 SW100 Janitor W100-W111	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W106 M101	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W101-W102-W106 M104-M105	D100-D101-D102- D103-D104*- D105-D106-D107- D108-D109 W103-W104-W113 SW100 Janitor M500	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W107-W108 M401 April to October, inclusive	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W105-W109-W110- W112	TW 100 See last inspection TM100 January, April, July, etc. TM January, April, July, etc.
Fourth	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 SW100 Janitor W100-W111	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W106	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 M113-M118 BM-600 February, April, June, August, etc.	D100-D101-D102- D103-D104**-D105- D106-D107-D108- D109 SW100 Janitor W103-W104-W113 M114-M300 SA300 January and July	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W107-W108	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W105-W109-W110- W112	TW100 See last inspection
Fifth	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 SW100 Janitor W100-W111	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W106	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W101-W102-W106	D100-D101-D102- D103-D104* -D105- D106-D107-D108- D109 SW100 Janitor W103-W104-W113	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W107-W108	D100-D101-D102- D103-D104*-D105- D106-D107-D108- D109 W105-W109-W110- W112	TW100 See last inspection

Advisable Frequency of Inspection by Job Numbers

Daily

Job No.	
D-100	Inspect ratchet rheostats.
D-101	Test voltage regulators.
D-102	Inspect turbine and engine governor control.
D-103	Inspect station manholes.
D-104	Coal crane and conveyor—clean and inspect motors, controller and all auxiliaries—crane operator only. Thursday by electrician also.
D-105	Inspect and wipe exciters Nos. 4, 5, 6 and 7.
D-106	Inspect arc tubs
D-107	Inspect 2,300-volt, 500-volt, exciter board and benchboard.
D-108	Renew burnt out lights back of 2,300-volt switchboard and 11,000-volt bus.
D-109	Inspect arc regulator, control, and secondary relay switch.

Semi-weekly

SW-100	Fire apparatus—replace burned out red lights and see that all fire apparatus is in proper place—janitor.

Weekly

W-100	Clean Nos. 4, 5, 6 and 7 exciters.
W-111	Inspect frequency changers and starting motors, brushes, rings and commutators.
W-106	Clean and repair motor generator sets.
W-101	Air compressor and motor—clean and repair.
W-102	Voltage regulators—examine for loose bolts, nuts and connections—oil all parts where needed.
W-103	Brush arc motors and machines, transformers—inspect and clean.
W-104	Battery charging set—inspect and clean.
W-105	Elevator—clean and repair motor and starting equipment, lights on elevator—examine fire apparatus in penthouse.
W-107	Storage battery—inspect connections and fluid level.
W-108	Fire alarm system—ring one round on each box—rewind and repair after 10 a. m. Friday
W-109	Inspect arc boards, arc tubs and rectifiers.
W-110	Switchboard—clean front of board and switchboard gallery (operator).
W-112	Turbine No. 3—electrical inspection after 12 noon (special).
W-113	Subway feeder switches—inspect and clean.

Triweekly

TW-100	Frequency changers—general inspection and cleaning.
TW-101	Clean and inspect 11,000-volt oil switches in switch house.
	Special [illegible] Wednesday or Saturday as TW-100

Monthly

M-100	Arc tubs—rectifier tanks and switchboard—clean.
M-101	Turbine No. 1—clean and inspect—first Tuesday. Turbine No. 2—clean and inspect—second Tuesday. Turbine No. 3—clean and inspect—third Tuesday.
M-102	11,000-volt lightning arresters—clean arresters and shed.
M-103	Machine shop motors, carpenter shop and garage—inspect and clean.
M-104	Step-bearing motor—clean
M-105	Auxiliary motors—clean
M-106	Engine No. 5—clean and inspect—first Thursday (wiper). No. 6—clean and inspect—first Thursday (wiper). No. 7—clean and inspect—second Thursday (wiper). No. 1—clean and inspect—second Thursday (wiper).
M-107	Regulators—clean regulators and all auxiliaries.
M-108	11,000-volt arresters—inspect and test electrolyte.
M-109	atchet rheostats—clean.
M-110	Inspect bell relay batteries.
M-111	Clean station manholes.
M-112	Station lighting—inspect all cabinets, fuses, etc.
M-113	Transformers for exciters, motor-generator set, auxiliary and station lighting, cleaning and inspection.
M-114	2,300-volt oil switches—clean.
M-117	Tirrill regulator—check setting.
M-118	2,300-volt and arc arresters—clean and inspect.
M-300	Solvay station—clean and inspect.
M-400	Substation inspection—E. Syracuse and Fayetteville—first Tuesday. Substation inspection—Camillus—first Wednesday. Substation inspection—Liverpool—first Thursday.
M-401	Lightning arresters in substations—inspect monthly April to October.
M-500	Inspect consumers' lightning arresters—April to October.

Bimonthly

BM-600	Gas department—inspect lighting, switches, motor compensators. Make necessary repairs—February, April, June, etc.

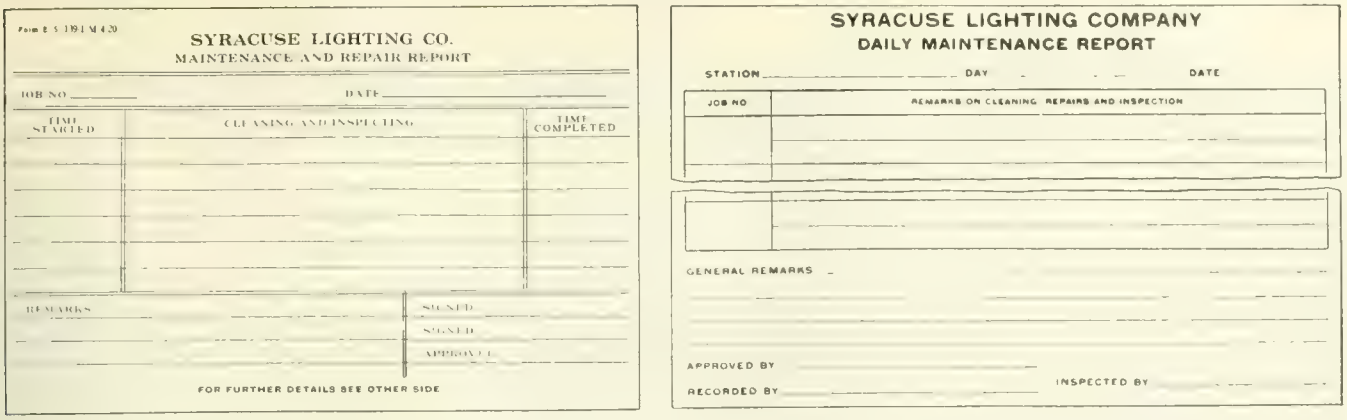
Trimonthly

TM-100	11,000-volt, 60-cycle transformer banks and wiring—clean January, April, etc.
TM-101	11,000-volt bus oil switches—clean.
TM-103	Test all 11,000-volt switches by tripping relays—second Saturday, January, April, etc.
TM-303	Test all 11,000-volt and 60,000-volt switches by tripping relays—second Saturday, January, etc.

Semi-annual

SA-100	Test oil from transformers for exciters, auxiliaries, station lighting and arc machines—January and July.
SA-101	Change oil in frequency changers, motor-generator sets and Nos. 4, 5, 6 and 7 exciters—June and December.
SA-102	Change oil in machine oil switches—February and August.
SA-103	Test oil from feeder regulators—January and July.
SA-104	Test oil 11,000-volt, 60-cycle transformers January and July.
SA-105	Change oil in brush arc machine and motors—first Monday—January and December.
SA-300	Test oil—Solvay transformers January and July.
SA-301	Solvay substation, 60,000-volt and 11,000-volt apparatus, clean and repair—May and October.
SA-400	Test oil substation transformers—East Syracuse and Liverpool—January and July.
AS-500	Inspect transformer vaults.

* Crane operator only. ** Crane operator and electrician.



SYRACUSE LIGHTING CO.
MAINTENANCE AND REPAIR REPORT

JOB NO. _____ DATE _____

TIME STARTED	CLEANING AND INSPECTING	TIME COMPLETED

REMARKS _____ SIGNED _____ SIGNED _____ APPROVED _____

FOR FURTHER DETAILS SEE OTHER SIDE

SYRACUSE LIGHTING COMPANY
DAILY MAINTENANCE REPORT

STATION _____ DAY _____ DATE _____

JOB NO	REMARKS ON CLEANING, REPAIRS AND INSPECTION

GENERAL REMARKS _____

APPROVED BY _____

RECORDED BY _____ INSPECTED BY _____

RECORD SYSTEMS ARE NECESSARY FOR THE PROPER ANALYZING OF TROUBLES TO REDUCE SERVICE INTERRUPTIONS

On the left is a maintenance and repair report. The back is the same as the front, with the exception that the heading "Repairs and Replacements" becomes "Cleaning and Inspecting." On the right is a "Daily Maintenance Report." These reports are entered on the maintenance and repair report if the information is considered valuable enough for permanent record.

superseded by a system of *prevision, provision* and *supervision.*

The first step in the problem is to realize the necessity of a plan of systematic inspection. In the second place, a carefully prepared time schedule of the details of the inspection should be laid out. Finally, the responsibility for carrying out the schedule must be placed in the hands of a competent person whose duty it must be to see that the inspections are made and duly reported. The men who are associated with him must be impressed with the fact that the work they have undertaken is important and must not be neglected.

The frequency of inspection on a given piece of apparatus can best be judged by asking the following questions: (1) How important is this piece of apparatus to the system? (2) Is it susceptible to frequent trouble? (3) Does its location permit frequent or infrequent inspections? (4) Does the system of operation permit an inspection without interruption? An analysis of these questions will usually determine how often it is necessary and practicable to inspect apparatus.

TABLE II—FREQUENCY OF INSPECTION VISITS FOR AN 11,000-VOLT STEP-DOWN SUBSTATION

This work is also scheduled by days as in Table I

DAILY

Inspect motor-driven rheostats.
Test feeder regulators.

WEEKLY

Inspect motor-driven rheostats and circuit breakers.
Clean feeder regulators.
Inspect feeder regulators, transfer bus and switches.
Clean battery-charging set.
Inspect battery-charging set.
Clean and inspect station auxiliary transformers and switchboard.
Clean and inspect storage batteries.
Clean and inspect arc tubs, rectifiers and arc switchboard.
Inspect arc tubs, rectifiers, arc switchboard and arc oil switches.
Inspect station manholes and subway.
Clean and inspect frequency changers.
Inspect frequency changers.
Clean air compressor and motor.
Inspect air compressor and motor.
Inspect benchboard, 2,300-volt board and exciter board.
Inspect 2,300-volt bus and disconnect switches.
Inspect and clean exciters 1, 2, 3.

MONTHLY

Clean and inspect lightning arresters.
Clean and inspect 11,000-volt oil switches—second and third Tuesday.
Clean and inspect 2,300-volt oil switches.
Clean and inspect compensators.
Inspect 11,000-12,300-volt transformers.
Inspect station auxiliary transformers and switchboard.
Clean oil and repair crane and equipment.
Blow out frequency changers.
Clean and repair solenoid-operated field switches—first Tuesday.
Inspect Terrill regulator.
Test all 11,000-volt switches by tripping relays—second Saturday, January, April, etc.

BIMONTHLY

Clean and repair solenoid-operated field switches, February, April, etc.

SEMI-ANNUAL

Change oil in frequency changers.
Inspect and change oil, if necessary, in frequency changers and oil switches.
Oil test transformer banks.
Oil test feeder regulators.
Oil test 11,000-volt compensators, 29th, 30th or 31st of January and July.
Oil test station light and power transformers, 29th, 30th or 31st of January and July.
Clean and wipe insulators, bus compartment current transformers, potential transformers, etc., 11,000-volt.
Clean 11,000-volt transformers.

The first point, the importance of the apparatus to the system, may not be a deciding factor in determining the frequency of inspection, because the second point, susceptibility to trouble, might indicate that frequent inspections would be a waste of time. The fact that apparatus cannot be inspected without interruption of service is a point that often outweighs all others. It is sometimes possible to take care of such inspections at times of reduced load such as Sunday operation. By reference to Table I it will be noted that certain work is definitely scheduled for that day.

It has become increasingly evident during the last few years that station design should actually take into consideration the inspection schedules which will necessarily have to be adopted if the equipment is to be properly maintained. Spare capacity, transfer buses, ease of accessibility and many such points are very important considerations in design which later affect the inspection schedules.

However, a station as a rule must be taken as it stands and maintenance and inspection schemes must be arranged accordingly. For an old station it is possible to improve the maintenance problem by careful analysis of all troubles and the laying out of schedules as described.

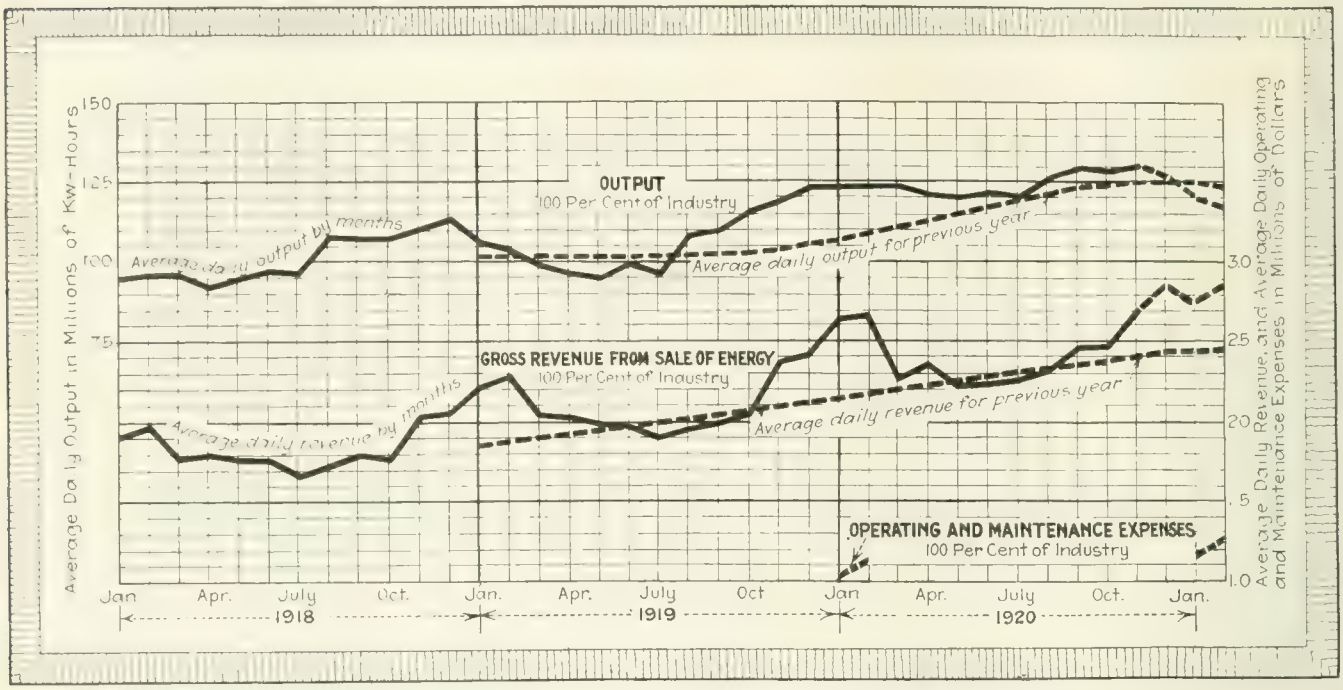
The system employed by the Syracuse Lighting Company calls attention to the necessity for definite methods of inspection procedure in all central-station systems.

Hydro-Electric Progress in Italy

THE United States Commercial Attaché at Rome reports that whereas in 1915 Italy's electric power resources amounted to 2,500,000,000 kw.-hr. per annum, they now approximate 4,000,000,000 kw.-hr. During the five years from 1915 to 1920 hydro-electric plants yielding 265,000 hp. were completed, and plants now under construction will yield 400,000 additional.

In these new undertakings it is estimated that approximately $400,000,000 (at old rates of exchange) will be invested.

Industrial Load Reaches Low Level



ELECTRIC LIGHT AND POWER COMPANIES REPORT DECREASED OUTPUT BUT INCREASED REVENUE DURING FEBRUARY

RETURNS received for the month of February by the ELECTRICAL WORLD from central generating companies representing 76 per cent of the installed rating of the country indicate that the industrial depression prevailing throughout the nation reached a low level during that month. Reports from some sections, however, point to considerable increase in power requirements by certain industries over those reported for January. The average daily output of the light and power plants in the aggregate was about 1,600,000 kw.-hr. below that of January, but this decrease is attributed in large part to the advancing season and consequent decrease in lighting requirements. Gross daily revenue received from sale of energy during February was about 5 per cent in excess of that reported for January, and only a fraction of 1 per cent below the record earnings reported in December. The average daily operating and maintenance expenses, however, were about 7 per cent above those reported for January, giving in general a resulting operating ratio during February slightly above that indicated by the January returns. A similar increase in the operating ratio was reported for the same period in 1920.

Increased activity in the boot and shoe manufacturing industry and definite improvement in textile-mill operations over those of January were prevalent throughout New England during February. Several other important industries, however, decreased their operations below those of January, with the result that the electrical energy sold to power customers in this section was probably about the same as during January. The average daily output of the central generating stations of New England decreased about 30,000 kw.-hr., due probably in large part to decreased lighting requirements.

During February the iron and steel mills reported the greatest curtailment in operations of all the primary industries. Judged by the decrease in number of men employed, operations in this industry showed a curtailment under January of about 7.3 per cent. However, the decreased energy requirements by the iron and steel industries of the Atlantic States were offset to a large extent by material increases in operations in the automobile, textile, leather and lumber industries of this section. In the South Atlantic States the textile indus-

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase
Mar.	70	2,698,890	2,103,587	28 0	65	$46,155	$36,840	25.0
April	70	2,603,692	2,098,559	24.1	65	45,547	36,541	24.5
May	70	2,631,560	2,179,916	21.2	65	43,888	35,512	23.4
June	71	2,630,831	2,175,645	20.2	66	44,434	35,528	24.5
July	71	2,677,131	2,234 215	20 0	66	46,608	36,265	28.5
Aug.	71	2,769,175	2,303,099	20.1	66	47,410	36,713	29.1
Sept.	71	2,734,179	2,327,460	17.4	66	49,224	38,209	28.5
Oct.	71	2,797,625	2,499,488	11.9	66	51,370	41,055	25.1
Nov.	71	2,741,705	2,503,402	9.6	66	54,620	44,711	22.0
Dec.	71*	2,792,554	2,648,746	5.4	66*	57,697	48,580	18.6
		1921	1920			1921	1920	
Jan.	76†	2,803,241	2 967,611	-5.5	70†	59,486	51,276	15 9
Feb.	76‡	2,499,412	2,700,629	7.4	70‡	56,450	48,755	15.7

	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies reporting) 1921 Thousands of Dollars	1920 Thousands of Dollars	Per Cent Increase	OPERATING RATIO Steam Plants 1921	Steam Plants 1920	Hydro Plants 1921	Hydro Plants 1920	Combined Systems of Steam and Hydro 1921	Combined Systems of Steam and Hydro 1920
Jan.	40	14,620	13,150	11 2	56.3	55.5	26.8	27.0	38.7	46.5
Feb.	43	15,165	13,687	10.8	55.7	54.6	24.2	26.5	41.7	48.0

* Includes estimates for thirty-seven companies, representing 4.3 per cent of the total installed rating of all central stations.

† Includes estimates for thirty-four companies, representing 11 per cent of the total installed rating of all central stations.

‡ Includes estimates for seventy-four companies, representing 19.5 per cent of the total installed rating of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States		
		Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	1920 Thousands	1919 Thousands	Per Cent Increase
KW.-HR. OUTPUT	Mar.	82	198,603	148,512	33.7	64	897,327	711,828	26.0	74	913,659	711,761	28.1	56	137,306	102,545	33.6	79	551,995	428,941	28.6
	April.	82	187,174	144,922	29.1	65	883,264	701,778	25.9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May.	82	188,566	148,186	27.5	65	854,631	711,276	20.0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June.	82	189,934	149,607	26.5	66	865,714	721,688	19.9	74	855,013	681,780	25.5	56	132,733	99,660	33.2	79	587,437	522,901	12.2
	July.	82	190,668	159,000	20.0	66	881,241	714,485	23.5	74	841,351	702,302	19.7	56	138,937	106,460	30.1	79	614,934	551,959	13.4
	Aug.	82	194,028	171,002	13.5	66	905,170	728,097	24.2	74	891,712	750,787	18.6	56	147,082	111,573	32.0	79	631,183	541,640	16.5
	Sept.	82	194,730	170,593	14.1	66	905,872	758,737	19.5	74	878,237	758,017	15.9	56	147,524	113,649	30.0	79	607,816	526,464	15.5
	Oct.	82	196,310	191,132	2.7	66	964,739	841,694	14.5	74	896,241	817,757	9.5	56	157,267	126,769	24.1	79	583,068	522,136	11.7
	Nov.	82	193,231	183,624	5.4	66	953,436	825,011	15.5	74	895,229	861,352	10.5	56	144,889	125,438	15.0	79	554,920	507,977	9.2
	Dec.	82	210,494	227,403	-7.4	66	969,909	917,945	5.7	74	903,628	852,264	5.9	56	140,485	133,419	5.3	79	568,038	517,715	9.6
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.	81	199,046	247,800	-19.7	77	1,005,566	1,043,650	-3.7	73	897,076	980,159	-8.5	62	144,936	145,336	-0.3	81	556,617	550,666	0.1
	Feb.	81	178,694	216,890	-17.6	77	886,578	948,043	-6.5	73	845,105	896,318	-5.7	63	132,290	132,544	-0.2	81	456,745	506,834	-9.9
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
REVENUE	Mar.	82	$5,136	$4,044	27.0	63	$17,696	$14,299	23.7	57	$13,270	$10,469	26.5	54	$2,910	$2,287	27.8	79	$7,148	$5,741	24.2
	April.	82	5,087	3,943	29.0	64	17,700	14,383	23.5	57	12,690	10,042	26.9	54	2,952	2,181	35.2	79	7,118	5,992	19.2
	May.	82	4,897	3,741	30.1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32.0	79	7,067	6,147	15.1
	June.	82	4,948	3,778	30.5	65	16,525	13,449	22.1	57	12,412	9,776	26.9	54	2,849	2,127	33.9	79	7,700	6,398	20.5
	July.	82	5,009	3,802	28.5	65	16,899	13,438	25.5	57	12,822	9,793	30.9	54	2,747	2,194	35.0	79	9,131	6,948	31.5
	Aug.	82	5,075	4,093	24.0	65	17,210	13,731	25.9	57	13,497	10,151	32.9	54	3,168	2,281	38.1	79	8,460	6,457	31.1
	Sept.	82	5,409	4,296	25.9	65	18,081	14,456	24.5	57	13,834	10,522	31.5	54	3,262	2,386	36.5	79	8,638	6,549	32.0
	Oct.	82	5,675	4,623	22.7	65	19,201	15,722	22.0	57	14,458	11,667	23.9	54	3,504	2,551	37.3	79	8,532	6,492	31.5
	Nov.	82	5,898	5,017	17.5	65	20,938	17,119	22.2	57	15,158	12,561	20.8	54	3,853	2,910	32.4	79	8,775	7,104	23.5
	Dec.	82	6,548	5,744	14.0	65	22,332	19,149	16.7	57	16,004	13,142	21.8	54	3,722	3,113	19.8	79	9,091	7,432	22.3
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.	81	6,457	6,243	3.7	74	22,213	19,226	16.2	59	17,345	14,777	17.5	62	4,155	3,484	19.3	81	9,316	7,546	23.4
	Feb.	81	5,924	5,728	3.5	74	21,169	18,023	17.2	59	16,842	14,436	16.8	62	3,971	3,328	19.3	81	8,544	7,240	17.8
OPERATING EXPENSES:																					
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan.	34	$1,098	$1,288	-14.7	48	$6,400	$5,437	17.8	28	$3,972	$3,488	13.8	37	$1,027	$916	12.1	54	$2,135	$2,030	5.2
	Feb.	35	1,070	1,240	-13.7	53	6,825	5,929	15.0	29	3,997	3,484	14.6	44	1,232	1,065	15.7	55	2,041	1,969	3.6

try consumes about 41 per cent of the energy sold by light and power companies, and this industry reported about 250,000 more spindles active during February than during January. Moreover, the lumber mills of the South, which purchase more than 5 per cent of the electrical energy sold to power customers in that section, reported that operations in that industry had increased from 51.5 per cent below normal in January to only 35.5 per cent below normal in February. As a result of these conditions, together with a falling off in the lighting load, the daily output of the light and power companies of the Atlantic States was only about 2 per cent below that of January.

In the North Central States two opposite conditions were presented by two of the chief consumers of electrical energy in that section, the iron and steel industry and the automobile and allied industries. The iron and steel mills of this section were operating at near 10 per cent below January, while the automobile industry as a whole increased operations by almost 20 per cent over those of January. The prevailing trend in this section during February was toward increased activity except in a few industries. These increased activities were reflected in an increased daily output for the central generating stations of more than 1,700,000 kw.-hr.

The Mountain and Pacific States reported a larger decrease in central-station output for January than any other section, about 9 per cent. A slowing down in industrial activities was reported from all parts of this section, which was to be expected as a reflection of the depression existing in the East. The largest decreases in electrical energy requirements, however, were reported by the Mountain States and were due to a low ebb in both mining activities and operations by urban industries.

TABLE III—AGGREGATE OPERATING RATIO OF COMPANIES REPORTING DATA MONTHLY TO THE "ELECTRICAL WORLD"

Type of Generating Plant and Month	New England States				Atlantic States				North Central States				South Central States				Mountain and Pacific States			
			Average for Year				Average for Year				Average for Year				Average for Year				Average for Year	
	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920
Steam Plants:																				
January	54 0	60 8	54 0	60 8	53.5	50 9	53.5	50 9	61.5	62.1	61 5	62 1	54 0	54 7	54 0	54 7	69 0	60 5	69 0	60 5
February	54 3	59.5	54 2	60 3	52.3	53.6	52.8	52.1	63.1	58.1	62 3	60 2	59 8	50 0	57 0	50 8	60 2	60 3	64 3	60.3
Hydro Plants:																				
January	26 5	35.2	26 5	35 2	21.2	21.2	21.2	21.2	25 0	20.8	25 0	20 8	26 4	20 1	26 4	20 1	28 4	27 9	28 4	27.9
February	30.1	46.5	26 8	35 6	20.1	20 6	20.7	20.9	26.1	29.3	25.6	25 1	28 6	21 4	27 4	20 5	25.7	28 5	27.2	28.2
Combined Systems of Steam and Hydro Plants:																				
January	45.3	53 5	45 3	53 5	45.3	48.1	45.3	48 1	42.8	44 8	42 8	44 8	38 6	46 6	38 6	46.6	35 0	45 5	35.0	45.5
February	44 3	60 0	44 7	58 8	43.4	43.8	44.4	45.9	43.2	50.9	43 1	50 0	41 7	38 6	40 5	42 0	39 2	44 0	37.0	44.7

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Electrical Importance of the Southwestern States

To the Editor of the ELECTRICAL WORLD:

SIR: In studying the summary of the "Electrical Importance of the Various States" in the March 19 issue of the ELECTRICAL WORLD the writer was forcibly impressed with the peculiar position occupied by the States of Arizona and New Mexico. These two states, which actually have a very high ratio of kilowatt-hours per capita, are shown as almost a negligible factor. In the majority of the states the output of the central stations is vastly greater than the combined output of the isolated plants and the isolated plants have a comparatively small installed capacity when compared with the central stations. In the Southwestern States, however, the reverse is true. The largest and most modern plants are installed by companies which use the bulk of the power generated in their own processes and usually carry the utility load of the community as a convenience for their employees.

On the basis of the 1919 output, which marked a period of severe restriction in the production of copper, there were a number of companies in these states that produced far more power in the course of the year than the total reported sold for power purposes. In fact, several of these plants generated more than the combined power sold in the state for both light and power. These plants are not large in comparison with many of the central stations in other sections, comparatively few of them being of sufficient capacity to justify the use of units larger than 10,000 kw. capacity, although a good many require units of 5,000 kw. to 7,000 kw. The load factor is very high. In normal times a variation of 20 per cent in twenty-four hours is unusual, and this variation is frequently caused by hoisting loads with regular cycles and can be provided for. With a steady load and small peaks, the plant investment is small in comparison with the total annual output, and power costs are on a comparative basis with many larger plants operating on a lower load factor. From this point of view the relative electrical importance of these states cannot be measured by the output of the central stations alone. This is, of course, true in any state, but not nearly to such an extreme.

Regarding future possibilities, the central and northern portions of these states have considerable potential hydro-electric development, but these water-power sources are mainly in very inaccessible locations and will be costly in development. A large portion of the power now being used is generated from the waste heat of the smelters, and this will hardly be supplanted by purchased power. The mines are in very rough country and are widely separated. Very little additional load can be expected along the lines, except possibly extensive railway electrification. The long distances and density of traffic will hardly warrant the expenditure under present conditions.

In all probability the development of these water powers will be slow, and the electrical importance of these states will for a long time lie not in the central stations but in the large mining companies.

El Paso, Tex. T. H. ARNOLD.

[In preparing tabulations and maps no effort was made to include the energy generated by private plants. At the present time such data are not available for the entire country, but they are being rapidly accumulated by the ELECTRICAL WORLD and will be published as the survey of various sections is completed. The operations of the central generating stations, however, are believed to be a very dependable barometer of the status of electrical development in the various states.—EDITOR.]

Cost Estimate for 60,000-Volt Line

To the Editor of the ELECTRICAL WORLD:

SIR: On page 431 of the Feb. 19, 1921, issue of the ELECTRICAL WORLD the estimated cost of a 66,000-volt branch line is given in detail. It is noted that nothing is included in the estimate to cover the cost of surveying, engineering and overhead. In a country where clearing costs about $700 per mile I should expect that it would cost about $75 to $200 per mile to make the survey. In general, overhead expenses, including engineering and surveying, run from 10 to 20 per cent of the cost of material and labor. Since the estimate given does not include this item it seems to me that it does not reflect the true cost of the line.

PAUL P. ASHWORTH,
Distribution Engineer.

Utah Power & Light Company,
Salt Lake City, Utah.

Hydro-Electric Construction in Italy

To the Editor of the ELECTRICAL WORLD:

SIR: Every now and then American readers of technical publications hear about wonderful hydro-electric projects which should accomplish even more wonderful results. Frank W. Chase's letter in the ELECTRICAL WORLD for Jan. 8, 1921, shows the natural reaction of an engineer's mind against all the nonsensical exaggeration of the power schemes which are one of the blessings of the aftermath of the great war.

Projects foolish both in their engineering conception and in the calculation of their financial possibilities have been springing up like mushrooms all over Europe, and Italy has shared this experience with all her neighbors. It is said that engineers of important American public utility corporations have come hither on a wild-goose chase after wonderful sites which had the only drawback of being already leased under franchise to other companies, and it is certain that any person who has suffered such disappointments is likely to drop European power schemes like a hot potato. But, nevertheless, there are a number of very important hydro-electric projects under construction in Italy, and a few are of such magnitude as to rank among the leading ones in the whole world.

The Adriatic Electric Power Company and its associated companies are building what may be considered one of the most important installations on the Continent. By deflecting the Piave River into the Santa Croce Lake near Belluno, by damming the Alpago Valley and build-

ing tunnels and pipe lines, this company will be able to operate six power plants with a total of 300,000 hp., the average yearly output of power being calculated at about 650,000,000 kw.-hr. Two of the power plants, the Fadalto No. 1 and the Nove No. 1 installations, are already supplying more than 100,000,000 kw.-hr. at 55,000 volts and 42 cycles. By the end of this year the Fadalto power house No. 2 and the San Floriano plant will probably be completed, adding a yearly average output of 120,000,000 kw.-hr. The transmission voltages will be 55,000 volts and 110,000 volts, 42 cycles.

By 1924 the tunnel from Lago Morto to Nove will be completed, and the Nove No. 2 plant will be started, adding 90,000,000 kw.-hr. yearly, with transmission voltages as above. By 1926 the Livenza canal and power plant will be put in operation, adding a yearly average output of 150,000,000 kw.-hr. By 1928 the project will be definitely completed by the addition of new pipe lines and tunnels and of six 20,000-hp. and two 1,300-hp. generating units in the existing plants. This will add a medium yearly energy output of 225,000,000 kw.-hr.

It must be understood that a rather important amount of tunnel work is responsible for the length of the construction period, together with the fact that all this work has to take place in a region which was most severely dealt with by the Austrians during the war, and where, therefore, electrical construction work must go hand in hand with general reconstruction work of a very difficult nature.

The members of a committee of American bankers and business men, delegates to the International Chamber of Commerce convention, were truly astonished when they were shown through the different plants and works of the Santa Croce undertaking in July, 1920, to find that every nook and corner was alive with hustling construction work where only eighteen months before one of the greatest battles of the war, that of Vittorio Veneto, had been fought and won.

Other Italian companies are pushing toward completion a number of very important hydro-electric projects, the most important of which, after those of the Adriatic group, is no doubt that of the Italian Edison General Electric Company. This company and its associated undertakings have in construction a number of plants totaling over 350,000 hp. Then there is the Ovesca development, which makes use of the water of the Introna Lake and of the artificial reservoirs of Alpe Cavalli and Alpe Campiccioli to operate the Rovesca power house (48,000 hp., 130,000-volt, 42-cycle transmission), and, further down, the Pallanzeno power house of the same capacity. The Mese and Truzzo power plants of the Cisalpine Hydro-Electric Power Company (an Edison subsidiary) will total 200,000 hp., with a medium annual output of 280,000,000 kw.-hr. The Adamello Electric Company has under construction the Ozola development, which will total 60,000 hp., with a medium yearly production of 115,000,000 kw.-hr., and the Salarno and Avio developments, totaling about 55,000 hp., with a yearly medium output of 140,000,000 kw.-hr.

These are by no means the only hydro-electric plants under construction in Italy. Installations of between 15,000 hp. and 20,000 hp., of which there are more than a score nearing completion, and other plants under construction of lesser power have not been considered.

LYMAN GEORGE STUCKE,
Secretary.

Compagnia Italo-Americana di Elettricita,
Rome, Italy.

Sane Safety Versus Insane Safety

To the Editor of the ELECTRICAL WORLD:

SIR: The man who plays absolutely safe seldom gets very far ahead in the world. Usually he falls behind and is a failure compared to the normal business man who takes normal business risks. The man who occasionally runs a risk may lose occasionally, but on the whole he gains more than the man who tries for 100 per cent safety.

The campaigns for increased safety are most of them sane, and most of them have accomplished fine results. The following examples are not put forward, therefore, in order to decry the safety movement, but are merely to point out that service and sanity are the really important things and that we should strive for safety only when on the whole increased safety means increased service and comfort.

A good example in electric work is the question of a safe voltage, say for trolley wires. A voltage of 500 may kill if a wire drops into the street. So may 220 volts and so may 100 volts if the conditions are just right. There is a case on record, or at least current in medical circles, where 2 volts killed a patient with a weak heart. The 2 volts was on an exploring lamp in the throat near the nerve centers and the moist mucous membrane made a good contact. It was a most unusual accident, but it shows that even 2 volts is not a 100 per cent safe voltage, and it is clear that 500-volt trolley wires are not 100 per cent safe. Yet, is not 500 volts a proper trolley voltage in cities in spite of not being 100 per cent safe? Again, what is a safe speed for an automobile? Is there not some danger in anything over 4 miles an hour, the speed provided by the old English code or law for automobiles? Yet who wants an automobile speed that is 100 per cent safe?

One hundred per cent safety is an absurdity. What is wanted is sane safety, which may be sometimes 99.9 per cent, sometimes 99 and sometimes 90 per cent. It is always a question not of safety alone but of balancing advantages. The first safety precautions and some safety campaigns pay well, but they easily get beyond the point of sanity.

The expressed desire for 100 per cent safety, based on the plea that human life is worth any number of dollars, may be merely the lazy-minded excuse of the man who wants to put something over. Sometimes his scheme is good in itself. For instance, the block signal system on railways is probably worth while, the steel railroad car is probably worth while, and so on. On the other hand, the guard wires above the trolley wire are not worth while. It is not worth while to force transatlantic vessels to travel in pairs or with convoys in time of peace.

We want sane safety, not insane safety. We don't want to spend more for any particular kind of safety device than that device is worth. Even if it will save human life, yet its cost may be such that the same money spent in some other way, as on some other safety device, may save still more human lives or add more to human happiness.

For any safety device or scheme it should be shown, first, what it will cost and, second, what it will accomplish. If it will accomplish more than the same money and same effort when applied in some other way, the cause is good and it is unnecessary to talk 100 per cent safety and the sanctity of life. KASSANDRA.

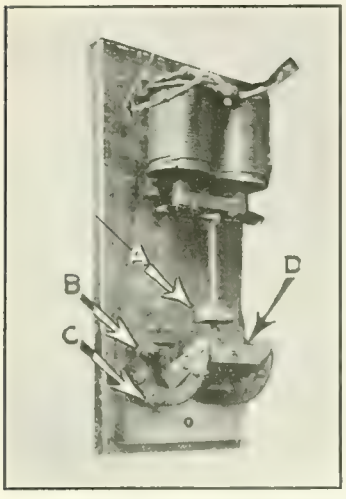
Boston, Mass.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Effective Street-Light Switch

AN INEXPENSIVE switch to use where 110-volt lamps for decorative lighting in parks and on bridges are to be turned on at the same time as the street arc lights is shown in the accompanying illustration. The solenoid coils with their yoke were taken from an old arc lamp, and the switch is part of an excess-demand indicator. These were mounted on slate and connected by a rod having a weight *A* on it to pull the switch open. With this type of switch there is the smallest amount of pitting and friction since it was designed for just such use. The coils are connected in series with the arc circuit, the 110-volt circuit being connected to binding posts *B* and *C* and the two on the other side not shown. Normally weight *A* holds the switch open by gravity, but when current flows through the coils the yoke pulls up the rod and switch arm, holding the switch closed as long as current flows in the arc circuit.



SWITCH FOR TURNING ON LIGHTING CIRCUIT

Laminated cores may be put in the top of the coils but should not extend down far enough for the yoke to hit them, and the laminations should be tight as vibration might be objectionable. The two circuits can have no electrical connection even if the coils become grounded as bar *D* is of fiber. The switch was devised by T. F. Breithaupt of the Connecticut Light & Power Company.

D. A. McNULTY.

Waterbury, Conn.

Curve-Drawing Thermometers to Study Insulator Failures

IN ORDER to determine the relation between temperature and failure of suspension insulators on the 150,000-volt Big Creek lines of the Southern California Edison Company, four curve-drawing thermometers have been installed at points along the line. These thermometers are provided with weekly charts and have a temperature scale from 0 deg. to 120 deg. F. Two of the instruments have been placed at the points where the maximum number of insulator failures have occurred, and two have been placed at those points where the minimum number of insulator failures have occurred.

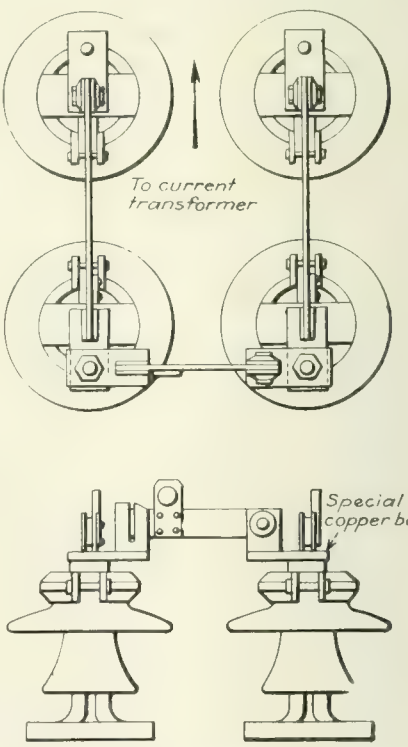
Along portions of this line as much as 60 deg. F. daily variation has been found in the temperature, and from a careful analysis of these results it is hoped to determine what relation if any exists between temperature and insulator failures.

S. R. VAN DREZER,
Chief Patrolman.

Southern California Edison Company,
Kern, Cal.

Convenient Disconnecting Switch for Current Transformers

A COMBINATION of two disconnecting switches with a short horizontal blade across the upper terminals to short-circuit them makes a convenient arrangement for use with current transformers. The arrangement is shown in the illustration and may be made up with any manufacturer's standard disconnecting switch. The smaller short-circuiting blade will require special castings to fit the standard disconnecting terminals. Current transformers connected through such an arrangement can be readily cut out of circuit for repairs, and meter testers can test current transformers and meters together as a unit without the necessity of waiting for night or Sunday hours when load conditions will permit interruptions to service to take equipment out of circuit. The arrangement can be easily applied on circuits of any voltage and the switches made up for indoor or outdoor use. The switch is used by a large Middle Western company as standard equipment on customers' substations up to 27,000 volts. No means has been developed of interlocking the short-circuiting and main disconnecting switches to prevent opening the circuit until the short-circuiting switch has been closed, though a simple mechanical interlock would seem easily possible.

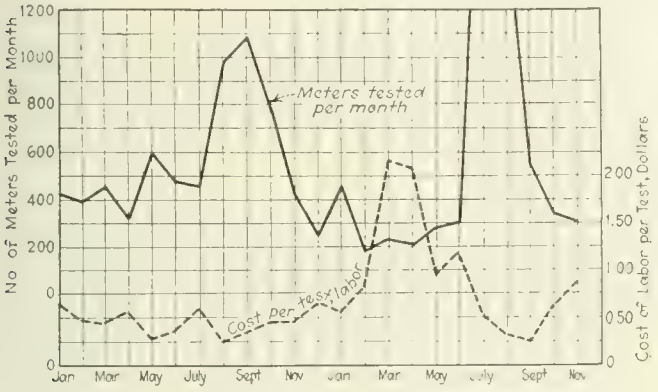


CURRENT TRANSFORMER CONNECTED ABOVE MAY BE SHUNTED OUT WHEN DESIRED

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Graphic Form of Records for Showing Cost of Testing Meters

IN ORDER to show at a glance the cost of meter tests a graphic form of record is kept by the Worcester (Mass.) Electric Light Company. This record shows the number of meters tested monthly and the cost of testing per meter. It may be noticed from the curves that as more meters are tested the cost of testing each meter is lower. These curves are plotted from the monthly records of the number of meters tested. George



COST OF METER TESTS AND NUMBER TESTED EASILY SEEN FROM THESE CURVES

M. Hardy, superintendent of the company, is responsible for the development of these charts.

Similar records used for various purposes have been described in previous issues of the ELECTRICAL WORLD and more will be published later.

FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

Economical Use of Flashboard Supports on a Curved Dam

A SAVING is effected at the stations of this company at Turners Falls by making the pipes which support flashboards 11 ft. long, thus making it possible to use them three times. When the spring high water of the Connecticut River falls sufficiently to enable the total flow of the river to be taken through the wheels and floodgates, flashboards are installed on the curved dam at this development. These boards are supported by 3.5-in. iron pipes. The pipes are purchased in 22-ft. lengths and are cut in half. On them are bolted 2-in. x 4-in. hemlock nailing strips, to which the flashboards are nailed. The pipes are set in sockets in the dam 2 ft. deep and 7 ft. of flashboards are maintained. If the pipes are bent over once, the 2-ft. portion in the socket is cut off and the remaining 9 ft. are used over again.

If the pipes are bent a second time, they are 2 ft. shorter than is required, and in the top of the pipe a wooden plug is inserted, the latter being made by turning down a 4-in. x 4-in. hardwood stick. Even with a recent pipe cost of 85 cents per foot, the cost per year is not heavy on account of this triple use, and in most years it is possible to remove the pipe with virtually no loss.

In erecting the flashboards the pipes are first inserted in the sockets. A ranger, consisting of 4-in. x 4-in. hardwood timber, runs the entire length of the dam and about 5 ft. above the crest. This is attached to the pipes by U-bolts. Braces are placed under the ranger and against the pipe, being set against solid iron pins on the crest of the dam. These pipes with 7 ft. of board are figured to fail without any bracing when the water is 6 in. over the top of the boards, and experience shows that they fail at about this height.

As the water begins to rise in the fall the braces are not removed because there is no ice and there is insufficient rubbish in the river to cause damage. The boards are stripped off and the water is allowed to flow between the pins. No braces or rangers are removed. After high water passes the boards are replaced and are usually not touched during the winter. In spring, when the river breaks up, the heavy ice in the pond above the dam makes it necessary to strip off all the rangers, braces and pins. When the rise of water starts the braces are removed to make sure that the water will not back up too far. The boards are removed to the crest and the pins and rangers taken off to give a clear crest when the water reaches a height that requires the removal of all flashboard equipment.

C. I. HOSMER,
Hydraulic Engineer.
Turners Falls Power & Electric Light Company,
Turners Falls, Mass.

Gate-Opening Indicator Used for Indicating Kilowatts

A GATE-OPENING indicator is employed to measure the kilowatt output of an isolated hydro-electric plant in which there was no indicating wattmeter installed to measure the power. Because a new plant is to be built in the near future it was not desired to purchase any equipment for the present one as it will be dismantled. However it was necessary to measure the kilowatt output, approximately, and the method mentioned was found nearly enough satisfactory.

A portable wattmeter was obtained and its performance recorded on a paper disk pasted on the gate-opening indicator of a 2,500-ft.-lb. special Lombard governor. Lost motion in the connections and between the governor and gate was found to be negligible, as also was the small clearance in the meshing of the pinion and "rack" by which the pointer on the indicator is driven. The

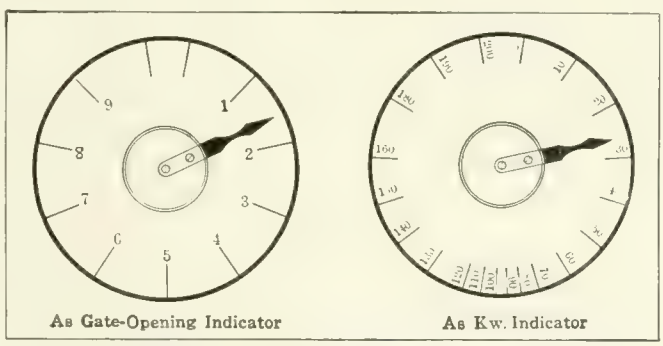


CHART CALIBRATED IN KILOWATTS WAS PASTED ON DIAL OF GATE-OPENING INDICATOR

portable indicating wattmeter was retained for two days following the recording of the chart, during which an average of the various load changes occurred. This little governor, kept in first-class condition, is very sensitive and steady in its actions. The two days' checking showed no appreciable change. R. W. LOYD,
Electrical Engineer.
Florence Silver Refining Company,
Ainsworth, B. C., Canada.

Size and Type of Condenser Required for Small Plants

IN NEARLY all power plants surface condensers should always be used unless the cooling water is particularly good for boiler feed, which is not often the case. By the use of surface condensers condensed steam becomes available for boiler feed, which, unless the condenser leaks, is pure distilled water and will not scale up the boiler tubes. Consequently boilers may be run for longer periods between cleanings and fewer tube failures will result. But surface condensers are more expensive and jet condensers are often put in to reduce the initial investment. With this condenser the cooling water mixes with the condensed steam, and usually all is thrown away unless the condensing water is very good.

With surface condensers the amount of surface is usually based on a condensation of about 7 lb. of steam per square foot of surface per hour, or about 1.6 sq.ft. of surface per kilowatt of rating. For instance, for a 12,500-kw. generator this amounts to 20,000 sq.ft. A modern turbine of this size designed for 200 lb. pressure and 200 deg. Fahr. superheat will generate a kilowatt-hour on about 11.25 lb. of steam, or 140,600 lb. of steam per hour, which amounts to approximately 7 lb. per square foot of condenser surface. To condense 1 lb. of steam in the condenser requires the extraction of about 950 B.t.u. per pound of steam. If the rise in temperature of the cooling water passing through the condenser is 15 deg. Fahr., the quantity of water required will be about 18,000 gal. per minute. If clean enough, this water can be pumped into the service water lines; if not, it can be thrown away. With this quantity of condensing water a vacuum of 29 in., or 1 in. absolute, will be obtained with inlet water at 50 deg. Fahr. and the condenser reasonably clean. Better results are possible with the condenser in good condition.

The condensing water will be pumped by a centrifugal pump, and if the discharge pipe from the condenser is carried below the water level, the head against the pump will be about 15 ft. or 16 ft. As the pumps in ordinary commercial service will not average much over 50 per cent efficiency, a 75-hp. motor will be required, although it is good practice to use a larger size, say 100 hp., especially if the motor is in a warm place. Low-speed pumps are, generally speaking, more efficient than high-speed ones for this service. Speeds of 200 to 300 r.p.m. are about right if steam drive is required. This calls for a reduction gear which, however, should give very little trouble.

To remove the condensate from the condenser a centrifugal pump is now universally employed, and provided that it is correctly vented back to the condenser, no trouble is to be expected from it. To remove the air it is now customary to use a type of hydraulic vacuum pump which operates by trapping air between sheets of water and so carrying it out to atmosphere against the vacuum. This pump gives a good vacuum if the air leakage is normal, say 5 cu.ft. to 10 cu.ft. of free air per minute. The only draw-back is that it takes a lot of power. On a large unit the percentage of the total is not large, say 100 hp. for a 30,000-kw. machine; but for a 5,000-kw. unit the ratio grows larger. The old Edwards air pump takes little power and has the advantage that less power is required as the vacuum is increased.

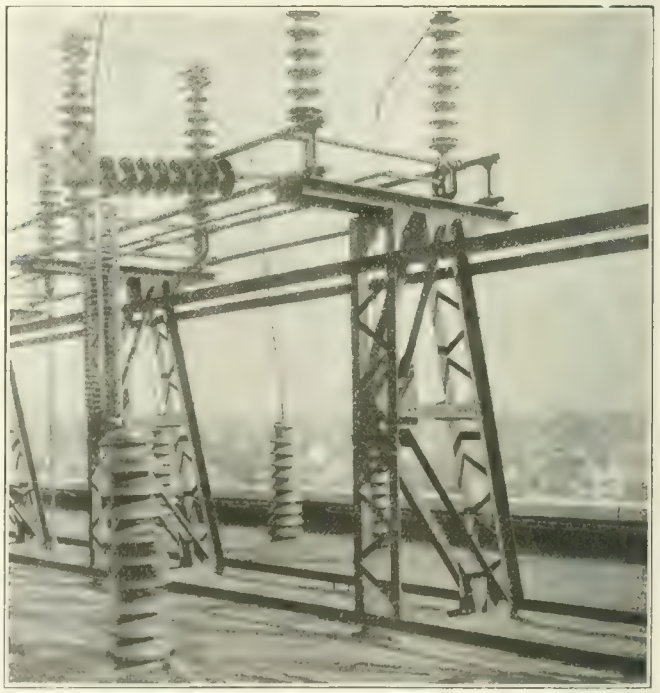
Steam-jet pumps are now being put on the market and have the advantage of small size, and so long as the steam can be returned to the feed water no heat is lost. Provided that a simple arrangement can be worked out, the steam jet is quite economical.

Sargent & Lundy, Chicago, Ill. A. B. Clark, Engineer.

Space Saved and Troubles Reduced by Design of Choke Coil

CHOKE coils for four incoming 100,000-volt lines originally occupied a space 15 ft. wide and the full length of a St. Louis substation roof, but by a change in design and arrangement that space has been cleared of equipment. Each coil was originally mounted horizontally on three post insulators, each of which was equipped with seven 10-in. disks. These post insulators gave a considerable amount of trouble from deterioration of individual disks, and their proximity to the roof presented a considerable life hazard. Both of these objections were overcome by the choke coil designed and manufactured by the power company's engineers and shown in the accompanying illustration. Instead of going through the choke coils as the line crosses the roof of the substation, as was the case in the original design, the line is now carried directly across the roof and then down through a vertically mounted choke coil which acts as a connection between the overhead lines and the roof bushing.

The coil is made of extra-hard bronze, and the turns are kept in position by reinforcing strips of hard wood. This construction is used at the 100,000-volt Page



VERTICAL CHOKE COIL MORE SATISFACTORY IN THIS LOCATION THAN STANDARD HORIZONTAL DESIGN

Avenue substation of the Union Electric Light & Power Company, St. Louis, and by the changes which have been described it has been possible to eliminate three post insulators on each phase of the four lines.

Union Electric Light & Power Co. C. C. Robinson, St. Louis, Mo. Superintendent of Electric Stations.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Standardized Pumping-Plant Substation for Arizona Valley

SUBSTANTIAL yet simple and inexpensive construction of transformer stations for pumping plants on the 200,000 acres of the Salt River Valley Water Users' Association, surrounding Phoenix, Ariz., has been achieved as shown in the illustration. The pole on the right acts as a dead-end pole. It is guyed to the pole on the left, which in turn is guyed to a dead-man. The line crosses to the pole-top lightning arrester placed at the top of the pole to the left. From this it is connected to the outdoor-type oil switch, which is suspended from buck-arms. From the switch the lines connect with a bus strung between the two poles. Thence they connect with the transformers placed on a platform between the poles. Between the bus and the transformers the connecting wires are steadied by an intermediate support. Within the pump house the meters and motor switch are placed on a panel. The whole makes a very substantial form of construction. Several score of such plants are now in operation. FIELD EDITOR ELECTRICAL WORLD.



TRANSFORMER STATION AT PUMPING HOUSE WHICH IS BOTH SAFE AND INEXPENSIVE

San Francisco, Cal.

Furnace Logs and Records Aid in Operation

IN ORDER to know more closely the cost of the particular grade of metal being manufactured in an electric furnace, and also to attain more nearly maximum efficiency, many operators keep an accurate log of every step of the process. This log shows at a glance the charge, weights and constituents, the amount of the various alloys and slag material used and their time of addition, the production of each melt, the amount of scrap, a careful record of the actual furnace operation, a record of delays, electrode record and analysis covering the metal and slag. Such a log is kept of each individual heat, and a summary of logs is made at the end of every month.

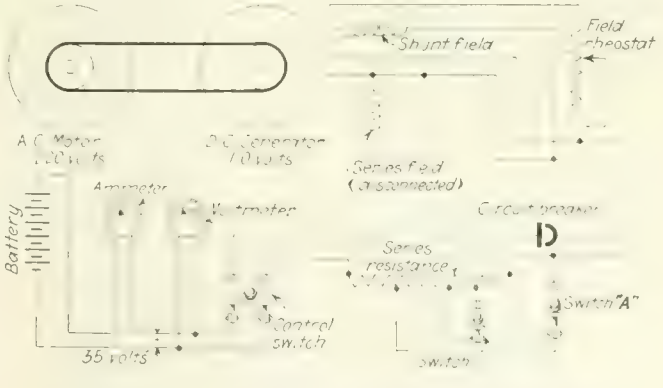
This summary shows among other items the number of kilowatt-hours per pound of electrode. It is obvious that the manufacturers of various grades and kinds of steel require different input in kilowatt-hours per ton, and it can easily be seen that because of this the best basis of comparing electrode service is the figure showing the number of kilowatt-hours per ton of electrode and not the number of pounds of electrode per ton of product.

Frank J. Vorbergh of the National Carbon Company, Inc., furnished this information.

Simple Improvement in Truck-Battery Charging Saves $36 a Year

A SAVING of $36 per year in the cost of charging a storage-battery industrial truck resulted from a recent study of conditions in an industrial plant by Reeds & Thorpe, consulting engineers, Hartford, Conn. The charging was done originally by a 115-volt generator, cutting the potential down to 35 volts with a charging rheostat. A 51 per cent reduction in energy consumption was effected by decreasing the generator voltage to 50 by the field rheostat and using only part of the charging resistance.

The truck was equipped with Edison batteries and was charged after working hours by a direct-current, 115-volt compound-wound generator driven by a 10-hp. alternating-current motor supplied by purchased power. The charging current was 35 amp. at 35 volts. The generator potential of 110 volts was reduced to 35 volts by a resistance grid with various taps connected to switches for cutting out parts of the resistance. These switches, however, were never used, all of the resistance being left in service, and the charging current was regulated by the generator field rheostat. The accompanying diagram makes the connections clear. The 115-volt generator was used because it met other uses in emergency as an exciter, etc. As a result of this method of operation the generator output was: 110 volts × 35 amp. = 3.85 kw. The power utilized by battery was 35 volts × 35 amp. = 1.25 kw.; thus



POWER REQUIRED FOR CHARGING BATTERY WAS DECREASED BY LOWERING GENERATOR VOLTAGE AND SHUNTING MOST OF RHEOSTAT

only 1.25 kw. ÷ 3.85 kw. = 32.5 per cent of the generator output was utilized.

By closing switch *A* most of the series resistance was cut out of service, and the generator potential was reduced to 50 volts by the field rheostat. The generator output was then 50 volts × 35 amp. = 1.75 kw., so that 1.25 kw. ÷ 1.75 kw. = 71.5 per cent was utilized. The annual saving, on the basis of three hours per day charging, $0.015 per kw.-hr. for power, and efficiencies of conversion through the motor and generator of 76 per cent before and 73 per cent after the change, are as follows:

Motor input before change =
3.85 kw. ÷ 0.76 = 5.06 kw.
Motor input after change =
1.75 kw. ÷ 0.73 = 2.40 kw.
Saving due to change = 2.66 kw.
2.66 kw. × 3 hours × 6 days × 50 weeks = 2,400 kw.-hr., 2,400 kw.-hr. × $0.015 = $36 per year.

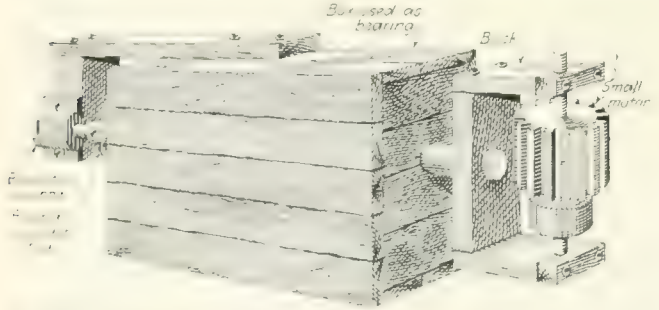
The operation of the compound-wound generator, while not so stable as at 110 volts, was satisfactory. One night, however, the power supply failed, and the batteries started to discharge and drive the generator as a motor. Before either the circuit breaker or the no-voltage release on the motor compensator opened, as they should have done, the reversal of current had changed the polarity of the generator. To eliminate the possibility of a recurrence of this trouble the series field was disconnected. The operation since then has been more stable and entirely satisfactory.

Reeds & Thorpe, Hartford, Conn. — Clarence Auty, Electrical Engineer.

Arrangement for Quickly Winding a Small Armature

TO MAKE a rapid and accurate rewinding of the small armature of an appliance motor use was made of the hastily constructed machine shown in the sketch. The armature was mounted in a small buck of the same model as the larger ones in use in the shop. A broom handle was then fitted to a hole bored in the center of the buck base. In each end of a suitable box a hole was bored just big enough to take the broom handle with a snug fit. A revolution counter, direct-connected, was attached to the back end of the broom handle and the apparatus was complete.

The armature was revolved with the right hand, while the left hand guided the wire into the slots. The



EMERGENCY ARRANGEMENT FOR WINDING A SMALL ARMATURE

revolution counter recorded the number of turns and allowed all attention to be concentrated on the proper placing of the wire in the slots. The job in question was turned out in about two-thirds of the time required by the customary hand method.

Frank Soete.
Honesdale, Pa.

High Intensity Improves Sewing-Machine Lighting

IN RECENT industrial lighting installations the very decided trend has been toward general overhead systems. However, cases are sometimes encountered where certain operations require a much higher level of illumination than is required for the work as a whole, and in such cases a general lighting system which will provide sufficient light for these special operations is likely to be uneconomical. This is usually true with regard to sewing-machine lighting, although general lighting has been used very satisfactorily where the sewing was done on light-colored goods, or even on dark goods if close accuracy was not required. For close work in sewing on dark goods it is necessary to have in the neighborhood of 40 foot-candles at the needle point to enable the operator to work at the best advantage. However, with a system of local lighting

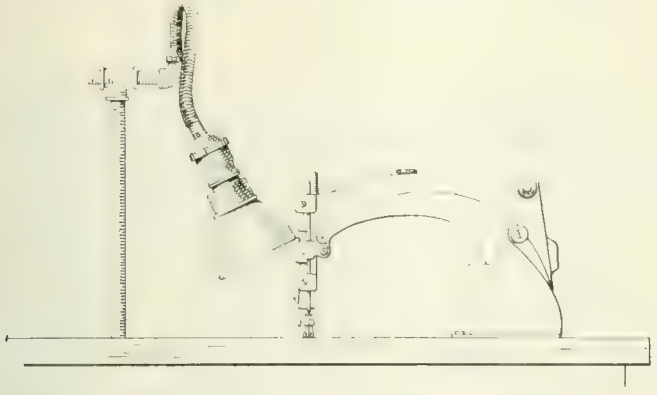


SEWING-MACHINE ROOM, SHOWING EFFECT OF 9 FOOT-CANDLE GENERAL ILLUMINATION AUGMENTED BY LOCAL LIGHTING AT NEEDLES

giving this illumination at the work a certain amount of general illumination is very desirable in order to relieve contrasts, improve appearance and make for the safety and comfort of the workers. The usual practice has been to provide from 1 to 4 foot-candles of general illumination in addition to the local lighting.

A Cleveland company which manufactures women's cloaks and suits has recently installed a modern system of local lighting in its sewing-machine room. The old system in this room consisted of a number of 100-watt clear gas-filled lamps in reflectors hung more or less promiscuously about the room. Over each sewing machine was a drop cord with a 40-watt or 60-watt clear vacuum lamp equipped with a battered tin shade of little or no reflecting value. The effect of the whole installation was to give the room a very untidy and crowded appearance, due chiefly to the large number of drop cords. The new general overhead-lighting system consists of 150-watt bowl-enameled, gas-filled lamps fitted with "RLM standard dome" type enameled-steel reflectors on approximately 10-ft. x 10-ft. (3-m. x 3-m.) centers, mounted 10 ft. above the floor. Local lighting is supplied to each machine by a 15-watt clear vacuum lamp fitted with a deep-bowl reflector mounted on an adjustable arm. With this installation fully 40 foot-candles is obtained at the needles, with an average of

9 foot-candles general illumination throughout the room. Although 9 foot-candles is a higher level of general illumination than is found with older local lighting systems, it was considered desirable in this instance on account of the accurate work required on the dark goods and to facilitate the handling and arranging of



SPECULAR REFLECTION MUST BE PREVENTED TO SAVE EYE STRAIN AND MAKE COMFORTABLE WORKING CONDITIONS

goods at the machines. This higher general illumination also relieves the contrast between the brightness of the work and the rest of the room and has proved more restful to the operators' eyes than the previous installation, when the room was in comparative darkness.

This installation has been in use for several months, and the managers are satisfied that much better work is being done because of the higher level of illumination on the work and the improved appearance of the room as a whole.

D. S. MYERS,
Engineering Department.
National Lamp Works,
Cleveland, Ohio.

Procedure to Follow in Dipping and Baking Armatures

EXPERIENCE gained in the treatment of a large number of motor armatures has indicated certain methods which should be followed to produce the best results. Careful draining after dipping and thorough baking are very important points.

The general process may be divided into two classes, depending on whether the armature requires overhauling or a complete rewinding. Where it is desired to overhaul the recommended steps are as follows:

When the armature is very dirty remove the accumulation of dirt and grease with a scraper. Then clean with benzine or gasoline by brushing or dipping. Remove the bands and insulation on the end windings and make any necessary repairs. Make sure that the core bands are tight and that the coils are tight in the slots. If either is loose, reband, placing a filler in the slot, when required, to get pressure on the coil, at the same time making sure to have the bands down on the iron.

Where wedges are used inspect for tightness, and when it is thought that they will not tighten when dipped rewedge, using fillers under wedges to make the coils tight. Place temporary bands on armatures if there is a tendency for the coils to spring out of position when dipped. So place the bands that the armatures will drain readily after dipping. Some operators may wish to dip and bake armatures without removing bands or hoods. In such cases care must be taken to see that the armatures drain and bake out satisfactorily.

Heat the armature in an oven with freely circulating air, using an oven temperature of 95 deg. to 100 deg. C. (200 deg. to 220 deg. Fahr.) for the length of time given: Armatures below 18-in. diameter, twelve hours; armatures 18-in. to 30-in. diameter, eighteen hours; armatures over 30-in. diameter, twenty-four hours.

It has been suggested by one operator that armatures can be preheated in a storage furnace utilizing the waste heat from the main oven and that thus a saving may be effected, provided that the arrangement can be worked out satisfactorily.

While the armature is still hot dip it in a good grade of baking insulating varnish. A clear amber baking insulating varnish with a specific gravity of 0.835 is recommended, but other varnishes may be used, the specific gravity depending upon the varnish and the thickness of the varnish coat desired. Should the varnish be too heavy thin with benzine. Dip the armature in a vertical position, commutator end up, varnish coming only to the commutator neck, allowing the armature to remain in the varnish for five minutes. If vapor rises from the varnish in large quantities, it indicates that the armature was too warm when dipped. Place all double-commutator armatures in a horizontal position so they can be rotated in varnish to twice the slot depth. In case they cannot be rotated as described, pour varnish over the armature until the windings are filled. After an armature has been dipped wash off the varnish on all finished metal parts with benzine. The commutator should not be immersed as varnish may get inside of the commutator and be trapped, neither draining out nor baking. Such a condition is undesirable. Some operators roll armatures in a tank, instead of completely dipping them, and apparently get good results. When this is done the armatures should be rotated slowly several times to insure that all coils shall be thoroughly soaked with the varnish.

Drain at room temperature until dripping ceases, which will require fifteen to twenty minutes. Place the armature in such a position that there will be no pocketing of varnish in the winding or iron. When the armature is such as to require draining in other than a vertical position, turning will be necessary to avoid the gathering of varnish at one point, the amount of turning depending upon the general construction of the armature. It has been suggested that this draining can be done by spinning the dipped armature in a lathe provided with a shield or cover to catch the surplus varnish.

After dipping and draining bake the armature in an oven at an oven temperature of 95 deg. to 105 deg. C. (200 deg. to 220 deg. Fahr.) until it is dry. This can be determined by taking the insulation resistance. For most cases the length of time given here will be sufficient to dry the armature: Below 12-in. diameter, forty-eight hours; 12-in to 30-in. diameter, sixty hours; over 30-in. diameter, seventy-two hours.

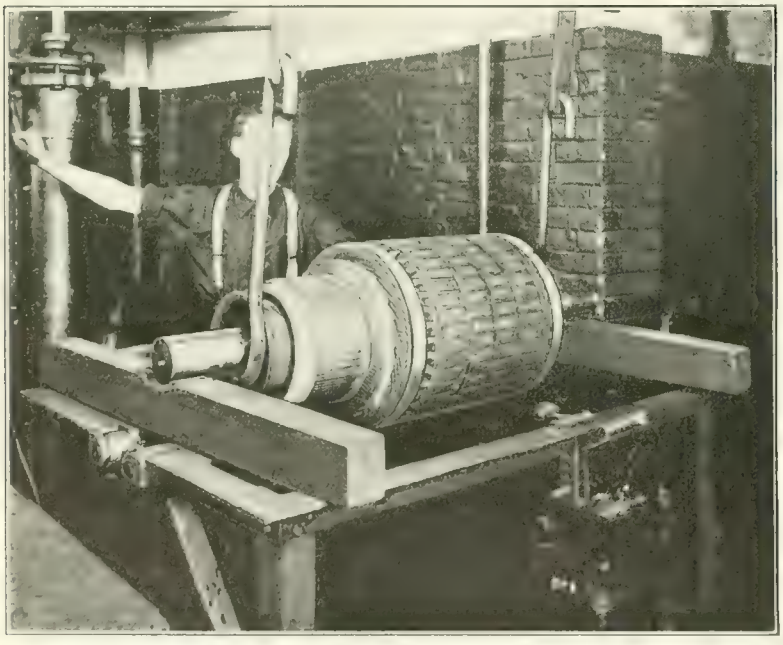
Bake the armature in such a position that there will be no pockets of varnish when it is dry. In baking the armatures in a vertical position care must be taken in placing them in the oven so as to get free passage of air through the air ducts and around them. Ventilation is necessary to attain the best results in baking. When an armature is so constructed that varnish will pocket when the armature is baked vertically, or in the case of dipping and baking with end bands in place, bake in a horizontal position. Such armatures are ventilated with radial air ducts. Arma-

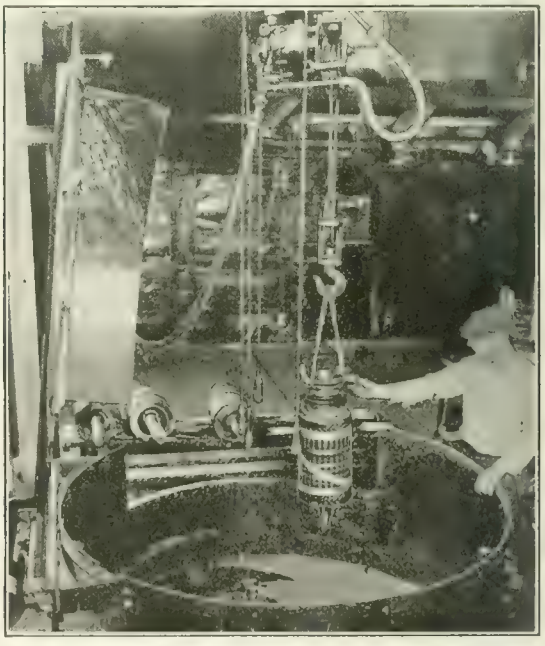
tures baked in this position should be turned during baking to avoid any gathering of varnish at one side.

After taking from oven, true up commutator face and neck, applying hoods at front and rear and the end bands. Fill hoods and coat surface by brushing on baking varnish. Place in oven to set varnish, applying as many additional coats as desired. Undercut the commutator and paint the armature with black air-drying insulating varnish, if a clear varnish has been used and a black finish is desired.

Procedure When Armature Needs Rewinding

When an armature requires rewinding the general procedure is the same as for the overhauling, although there are some details connected with the winding work that are of interest. If rewinding is necessary, strip off the coils, clean the commutator and test for short circuits or grounds and clean the iron. Straighten bent punchings and file off any rough surface. Wind the coils on the core, making sure that they wind snugly into the slot, using such winding cells and filling pieces as are necessary to make them tight. Wind the top part of the coils high enough in the slot for the core bands to exert a pressure on the coils when down on the core. Place leads down in an even manner so there will be no crosses in the leads. Use such insulating material as is necessary at points where there may be danger. After the top leads have been put down plug the commutator and solder.





DIPPING MAY BE DONE WITH THE ARMATURE IN EITHER A HORIZONTAL OR A VERTICAL POSITION

After soldering place the armature in oven for eight or ten hours for heating before banding. If the coils are high and it is thought that it will be difficult to get them down and also have tight bands, run on temporary bands. Use material enough under bands to insure that the wire will not damage the winding. Place the bands so that there will be no tendency for the varnish to pocket during dripping and baking.

If no temporary bands are needed, the permanent bands can be placed on the core, and if the armature is baked in a vertical position, the hood and end band that are up during baking can be applied if desired.

Dip and bake the armature according to the method previously outlined. After dipping and baking, turn the commutator and neck and put on the hood, insulation and permanent bands, treating the armature as recommended for overhauled armatures. Finish the completed armature in the same manner as before.

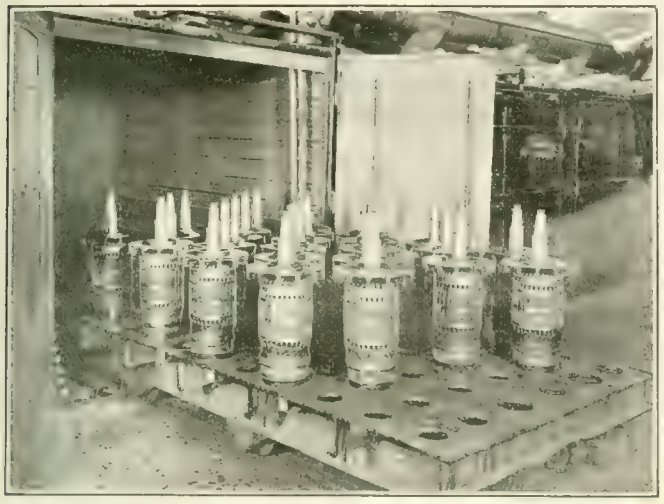
The dipping tanks should be made of sheet metal (preferably steel) of a thickness sufficient to retain the dipping compound without buckling. It should be made water-tight by welding the edges. Some tanks have been equipped with covers that are released in case of fire by the melting of a fusible wire, thus releasing a latch and dropping the cover automatically, which quickly smothers the flame. When large tanks are used with heavy covers it is somewhat more convenient to make the cover removable altogether. With this type of tank it is advisable to provide a cistern outside of the building, connected to the tank by a pipe line provided with a valve in case of fire that can readily be opened, thus emptying the dipping compound into the cistern. In connection with the dipping tank it is necessary to provide a suitable rack on which to drain armatures after the dipping process. This can take the form of a rack placed over the tank or built at the side of the tank with a suitable drain connected.

Although the practice and recommendation of the Westinghouse Electric & Manufacturing Company is to dip the armatures, a number of operating companies find it more convenient to roll their armatures in a pan or trough. By the use of this method they report very good results in service. These troughs in some cases are made of wood set on the floor and ends of troughs are used to support armatures while being rolled. Another type of tank shown in an accompanying illustration is made of sheet steel. This tank is swung on a stand that supports the armature and is raised and lowered by means of a lever.

In connection with the apparatus used to raise and lower the armatures it is recommended that an air hoist or a differential chain hoist be used in preference to an electric hoist in the vicinity of the dipping tank. A slight spark in the electric hoist may be the means of igniting the explosive mixture produced above the tank

by the vaporization of the benzine. A type of truck for draining and to hold the armatures during the baking process in a vertical position is shown below.

Two grades of dipping varnish commonly used in connection with the process of dipping and baking armatures are marketed—one with a china-wood-oil and the other with a linseed-oil base. Our company has used



THOROUGH BAKING IS ESSENTIAL IF GOOD RESULTS ARE TO BE EXPECTED

both as either one is suitable for this work. At present we are using a clear varnish which has a china-wood-oil base because it tends to dry out more uniformly and has a less injurious effect on built-up mica parts. The solvent for both of the above makes of varnish is benzine.

Ovens for this work have been made of wood lined with asbestos, sheet iron, cement or brick and heated by either steam, hot-air furnaces or electricity. This variation in the design depends largely on local conditions.

Formerly it was the practice to bake armatures at 125 deg. C. (257 deg. Fahr.) from twenty-four to forty-eight hours, depending on the size of the armature. This has recently been changed to a baking temperature of 95 deg. to 105 deg. C. (203 to 221 deg. Fahr.) from forty-eight to seventy-two hours. The lower temperature and longer baking time give the better results as the danger of taking the life out of the insulation is removed and the varnish bakes more evenly, the surface setting less rapidly. It is recommended that the lower temperatures be used in the belief that the best results will be obtained.

JOHN S. DEAN,
Motor Engineering Department.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Speed of Small Motors Determined by Rotating-Disk Comparison

A PROBLEM which often confronts the electrical engineer is that of measuring the speed of very small motors running at a high rate. Tachometers are available reading as high as 10,000 r.p.m., but even the best of tachometers consumes sufficient power to slow down a small motor considerably. Sometimes the motor may be so mounted that it is not convenient to attach a tachometer. The ideal method for rating such motors would be one which would not require any mechanism to be attached to the motor itself and the speed of which would therefore not be affected in this way. The method should be sufficiently flexible to cover a wide range of speeds.

The writer has been using for some time a stroboscopic method for rating small motors which satisfies the above requirements. This method employs a second spindle capable of being rotated at a variable speed. The spindle is adjusted to rotate synchronously with the motor under test at any speed which may be chosen, such as one-half, one-third or one-quarter the motor speed. The speed of the spindle is then found with a tachometer or speed counter and multiplied by the proper ratio.

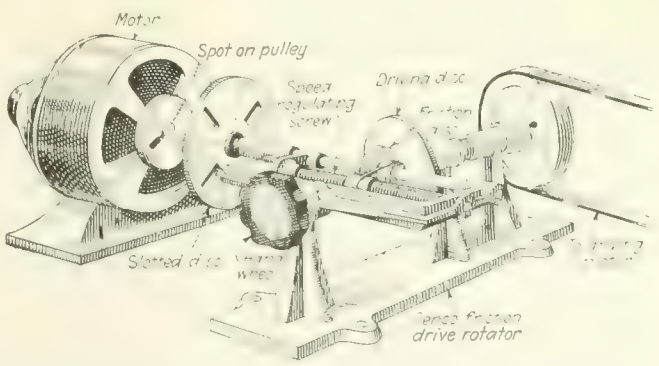
The apparatus employed and the method of synchronizing used in making this test are as follows:

A small spot, such as a chalk mark or a small paper sticker, is placed on the armature or pulley of the motor. A disk having two or more radial slots, symmetrically disposed, is mounted on the spindle of a "Cenco" friction-drive rotator. As the number of slots in the disk determine the ratio between the speed of the disk and that of the motor, the number of slots used depends on the speed of the motor under test. The rotator is driven by a constant-speed motor and is so arranged that the spot described above can be observed through the slots in the disk.

The motor under test is allowed to come up to constant speed. The rotator is then started and gradually speeded up by means of the friction-drive mechanism. Meanwhile the spot on the small motor is observed through the slots in the rotating disk. A convenient arrangement of motor and rotator is shown in the accompanying drawing.

When a synchronous speed has been reached only one spot is seen, and it is apparently standing still. This means that one slot passes the eye of the observer for each revolution made by the motor. The speed of the spindle of the rotator—*i.e.*, the speed of the disk—is then measured with a speed counter or tachometer.

This speed multiplied by the number of slots in the disk gives the speed of the motor under test. For example, if the rotator when synchronized is found to have a speed of 1,500 r.p.m. and the disk used has four slots, the speed of the motor is 6,000 r.p.m. Even if the speed of the motor is fluctuating, this method can still be used, provided that a direct-reading type of



WHEN DISK REVOLVES AT SPEED PROPORTIONAL TO THAT OF MOTOR THE SPOT ON PULLEY APPEARS STATIONARY WHEN VIEWED THROUGH SLOTS

tachometer is employed. In such a case the speed of the rotator is adjusted from time to time to correspond with the speed of the motor, and the corresponding readings of the tachometer are noted.

Central Scientific Company, W. H. FARR,
Chicago, Ill. Physical Engineer.

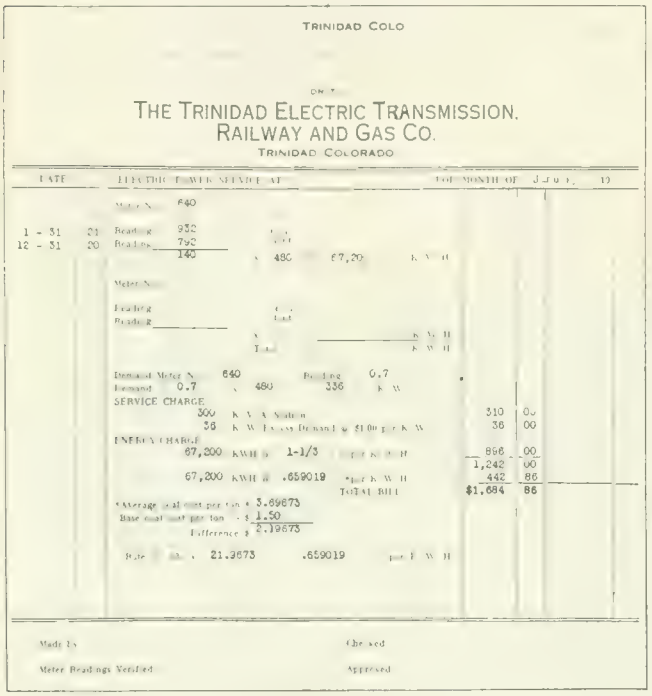
Central Station Service

A Department Devoted to Commercial Policy
and Management Topics, Including Methods of Increasing the Use
of Electric Light, Power and Heat

Specific Bill Form Makes Coal Clause Understandable

THE Trinidad (Col.) Electric Transmission, Railway & Gas Company has a rate for power service which includes a fuel-cost clause in addition to which are a demand charge and an energy charge based on pre-war coal cost.

Altogether these charges make for a complicated



TRINIDAD COLO

THE TRINIDAD ELECTRIC TRANSMISSION.
RAILWAY AND GAS CO.
TRINIDAD COLORADO

DATE — ELECTRIC POWER SERVICE AT — FOR MONTH OF — 19

Meter No. 640

1 - 31 21 Reading 930
12 - 31 20 Reading 792
140 × 480 67,20 K. W. H.

Meter No.
Reading
Reading
K. W. H.
K. W. H.

Demand Meter No. 640 Reading 0.7
Demand 0.7 × 480 336 K. W.

SERVICE CHARGE
300 K. V. A. Station 310 00
36 K. W. Excess Demand @ $1.00 per K. W. 36 00

ENERGY CHARGE
67,200 KWH @ 1-1/3 per K. W. H. 896 00
1,242 00
67,200 KWH @ .659019 per K. W. H. 442 86
TOTAL BILL $1,684 86

*Average coal cost per ton = $ 3.89673
Base coal cost per ton = $ 1.50
Difference $ 2.39673

Rate 21.9673 .659019 per K. W. H.

Made By — Checked
Meter Readings Verified — Approved

FORM OF BILL WHICH SHOWS CLEARLY HOW COAL COST IS CALCULATED

billing. Were it not for the clear and specific form used, as shown herewith, numerous complaints might be registered by some of the forty large consumers receiving this form of bill.

On each bill is first calculated the kilowatt-hours used and the maximum demand. From the latter the excess demand over the normal or contracted demand for the size of the installation is calculated and billed at $1 per kilowatt. Next is added the charge of $0.01⅓ per kilowatt-hour for energy consumed. From the average cost of coal during the month is subtracted the pre-war coal cost—$1.50 per ton—and this difference is multiplied by $0.0003, which gives the increased charge per kilowatt-hour of energy consumed. In the case illustrated the increased cost was $0.00659019 per kilowatt-hour.

The coal clause on which this billing is based reads in part as follows:

The rates for energy under this schedule are based on an average cost of coal of $1.50 per ton of 2,000 lb., f.o.b. the Trinidad and Walsen plants of the power company. Should the average cost of coal purchased by the power company for use as above set forth during the month for which the bill for service and energy is rendered be less than $1.50 per ton, the bill for service and energy shall be decreased by an amount representing a decrease in energy charge computed at the rate of three-tenths of one mill per kilowatt-hour for each 10 cents decrease in the average cost of coal below $1.50 per ton for the month covered by the bill in question; and, correspondingly, should the average cost of coal purchased by the power company be more than $1.50 per ton, the bill for services and energy shall be increased by an amount representing an increase in energy charge computed at the rate of three-tenths of one mill per kilowatt-hour for each 10 cents increase in the average cost of coal above $1.50 per ton for the month covered by the bill in question.

Valuation and Rate of Return of Public Utilities

OF THE many problems which confront operators of public utilities, those of valuation and rate of return stand out most prominently, declared Robert A. Brown, attorney for the St. Joseph Railway, Light, Heat & Power Company, in an address on "Methods of Valuation and Rates of Return of Public Utilities," at the recent meeting of the Missouri Association of Public Utilities in Kansas City. What is the correct method of arriving at the present fair value of the property of a utility for rate-making purposes? Shall this value be fixed upon the basis of original cost? Shall average prices prevailing over a fixed period of years control or shall the property be valued upon the basis of the present reproduction cost? These are questions, he stated, over which the owners of utilities, public service commissions and the courts of the country have contended for a period of years since the decision of the Supreme Court of the United States in the pioneer case of Smyth vs. Ames.

Mr. Brown continued:

Since the rendition of that decision the Supreme Court has in a long line of decisions apparently intended to say that such properties must be valued for rate-making purposes upon the basis of the reproduction cost thereof new at the time the rates are to be fixed. While the utterances of the Supreme Court are not definite and explicit in announcing a fixed rule by which the properties of utilities are to be valued, we believe that after due consideration of all its decisions no conclusion can be drawn other than that the court has intended to approve the reproduction-cost-new method.

The time is here when the courts, public service commissions and legislative bodies must realize that the public utilities of the country must be placed upon the same economic basis as other industries. The property of every other industry and of every individual is worth just what it would cost to reproduce it, and by what method of reasoning may it be said that a different rule should apply to the property of utilities? Such property does not belong to the public any more than does the property of a banker, merchant or manufacturer.

Should a utility company purchase a site for a power house, paying therefor the sum of $100,000, and should the

value of the property increase 100 per cent before the power house was erected, is there any sound reason why the company should not be permitted to sell the power-house site for $200,000, if it could buy another site equally good for $100,000? If it should then invest the $100,000 profit made upon the real estate deal in new equipment, should it then be permitted to earn a reasonable return upon such additional investment? If so, why should it not have been allowed to earn a reasonable return upon the fair value of the original power-house site purchased by it, should it have retained title thereto and should its value have remained at $200,000?

The properties of public utilities are always to be valued at the time rates are to be fixed, and a return is supposed to be allowed upon the fair value of the property at that time. Under such circumstances it would seem wholly immaterial what the property originally cost. The question is, What is the property reasonably worth at the time rates are to be fixed?

One of two things is certain—either the property of utilities must be valued upon the basis of reproduction cost new or else the rate of return allowed upon the original cost should be doubled during the period of inflated property, material and labor values and the depreciated value of the dollar. If a return of 7 per cent was reasonable on a pre-war basis, a return of 14 per cent would not be unreasonable under modern conditions. No one, however, would be foolishly optimistic enough to hope that any rate-making body, necessarily influenced as they always are to a greater or less degree by political considerations, would ever permit a return of 14 per cent to be earned and retained. It seems essential, therefore, that utilities, if they are to secure any adequate return upon their investments, must insist that their properties be valued upon the basis of reproduction cost new.

In this connection it must be remembered that all utilities are regulated by public authorities and rate-making bodies, and that the property of a utility can always be revalued and its rate of return fixed and changed as conditions and circumstances may warrant.

While the method of valuation suggested may not be without serious objections, it nevertheless seems to be the only method by which utilities can hope to be permitted to earn any substantial return upon their properties.

While the question of valuation is vital, the rate of return a utility is to be permitted to earn must finally determine whether these products of modern civilization are to continue to be owned and operated as private enterprises or whether they are to be taken over by the government, the states and the municipalities and operated at the expense of the people as political spoils and adjuncts.

If a private enterprise is to continue the operation of utility properties, investors must necessarily be reasonably assured of a fair return upon their investments. It will not be sufficient to say to them that they may be permitted to earn as much as a 7 per cent return so long as the chances remain ten to one that they will not only not earn a 7 per cent return, but that they will lose the original investments made by them.

The people are not easily educated, especially upon subjects about which they do not wish to be enlightened. It will therefore be necessary that they believe themselves to be personally and individually interested in the utilities before they can ever be induced to permit such utilities to earn a sufficient return to justify and induce the investment of private capital. Then, and not until then, it may be possible to devise some method whereby utilities can be guaranteed a low rate of return upon the fair values of their properties and receive a reasonable chance to earn a very substantial increase in addition thereto. One-half of this increased return should be paid to the government, the state or municipality, as the case may be, and the remaining one-half should be retained by the utility. Personally I can conceive of no other solution of the problems that now confront the utilities of the nation. Under the method named, efficient management and operation would be assured, and an abundance of capital would be thereby attracted.

Unless the people and their official representatives are willing to become in a measure partners with the utilities and to aid in devising ways and means whereby reasonable returns may be expected from their operation, then of necessity they must in the near future pass to the scrap heap, and we will enter upon an era of political and socialistic government ownership, which in turn must finally bring about fundamental changes in our form of government and lead it at least to the very brink of destruction.

Relation of Water Power to Industrial Development in California

THAT industry is the best guarantee of the permanence and prosperity of a community, a state or a nation was emphasized by W. E. Creed, president of the Pacific Gas & Electric Company, in a recent article in the company's magazine, *Pacific Service*. Discussing the relation of water power to industrial development in California, he said:

"Many factors aid in industrial development, but of all factors population and power are indispensable. Population furnishes the labor supply and the immediate local markets, but population will not alone suffice. In modern times no great industrial structure can exist without power. It must be available to turn wheels, to transport goods and to render countless other services to industry.

"The possession of raw materials, while not essential, is nevertheless a great stimulus to the development of manufactures. All the nations of Europe are densely populated, and the world war disclosed the great importance these nations attached to power and raw materials, particularly to the sources of power to be found in oil and coal. They know that with population and cheap power industrial development is certain even without raw materials, as great masses of people must secure raw materials either in manufactured form or in the raw state to be manufactured, and usually the course is for raw materials to be manufactured into usable products at centers of population regardless of the place of origin. But if in addition to population and power, raw materials are also at hand, the most favorable conditions exist for manufacturers to develop and flourish.

Industrial Activity and Growth Dependent on Power

"California has in the last ten years made a great gain in population. In addition, it possesses most of the basic raw materials necessary for manufacture. The third thing needed by California for unrestricted industrial development is power. A brief survey of the history of manufactures in California discloses that prior to 1900 the state was comparatively unimportant as a manufacturing state, but that it now produces more manufactures than all the other Western states combined. This remarkable improvement in industrial position is directly traceable to the California oil industry, which began about twenty years ago to furnish cheap oil, from which cheap power could be developed. In the past fully 60 per cent of the power used in California has come from oil. The supply is limited, and every barrel of oil used decreases the available supply. As a result, the oil industry is carrying a burden beyond its capacity and must be relieved.

"California has no coal supply of good quality. The old days of 40-cent oil are gone. The only sound solution for the power needs of California lies in the de-

velopment of hydro-electric power. There is no cheaper power available, and if the development of water power proceeds unhindered, it will be the impulse for a wonderful economic growth in the state, from which will come further great gains in population and wealth. The advantages will accrue not only to the large centers of population but to every part of the state. Markets for the product of the farmer will increase, and money available for investment in and development of agricultural lands and communities will be abundant.

"The extent to which California can develop industrially with adequate water power is almost without limit. Its geographical position on the Pacific gives it opportunity for trade with Pacific countries, its population affords the necessary local markets, and it possesses nearly all the basic raw materials. They may be roughly classified as lumber and forest products, agricultural products, fisheries, and mines and minerals including petroleum. These materials for manufacturing, of which perhaps the most important is the product of agriculture, place the state in a position, having cheap power, to develop and extend most advantageously the packing, canning, preserving, milling, lumber, chemical, fabric, leather and metal industries and a long list of secondary industries.

Public Co-operation Needed

"The question naturally occurs whether the State of California, having the great advantage of population and raw materials, is in a position to develop the necessary hydro-electric power. There is no question at all that favorable physical conditions exist. What is most needed is the co-operation of the public and an understanding by the public of what the development means in order that it may be stimulated and encouraged.

"Careful studies indicate that there is possible of development in hydro-electric power in California 9,250,000 hp., of which only 942,000 hp. (a little over 10 per cent) is thus far developed. The potentiality of the state for power development is relatively strong. The total maximum horsepower in water in the whole United States is 59,369,000 and in the eleven Western states is 42,850,000. California thus possesses about 15 per cent of the total possible hydro-electric development in the entire country, and about 23 per cent of the possible hydro-electric development in the Western States.

"The power companies of the state are not unmindful of the need for power. The combined construction programs of all the California power companies contemplate the development of about 2,000,000 hp. in the next ten years. This development, if carried out, will require an expenditure of $500,000,000 to $800,000,000 during the period of construction. Probably $600,000,000 is a close estimate of the amount of new money required.

"Will this amount of power be necessary? If growth continues in the future at the same rate it has in the past, the state will require about 100,000 hp. additional each year. If, in addition to taking care of the normal growth and development based upon the rate of progress in the past, the water-power companies are to relieve the oil industry of some of its burdens in order to reduce the cost of power and preserve for other uses the oil supply for which there is no substitute, then the additional amount of power required will be greater than 100,000 hp. per annum. At the present time the users of hydro-electric power are distributed in about the following percentage: Lighting, all classes, 13.6; commercial and industrial power, 45.7; agricultural power, 12.9; railway power, 27.8.

"Increased demands will come from (a) normal increase in the needs of present users; (b) the substitution of water power for oil in many branches of industry; (c) new industries, and (d) new uses for power. Aside from the demand for water power to displace oil, the greatest use in the future will probably come from the agricultural industry. The best available data indicate that there are 22,000,000 acres of cultivable land in the state out of a total of 101,800,000 acres. Of the 22,000,000 acres suitable for cultivation, approximately 4,000,000 acres are under cultivation, including all the irrigated lands. At present there is installed for irrigation purposes in the state a capacity of about 275,000 hp.

"If within the next ten years, as a reflex of the industrial growth of the state, the entire 22,000,000 acres of land be put under irrigation, the power installation required will probably equal about five times the present capacity installed for irrigation purposes.

"The whole state should be animated by a spirit of co-operation toward water-power development. The destiny of California as an industrial empire will be hastened or delayed as its people encourage or discourage the invitation to capital to support projects to harness the mountain waters. In truth, the future of California will be measured in terms of horsepower from hydro-electric development."

Citizens Appointed Custodians of Street Lights

AN EFFECTIVE means of insuring the assistance and co-operation of the public in keeping street lights burning, by appointing citizens as custodians of certain lights, has been adopted with great success by the Willamette Valley division of the Portland (Ore.) Railway, Light & Power Company. This was accomplished by sending the following letter to the citizen who lived nearest to a given street light, provided that he had a telephone, the nearest citizen with a telephone being selected in the other case:

"We want to keep as many of the street lights burning every night as possible. We must depend to a large extent upon the public to let us know when the lights do not burn. 'What is everybody's business is nobody's business.' Hence frequently we are not advised when lamps are out. May we appoint you custodian of the light at No ——— and ask you to call Main 55 and let us know when it does not burn."

Inclosed with the letter was an acceptance postal card.

There is a penalty clause in the company's contract with the city, but it was felt that the good will that would be engendered by showing that the company really wanted to keep its lights burning continuously was of greatest importance. The responsibility thus placed upon individuals has in many cases had the psychological effect of causing the individual in question to feel that he or she is a part of the company's organization and therefore to take a corresponding attitude in other matters relating to the company's business.

W. M. Hamilton,
Manager Willamette Valley Division.
Portland Railway, Light & Power Company,
Portland, Ore.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Use of Synchronous Motors for Power-Factor Correction.—RENÉ MARTIN.—The use of synchronous motors for improving power factor by overexciting is taken up in detail and the various phases of their application are indicated. From an economical standpoint it is shown that such means are the best for the purpose. Finally the matter of regulating the voltage at the end of a long line by means of synchronous machinery is considered.—*Revue Générale de l'Electricité,* Feb. 12, 1921.

Rotary-Converter Practice.—A. BARJON.—In this article the author gives an excellent and quite exhaustive account of the principle and the operation of the modern converter. It has been written in such a simple and thoroughly practical manner as to make it useful for any substation operator. There are eight chapters touching upon the most important points, such as the commutation principle, operation as synchronous motor, operation as direct-current generator, starting methods, synchronizing, voltage regulation and efficiency.—*L'Electricien,* Feb. 1 and 15 and March 1, 1921.

Continuous Rated or 50-Deg.-Rise Motors.—L. F. ADAMS.—In this paper the author sets forth the case for the 50-deg.-rise motor as distinguished from the 40-deg.-rise motor.—Paper presented before Association of Iron and Steel Electrical Engineers, March, 1921.

On the Design of Split-Phase Motors.—E. A. BINNEY.—The writer gives a method of calculating the starting performance of split-phase motors for labor-saving devices requiring only fractional horsepower. A method of calculating the starting performance of such motors is given.—The London *Electrician,* March 18, 1921.

Lamps and Lighting

Use of the Pintsch "Glim" Lamp for Switch Circuits.—DR. SCHRÖTER.—If two metallic electrodes are introduced into a glass bulb containing a rarefied atmosphere of neon or helium and a direct-current voltage of at least 160 volts is impressed upon the two electrodes, the negative pole will emit a distinctly visible light, which at about 220 volts becomes so bright that such a lamp may be used advantageously for signal purposes on switches and similar apparatus. On alternating-current lines both electrodes show the light emission. A great variety of such lamps were recently introduced commercially by the Julius Pintsch company of Berlin. The resistance of the lamps, as defined by voltage impressed and current passed, is not fixed but varies with the intensity of discharge; that is, the more current is passed the less the resistance becomes. A lamp for 20 milliamperes direct-current passage has about 10,000 ohms resistance. A passage of even a fraction of a milliampere shows a distinctly visible luminescence. In general a consumption of from 4 watts to 5 watts is fully sufficient. Among the many possibilities inherent in the use of such lamps these may be enumerated: Parallel with a fuse it detects and shows a burn-out; it will serve as a position indicator for switches or as a distant indicator of the condition of a motor; put in series with a condenser it limits the charge or discharge energy; put in series with an X-ray tube the luminosity of the "glim" lamp becomes a measure of the current passed by the tube; in series with a selenium cell the combination permits the observation of the density of general illumination at some distant point; it facilitates the steady control of fire-alarm systems, and it serves as a polarity indicator.—*Elektrotechnische Zeitschrift,* Feb. 10, 1921.

Generation, Transmission and Distribution

Checking Up on Automatic Substations.—CHARLES H. JONES.—A complete and detailed study of the functioning of the equipment in the substations on the Chicago, North Shore & Milwaukee Railroad. It is shown that from 1915 to 1920 the kilowatt-hour consumption per car-mile on this interurban system has been reduced from 5.78 to 4.31. The efficiency and distribution losses in three stations were analyzed by means of test runs, the results of which are given in the article.—*Electric Railway Journal,* March 26, 1921.

Speed Regulations of the Hydraulic Turbine.—RAYMOND D. JOHNSON.—Some consideration is given to the governor action, but the principal discussion is directed to the use of surge tanks in hydraulic systems.—*Journal Engineers' Club of Philadelphia,* March, 1921.

Points to Consider in Using the Wind as a Source of Power.—PAUL BASIAUX.—With the ever-increasing demand for power it has come to be a practical idea to study the possibilities of utilizing the wind as a means of generating power. Some general information is given regarding the available power in the wind, and many of the points to be considered are presented. As a means of taking care of the condition brought about by the varying velocity of the wind it is suggested that possibly storage of power by means of compressed air might be feasible.—*Revue Générale de l'Electricité,* Feb. 12, 1921.

The Hydro-Electric Power Scheme at the Nore Falls.—Description of a new hydro-electric plant on the Laagen River, some 50 miles (80 km.) from Christiania. It is asserted that the ultimate development will include twelve Pelton wheels of 21,500 hp. each operating at 300 r.p.m. under a head of 1,119 ft. (341 m.). The generators are 12,000-volt, 50-cycle machines, and energy is stepped up to 110,000 volts for transmission.—London *Engineering,* March 4 and March 18, 1921.

Determination of Sag of Heavy High-Voltage Lines Suspended on Disk-Type Insulators.—H. SCHENKEL.—A new method is given to predetermine the sag, considering the string of disk insulators as a flexible part of the line which assumes a catenary curve form and may be calculated according to the laws of such

curves. Several practical examples are figured out. The formula given applies only if both ends of the span are located at the same elevation.—*Elektrotechnische Zeitschrift,* Feb. 17, 1921.

Traction

Portable Bond Testers.—G. H. McKelway.—Portable instruments are said to afford the most effective means for testing bonds in order to locate those in poor condition. With the portable set described in this article it is shown that convenient tables may be supplied the men making the tests in order to minimize calculations in the field.—*Electric Railway Journal,* March 19, 1921.

Swiss Electric Locomotive Progress.—Details are given of recent locomotives equipped by the two leading builders of electrical apparatus in Switzerland—namely, the Brown-Boveri and Oerlikon. Particular attention is given to the machines for the federal railways. Some experiments with new types of drive are included, indicating a leaning toward gears as a substitute for side rods.—*Electric Railway Journal,* April 16, 1921.

Branch of St. Paul Railroad Electrified.—The freight on the old Chicago-Evanston Branch of the St. Paul Railroad is now handled electrically by the Northwestern Elevated Railroad. The overhead construction of this electrification is described in this article.—*Electric Railway Journal,* April 2, 1921.

Installations, Systems and Appliances

Magnetic Plate-Handling Crane.—The importance of the magnetic crane for handling steel plates in shipbuilding, boiler-making and similar plants is emphasized, with a description of one type used in the British industries.—London *Engineer,* March 18, 1921.

The Performance of Electric Furnaces.—This table is said to represent the cost of producing electrical

PERFORMANCE OF ELECTRIC FURNACES

	Continuous Running				Single Shifts			
	£	s.	d.	Per Cent	£	s.	d.	Per Cent
Scrap and metallic and slag-forming additions	6	0	0	41 78	7	10	0	41 1
Electrodes	0	18	0	6 27	1	5	0	6 85
Power	3	12	0	25 08	4	15	0	26 05
Labor	2	0	0	13.93	2	10	0	13.7
Electricians, yard staff	0	12	0	4 18	0	15	0	4 1
Maintenance and stores	1	5	0	8 71	1	10	0	8.22
Totals	£14	7	0	99 95	£18	5	0	100.02

steel from small furnaces of from 1 ton to 3 tons in England when labor prices were at the 1919-1920 level. —London *Engineering,* March 4, 1921.

Automatic Speed Control for Sectional Paper Machine Drive.—Stephen A. Staege.—The advantages of electric drive for paper machines are set forth, and control of motors is dealt with more particularly in regard to speed control.—*Electric Journal,* March, 1921.

Electric Smelting of Pig Iron at Domnarfvet, Sweden. —Gerard de Geer.—The early operations at the Domnarfvet Iron Works and conditions inducing the adoption of electric furnaces are dealt with. It is said that the possibilities of using non-charcoal reducing agents and pit instead of cast furnaces are still in the research stage.—*Chemical and Metallurgical Engineering,* March 9, 1921.

Battery Charging for Industrial Trucks and Tractors.—Charles A. Rohr.—While the equipment for charging storage batteries for industrial trucks and tractors naturally varies with the number of vehicles in use, the size and number of their batteries and the form in which the energy is purchased, the writer concludes that a motor-generator set with control suitable for charging by the constant-current or series-resistance method is advisable in most cases.—*General Electric Review,* April, 1921.

Brief Directory of Material-Handling Apparatus.— R. H. McLain.—The article is intended to assist in making the selection of equipment which is best suited for material handling in any particular case. It presents in condensed form descriptions and illustrations of a large number of electrically driven freight-handling devices which are suitable for handling almost all classes of materials through horizontal and vertical motions over long and short distances.—*General Electric Review,* April 1921.

Electrophysics and Magnetism

Magnetic Susceptibility of Low Order.—E. Wilson. —The author deals primarily with the subject from the standpoint of practical application. The magnetic properties of certain minerals can be changed by oxidation or reduction. Rock susceptibility is studied in view of its bearing on magnetic survey work. A knowledge of the subject, the author says, is particularly necessary to those engaged in the construction of scientific instruments.—London *Electrician,* March 11, 1921.

Effect of Rate of Cooling on the Magnetic and Other Properties of an Annealed Eutectoid Carbon Steel.— C. Nusbaum and W. L. Cheney.—This paper discusses the results of a study of the effect of the rate of cooling upon the magnetic and other properties of an annealed eutectoid steel. In carrying out the experiment six specimens of this steel were selected, heated to 800 deg. C. and allowed to cool at various rates—one in air, another in lime, and the remainder in the furnace at slower and slower rates. The following properties were then measured: Normal induction for ordinary and large magnetizing forces, residual induction, coercive force, resistivity, and Shore scleroscope hardness.— *Scientific Paper No. 408, U. S. Bureau of Standards.*

Electrochemistry and Batteries

Apparent Irreversibility of the Calomel Electrode.— A. W. Laubengayer.—Tests to determine whether the irreversibility of the calomel electrode is real or only apparent. The observed phenomena of irreversibility are explained as due to the formation of an absorbed film of mercurous chloride on the mercury anode, which offers high resistance to the passage of the current. A current of 0.2 milliampere can pass before the film forms. A number of points are not yet cleared up and call for further study, it is said.—From paper presented before American Electrochemical Society, April 21, 1921.

Phenomena of Arc Welding.—O. H. Eschholz.—A detailed discussion of metal deposition, fusion and arc stability during electric welding. Under the first item there are discussed the function of transport of metal by molecular forces, effect of evolution of gases, and vaporization or condensation, with the conclusion that the molecular forces play the main part. Under fusion are considered the effects of impact of ions, atmospheric convection currents, sudden liberation of gases, and combination of material with oxygen and nitrogen. Arc stability is discussed from the standpoints of long and short arcs, constant potential circuits, use of ballast resistance, etc.—From paper presented before American Electrochemical Society, April 21, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

City in Error in Taking Rate Case to Courts First

NEW YORK CITY erred in applying to the courts for an injunction to prevent local electric lighting companies from raising the rates instead of taking the matter up first with the Public Service Commission. Such was the unanimous opinion handed down last week by the Appellate Division of the Supreme Court of New York in setting aside the injunction previously granted by Supreme Court Justice Cohalan in favor of the city of New York, restraining the New York Edison Company and the United Electric Light & Power Company from putting into effect increases in rates in proportion to higher coal costs.

Coal riders were extended to all consumers on Dec. 1 providing for a charge of fifty-one-thousandths of a cent per kilowatt-hour for each 10 per cent advance in the price of coal above $3 per ton, the average price in effect when the previous rate schedule was authorized. The companies' rates had remained unaltered from the first of July, 1917, when they were reduced from 7½ to 7 cents per kilowatt-hour. At that time the two companies reserved the right to go back to 8 cents if conditions were reversed. The increased coal cost actually made it necessary to bring the rate to 7.9 cents.

The new schedule was filed with the Public Service Commission on Nov. 1, and it was not until after the new rate had gone into effect on Dec. 1 that the city officials tried to prevent it. Without attempting to obtain a hearing before the commission the city immediately applied to the courts for an injunction.

Mouth-of-Mine Plants Found Impracticable for Superpower Project

SUFFICIENT progress has been made in the Boston-Washington Superpower Survey to determine that it is impracticable to locate large power plants either at the mine mouth or elsewhere in the coal-mining regions because of an insufficiency of water available for condensing purposes. It is estimated that 800 tons of condensing water is required for each ton of coal put under boilers. There are no streams in the mining districts that could be relied upon to furnish the quantities of water that would be required by plants of the size contemplated. Even the large near-by rivers seem to have been eliminated from the consideration. The eastern branch of the Susquehanna River is said to carry too much sulphur to allow of its successful use in connection with a large power plant. The Delaware River would be eliminated, it is believed, because the storing and discharging of water in connection with the operation of a large plant would induce an irregular flow of the river which would interfere with its use for power purposes.

It also has been demonstrated that the steam sizes of anthracite coal are too valuable to be considered as fuel at a superpower station. No one mine would be able to provide sufficient culm or waste coal for the operation of such a plant.

Iowa Conflict Due to Misunderstanding

IN CONNECTION with the veto of the Iowa utility court bill, for which the electric light and power companies of the state blamed the electrical contractors, as reported in last week's issue, W. H. Morton, general manager of the National Association of Electrical Contractors and Dealers, made the following statement this week to the ELECTRICAL WORLD:

"The National Association of Electrical Contractors and Dealers has investigated the Iowa situation, and whatever action was taken was apparently due to a misunderstanding of the provisions of the bill and was contrary to the declared policy of the national association as expressed in the resolution of the national executive committee passed at the January meeting this year in which the association pledged itself to do everything in its power to promote public good will toward electric light and power utilities.

"Steps are now under way for a conference committee of the Iowa utilities and contractors to adjust the misunderstanding. A survey of the situation leads the national association to believe that opposition of the municipalities was the deciding factor in causing the Governor's veto."

Electric Utilities' Coal Stocks in Good Shape

BITUMINOUS coal stocks held by electric utilities are in strong shape. This is indicated by the preliminary report on commercial stocks of coal as of April 1, 1921, made by the Geological Survey.

Returns from 241 electric utilities showed a stock on hand on April 11 of 2,116,000 tons of bituminous coal, against 2,068,000 tons Jan. 1, 1921; 1,098,000 tons June 1, 1920; 1,081,000 tons March 1, 1920; 2,013,000 tons April 1, 1919, and 2,112,000 tons Jan. 1, 1919.

The report states that in comparison with 1920 public utility coal stocks showed an improvement in virtually every state, while the Appalachian, Middle Atlantic and New England States and much of the Great Lake docks territory recorded increases over even April 1, 1919.

In speaking of the general situation with respect to coal production and consumption, the report brings out facts disproving the alarming reports that have sprung from interested sources regarding a pending coal shortage. In this connection the report says:

At first thought this profound slump in production might give ground for alarm as to the sufficiency of next winter's supply of coal. Before, however, it is assumed that the slump in output foretells a shortage of coal two other facts must be taken into account. The first fact is that

the slump was preceded by several months of heavy production, which brought the total output in 1920 up to 556,000,000 tons, exceeding even the war year, 1917, and approaching the record production of 1918—579,000,000 tons. Not all of this large output was consumed or exported. Some millions of tons of it were added to consumers' stocks, and it was to be expected that these stocks would be drawn upon during the late winter. The second fact to be remembered is that the slump in output was accompanied by a great cut in consumption. While complete data on current consumption are lacking, there is enough evidence to show that the combined domestic consumption and exports during the first quarter of 1921 were 20 per cent less than during the first quarter of 1920. Comparing the month of March, 1921, with March, 1920, the decrease was about 30 per cent.

I. E. S. to Retain Part of Present Quarters Another Two Months

AT A MEETING last week of the board of directors of the United Engineering Societies and the Illuminating Engineering Society it was decided that the latter should relinquish one of the two rooms it now occupies in the Engineering Societies Building in New York to the National Electric Light Association. The other room is to be retained by the Illuminating Engineering Society for a period of two months or so to allow the United Engineering Societies more time in which to procure if possible other accommodations for the society in the building.

Customer Ownership Committee "Gets Busy" in New England N. E. L. A.

TO "SELL" the idea of customer ownership among New England electrical utilities a committee has been formed in the New England Division of the National Electric Light Association, consisting of P. H. Whiting, Central Maine Power Company, Augusta, Me., chairman; Franklin L. Hall, Narragansett Electric Lighting Company, Providence, R. I.; William Gould, Gas & Electric Improvement Company, Boston, and Everett Olds, Twin State Gas & Electric Company, Boston. The first meeting of the committee was held last week, and it was brought out that not more than ten companies in New England are at present selling their securities to their customers. Besides planning to promote the idea of customer ownership the committee is prepared to assist companies wishing to take up this method of marketing their securities and will collect full information about various successful campaigns, with exhibits of advertising used, forms, plans, sales manuals, etc.

New Power Business Expanding in Baltimore

NEW power business is expanding in Baltimore. Reports from the power sales department of the Consolidated Gas, Electric Light & Power Company of that city for March show added load from sixty-two customers, these customers representing thirty-six kinds of industries. This added load amounted to 1,403.3 hp. of power load and 352.8 kw. lighting. The total business for the month showed an increase over February.

N. E. L. A. Chicago Convention Program

DETAILS of the tentative program of the convention of the National Electric Light Association to be held at the Drake Hotel, Chicago, May 31, June 1, 2 and 3, have been announced as printed on the opposite page. In number of papers and reports the program is somewhat shorter than last year's.

Local committees in Chicago are working on the entertainment programs, details of which are expected to be announced shortly.

The association has again decided not to hold an exhibition, as was customary prior to the war. The only exhibits planned so far are one by the Lighting Sales Bureau on domestic lighting, following along lines somewhat similar to the now well-known industrial lighting demonstration, and the Electric Vehicle Show in the showrooms of the Commonwealth Edison Company and under its auspices.

April Financing Unusually High

THE April bond and note issues of electric light and power companies amount to $34,824,000 and bear an average yield of 7.78. This comparatively high total not only exceeds the total for April of last year by more than $2,000,000, but also denotes an increase of 35 per cent over last month's total. Long terms and high yields are again the chief characteristics of the issues. Of the thirteen companies represented below, nine offer securities to mature in not less than ten years. The sum of these issues alone almost equals the entire March offering. The 9 per cent yield on the $1,000,000 issue of the Standard Gas & Electric Company is exceptionally high. The average yield for the month was 7.78 per cent. The most important offering of the month is the $13,734,000 issue of the Puget Sound Light & Power Company, the largest in over a year in this field.

Name of Company	Amount of Issue	Period	Class of Security	Purpose of Issue	Rate of Int.	Per Cent Yield	Offered at
Puget Sound Power & Light Co	$13,734,000	20-year	General and refunding mortgage gold bonds, series "A"	Retirement of sinking fund gold notes	7.5	7.75	97 5
Northern States Power Co	1,000,000	20-year	First and refunding mortgage gold bonds	Refunding	6	7.10	88.5
Standard Gas & Electric Co	1,000,000	20-year	Gold notes of 1915		6	9	76
Southern Indiana Gas & Electric Co.	1,000,000	20-year	First lien and refunding mortgage gold bonds, series "A"	Refunding	7 5	8.10	94
Detroit Edison Co	2,750,000	25-year	First and refunding mortgage gold bonds, series "B" of 1915	Refunding	6	7.10	88 5
Twin State Gas & Electric Co	1,000,000	10-year	Bond-secured gold notes	Refunding and new construction	8	8.37	97.5
Hagerstown & Frederick Ry	1,600,000	30-year	First and refunding sinking-fund gold bonds of 1914	New construction	6	7.5	83.5
Hagerstown & Frederick Ry	540,000	8-mos.	Convertible collateral trust coupon notes, series "A"		8	8	Par
Portland Ry, Light & Power Co	1,000,000	5-year	Gold notes		8	8	Par
Northern Virginia Power Co	1,200,000		General mortgage gold bonds, series "A"	Retirement of outstanding notes and floating debt	7	7.5	96.5
Laurentide Power Co., Ltd	1,500,000	15-year	General mortgage bonds	New construction	7	7.5	95.54
Penn Public Service Corp	1,500,000	15-year	First and refunding mortgage gold bonds, series "B"	Refunding	7.5	8	95 75
Philadelphia Electric Co	5,000,000		Cumulative preferred stock		8	....	Par
Monongahela Valley Traction Co	2,000,000	1-year	Sinking-fund gold notes	Retirement of outstanding notes	8	8	Par
Total	$34,824,000						

N. E. L. A. Chicago Convention Program

(Tentative Draft Subject to Revision)

General and Executive Sessions

TUESDAY, MAY 31, 9:30 A. M.

1—Welome to Chicago (speaker to be selected).
2—Address of President Insull.
3—Appointment of committee on president's address.
4—Report of Treasurer Abell.
5—Report of Executive Manager Aylesworth.
6—Address of chairman Accounting Section, J. C. Van Duyne.
7—Address of chairman Commercial Section, M. S. Seelman, Jr.
8—Address of chairman Public Relations Section, J. E. Davidson.
9—Address of chairman Technical Section, I. E. Moultrop.
10—Report of committee on constitution and bylaws, W. C. L. Eglin.
11—Report of committee on constitutional revision.
12—Announcements.
13—Report of committee on membership, Walter Neumuller.

WEDNESDAY, JUNE 1, 9:30 A. M.

1—Report of committee on company employees' organizations, David Darlington.
2—Report of committee on rate research, Alex Dow.
3—Report of committee on constitutional revision.
4—Vote on constitutional amendments proposed.
5—Election of nominating committee.
6—Address, "Power," Samuel Insull.
7—Appointment of committee on memorials.
8—Appointment of committee on resolutions.
9—Address (subject to be selected), James A. Perry, president National Association of Railway and Utility Commissioners.
10—Report of public policy sub-committee on inductive interference, R. H. Ballard.
11—Announcements.
12—Report on "Superpower Survey," Charles L. Edgar.
13—Report of lamp committee, Frank W. Smith.
14—Report of wiring committee, R. S. Hale.

THURSDAY, JUNE 2, 9:30 A. M.

1—Report of insurance committee, S. E. Wolff.
2—Report of committee on electrical resources of the nation, M. S. Sloan.
3—Report of committee on water-power development, Franklin T. Griffith.
4—Address (subject and speaker to be selected).
5—Announcements.
6—Address, "The Electric Vehicle," Arthur Williams.
7—Address (subject and speaker to be selected).
8—Report of committee on co-operation with other associations, Sidney Z. Mitchell.
9—Report of committee on accident prevention, Charles B. Scott.

FRIDAY, JUNE 3, 9:30 A. M.

1—Report of committee on Doherty and Billings Prizes, A. S. Loizeaux.
2—Report of exhibition committee, C. L. Peirce, Jr.
3—Report of committee on electrification of steam railroads, Louis A. Ferguson.
4—Address, "Customer Ownership," John F. Gilchrist.
5—Address (subject and speaker to be selected).
6—Report of committee on president's address.
7—Report of committee on memorials.
8—Report of resolutions committee.
9—Report of nominating committee.
10—Election and installation of officers.

Technical Sessions

TUESDAY, MAY 31, 2:15 P. M.

1—Address of chairman, I. E. Moultrop.
2—Appointment of nominating committee.
3—Report of committee on electrical apparatus, R. F. Schuchardt.
4—Report of committee on safety rules, Thomas Sproule.

PARALLEL SESSION

Report of meter committee, W. L. Wadsworth.

WEDNESDAY, JUNE 1, 2:15 P. M.

1—Election of officers.
2—Report of committee on overhead systems, W. K. Vanderpoel.
3—Report of committee on inductive interference, A. E. Silver.

THURSDAY, JUNE 2, 2:30 P. M.

1—Report of committee on hydraulic power, Markham Cheever.
2—Report of committee on prime movers, N. A. Carle.

PARALLEL SESSION

Report of committee on underground systems, F. E. Ricketts.

Public Relations Sessions

WEDNESDAY, JUNE 1, 2:30 P. M.

1—Address of chairman, J. E. Davidson.
2—Appointment of nominating committee.
3—Report of committee on manufacturers' advertising, P. L. Thomson.
4—Report of committee on public utility information, John F. Gilchrist.
5—Report of committee on public utility taxation and uniformity of regulatory laws, W. W. Freeman.
6—Report of committee on relations with bankers, M. S. Sloan.
7—Report of committee on relations with regulatory bodies, R. H. Ballard.
8—Report of committee on upbuilding the industry, F. R. Coates.
9—Election of officers.

THURSDAY, JUNE 2, 8:30 P. M.
(With music)

1—Report of public policy committee, Sidney Z. Mitchell.
2—Address (speaker of national prominence invited).

Accounting Sessions

TUESDAY, MAY 31, 2:15 P. M.

1—Address of section chairman, J. C. Van Duyne.
2—Appointment of nominating committee.
3—Report of committee on accounting education, Fred R. Jenkins.
4—Report of committee on classification of accounts, reports to commissions and relations with other associations, W. J. Meyers.
5—Report of committee on purchasing and storeroom accounting, W. F. Stevens.

WEDNESDAY, JUNE 1, 2:15 P. M.

1—Report of committee on federal income-tax procedure, F. B. Odlum.
2—Paper, "Accounting for Coal," H. M. Edwards.
3—Report of committee on customers' records and billing methods, J. D. Jacobus.
4—Report of committee on credits and collections, David Darlington.

THURSDAY, JUNE 2, 2:15 P. M.

1—Election of officers.
2—Report of committee on bonus systems A. H. S. Cantlin.
3—Report of committee on security holders' records, William S. Kline.
4—Report of committee on investment budget control, Harry A. Snow.
5—Address, "Accounting Service to Member Companies," E. J. Fowler.

Commercial Sessions

TUESDAY MAY 31, 2:15 P. M.

1—Address of section chairman, M. S. Seelman, Jr.
2—Appointment of nominating committee.
3—Report of Bureau of Advertising and Publicity Service, L. D. Gibb
4—Report of division on adequate outlets and co-ordinate advertising P. L. Thomson.
5—Report of division of illuminating engineering, non-technical, P. B. Zimmerman.
6—Report of division on motion-picture films, M. C. Turpin.
7—Report of division on national commodity advertisers, Earl E. Whitehorne.
8—Report of division on newspaper advertising campaigns, Norman Maul.
9—Report of division on news syndicate and magazine writers, Frank B. Rae, Jr.
10—Report of division on publications, Cyril Nast.
11—Report of committee on education, Fred R. Jenkins.
12—Report of committee on "Electrical Salesman's Handbook," George H. Stickney.

PARALLEL SESSION

1—Report of Power Sales Bureau, H. H. Holding.
2—Report of division on economics of the use of central-station electric power, J. W. Meyer.
3—Report of division on industrial electric heating, N. T. Wilcox.
4—Report of division on electric arc steel furnaces, Joseph McKinley.
5—Report of division on general power, George H. Jones.
6—Address on "The Power of Transportation," E. S. Mansfield.

WEDNESDAY, JUNE 1, 2 P. M.

1—Report of Merchandise Sales Bureau, Dorsey R. Smith.
2—Report of division on electrical merchandise, C. E. Greenwood.
3—Report of division on electric shop management, Thomas Berger.
4—Report of division on standardizing and testing, R. S. Hale.
5—Report of electric range division, C. O. Dunten.

PARALLEL SESSION

1—Report of Electric Vehicle Bureau, E. S. Mansfield.
2—Reports of several committees (details to be supplied).
3—Paper, "Economy of Electric Vehicles," (speaker to be selected).
4—Paper, "Electric Vehicle Problems," (speaker to be selected).
5—Discussion.
6—Report of committee on compensation of salesmen, L. R. Wallis.
7—Address, "Capitalizing an Opportunity," William L. Goodwin.
8—Report of committee on commercial service and relations with customers, L. A. Coleman.

THURSDAY, JUNE 2, 2:15 P. M.

1—Report of nominating committee.
2—Election of officers and executive committee.
3—Report of Lighting Sales Bureau, Oliver R. Hogue.
4—Report of committee on educational exhibits, Clarence L. Law.
5—Report of division on residence lighting, M. Luckiesh.
6—Report of division on street and highway lighting, W. D'A. Ryan.
7—Report of division on industrial lighting, G. Bertram Regar.
8—Report of division on lighting of large buildings, F. A. Gallagher.
9—Report of division on commercial aspects of lamp equipment, Earl A. Anderson.
10—Report of division on sign, display and billboard lighting, H. I. Markham.
11—Report of division on store lighting, James J. Kirk.

To Consider Symbols for Electrical Equipment in Buildings

FOR the purpose of adopting a program looking toward the establishment of national symbols for electrical equipment in buildings the American Engineering Standards Committee has at the joint request of the National Association of Electrical Contractors and Dealers and the American Institute of Architects, called a conference of representatives of all interested national associations for May 10 at the Engineering Societies Building, New York.

Among the standards recently approved by the American Engineering Standards Committee are the standard method for sampling of coal submitted by the American Society for Testing Materials and the National Electrical Code.

Service Charge Legislation Rejected in Connecticut

THE Connecticut Legislature has rejected the proposed anti-service-charge legislation which received considerable attention early in the present session. In its place an act has been drafted which would authorize the Public Utilities Commission to regulate all rates and charges upon petition of companies, municipalities or any ten patrons of a public utility. Service charges by gas companies have been chiefly attacked.

Governor Lake has signed the bill authorizing the Hartford Electric Light Company to increase its capital stock to $20,000,000, issued at not less than par.

The bill authorizing to transmit and sell electricity for manufacturing uses under the jurisdiction of the Public Utilities Commission any corporation allowed to construct and maintain dams, to own and operate mills and to utilize its generated power in such operation has passed both branches. Such distribution and sale, however, are not permitted in territory already covered by municipal or private franchise.

Southwestern Division, N. E. L. A., Will Discuss Many Topics

AN EXTENSIVE program has been arranged for the annual convention of the Southwestern Geographic Division of the National Electric Light Association, which is to be held at Hot Springs, Ark., May 13 and 14. The program includes papers and addresses on the following subjects: "Customer Ownership," by C. J. Stubner of Henry L. Doherty & Company; three papers, on "Security Holders Records," "A Uniform System of Accounting" and "The Bonus System" respectively, to be read at the afternoon session on May 13; an address by W. E. Clement, New Orleans Railway & Light Company; "Merchandise Sales," by W. B. McSpadden of the City Light & Water Company of Amarillo, Tex.; "Commercial Service and Relations with Customers," by P. C. Tucker; "Lighting Sales," by C. S. Barber; "Power Sales," by R. I. Brown; "Advertising and Publicity Service," by J. C. Lamb; "Electric Vehicles" and an illustrated lecture on "Correct Industrial Lighting," both by F. J. Schwab; "Publicity," by H. A. Lane, secretary of the division; "Should the Public Utility Company Advertise?" by G. A. Davis; an address by J. B. Thomas, chairman of the Technical Section; "The Application of Diesel Engines to Small Electric Power Stations," "Valuation for Rate Making," "The Economies of Transmission-Line and Distributing System Supports," and "The Operating Problems of Inductive Interference," all four of these papers to be read before the Technical Section on May 13.

On the evening of May 13 the annual banquet of the division will be held. The members will hear a talk by Martin J. Insull, president of the N. E. L. A., on "The Public's Business," following a talk by A. Hardgrave, president of the division. On Saturday morning, May 14, there will be a general session at which the following addresses will be given: "Public Policy," by Hamilton Moses; "The Kansas Industrial Law," by W. L. Higgins of the Court of Industrial Relations of Kansas, and "The Superpower Central Station," by J. B. Thomas of the Texas Power & Light Company. The report of the wiring committee will be presented at this meeting also. At the general session of Saturday afternoon will be presented papers on "Needs of the Industry," by J. H. Gill; "Work of the N. E. L. A.," by W. J. Canada, and "Internal Organization," by J. F. Owens.

English Publisher of Industrial Periodicals Here to Study Labor

ERNEST J. P. BENN, managing director of Benn Brothers, Ltd., of London, the foremost publishing house of engineering and trade papers in Europe, arrived in the United States a few days ago to study industrial conditions and confer with officials of the National Civic Federation. Mr. Benn has been engaged in publishing for forty-odd years, and among his twelve publications are the *Electrician* and the "Electrical Trades Directory," both extremely well known in the United States.

At the present time he is especially interested in labor conditions and is considered one of the foremost authorities on that subject in England. His trip to the United States primarily is to obtain as much information as he can regarding the labor situation.

On Thursday noon representative business-paper publishers gave a luncheon at the Engineers' Club in honor of Mr. Benn, at which James H. McGraw, president of McGraw-Hill Company, Inc., was invited to preside as toastmaster. At this time the representatives of American engineering papers who made the trip to Europe at the close of the war took occasion once more to express to Mr. Benn their lasting appreciation of the many courtesies which he showed them at that time.

Southwestern Men Have Full Program for Galveston Meeting

MARTIN INSULL, president of the National Electric Light Association, will on May 19 address the seventeenth annual convention of the Southwestern Electrical and Gas Association at Galveston, Tex., on "The Public's Business"; J. H. Gill will discuss "The Utility Association as a Permanently Profitable Investment," and Dr. E. P. Schoch will speak on "The Latest Development in Texas Lignite." On May 20 W. G. Busby, chairman Missouri Public Service Commission, will speak on "State Utility Commissions," W. J. Canada of the N.E.L.A. on "Inductive Interference," and there will be two addresses on "Home-Town Financing of Local Utilities" by men who have had practical experience along this line and an address on the same topic from the banker's point of view by a Texas banker.

The convention will open on Wednesday afternoon, May 18, when the president's address and an address by an invited speaker will be made.

Need for Uniformity in Contractors' Licensing Risk Seen

LACK of similarity in legislation relative to licensing electrical contractors is receiving attention from the New York State Association of Electrical Contractors and Dealers. The subject of licensing is now up in a number of different cities in the state, no two of which are considering similar arrangements. The association states that it fears that if this matter is handled in such a miscellaneous way it will result in a "welter of rules and regulations that will be contradictory and obviously embarrassing to contractors in attempting to execute work in different localities."

The New York State association suggests the serious consideration of this subject by members of the national association and district associations.

All Branches of the Industry Co-operate in Illumination Exhibit

AN EXHIBIT designed to display the most modern equipment available for industrial, commercial and residential lighting will be opened in the Rogers Building, Massachusetts Institute of Technology, Boston, in the latter part of May under the auspices of the Institute, the central-station, jobbing, manufacturing and contractor-dealer interests of the city. It is hoped that the exhibit can be maintained for at least five years as a center of advanced lighting instruction and demonstration. The "Bureau for Better Illumination" has been organized to handle the work, and the following committees have been appointed: Engineering, Prof. W. J. Drisko (chairman), J. Daniels, R. R. Ringer; publicity, L. D. Gibbs (chairman), M. R. Griffeth, C. M. Stow, E. H. Whitney; finance, V. M. F. Tallman (chairman), J. E. Wilson, C. B. Burleigh, W. F. Abely; general, H. F. Wallace (chairman), A. W. Ives, J. E. Wilson (secretary), W. J. Drisko, W. H. Atkins, W. F. Abely, F. S. Price, C. S. Davis, J. Daniels, H. T. Sands, William Gould. A maintenance committee has been suggested to care for the exhibit.

Cincinnati Company Installs More Generating Capacity

IN THE report just issued to stockholders of the Cincinnati Gas & Electric Company, Charles D. Jones, president of the company, shows that the total assets at the close of 1920 were listed at $53,050,478.82. The report also reviews the various features, physical and financial, of the company. In view of the present condition of the bond market the issuing of any bonds under the new $50,000,000 authorized mortgage has been deemed unwise.

A fourth unit of 30,000-kw. capacity is now being installed in the company's plant and is expected to be in readiness for operation some time during the coming summer. This will bring the total generating capacity of the plant to 120,000 kw. and the company then will be in a position adequately to handle the rapidly increasing demand for power.

The approved capital charges for the year 1920 other than power house expenditures amounted to $1,000,749, an increase of $465,907 over 1919. This large increase, it is pointed out in the report, is due mainly to the tremendous increase in the demand for electric service. The budget of estimated expenditures for this year is figured at $559,000, of which $82,000 is for the gas department and $447,000 for the electric department.

Seasonal Freight Rates on Lake Coal

THE Interstate Commerce Commission by authorizing the carriers to put in effect reduced rates on lake coal has authorized what is in effect a seasonal coal rate. The decision is regarded as being one of the most significant since the priority orders of last fall.

The authorization took the form of a special permission. Such permissions, No. 52,757 and No. 52,761, dated April 27, authorized the carriers participating in the movement of coal to Lake Erie ports for trans-shipment by water to reduce rates for such transportation 28 cents per net ton until Oct. 31, 1921.

This order is expected to stimulate the shipment of coal to lower lake ports. The adjustment of the rates from the upper lake ports to interior points still is under discussion.

A. I. E. E. Standards Committee Meets May 19

THE standards committee of the American Institute of Electrical Engineers will hold a meeting on May 9 at the headquarters of the Institute in New York, at which time it is expected that the latest edition of the standardization rules will be off the press. Prof. D. C. Jackson, Massachusetts Institute of Technology, Cambridge, Mass., is chairman.

A. I. E. E. Now Has 12,201 Members

THE year-book of the American Institute of Electrical Engineers for 1921, which has just been published, shows an increase in membership from Jan. 1, 1920, to Jan. 1, 1921, of 1,509. The present membership of all grades is 12,201, distributed as follows:

	Jan. 1, 1920	Jan. 1, 1921
United States	9,770	10,447
Canada	525	624
Newfoundland	2	2
Mexico	37	42
Central America	60	59
West Indies	34	51
South America	109	124
South Africa	20	24
Asia	226	280
Australia	127	149
Europe	346	399
Total	10,692	12,201
Honorary members	6	6
Fellows	494	528
Members	1,541	1,799
Associates	8,651	9,868

This increase in membership makes the slope of the curve of membership for the period 1916 to 1921 considerably steeper than for the period 1900 to 1910, just prior to the regrading of the membership and the establishing of the grade of fellow in 1912. Between 1900 and 1910 the increase was at the average rate of 575, and from 1910 to 1916 it was at the rate of 233 per year. Since that time the average rate has been 950 per year. Eighty per cent of the increase of the past year was in the associate grade, with new members drawn mostly from the engineering and sales departments of the large electrical manufacturing companies and from the operating departments of public utilities and industrial plants.

Colorado River Commission Now Gathering Data

THE recently formed Colorado River Commission is now gathering data to be used as a basis for recommendation as to the development of the river. This commission consists of the state engineers and officers having jurisdiction over irrigation and water rights, together with officers of the Reclamation Service. It was formed through the efforts of the League of the Southwest, in which are joined as official members the Governors of California, Nevada, Arizona, New Mexico, Utah, Colorado and Wyoming. In addition to the engineering commission a treaty commission is being formed to formulate laws and prosecute treaties between the several states. These treaties will require approval by Congress.

Up to the first of the year filings for power developments on the Colorado River and its tributaries exceeded 4,000,000 hp. Principal among these is the application of the Southern California Edison Company for development of three sites totaling 3,570,000 hp.

Under the Kincaid act, which authorized the Reclamation Service to investigate the problems of the Imperial Valley, a report has been rendered covering the studies completed to date of Nov. 6, 1920. Since that date the investigations have been continued, including work at the Boulder Canyon dam between California and Arizona, where it is proposed to construct a 25,000,000-acre-ft. storage and flood-control reservoir.

All available data will be given to F. E. Weymouth, chief engineer of the Reclamation Service, Denver, who is secretary of the Colorado River Commission, for compilation. A. J. McCune, Colorado state engineer, is chairman of the commission.

Efficiency in Business to Help Meet Demand for Lower Prices

MORE work from fewer men, greater efficiency in advertising and a careful study of costs and credits—these are the tools used by American business to effect lower costs in order to meet the demand for reduced prices, according to the findings derived from a survey just completed by the department of domestic distribution of the Chamber of Commerce of the United States. Answers were received from about 2,000 business men, retailers, wholesalers and manufacturers. The questions had to do only with distribution costs, and all answers which deal solely with production problems were omitted.

The replies for the most part report what has been done, but a final question asked for suggestions as to how the domestic distribution department might help in lowering the cost of merchandising to a normal basis. By far the largest number of answers said, "Do something to lower freight rates."

The greatest variety of answers was received in response to the question, "What are you doing to reduce your personnel costs to a normal basis?" The general tone of these answers pointed not so much toward a reduction in wages as to a reduction of the number employed. Only about one-fourth of those who answered had made any direct reduction of wages. About 58 per cent have reduced the number of employees and have done away with one-fifth of their workers. One-fifth reported that they had done away with or reduced commissions and bonuses.

More than one-fourth of those answering said they had cut down advertising space. This was in part balanced, however, by reports from many others who found depression a justification for an increased use of space. Frequently through the comment which accompanied the answers to the questions about publicity there appeared a note of determination not to cut off this method of selling but to make certain of greater results.

Surprisingly little was done by the 2,000 business men in the cutting down of service to customers.

More than 20 per cent of those who answered had made a reduction in volume of credit business. Some had shortened the time on charge accounts, while a considerable number—more than 4 per cent of the whole—had lengthened time on this class of business.

A general question as to what other means had been used to reduce costs drew forth a wide variety of replies. Stopping the little leaks has engaged as much of the business men's attention as reducing the heavier expenses. Budgets are getting much more careful attention.

Arc-Welding Applications Increase 100 per Cent in 1920

ELECTRIC arc welding has had a very rapid growth during the past few years both in sale of apparatus and in increasing scope of application, according to data presented by the electric arc welding committee before the recent annual convention of the American Welding Society at New York on April 27, 28, 29 and 30. The number of sales of equipment for 1920 was double that for 1919, and at the same time the increased sale of electrode material shows that the field of application has also more than doubled. It was the consensus of opinion that the field for electric welding was so large that no unnecessary attempts should be made to compete in work that logically belongs to the field of gas or thermit welding.

Carbon arc welding has shown better results for welding $\frac{1}{8}$-in. or $\frac{3}{32}$-in. steel plates than metallic electrode welding, asserted R. F. Wagner of the General Electric Company in his discussion before the electric arc welding committee. Less skill is required of the operator in manipulating the tapered carbon pencil electrode used for this work than in handling the metallic electrode. Greater speed is also obtained. Both direct current and alternating current are used for the welding on thin plates, although smoother work is done with direct current. Other important subjects considered by this committee were cast-iron welding, locked-up stresses and standard tests for welds.

The committee on training of operators, William Spraragen, chairman, decided to get in touch with various welding schools in order to find out the methods of handling courses of study and training for operators. An attempt will also be made to work up a series of standard tests that may be given to operators to determine their fitness for handling welding work.

Standardization of apparatus ratings for the benefit of the manufacturer, user and central station will be attempted by the resistance welding committee, Herman Lemp chairman. Nomenclature standardization will also be taken up.

New officers elected for the American Welding Society were: President, S. W. Miller, Rochester Welding Works, and vice-president, C. A. McCune, Paige Steel & Wire Company. The American Bureau of Welding,

which is a joint advisory board of the American Welding Society and the Engineering Division of the National Research Council, retains its former officers, Comfort A. Adams, director, and William Spraragen, secretary.

Mechanical Engineers Will Discuss Power Problems at Spring Meeting

WELL-DEVELOPED programs will be carried out by the different divisions of the American Society of Mechanical Engineers, which will hold its spring meeting at the Congress Hotel, Chicago, on May 23-26. The Power Division is co-operating with the Chicago Section of the A. I. E. E. and the mechanical and electrical sections of the Western Society of Engineers to provide papers on the power resources of the Middle West. The power session will be presided over by Samuel Insull, president of the Commonwealth Edison Company. The situation regarding power development and interconnection of power systems will be reviewed by W. L. Abbott, Commonwealth Edison Company, and there will be a paper by C. W. Place of the General Electric Company, describing the water-power resources of that section. The first three power test codes developed by the A. S. M. E. will be presented for public hearing. These are on general instructions, reciprocating steam engines and evaporative apparatus.

Other features of the meeting will be a paper on the hydraucone regainer by William M. White, manager and chief engineer of the hydraulic department of the Allis-Chalmers Manufacturing Company, which will outline the development of this device and its successful application in hydro-electric projects, leading to high water-wheel efficiency, and more ecnomical power-house construction; a paper on boiler-water analyses by J. R. McDermet, research engineer of the Elliott Company, and a paper by H. B. Reynolds of the Interborough Rapid Transit Company presenting the results of a series of tests on a 30,000-kw. steam turbine.

Power-Load Figures Reflect Industrial Conditions in Ohio

INDUSTRIAL conditions throughout Ohio are reflected by statistics compiled by the Ohio Committee on Public Utility Information showing the quantity of electricity generated for light and power by large central-station plants during March, as compared with the same month last year. The figures indicate a falling off of around 23 per cent in the production of electricity as compared with March, 1920. In that month 150,704,416 kw.-hr. was generated by central-station plants in eleven of the largest cities of Ohio, while in March of this year the amount generated was 115,887,465 kw.-hr., a decrease of 34,816,951 kw.-hr.

This large decrease is due to the fact that industrial plants are not using nearly so much electricity as they were last year. More electricity is being used in homes, however, according to central-station operators, one large central-station company adding domestic consumers at the rate of 2,000 a month.

Program for National District Heating Association Convention

A LARGE attendance is expected at the twelfth annual convention of the National District Heating Association, which is to be held at the Breakers Hotel, Cedar Point, Ohio, June 22, 23 and 24. The tentative program of the convention includes papers and discussions on "Insurance Rates as Affected by District Heating Installations," "Does Installation of Electric Generators in Connection with Steam Heating Pay?" "Experience with Non-condensing Turbines in Industrial Heating Work," "Use of Pulverized Coal," "Hot Water Rates," "Customers' Installations" and "Advantages of Central-Station Heat from the Viewpoint of the Building Manager." There will also be a symposium on the mechanical stokers and their performances and an address on the coal situation.

Southwest Unites in Electrical Show



ONE hundred and fifteen exhibitors participated in the first Kansas City electrical show, which closed April 23. There were around 75,000 paid admissions. While the show was conducted co-operatively by the Kansas City electrical interests, it served in a measure to unite the electrical industry of the Southwest. A number of the associations of that section arranged to meet in Kansas City during electrical show week. One of the features of the show was the general illumination, the general scheme of which can be seen in the illustration. Eighty 1,000-watt "tip-up burning" lamps were used in inverted bowl reflectors. An intensity of 16-foot candles on the lighting plane was secured.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Pennsylvania Company's Rights in Ellwood City Sustained.—The Public Service Commission of Pennsylvania has ordered the Harmony Electric Company to "desist from constructing a distribution line or any additional facilities for the purpose of supplying electrical energy to consumers in the borough of Ellwood City." This action was taken on the complaint of the Pennsylvania Power Company, between which and the Harmony company a dispute over rights in the territory concerned existed. The commission had previously refused approval of a contract between the Harmony company and the borough.

War Department Will Train Amateur Radio Operators.—The United States War Department, through the Chief Signal Officer of the army, is making arrangements for the training of amateur radio operators and devising plans for utilizing their services should a national emergency arise. There are nine army corps areas, and in each of these it is intended that an organization of amateurs shall be formed. At the respective corps headquarters there will be established a transmitting radio station with a range sufficient to cover the entire corps area. Courses of instruction will be prepared and sent out by radio and by mail. The amateur personnel will be formally inducted into the Signal Reserve Corps and will where practicable be called to active camp service for two weeks in the summer.

Pacific Gas & Electric Company Enters Into Contract with Red River Lumber Company.—An important contract has been drawn between the Pacific Gas & Electric Company and the Red River Lumber Company, which has large timber holdings in the Pit River country, where the Pacific Gas & Electric Company is engaged in a large construction program. By virtue of its large holdings the Red River Lumber Company held large riparian rights on Pit River, Fall River and Hat Creek and had intended to develop power on these streams for the purpose of making paper pulp. In exchange for all of its water rights and clear title to a strip of land 25 ft. wide on each bank of these streams above high-water mark, the use of roads, trails and camp sites and rights-of-way for pole and tower lines, and the right of rental of certain of the Red River Lumber Company's stock and equipment, the Pacific Gas & Electric Company had given the Red River company an option on Hat Creek Power House No. 1 and Hat Creek Power House No. 2. When and if it takes over Power House No. 1 the Red River company will pay for the actual cost of the plant minus a certain consideration. When and if it takes over the second power house it will pay the Pacific company the actual cost of the plant. Until the time that these plants are taken over by the Red River company they will be operated by the Pacific company. The contract has been submitted to the California Railroad Commission.

Rural Electrification in Finland.—A report from the American Consul at Helsingfors, Finland, says that thirty-one rural districts in that country out of sixty-four having 25 per cent of their total area under cultivation are supplied with electricity and that service is also being given to some districts with a poorer percentage of cultivated land. There are three large electric plants in the agricultural sections, of which one has just been built to take advantage of a water-power source in the Province of Abo. This plant produces low-tension energy for use in its immediate neighborhood and also transits power at 20,000 volts for a distance of 26 miles, this energy being stepped down for lighting and motor service to farms within the area supplied.

Electricity in British Columbia Coal Mines.—The only smelter in the world refining five different metals—gold, silver, lead, copper and zinc—is, according to E. A. Haggen, a Britihh Columbia mining authority, to be found at Trail, in that province. This development, as well as that of the Rossland mines, had come through the exploitation of hydro-electric power at Bonnington Falls on the Kootenay River. The West Kootenay Light & Power Company, which operates the Bonnington Falls plants, is extending its lines westward to Princeton, 180 miles from the plants, and eastward to the Sullivan mine in East Kootenay, more than 100 miles. Transmission on the westerly line is to be at 110,000 volts. Mr. Haggen expresses the conviction that if up-to-date electrical machinery were installed in the coal mines of Vancouver Island, at a cost of two or three million dollars, the price of coal would be $3 a ton less in the city of Vancouver.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

O. E. L. A. Committee Meetings.—Two meetings of the station operating committee of the Ohio Electric Light Association are scheduled for next week—one on Wednesday at Toledo, and the other on Thursday at Detroit.

A. I. and S. E. E., Pittsburgh Section.—At the meeting of this section on Saturday, May 14, to be held at the Hotel Chatham, Pittsburgh, Frederick J. Crolius, Carnegie Steel Company, Munhall, Pa., will present a paper on "Powdered Coal and Its Application to Boilers."

Connecticut Section, A. I. E. E., Organized.—The thirty-second local section of the A. I. E. E., to be known as the Connecticut Section, which was formally organized at New Haven on April 22, will include all of Connecticut with the possible exception of the three corners of the state within the technical radius of the New York, Pittsfield and Providence Sections respectively. About forty-five electrical engineers were present at the organization meeting. Dr. William McClellan, nominee for president of the parent body, addressed the gathering, pleading for the development of an engineering atmosphere in the new section as well as the discussion of engineering problems. Officers elected were: Chairman, C. F. Scott, professor of electrical engineering Yale University; secretary and treasurer, A. E. Knowlton, electrical engineer of the Public Utility Commission of Connecticut and instructor in electrical engineering at Yale; executive committee, Samuel Ferguson of Hartford, E. C. Bryant of Bridgeport, W. H. Bristol of Waterbury, E. H. Everit of New Haven, G. B. Leland of Stamford.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Philadelphia, May 7; Cleveland, May 9; Pittsburgh, May 14.

American Association of Engineers—Buffalo, May 9-11.

Society for Electrical Development Annual Meeting—New York, May 10.

Arkansas Utilities Association—Hot Springs, Ark., May 11-12. (For program see issue of April 30, page 1014.)

N. E. L. A., Southwestern Geographic Division—Hot Springs, Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond, Va., May 19-20.

A. I. E. E. Annual Meeting—New York, May 20.

American Society of Mechanical Engineers—Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3.

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Cost of Financing Extensions.—The Pennsylvania Public Service Commission has condemned the practice of an electric supply company in requiring a deposit to cover the cost of making simple extensions under a provision in its rate schedule that the company reserves the right to charge the consumer the cost of connecting with the delivery of electrical energy and that a deposit may be required of the consumer at the discretion of the company, this clause being, in the commission's opinion, too general and misleading.

Cost of Waiving Rights Must Be Borne by Utility.—In establishing increased electric and gas schedules for the Western States Gas & Electric Company the California Railroad Commission, commenting on the action of the company in waiving as regards street lighting in Stockton the surcharge of 10 per cent previously authorized on all rates, said: "Obviously the proper consideration of applicant's electric revenue should be based upon established standard rates, and the diminution of its return by reason of applicant's favoritism in the instances of municipal service it supplies should not, in our opinion, be counted adversely against its regular consumers." The company's revenue was therefore estimated with the uncollected surcharge included.

Basing Rates Upon 100 per Cent Efficiency.—In making application for increased rates to the Virginia State Corporation Commission the Virginia Railway & Power Company contended that no deduction should be made from the fair value of the property, on a reproduction basis, for depreciation that has accrued through the years its various component parts have been in use, the argument being that so long as the property is well maintained and is adequately serving the public it should be regarded as having a value of 100 per cent for rate-making purposes. The commission held that this theory might be worthy of serious consideration when the value is made on the basis of original cost. The situation is entirely different when the reproduction cost theory is approached, for the reproduction cost of nearly any utility property today will be found to be greatly in excess of the original cost. The company contended that rates should be based upon 100 per cent efficiency and that this should be accomplished through rates that will take care of replacements and renewals. With this the commission agreed, but said that the subject was one that came under rate adjustments and not value, and that it would be taken care of in the usual allowance for depreciation reserve.

Steam-Heating Service Is By-product of Electric Service, Never Vice Versa.—The Public Service Commission of Oregon points out that no steam-heating business can be operated successfully as a separate and independent plant and that therefore a heating utility combined with an electric utility should not be charged the full proportion of fuel cost for heat sent to the heating system, since such a method would produce electric service at a considerable reduction over the cost of obtaining its equivalent by the most economical alternative method and the electric service would be considered a by-product of the steam-heating system. Inasmuch, the commission holds, as a heating plant cannot stand alone and must have the support of a more stable industry, the contrary is the case.

Apportionment of Expenses Between Departments.—The Tennessee Railroad and Public Utilities Commission in fixing rates for the Memphis Gas & Electric Company declined to follow the rule favored by many commissions of so adjusting rates that each department should bear its full position of the expense, and, finding that the rate for gas fixed in an agreed order between the municipal authorities of Memphis and the receivers of the company would, if the present electric rates continued in effect, be in excess of the rate required to provide for operating expenses and for a proper allowance for return, ordered that the rates for gas should be reduced, while the rates for electricity should stand as currently in effect. In handing down this decision the commission took occasion to declare its belief in the "service-at-cost" plan of rate adjustment as the fairest method.

Rewards for Efficiency.—In its recent findings in the Southern California Edison Company rate hearings the California Railroad Commission approved of the plans of the company to reward employees for increased efficiency and economies in operation and invited the submission of a more definite and specific plan. On this head the commission said: "We believe that utilities, which are largely monopolies and therefore not subject to the same active competition as most industries, have less incentive to maintain high efficiency, and we therefore welcome a sound and logical plan whereby utilities and the public may share in the savings from efficiencies and economies in operation. . . . It must be pointed out, however, that the public utilities act does not contemplate a division of increased profits due to reductions in price of labor, materials and supplies, increased earnings due to reductions in the level of economic conditions, possible reductions in the price of oil, or reduced cost of development of power resulting from conditions not under the control of the company."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and otner public utility companies

Alleged Benefit to Land from Overflow of Dam Not to Be Considered in Damage Suit.—The Supreme Court of Washington has sustained the inferior court in refusing to instruct the jury in Caldbick vs. Marysville Water & Power Company, a suit for damages from overflow of company's reservoirs, that there could be no recovery if the benefit to the land from material washed thereon, as reflected in its market value, was greater than the damage. The question whether the escape of the water was due to unprecedented rainfall was for the jury. (195 Pac. 1027.)*

Right to Use of Land for Water Flowage Not Lost by "Adverse User."—In a suit brought by M. Hemmis against the Consolidated Water Power & Paper Company for trespass because plaintiff's lands would be flooded by the raising of defendant's dam the Supreme Court of Wisconsin denied that the company, whose ownership of the water power, water flowage and dam privilege on the stream concerned was not disputed, had lost the right to flow the land because of "adverse user" for twenty years. The use of the land for pasturage for eight or ten years and thereafter for no other use than to cut wood and trees was not, the court held, inconsistent with the defendant's easement. (181 N. W. 743.)

Ordinance Requiring Free Municipal Service Void.—An ordinance adopted by the city of Milwaukee in 1890 and permitting the consolidation of certain electric companies in consideration of the consolidated company furnishing electrical energy to the city without charge has been declared void by the Supreme Court of Wisconsin, in Milwauke Electric Railway & Light Company vs. City of Milwaukee, in view of the invalidity of a prior ordinance attempting to prevent the consolidation of the companies, the contract being thus made without providing consideration for the service rendered. The contract requiring free energy was not validated by the statute providing that rates contained in contracts executed prior to April 1, 1907, shall not be held discriminatory, and the company, while operating under an indeterminate permit, was not excluded from claiming that the city's ordinance was invalid, because, having become subject to the restrictions of the indeterminate permit, the company became entitled also to the benefits that accrue with this form of contract. (181 N. W. 298.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

G. R. Milford, who was appointed manager of the Shasta (Cal.) division of the Pacific Gas & Electric Company at the time of the recent reorganization of that company's commercial departments, has had a long experience in engineering, construction and operation. He was born in Lamoille, Ill., in 1883 and, immediately after being graduated from the Bliss Electrical College in Washington, D. C., in 1902, entered the employ of the Moravia (N. Y.) Electric Railway Company, where he was engaged on preliminary work incident to the construction of the railway. In October, 1903, he left to take the position of engineer in charge of the Oriskany and Rome (N. Y.) divisions of the Utica & Mohawk Valley Electric Railway Company. After a short period Mr. Milford went to California and entered the employ of the Northern California Power Company, later the Northern California Power Company, Consolidated. His first duties were in connection with the construction of the Kilarc hydro-electric generating station. After this station was placed in operation he was in charge of the substations and distribution system until, in 1907, he was given charge of the entire Kilarc division. In 1910 he was promoted to be superintendent of power houses, in which position, in addition to superintending the operation and maintenance of the company's generating equipment, he had charge of the completion of the Coleman hydro-electric station then being built. In 1912 he became assistant to the general manager, E. V. D. Johnson, and was active in the consolidation of this company with the Sacramento Valley Power Company. In 1915 he was made division superintendent of the consolidated companies. When the Pacific Gas & Electric Company took over the properties of the Northern California Power Company, Consolidated, he was appointed to his present position. The Shasta division comprises a large area in the extreme northern end of the Sacramento valley.



G. R. MILFORD

E. I. Lewis, head of the Indiana Public Service Commission, has been named by President Harding as a member of the Interstate Commerce Commission and confirmed by the Senate.

Frank A. Wood has been appointed general superintendent of the Beverly (Mass.) Gas & Electric Company, succeeding C. R. Pritchard, who has resigned to become vice-president and general manager of the Lowell (Mass.) Gas Light Company. Charles B. Hodgson has been elected assistant treasurer of the Beverly company.

M. O. Leighton has been appointed director of the Southeastern branch of the Engineering Business Exchange, New York City, which conducts the purchase and sale of engineering and technical business properties. Mr. Leighton was for a number of years one of the principal engineers of the United States Geological Survey and for the past three years has been chairman of the national service committee of the Engineering Council. Associated with Mr. Leighton in carrying on the exchange will be A. C. Oliphant, who was also active in the work of the national service committee. The Southeastern branch of the Engineering Business Exchange has offices in the McLachlen Building, Washington, D. C.



M. O. LEIGHTON

Herman Spoehrer, secretary of the Union Electric Light & Power Company of St. Louis, has recently been elected president of the Missouri Association of Public Utilities, composed of officials of gas, water, electric light and power companies of the state. He was formerly vice-president of the association. Mr. Spoehrer was born in New York City in 1876. Upon his graduation from Cornell University in 1899 he received an appointment in the Brooklyn Navy Yard, where he remained five years. During the world's fair in 1904 he joined the ranks of the Union Electric Company, successively filling the positions of assistant in the general manager's office, purchasing agent and superintendent of construction to supervise the river wall, intakes and settling basins of the Ashley Street power plant. In 1906 he was appointed auditor of the company, later secretary and then secretary-treasurer. In October, 1920, he was relieved of his duties as treasurer because of the enlargement of his functions as secretary.



H. SPOEHRER

N. A. Lee has been appointed superintendent of the municipal electric light plant and waterworks system of the city of Luverne, Minn., succeeding Otto Pyles, resigned.

Roderic McRae, formerly chief lineman of the Pacific Power & Light Company, Yakima, Wash., has been transferred and has been appointed district manager of the company at White Salmon, Wash.

Ottomar H. Hanschel, at one time connected with the Sheboygan (Wis.) Railway & Electric Company and later superintendent of power plants for the Central Illinois Light Company, Peoria, Ill., has resigned as associate editor and consulting engineer on the staff of *Power Plant Engineering*, Chicago, to become associated with Deane S. Holt of Milwaukee in the Holt Power Equipment Company. This company, in addition to specializing in the purchase, sale and reconstruction of electric generators and motors, will hereafter engage in electrical engineering construction and maintenance work.

C. H. Shepherd, who has recently entered private practice as a consulting electrical engineer specializing in street-lighting and general power-system engineering, is well known for his work as electrical engineer in charge for the Commissioners of Lincoln Park, Chicago. While holding that position he redesigned and rebuilt the extensive electrical, water and motor transportation systems of Lincoln Park and in the course of this work developed the series-multiple transformer. He was graduated as an electrical engineer from the University of Wisconsin and was a student engineer with the Allis-Chalmers Company at Norwood, Ohio.



C. H. SHEPHERD

In 1908 he became connected with the Commonwealth Edison Company of Chicago and for two years was chief engineer of its Fisk Street station. From 1910 to 1912 he was operating engineer for the Commissioners of Lincoln Park. In 1912 he became connected with the department of electricity of the city of Chicago and was made chief layout engineer, designing and superintending the construction of a large part of the present municipal street-lighting system of the city. In 1914 he became electrical engineer in charge for the Commissioners of Lincoln Park. In 1920 he joined Dr. Edward S. Bemis, being made department engineer in charge of the valuation of the St. Paul street-railway system and the valuation of the distribution system of the Springfield (Ill.) Gas & Electric Company. From this position Mr. Shepherd resigned to enter private practice.

William J. Tideman, formerly chief engineer and factory manager of the Tideman Electric Company of Cairo, Ill., is now chief engineer in charge of production and design of the United Electric Company of Canton, Ohio, maker of "Ohio" electric cleaners. Previous to his connection with the Tideman company Mr. Tideman was a radio engineer in the United States Navy. In the early days of the war he was factory manager of the Menominee Electric Manufacturing Company of Menominee, Mich., at a time when this company was building high-tension magnetos for the British government. Prior to that he was general manager of the Dudley Tool Company of Menominee, manufacturers of ammunition.

Stephen I. Miller, dean of the department of business administration of the University of Washington, has been appointed manager of the Northwest Electrical Service League. Dean Miller will devote his entire time to the educational campaign to be undertaken by the league, retaining his connection with the university in an advisory capacity only.

Douglass Wood, formerly a district representative for the Bryan-Marsh division at Chicago, National Lamp Works of General Electric Company, has been promoted to the position of manager of the Colonial electric division, National Lamp Works of General Electric Company, at Warren, Ohio, succeeding A. E. Williams, who resigned April 1, 1921. Mr. Wood has been a member of the Bryan-Marsh division at Chicago since 1913. He enlisted in the army in April, 1917, as a private and was discharged as a major after twenty months' service overseas.

Obituary

Montgomery Clark died on April 20 at Atlantic Highlands, N. J. Mr. Clark was sales representative of the Bryan-Marsh Division of the National Lamp Works of the General Electric Company, New York City, for seventeen years. He was fifty years of age.

Z. V. Taylor, president of the Southern Public Utilities Company, Charlotte, N. C., died recently while en route from Charlotte to New York. Mr. Taylor had been identified with public utility affairs in the South for a number of years and was for a time associated with the Southern Power Company in an executive capacity. Later, when the Southern Public Utilities Company was organized by the uniting of electric light, power and railway interests in several of the largest cities in North and South Carolina, Mr. Taylor was placed in charge of the company's affairs as its president. He was born in Sparta, Tenn., in 1868 and spent his early life in the practice of law under Judge W. P. Bynum at Greensboro.

Samuel E. Tinkham, who had been associated with the engineering department of the city of Boston since 1874, died on April 21. Mr. Tinkham had been prominent in engineering affairs in New England for more than forty years, serving as secretary of the Boston Society of Civil Engineers from 1880 to 1882 and again from 1887 to the time of his death. Although a civil engineer, he was closely identified with all branches of engineering and gained a high reputation as a consulting engineer. He was graduated from the Massachusetts Institute of Technology.

Willard Layman Candee, organizer with Charles A. Cheever of the Okonite Company and its president for a number of years, suddenly died of heart failure on April 25 while riding in his motor car. Captain Candee was a well-known pioneer in electrical work. He became interested in the telephone soon after its invention and was among the first to see its commercial possibilities. In August, 1877, he became associated with Mr. Cheever and H. L. Roosevelt in the organization of the New York Telephone Company as construction engineer and salesman. A telephone line which he built in Brooklyn between his boarding house and his father's residence was one of the first in that city. Later he helped in the construction of the first lines in New York City to be operated as a commercial enterprise from the telephone company's offices to nearby points. One of these connected the office of a wire manufacturer in New York with the plant in South Brooklyn, a distance of about five miles. In 1879 Captain Candee became identified with the Weston Electric Light Company, and two years later he assisted in organizing the Jablochkoff Electric Lighting Company in New York City. Captain Candee did much experimental and development work in arc lighting and conceived the idea of telegraphing from a moving train, which he successfully accomplished. In March, 1884, with Mr. Cheever he organized an insulated-wire manufacturing business at Passaic, N. J., under the name Okonite Company, the designation being coined from the telegrapher's "O K" and the last syllable of "vulcanite." Under Captain Candee's direction the Okonite Company has developed an extensive line of insulated wire and cables and insulating materials and established standards of quality that are recognized the world around. Captain Candee for a number of years was associated with the National Guard of New York State as Captain of the Twenty-third Regiment. He was born in Yonkers, N. Y., March 28, 1851.



W. L. CANDEE

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

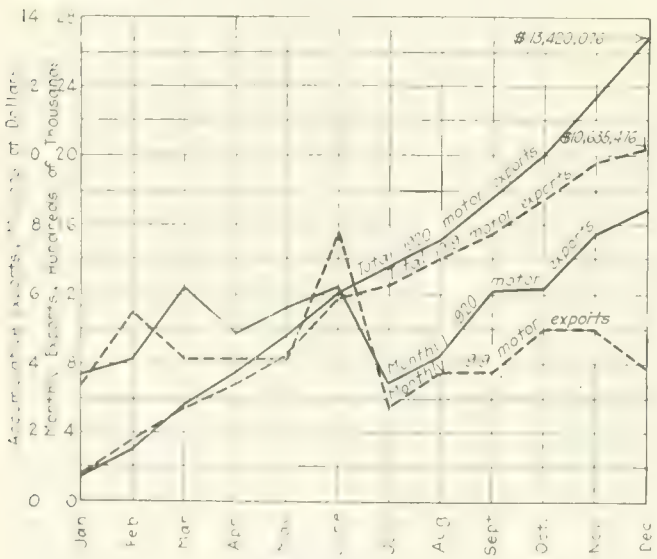
Small Agents' Lamp Business Holding Up Well

WITH the advent of summer and shorter nights it is not surprising to find a recession in lamp business. This has been accentuated by curtailed industrial activities and the discontinuance of night work and seems to be more pronounced in the case of industrial lamps than for other lamps. The business of the smaller agents, however, is holding up well, according to recent advices. Local stocks are good, although factory production is running anywhere from 60 to 90 per cent of capacity. With the increase in industrial activity, however, reported in many sections, this business too should soon show more life.

Sign-lighting business is holding up well, and because of the demand for higher and higher intensities for this application the representative lamp manufacturers have developed 25-watt and 50-watt blue "Mazda B" sign lamps with the coil filament. These are to take the place in sign lighting only of the "Mazda C-2" lamps which have been used to give the blue color but which are of too high temperature to work well in this service.

Motor Exports Greater in 1920 than in 1919

FROM an analysis of motor exports from the United States during the years 1919 and 1920, total exports in those two years amounted to $10,635,476 and $13,420,076 respectively. It is interesting to note that in this compilation, made by the ELECTRICAL WORLD from figures presented by the Bureau of Foreign and Domestic Commerce,



INCREASE OF 30 PER CENT SHOWN IN MOTOR EXPORTS OF 1920 OVER YEAR 1919

the twenty countries, each of which absorbed motors to the value of $100,000 or better in 1920, were the same countries which in 1919 ranked among the top twenty. In addition, Norway in 1919 ranked twentieth in motors but in 1920 dropped below the hundred-thousand line to $59,541.

During 1920 motors held chief place among United States exports, as they did in 1919 and 1918. The month of December supplied the highest figures, March, October, June and September being very close together.

Canada was the heaviest buyer both years, taking 18 per cent of the motor exports in 1920 and 15 per cent in 1919. Japan came second both years and England third. Canada,

1920 AND 1919 MOTOR EXPORTS FROM THE UNITED STATES

Country	Value of 1920 Exports	Value of 1919 Exports	Country	Value of 1920 Exports	Value of 1919 Exports
Canada	$2,404,280	$1,611,317	British South Africa	216,831	307,857
Japan	1,485,734	1,067,949	Peru	205,199	205,881
England	1,279,448	877,478	Chile	162,802	357,082
Cuba	972,087	505,022	Philippine Islands	157,510	267,408
Belgium	704,300	153,113	Dutch East Indies	139,291	181,676
France	700,519	591,227	66 miscellaneous countries importing under $100,000 each	1,043,782	875,139
Australia	660,269	760,150			
China	557,058	440,404			
British India	477,312	572,459			
Brazil	448,131	544,116			
Spain	425,842	343,854			
Italy	406,366	126,721			
Mexico	398,148	427,572			
Argentina	318,399	317,245	Total exports of motors	$13,420,076	$10,635,476
New Zealand	256,768	101,806			

Cuba and Mexico took $3,874,515 in motors in 1920; Brazil, Argentina, Peru and Chile took $1,134,531; England, Belgium, France, Spain and Italy took $3,516,475; Japan, China and British India took $2,520,104, and Australia and New Zealand took $917,037 in 1920.

In 1920 sixty-six miscellaneous countries importing less than $100,000 each took $1,043,782 worth of motors; in 1919, with Norway included at $108,206 worth, these miscellaneous countries took $875,139 worth of motors.

Lighting Fixture Standardization an Immediate Possibility

STANDARDIZATION of the mechanical details of lighting fixure parts bids fair to be an accomplished fact among the members of the National Council of Lighting Fixture Manufacturers if the proposition outlined by Mr. d'Olier at their recent Buffalo fixture market and convention is accepted by the members, according to recent advices from the National Council. The secretary goes on to say:

"The National Council has itself been investigating for some months past this question of standardization, but the system which is now under consideration will if adopted place at the Council's disposal a complete set of gages and templets covering every detail of glassware, heels, globe proportions, lamp positions, etc., which would eliminate the necessity of continuing the researches of the National Council itself in the matter.

"The urgency of adopting a standardization system for the mechanical details of lighting fixtures is recognized by every manufacturer, jobber and retailer in the business. It will eliminate the present necessity for rethreading and fitting when assembling fixtures in the manufacturer's plant. It will enable the parts manufacturer to simplify his dies and other tools and to give more prompt deliveries through the use of rapid production methods. It will enable the fixture dealer to order replacements of glassware and parts with the certainty instead of merely the hope that they will fit when installed.

"There are many proportions which must be included in any lighting-fixture-parts standardization system. The lamp position, for instance, is extremely important, yet it is by no means infrequently found that a lamp position, instead of being a constant dimension for each type of

shade or globe, is different for every make. Another important dimension is that of the 'heel' into the hollow of which the shade-ring screws are screwed. Yet another is the length of the shade-ring screws themselves. Each of these under the National Council's plan would have a definite proportion common to all makers within the organization. The efforts of the National Council of Lighting Fixture Manufacturers along standardization lines will be watched with interest throughout the electrical industry."

Trade Commission Files Complaint Against United States Steel

UPON application made by the Western Association of Rolled-Steel Consumers and other users of steel products, the Federal Trade Commission on April 26 issued a formal complaint against the United States Steel Corporation and eleven subsidiary companies. The case is an outgrowth of conditions complained of by more than 2,700 fabricators of steel in the Chicago, Duluth and Birmingham districts, by Legislatures of three states, by several municipalities and by chambers of commerce and many business organizations throughout the United States. There are implied unfair methods in competition in violation of sections of the commission's organic act and Section 2 of the Clayton act.

In brief, the applicants complain against the device known as the Pittsburgh plus price. Under this device all steel except rails wherever made, and whether made by the Corporation plants or by independents, is sold at the f.o.b. Pittsburgh price plus an amount equivalent to the freight to point of destination.

The complaint charges control by the Corporation and supervision and direction over the business conducted by its subsidiaries, control of a large percentage of raw materials and of the production of semi-finished and other steel products, issuance of price quotations and schedules covering steel except rails wherever made, and whether made by quotations are adopted by all of the respondent subsidiaries and their competitors, leading to the so-called "Pittsburgh base" price, "Pittsburgh plus" price, etc. The respondents are given thirty days to make formal answer.

What Supplies Should Jobbers Emphasize for Sales Efforts?

STARTING with the premise that the jobber does want to sell to the contractor, Charles L. Eidlitz, president of the R. B. Corey Company, New York, has worked out an analysis of the things a contractor buys and has placed a very definite weight on the value of the various electrical items entering into building construction.

At the same time it is Mr. Eidlitz's observation that many jobbers do not seem to want to sell to the contractor. This view is based upon the rather limited knowledge possessed by many jobbers' salesmen of the important items entering into building construction. The reflection is that the average salesman has only a smattering acquaintance with nearly every line carried and would be lost without his catalog.

As a remedy for this Mr. Eidlitz advocates the thorough instruction of jobbers' salesmen in the electrical lines that predominate in building construction. These lines he shows in a chart. Other jobbers' lines can be handled by specialty salesmen, he says, in order not to take up the time of the construction equipment salesmen.

All electrical material has been divided into nine classes by Mr. Eidlitz: (1) Mechanical; (2) energy transmitting; (3) contact making and breaking; (4) insulating; (5) resistance; (6) magnetic; (7) magnetically operated; (8) induction; (9) chemical. His analysis of several large building jobs shows the predominance of classes 1, 2 and 3, and on these the salesman's efforts should be directed.

Class 1 comprises conduit, outlet boxes, panel cabinets, bushings, lock nuts, couplings, fixture studs, hangers, bushettes, non-metallic flexible, metal molding, pull boxes, screws, nails, pipe straps and expansion bolts. Class 2 comprises wire, cord and flexible armored conductor. Class 3 takes in sockets, knife switches, push switches, attachment plugs, fixtures, cut-outs, panelboards, switchboards, oil switches, and bell push-buttons.

On one office building in New York City where $15,562 worth of electrical materials were used class 1 took $5,423, class 2 took $2,176, and class 3 took $7,122. These totaled 94.4 per cent of the total electrical material used on the job. Class 6 used $835 and class 9 $6. Cost of labor was 31 per cent.

On a bank building where the electrical material cost $12,792 class 1 took $6,209, class 2 $1,406 and class 3 $4,854, a total of 98 per cent of the total electrical material used. Class 4 used $15, class 6 $130 and class 9 $3. Labor charge was 40 per cent.

On analyzing a hospital job where it might be thought a large amount of low-voltage material would be used it was found that the electrical material cost $35,790. Of this class 1 took $13,005, class 2 $4,006 and class 3 $13,232. This totals 84.5 per cent. The low-voltage or magnetic equipment under class 6 took $4,498, or 12.5 per cent of the total electrical materials cost. Class 4 took $20, class 7 $850 and class 9 $132.

These figures open up an interesting subject and certainly can be said to cover the bread-and-butter materials of the electrical supply jobber. At the same time, it would be illuminating to analyze these costs for residence wiring, store wiring, loft and factory wiring, etc.

The Metal Market Situation

THE copper market is without essential change, but a more confident tone exists among producers. This is a result of the increase of deliveries into domestic consumption of 10,000,000 lb. during April to 70,000,000 lb. Consumers claim this is the result of delayed shipment on contracts, but producers' stocks at any rate are decreasing rather than increasing.

Some small lots of copper may still possibly be obtained at 12.62½ cents delivered for prompt shipment, but in general, producers are firmly holding electrolytic at 12.75 cents for May and June, with July quoted at 13 cents. In the outside market sales are light as the supply of copper held is small and prices asked are fully as high as producers'.

The strengthening of the lead market due to continued firmness abroad and curtailed production at home has resulted in another price increase, which makes a total advance of ½ cent over the previous low price. The New York "official" lead price of 4.50 cents per pound is still about ¼ cent below the outside market there. The zinc market is quiet with producers firmly maintaining their prices.

While dealers in the scrap market are waiting for general buying to open up the market shows very little life. Two little bright spots appear in a slightly higher quotation on better grades of scrap copper and on heavy lead. The lead, however, does reflect some life but the copper is quiet. There is not so much demand for lead for batteries for new automobiles as there was last year but for replacement batteries the call is good. There is little speculative scrap buying even under the low prices existing; the activity is for hand-to-mouth needs.

NEW YORK METAL MARKET PRICE

	April 26, 1921	May 3, 1921
Copper	£ s d	£ s d
London, standard spot	70 5 0	71 5 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	12 75—13 00
Electrolytic	12 75	12 75
Casting	11 62½	11 75
Wire base	14 50—15 00	14 50—15 00
Lead, trust price	4 35	4 50
Antimony	5 25	5 25
Nickel, Ingot	41 00	41 00
Sheet zinc, f. o. b. smelter	11 00	11 00
Zinc, spot	5 45	5 45
Tin	32 00	31 62½
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9 50—10 25	10 00—10 50
Brass, heavy	5 50— 5 75	5 50— 5 75
Brass, light	3 75— 4 00	3 75— 4 00
Lead, heavy	3 50— 3 75	3 75— 3 90
Zinc, old scrap	2 87½— 3 00	2 87½— 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

EVEN though reports from all over the country indicate the general quiet tone to business, an analysis of the industry will show a not unhealthy volume of business when taken in the light of pre-war buying. Of course it isn't up to the capacity of plants, but that capacity is based on war-time requirements.

One good reason for building slackness is the refusal of building labor to accept a wage reduction. Since May 1 strikes in this industry have been called in nearly all sections on this account. Strikes have also been called in printing and paper trades in several cities, as well as one of marine workers on merchant vessels. Chicago's interest now is in indictments in the building trades. Non-employment in New York State is high, but conditions are getting better in the Middle West, the Inter-Mountain regions and the Northwest. Collections are a little more satisfactory in New York and St. Louis, but are a little slower in New England.

There is a resumption in building in the Boston territory and an increase in wiring supply orders on jobbers. Ranges are selling well there. Wire sales on the West coast are better along with small utility motors. Car loadings of lumber are quite high in the Northwest. The industrial situation around Chicago is gradually improving. A wage reduction of 20 per cent, effective May 16, has been announced by the U. S. Steel Corporation.

NEW YORK

There is little consistency to business as reported by different jobbers. Some say there is no improvement in the situation, others report it as spotty, while some are finding the high spots a little closer together. Taken all in all and boiled down, the result would, of course, show a quiet market, but probably one that is tending to improve slightly. The consensus of opinion is that the bottom of things has been reached and the ascent begun.

Collections are evidence of this. Railroad accounts are very slow, but others are running about sixty days and show improvement of late. With the recent drop on conduit electrical prices represent marked declines, with the exception of schedule material. Jobbers are not buying a thing for stock, however, and are able to keep inventories very low because of quick prevailing shipments.

The building situation is quiet, but it shows some improvement. The tax exemption ordinance on dwellings is having its effect on the plans filed for apartments, which represent an increase of more than 600 per cent this year thus far over last. Non-employment is one of the pressing problems in this territory at present. It is estimated that there are nearly half a million unemployed in New York State, of which number half are concentrated in the largest city. The situation is augmented by the strike of 40,000 marine workers and 6,000 firemen against a 15 per cent cut in pay.

Rubber-Covered Wire—Good stocks are held and demand on the whole is not large, though a few jobbers report pretty fair sales. For No. 14 single-braid, in 10,000-ft. lots, from $7.25 to $8 per 1,000 ft. is asked.

Tape.—Very little is moving at prices that range all the way from 38½ to 45 cents per pound on friction and 36 to 50 cents on rubber tape, standard grades, in 100-lb. lots.

Conduit.—Prices are gradually trending lower in line with the recently reduced cost of pipe. This week, in 2,500-ft. lots, ½-in. black sells for $61 to $65.25; ½-in. galvanized, $66 to $74.75; ¾-in. black, $82.50 to $84.85; ¾-in. galvanized, $90.60 to $94.90, per 1,000 ft. There is some movement in the average stocks held, but it is not large.

Non-Metallic Flexible Conduit.—In 1,000-ft. lots the ⅜-in. size brings from $22.50 to $27.70 and the ½-in. size from $25 to $30 per 1,000 ft. Demand is slow.

Flexible Armored Conductor.—Prices are unchanged with 1,000 ft. of No. 14, two-wire, double-strip selling for $59 to $65, though more jobbers are coming to quote the middle price or around $62 to $63. Quite a little of this material is moving, but supplies are so easy to obtain that jobbers are not carrying very large stocks.

Metal Molding.—Jobbers are carrying only fair amounts in stock ranging from about 2,000 ft. to 5,000 ft.; demand is only fair. One thousand feet of "Wiremold," "National," etc., three-wire to four-wire size, sells for $62 to $70.

Sockets.—These are hardly moving at all, though there are plenty on the market and in some cases more than enough. Jobbers are quoting 20 per cent off list in standard package lots, but they rather freely express the opinion that maintenance of prices here is holding up improvement of the electrical market.

Safety Switches.—A couple of large houses at least report that demand has picked up within the last two or three weeks, but others state that there is no call. Very few are carried in stock. Prices are steady.

CHICAGO

The acuteness of the labor situation in the building trades has absorbed all interest in Chicago for the past week and has precluded the possibility of any active market. Some weeks ago the various employers' associations gave notice to the Building Trades Council that, effective May 1, the wage scale would be reduced from $1.25 per hour for skilled labor and $1 for unskilled, to $1 and 75 cents respectively.

All unions have refused to accept the cut and as a result all building in Chicago was scheduled to stop April 30. Some contractors, however, will go ahead under the old scale, thus permitting a large volume of apartment and home building to proceed. Among the jobs which will be tied up in Chicago are the Federal Reserve Bank and the Union Station. It is estimated that $35,000,000 worth of work actually under way will be halted.

Building permits, which have averaged around $2,000,000 per week so far this year have slumped on account of the wage controversy. This week's figure was swelled by a permit for a new bank building to cost $9,000,000, but outside of that ordinary permits aggregate only $500,000.

The industrial situation throughout the district, aside from the construction field, is showing gradual improvement. The automobile centers are gradually becoming more active, and the steel interests in the Calumet district are daily making small additions to their working forces. All retail lines report a slight improvement in trade as a result.

There have been no price changes reported in any electrical line and what little electrical business is being done is of a purely routine character.

BOSTON

Trade displayed little change in volume this past week. Good sales of labor-saving appliances resulted from the "Home Beautiful Show" at Boston, which closed April 30. Some jobbers report better wiring supply orders from contractor-dealers, following resumption of building operations in the city proper and suburban territory. Prices reflect some instability in sales, rubber-covered wire being weak and retail sales subject to reductions to move stock. A reduction averaging about 7½ per cent in the prices of single-phase and automatic starting polyphase Century motors was put into effect last week. Jobbers are buying very moderately from manufacturers. Collections are a little slower this week. The liquidation of labor con-

tinues and a threatened traction strike covering eastern Massachusetts outside of Boston appears to have been averted. Woolen, shoe and some of the metal industries are fairly well occupied. The demand for electric ranges is picking up rapidly, and in retail trade moderate buying is evident.

Ranges.—Increased activity is occurring, and five leading Boston jobbers have ordered a total of 640 ranges of a single make within the past month. Interest in fireless cookers is increasing. A representative range outfit is being sold to the retailer for $130. Vigorous merchandising is being rewarded.

Motors.—Interest in motors is at a low ebb for the time being and stocks are above current requirements. Spasmodic sales are occurring, but inquiries are in light volume. Century motors in some designs sustained a 7½ per cent reduction in price last week.

Rigid Conduit.—Little of this material is moving and deliveries are easy. A leading jobber quotes $67.30 per 1,000 ft. on ½-in. black in any quantity; ½-in. elbows are selling at $16.18 per 100. For ½-in couplings $5.96 per 100 is asked.

Meters.—Jobbers carrying meters are having no trouble in meeting deliveries as the demand is only moderate. Prices are steady.

Tape.—Small amounts are moving on the basis of about 50 cents per pound in 100-lb. lots, very light orders being booked as high as 60 cents. Good stocks rule.

Wire.—Quiet conditions still prevail, although some sales are being made to contractors and to central-station companies. No. 14 rubber-covered sells at $7.25 to $7.35 per 1,000 ft. in 5,000-ft. lots. Bare base is about 16 cents and weatherproof base 16.5 to 17 cents. Plenty of wire is in hand.

Portable Lamps.—Better sales are reported. Retailers are still heavily stocked in many cases, but the public is responding to vigorous sales efforts. Fixtures are moving a little faster.

Flexible Armored Conductor.—Moderate sales are being handled, and No. 14 double-strip sells at $60 to $65 per 1,000 ft., in 5,000-ft. lots. Goods stocks are in hand.

Schedule Material.—Sales are considerably below normal, but the improved outlook in the building industry warrants a better feeling in the Boston market.

Appliances.—Washers and cleaners are selling in fair quantities and much prospective business was uncovered at the recent Boston show. While the appliance business as a whole is spotty, the outlook is generally considered to be excellent.

ST. LOUIS

Jobbers this week report business to be considerably better than the average for the last few months. No large orders are reported, but the volume of small business has been extremely satisfactory considering general conditions. Inquiries show an increase in number and value, and the indications point to substantial improvement faster than many expected. Collections remain at an average of about sixty days, but because of improved business conditions in the territory it is felt that credit is more substantial than heretofore.

Some new building is under way, and a volume of large construction work is planned and ready for execution as soon as costs are more warrantable. In considering the volume of construction work there is a tendency to compare it with that existing in the boom period of 1919 and the first part of 1920. As a matter of fact, the estimated cost of work for which building permits have been issued in St. Louis for the first three months of this year exceeds that for the same period in 1919 by 60 per cent and is 40 per cent of that for the first three months of 1920, when building in St. Louis was on a scale far in excess of any previously experienced. The values for the first three months of each year are as follows: 1919, $1,263,954; 1920, $4,837,923; 1921, $2,022,275. These figures are for the city only and do not include any permits for buildings in the surrounding industrial or residential territory.

Non-employment is not as bad in St. Louis as in some other cities. The Federal Reserve Bank of St. Louis made a study of 102 concerns as of April 1, 1921, and found that there is a decrease of 22 per cent in the number employed and a decrease of 26 per cent in the total payroll wages. The comparatively healthy condition of St. Louis business is attributed to the fact that the largest single industry, that of shoe manufacturing, employs but 8 per cent of the total employees in all industries, there consequently being a wide diversity of employment.

Wire.—The demand for No. 14 rubber-covered continues good, but the demand for the larger sizes and for weatherproof and bare wire is still slow, though with indication of betterment. One large jobber has reduced the price on rubber-covered from an 18-cent to a 16-cent base, thus meeting the market price established by other jobbers. In 25,000-ft. lots No. 14 can now be purchased from $7 to $7.30 per 1,000 ft. Stocks are in fairly healthy condition.

Tape.—Both friction and rubber tape are meeting with a reasonable demand. Stocks are in good shape locally, and prompt shipment from manufacturers can be had. In 100-lb. lots friction tape sells at 36 cents per pound, and rubber tape at 38 cents.

Loom.—Practically no sales of loom are reported for the week, and stocks of some jobbers are quite heavy. A representative quotation for 5,000-ft. lots is $21 per 1,000 ft. for $\frac{7}{32}$-in. and $22 for ¾-in. In 1,000-ft. lots the quotations are $2 higher.

Lamp Cord.—Most jobbers report the demand for lamp cord exceptionally quiet, and stocks are larger than they should be. No. 18 twisted cotton pair is quoted at $16 per 1,000 ft. in 5,000-ft. lots.

Conduit.—Little change in the demand or supply of conduit is reported. One-inch black is quoted at $130 per 1,000 ft. by a representative jobber and ½-in. black at $66.10, both in carload lots. Other quotations on ½-in. black vary from $61 to $70.

ATLANTA

Little or no specific change is to be noted in business activities since last week despite the fact that the general impression of business men is that conditions are slowly but surely righting themselves. Several of the large electrical jobbers are in receipt of an unusual number of requests from contractors and dealers asking for cancellation of orders they had placed for household devices. Washing machines seem to be leading in the number of cancellation requests. This apparently unfavorable sign is somewhat offset, however, by the receipt of an increasing number of requests from larger and more progressive contractors for bids on material required for electrical installations in industrial plants. Jobbers report that the volume of business anticipated for the month of April did not materialize, one of the largest jobbers reporting a decrease of 25 per cent in April sales from the March volume. Construction has been stimulated by the lower price of building material and the action of the bricklayers and masons in the reduction of wages, while the recent action of the carpenters' union in reducing their wage scale 10 cents an hour will lend further stimulus to the movement. Building permits for the month of April in Atlanta number 320, valued at $77,358, and New Orleans also reports a healthy increase in the amount of construction under way and proposed. It might be of interest to note that the *Manufacturers' Record* states construction under way and proposed in the South for the week ended April 22 amounted to approximately $40,000,000.

Fans.—Both desk and ceiling fans are going out in good volume to the retail trade, though retailers' stocks have not as yet begun to move briskly except in the extreme Southern section. Jobbers report the 12-in. oscillating fan the most popular size. Sufficient stocks are on hand for the anticipated demand.

Commercial Lighting Fixtures.—This line seems to maintain its activity of the past few weeks, semi-indirect units of the better class leading the movement. Manufacturers have guaranteed no price reduction for three months. Local stocks are in good condition.

Non-Metallic Flexible Conduit.—This is very sluggish with stocks reported at above the average, though one or two jobbers have succeeded in reducing their supplies to normal. A price of $20 per 1,000 ft. is offered on ⅜-in.

Lamp Cord.—A price reduction of 10 per cent was recently announced, present quotations being on the basis of $18 per 1,000 ft. Stocks are plentiful and the movement is rather slow.

Flexible Armored Conductor.—Movement continues with fair satisfaction owing to the tendency to substitute for conduit wherever possible. Stocks are in excellent shape, some jobbers still having supplies above their requirements.

Portable Drills.—While the sale of this specialty to garages is almost at a standstill, a fair quantity of drills of the more popular size is being ordered by industrial plants. No changes in price have been reported recently. Stocks are reported in fair condition on the popular sizes.

Flashlights.—Practically no demand for flashlight cases is unearthed, but jobbers report batteries and lamps continuing to move very satisfactorily. Stocks of all three items are plentiful.

SEATTLE—PORTLAND

In Seattle, Portland and the Northwest generally several of the more important jobbers now state that they do not look for a return of normal business before the latter part of the summer, if then. The present market for electrical material is quiet, and from indications it will remain so for some time to come. Retailers are very cautious in their buying, partly because of money tightness but also on account of poor demand. However, manufacturers report that while business is not materially changed there is a feeling of greater confidence being expressed. This does not mean that there is anything affecting general business, but it augurs well for the future. Jobbers report a slight upward tendency in business, although as yet it is not a great factor. Stocks are being kept in good shape, the only shortage, if it could be so construed, being in porcelain and larger size motors. Lack of demand for these two, however, makes the supply more or less immaterial. There is no change in the collection situation, and generally speaking there is no credit requested or extended.

While there are reports each week of sawmills starting, there are still a large number idle. However, carloadings of forest products on the lines of the various Northwest railroads reached last month an average nearly as large as a year ago, owing solely to the increasing improvement in the lumber business. Figures supplied by railway companies on shipments to the East indicate that the swing upward has begun, and lumber seems to be moving more freely than shingles. New building construction, particularly in Portland, Tacoma and Spokane, including commercial and residence structures, is gradually increasing. The building program in Seattle, with the exception of residence work, is still lagging and from present indications will not be in full swing until late in the summer, if then. The employment situation in Seattle and the Northwest generally is showing improvement, and it is believed the worst of the situation will be over within a month. Reopening of camps and mills and farm demands are absorbing encouraging numbers of men. Wages are tending downward in all lines.

Panels and Switchboards.—Trade, which has been very quiet during the past few months, is slowly showing signs of improvement. Stock in plenty is on hand. Prices are tending downward, although no recent drops have been noted.

Farm-Lighting Outfits.—The activity in this equipment is reported considerably lighter than originally expected; in fact, there is little or no movement and none now is expected until early fall. Reports from eastern Washington and Oregon indicate that farmers are far from optimistic over their prospects for 1921 and are confining expenditures almost entirely to necessities.

Heating Appliances.—Dealers throughout this section as a whole report absolute quiet. Stocks are in good shape.

SAN FRANCISCO

An arbitration board of three men, selected last year by committees from the unions and the employers' associations, recently advised that average reductions of 7½ per cent be made in the wages of the building trades unions. These bodies now propose a strike in answer to the reductions. The recent allotment of several large Shipping Board steamers to San Francisco and the re-establishment of several other steamers on their old runs stimulated shipping industry in the bay region.

Two very successful merchandising conferences were held by the General Electric and Westinghouse companies during April in cities of the Pacific Northwest and north California, and these conferences are now extending into Los Angeles territory. These have been productive of great interest and it is felt they will greatly help merchandising.

Conduit.—There has been a 3 per cent reduction in rigid-iron conduit, the new prices being $8.10 per 100 ft. in 10,000-lb. quantities of ½-in. sherardized and galvanized pipe. Local stocks are good and demand is fair.

Boxes and Covers.—Another roughing-in. line to drop recently is the box and cover line, a 20 per cent decrease being just reported on the rigid iron boxes and a 10 per cent decrease on boxes for flexible non-metallic conduit. Sales are rather scattering.

Rubber-Covered Wire.—Rubber-covered wire prices are now running about $7.75 per 1,000 ft. in 5,000-ft. quantities for the No. 14 single-braid, solid, rubber-covered. Sales of wire run larger proportionately than the sales of other staples because many contractors believe that the lowest mark is just about reached, whereas it is felt that the steel market will show further marked reductions.

Motors.—An increasing demand for small utility motors is reported by dealers in the interior towns and cities. These motors are about ¼ hp. in size and are so arranged that they can be used for a variety of purposes about the farm. The list averages $50 each.

Vibrators.—A marked decrease in the call for vibrators and violet-ray machines is commented upon by local merchants. A serious cause of complaint has been the servicing of these machines, which are subject, of course, to considerable abuse.

SALT LAKE CITY—DENVER

Jobbers' trade in general is about 70 per cent off the trade of a year ago, but with prices much reduced this percentage represents a larger volume of merchandise moving to the retail dealer. The electrical industry is holding up to a good average. Building activity is slowly resuming with residences of average cost predominating. The employment situation is easing to some extent. Collections are continuing slow.

Lamp Cord.—Stocks are in good shape with an extremely unstable price condition. The demand is fair and constant.

Rigid Conduit.—With small activity in building sales, a 5 per cent reduction has been made within the last few days; ½-in. and ¾-in. sizes prevail in the regular demand.

Non-Metallic Flexible Conduit.—Stocks are plentiful. One reduction only has been made in the past few months; ⅜-in. size brings $26 per 1,000 ft. and deliveries are good.

Pole-Line Material.—Movement is in small quantities only and most of the demand is for materials in repair work. Few construction jobs of any consequence are now under way. When construction will resume is uncertain, but it is well known that there is big need of extensions.

Safety Switches.—These are little used in this region, since there is no law requiring them. The tendency to their use, however, is growing. Panel boards are in fair demand.

Insulating Materials.—There is small demand, with stocks more than ample to meet all requirements. Prices are characterized by stability.

Fans.—As yet dealers are showing little interest and indications are that they will not stock extensively until the actual consumer demand is in evidence. A good fan season is looked forward to by both dealers and jobbers. Stocks are varied and plentiful.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Associated Manufacturers to Meet at New London in June

All sections of the Associated Manufacturers of Electrical Supplies will hold their regular summer meetings and the board of governors will hold its June meeting at the Griswold, Eastern Point, New London, Conn. Reservations have been made for the period June 25 over July 4, but the dates for the meetings are June 27, 28, 29 and 30.

Changes in Schimmel Electric's Lighting Department

As part of the plans for the expansion of the Schimmel Electric Supply Company in connection with its removal from 318 Market Street to new and enlarged quarters at 526 Arch Street, Philadelphia, after alterations have been completed, is the appointment of Randolph E. Tyler to be in charge of the company's lighting department. Benjamin Hayllar, Jr., will devote his time exclusively to the lighting needs of industrial plants in and about Philadelphia.

Peerless Equipment Purchases Repair Tool Companies

The entire business of the Electrical Manufacturers' Equipment Company, Chicago, has been sold to the Peerless Equipment Company, Hanover, Pa. This includes the manufacturing and selling of those products known under the trade name of "Segur" coil-winding tools and allied equipment. The Peerless company has announced that it will combine the manufacture of this new line with that of "Peerless" armature repair tools, which business also it has recently purchased from the Manley Manufacturing Company, York, Pa. The Electric Service Supplies Company, New York, will continue to act as exclusive selling agents for the Peerless Equipment Company.

Cadillac Washing Machine Purchases Odin Company

The Cadillac Washing Machine Company, 325 West Ohio Street, Chicago, has purchased the physical assets of the Odin Company, Chicago, and is continuing the manufacture of its machine under the name "Cadillac." The Odin Company has entirely discontinued the manufacture of washing machines. While no radical changes have been made in the construction of the machine, a few minor improvements have been made and new methods of production installed in the factory. The present output of machines is very limited, says President Payne, but increased production has been planned and is being carried out as rapidly as possible.

Arrangements are also being made to acquire another factory where two new types of machines will be manufactured and as soon as the production of the present type and the two new types has been increased the company expects to inaugurate an intensive selling and advertising campaign on all three models. H. D. Payne is president and general manager of the new company, S. T. Sjoberg is vice-president and consulting engineer and C. L. Hibbard is secretary and treasurer.

Western Union Organizes Own Purchasing Department

As of May 1, the Western Union Telegraph Company, 195 Broadway, New York City, has organized its own purchasing department. This procedure had been followed by the company up to 1912, when it entered into a contract with the Western Electric Company whereby the Western Electric acted as purchasing agent for the Western Union. This contract has not been renewed for this year. Charles S. Voorhees is the new general purchasing agent, but the department is under the supervision of one of the vice-presidents of the Western Union.

The Western Union had four points of contact with the Western Electric in reference to supply bases. These were in New York City, Chicago, Atlanta and San Francisco. Under the new organization, which also includes a supply department in charge of W. G. Higgins as superintendent of supplies, these same four general centers of the country have been retained as supply and warehouse bases for the large amounts of line and station material required by the company. Besides the warehouse in Atlanta, new depots have been secured in San Francisco and in the Bush Terminal in Brooklyn, N. Y., and the former Western Union base in Chicago will again be utilized.

Universal Crane's New Factory in Operation

The new steel-frame and brick factory, 180 ft. x 110 ft., of the Universal Crane Company at Elyria, Ohio, has been completed and equipped. This plant has been put in operation and greatly increases the productive capacity of the company.

Rickard & Company Follows from Reorganization

The technical advertising agency of Rickard & Sloane has been reorganized as of May 1 under the name Rickard & Company, 25 Spruce Street, New York City. Mr. Sloane has not been with the company for six years, and with the growth of the business it has been decided to change the name and effect a new organization. W. L. Rickard is president, O. S. Tyson, formerly Eastern sales manager ELECTRICAL WORLD, is vice-president, Julian Gran, treasurer, L. F. Maher, secretary. Directors are Messrs. Rickard, Tyson and Gran and J. R. White, H. F. King and H. L. Fisher.

Increase Reported in Flexible Cord and Wire Business

With the Diamond Branch of the Rome Wire Company, on Clyde Avenue, Buffalo, N. Y., equipped for a capacity of about a million feet of finished product a day, reports show that business is getting better each month, although output is still well below plant capacity. There is a feeling of satisfaction at the plant over the volume of business now coming through under existing circumstances. Flexible wires and cables are manufactured there with a view to specialization, and it was to that end that the machinery and equipment were designed when the 75,000-sq.ft. addition was begun last April. The company already had 60,000 sq.ft. of manufacturing space when it located in Buffalo early in 1920. Wire drawing, annealing and tinning also are carried on at the plant.

Ideal Electric's New Factory for Synchronous Motors

The Ideal Electric & Manufacturing Company, has recently erected a new factory at Mansfield, Ohio, in order to accommodate the increased production required to manufacture its new line of synchronous motors. These fill out its regular line of direct-current and alternating-current power apparatus.

Allis-Chalmers 1920 Billings Total $31,516,209

In the eighth annual report of the Allis-Chalmers Manufacturing Company for the fiscal year ended Dec. 31, 1920, on sales billed of $31,516,209 there was a manufacturing profit of $4,177,128. After adequate provision for federal taxes and general contingencies, the net profit for the year 1920 was $3,564,248, compared with $3,599,713 for the preceding year. Inventories of work in process, manufactured stock, raw materials and supplies amounted to $19,659,225 on Dec. 31. At this time the value of unfilled orders, including all customers' contracts unbilled and in various stages of completion, was $17,046,724. Total bookings for 1920 were $32,696,566.

Capital expenditures for buildings, machinery and equipment amounted to

$1,852,917, principally in connection with the building and equipping of a new iron foundry at the West Allis works and additions to buildings and equipment at the Bullock works. Net working capital increased $1,820,977. On preferred and common stock of $42,500 000, current and working assets are $30,487,240 and current liabilities are $6,603,379, leaving net quick assets of $23,883,860. Accounts receivable total $7,094,989.

Motor Repair Company Establishes Brush Department

The Electric Motor Repair Company, 627 Myrick Building, Springfield, Mass., has established a separate brush department in its organization and will henceforth market its carbon brushes under the trade name "Mohawk carbon brushes." The company, in addition to its electrical maintenance work, began to make carbon brushes about two years ago in a small way, and the increasing demand has necessitated providing for production departmentally. In announcing this extension of its organization the company states that it is usually prepared to make immediate deliveries on brushes for both generator and motor service. J. B. Tufts is treasurer of the company.

Eveready Gains 37 per Cent in First Three Months

More than 200 firm members and buyers of electrical hardware, automobile accessory jobbers and drug jobbers of Greater New York were the guests of the American Ever Ready Works at the Long Island City factory on April 22.

The event was a "business revival" luncheon to celebrate the fact that so far as the Eveready flashlight and battery lines are concerned improved business conditions have already taken place.

Executives of the American Ever Ready Works quoted figures for January and March and stated that a 37 per cent increase in distributers' purchases over the company's estimated sales was shown this year, thus indicating conclusively that the retail trade and the buying public demand more flashlights and batteries than ever before.

F. A. Wilson-Lawrenson, vice-president, emphasized the company's standard policy of distributing its flashlight product exclusively to jobbers and announced the continuance of that policy so long as distributers cooperated in holding and increasing the business and giving acceptable service to the retail trade. R. A. Wentworth, in charge of factory production, announced important improvements in the Eveready flashlight line, stating that the company had spent the past two years in special experimental work in the study of light, with the result that flashlights can now be produced that will concentrate or diffuse light, exactly as desired. Mr. Wentworth showed samples of two new types of Eveready flashlights to be known as Eveready "Spotlights," which will be placed on the market immediately, and explained their new constructional features, such as new parabolic reflectors, a special concentrated filament "Mazda" lamp, a shock absorber, a focusing device and an end-cap container holding two reserve lamps. He also showed samples of new Eveready "Spreadlights," a new lantern type, and the new Eveready unit cell flashlight batteries.

Marquis Regan, merchandising counsel for the company, told of the growth of flashlight business until he thought it the second largest specialty product in the electrical field and stated that one person in every ten throughout the United States is a flashlight user. "During the first fifteen years of its history Eveready placed on the market 379 types of flashlights," said Mr. Regan. "During recent years the company made seventy-seven different types. By the end of 1921 the line will have been reduced to twenty-six types only."

McKenney & Waterbury Add to Their Representation

The McKenney & Waterbury Company, Inc., which has been developing its general jobbing business since its reincorporation, has been appointed representative of the entire line of Hotpoint heating appliances. Recent additions to the company's list of manufactured products include "Red Seal" dry cells and Hamilton-Beach motors.

Gainaday Electric Succeeds Good Housekeeping Appliance

The Gainaday Electric Company of New Jersey has recently been incorporated in New Jersey with a capital stock of $200,000 and succeeds the Good Housekeeping Appliance Corporation of Newark, having secured a controlling interest in that company. The new company is not a manufacturing company but confines its activities to the sale of Gainaday electric washing machines, ironing machines, vacuum cleaners and other household appliances.

Headquarters will be at 587 Broad Street, Newark, and branches operating through the main office at Newark have already been established at Brooklyn, N. Y., and Summit, Plainfield, Red Bank and Ridgewood, N. J. W. L. Rodgers, president of the Pittsburgh Gage and Supply Company, is president; Joseph Ewing is vice-president and general manager; E. J. Checkley, vice-president of the Pittsburgh company, is treasurer and L. J. McCarthy is secretary.

Electric Steel Plant Bought by Link-Belt

The Link-Belt Company, Philadelphia, has purchased the plant of the Dodge Steel Company at Tacony, Pa., for the manufacture of electric steel castings. The plant was constructed only last year and comprises about five acres of property. Present operating capacity is about 150 tons per month, but the Link-Belt Company plans to use only one-third of this capacity for its own uses and the remainder to supply the needs of local manufacturing establishments.

The steel company will be operated as a separate corporation under the name Dodge Steel Company, the officers being Charles Piez, president, and Staunton B. Peck, vice-president of the Link-Belt Company, president and vice-president respectively, and Chester S. Roberts, secretary, treasurer and manager.

The General Electric Company has moved its Denver (Col.) offices to the newly built United States National Bank Building. Greatly improved facilities have been obtained in the new location, which is in the center of the Denver financial district. H. D. Randall is district manager.

The Engineering Business Exchange, 30 Church Street, New York City, has established a Southeastern branch in the McLachlen Building, Washington, D. C. This office will be in charge of Marshall O. Leighton, consulting engineer, as director and will cover the territory from Maryland to Alabama inclusive.

The Electrical Engineering Company, Pittsburgh, has acquired property at 208-12 Cremoe Street, Northside, with factory, where it proposes to establish new works.

The Chicago Fuse Manufacturing Company has removed its New York office from the downtown section to the Tilden Building, 105 West Fortieth Street.

French & Hubbard, consulting engineers, Boston, have moved their offices from 88 Pearl Street to 210 South Street.

The National Council of Lighting Fixture Manufacturers has moved from 8410 Lake Avenue to 231-233 Gordon Square Building, Detroit Avenue at West Sixty-Fifth Street, Cleveland.

Pass & Seymour have removed their New York offices from 6 Church Street to 71-73 Murray Street.

The Superheater Company has removed its New York offices from 30 Church Street to 17 East Forty-second Street.

The Electric Service Engineering Company has moved its New York offices from 1416 Broadway to 105 West Forty-seventh Street.

The Mechanical Appliance Company, Milwaukee, manufacturer of Watson motors, announces the removal of its Buffalo district sales office from 318 Prudential Building to 311 White Building. W. C. Winterroth is in charge of this office.

The William C. Krauth Electric Company, Louisville, Ky., has filed notice of increase in capital stock from $20,000 to $50,000.

The Onondaga Auto Electric Service Company, Syracuse, N. Y., has filed notice of increase in capital stock from $75,000 to $112,500.

The Williamsburg Flint Glass Company has moved its New York office and sample room from 123 Chambers Street to 290 Broadway.

The Bristol Company, Waterbury, Conn., manufacturer of electric measuring instruments, has filed notice of increase in capital stock to $2,500,000.

The Finch Radio Electric Corporation, Buffalo, N. Y., has filed notice of increase in capital stock from $10,000 to $500,000, the proceeds to be used for improvements and expansions.

W. E. Quimby, 209 Parkhurst Street, Newark, N. J., manufacturer of electric pumping apparatus, has filed plans for the erection of a two-story addition, 40 ft. x 96 ft., to cost about $25,000.

The Ross Heater & Manufacturing Company, Inc., Buffalo, N. Y., manufacturer of boiler feed water heaters, surface condensers, evaporators, etc., announces the opening of a branch office in the New York district at 2 Rector Street. T. M. Hardin, formerly with the home office, will be in charge.

The Evansville Electrical Manufacturing Company, Evansville, Ind., which started operation last August, has been incorporated with a capital stock of $25,000. The company manufactures bronze bearings, trolley wheels, mine supplies, etc. John Polling is president.

The Big Sandy Electrical & Repair Company, Pikeville, Ky., recently organized, is planning to erect a machine shop and electrical repair works, 40 ft. x 70 ft. E. S. Shurtleff is president.

The American Electrical Supply Company, 953 Washington Boulevard, Chicago, it is reported, will soon ask for bids for the construction of a three-story building, 110 ft. x 120 ft., at 117-21 South Morgan Street, to cost about $100,000.

The Bovaird & Seyfang Manufacturing Company, Bradford, Pa., manufacturer of steam engines, boilers, etc., is reported to have taken bids for the construction of two one-story additions, 150 ft. x 187 ft. and 87 x 110 ft., to cost with equipment about $100,000.

Foreign Trade Notes

McDOUGALL, PEASE & FRIEDMAN, Montreal, consulting engineers, announce that they have moved their offices from 511 St. Catherine Street, West, to 85 Osborne Street.

THE DIAMOND STATE FIBRE COMPANY OF CANADA, LTD., Toronto, has established a branch office at 84 St. François Xavier Street, Montreal, in charge of J. Alexander Regan.

SHORTAGE OF TELEPHONE MATERIAL IN CEYLON. — According to the *Electrician* there is a very serious shortage of telephone material in Ceylon, and in Colombo alone there are several hundreds of applications for telephones awaiting attention, while the outstations are even worse in this respect. Of the material ordered in 1913 only a portion, including a switchboard capable of accommodating some 300 subscribers, was safely landed, the remainder being lost through the torpedoing of the steamer.

TARIFF REMITTED ON ELECTRICAL MACHINERY IN AUSTRALIA.—The Tasmanian government, according to the *Electrician*, has succeeded in getting the Commonwealth government to remit the customs duties on machinery imported for the extension to the state hydro-electric project. It has been decided to permit the importation of all machinery which could not be reasonably manufactured in Australia. This decision will apply to the plant which the Tasmanian government is now importing to extend its system.

D. J. BEATTY, formerly advertising manager for the Northern Electric Company, Montreal, has severed his connection with that concern to go into partnership with G. L. MacGillivray in the G. L. MacGillivray Company, Ltd., Montreal, which was recently organized to take charge of the sales of the following firms in eastern Canada: Edwards & Company, Inc., American Insulator Corporation, Waterbury Manufacturing Company, Chase Metal Works, Parker Supply Company, Inc., and the Prometheus Electric Company, as well as the R. M. Radio Company of London, England.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A manufacturer in Switzerland (No. 34,763) desires to purchase or secure an agency for the exploitation in Switzerland or the European continent of an article of the electrotechnical branch.

An import company in the Bahamas (No. 34,765) desires to purchase electrical equipment for the use of general contractors and builders.

New Apparatus and Publications

SYNCHRONOUS MOTORS. — The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has issued a bulletin on its new synchronous motors.

COPPER.—"Copper from Mine to Finished Product" is a publication of the Anaconda Copper Mining Company, 25 Broadway, New York City.

TRANSFORMERS. — Bulletin 2005 describes "Pittsburgh Power Transformers" of the Pittsburgh Transformer Company, Pittsburgh.

FLEXIBLE CORDS AND CABLES.—The Simplex Wire & Cable Company, 201 Devonshire Street, Boston, has developed solid-rubber-covered reinforced two-conductor and three-conductor portable cords and cable for heavy duty.

ENGINEERING.—Warren D. Spengler, engineer, Hanna Building, Cleveland, is publishing a series of "Engineering Service Talks."

JUNCTION BOX BREAKER.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently placed on the market type "JB" air-break switch, 250 volts, single-pole.

PORTABLE SIGN UNIT.—The Economical Electric Lamp Division, National Lamp Works of General Electric Company, 25 West Broadway, New York, has placed on the market a portable sign unit. The company is also merchandising a house-number-lighting and bell-ringing unit.

INCLOSED AND RENEWABLE FUSES. —The Chase-Shawmut Company, Newburyport, Mass., is distributing bulletin No. 201, covering its inclosed and renewable fuses and other products.

ELECTRIC WASHING MACHINES. — The Automatic Electric Washer Company, Newton, Iowa, has recently placed on the market a new model 214 copper-tub electric washer.

CRANES. — The Universal Crane Company, Cleveland, is distributing bulletin No. 11, describing the Universal cranes.

EVAPORATORS. — The Griscom-Russell Company, 90 West Street, New York City, is distributing bulletin No. 330, describing the Reilly self-scaling evaporator.

TURBO-GENERATOR SETS. — "Turbo-Generator Sets" is the title of bulletin No. 28 recently issued by the Ridgway Dynamo & Engine Company, Ridgway, Pa., in which it describes the latest improvements, including its pneumatic governor

LIGHTING FIXTURES. — The Lightolier Company, 569 Broadway, New York City, is distributing catalog No. 23, entitled "Immediate Delivery," covering many different types of "Lightoliers."

MOTORS.—The Advance Electric Company, St. Louis, has recently issued pocket catalog No. 19, describing the "Advance" motors for alternating current for either single or polyphase circuits in sizes from ⅛ hp. to 10 hp.

MOTOR.—A new single-phase motor of the repulsion-induction type has recently been put in production by the Robbins & Myers Company, Springfield, Ohio. This type "R" motor is furnished in ½-hp. size only, but sizes ranging from ¼-hp. to 1-hp. will soon be in regular production.

CONDENSER.—The Coto-Coil Company, 87 Willard Avenue, Providence, R. I., is distributing bulletin No. 1, describing its variable air condenser for radio.

ELECTRIC HOISTS.—The Sprague Electric Works of the General Electric Company, 527 West Thirty-Fourth Street, New York City, have issued bulletin No. 48,967.

INSULATORS.—The Hopewell Insulation & Manufacturing Company, Hopewell, Va., has recently published catalog No. 1, covering its various types of insulators.

ILLUMINATION.—"Illumination Design Data" is the title of bulletin No. 41 recently issued by the National Lamp Works of General Electric Company, Nela Park, Cleveland.

FOUNDRY SAND CUTTER.—The Whiting Corporation, Harvey, Ill., is distributing a four-page folder describing its motor-driven sand-cutting and screening machine for use in foundries.

New Companies

THE OCEANIC ELECTRICAL SUPPLY COMPANY, New York, N. Y., has been incorporated by J. V. Schraig, L. M. Fox and J. J. Gill, 1941 Benson Avenue, Brooklyn. The company is capitalized at $20,000 and proposes to manufacture electrical equipment and supplies.

THE UNITED ELECTRIC SERVICE COMPANY, Springfield, Mass., has been incorporated by Edward A. Higney, Palmer; John G. Waddell and Charles J. Weston, Springfield. The company is capitalized at $100,000 and proposes to manufacture electrical appliances and equipment.

THE CRAWFORD MANUFACTURING COMPANY, Concord, N. H., has been incorporated with a capital stock of $115 000 to manufacture electric motors. The incorporators are John J. Crawford, Philip Gill and Clarence R. Blanchard.

THE CYNTHIANA LIGHT & POWER COMPANY, Cynthiana, Ind., has been organized with a capital stock of $20,000. The directors are W. O. Boren, G. E. Meadows, V. D. Smith, J. E. Stevens, J. E. Gudgel, I. L. Turman and P. M. Kifer.

THE KEPS ELECTRICAL SUPPLY COMPANY, Pittsburgh, Pa., has been incorporated by Edward J. Kelsky, Monroe W. Petre, John Ehler and Jacob L. Simon, 1409 Park Building, to manufacture electrical fixtures and supplies.

THE AUTOMATIC ELECTRICAL MACHINE COMPANY, Wilmington, Del., has been incorporated by C. B. Outten, C. T. Cohee and S. L. Mackey. The company is capitalized at $500,000 and proposes to manufacture electrical machinery.

THE AUTOMATIC LIGHT & POWER COMPANY, Norfolk, Va., has been incorporated with a capital stock of $24,000. V. L. Cullen is president and R. P. W. Baylor is secretary.

THE AMERICAN FIBER CONDUIT CORPORATION, Fulton, N. Y., has been incorporated by G. Grossman, G. M. Fanning and R. F. Freeman. The company is capitalized at $350,000 and proposes to manufacture electrical conduits.

THE BERTRAND F. MILLER COMPANY, INC., Trenton, N. J., has been incorporated by N. F. House, Clifford M. and Bertrand F. Miller. The company is capitalized at $25,000 and proposes to manufacture electrical supplies.

THE AUTOMATIC ELECTRIC SHOE POLISHING MACHINE COMPANY, Bryan, Tex., has been incorporated by J. L. Edge, C. A. Harris and J. T. Maloney. The company is capitalized at $75,000 and proposes to manufacture special electrically operated machinery.

Record of Electrical Patents

Notes on United States Patents

(Issued April 12, 1921)

1,374,559. Induction-Motor Control; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Oct. 9, 1915. Starting and running control.

1,374,561. Trolley Hanger. Harry L. Garbutt, Wilkinsburg, Pa. App. filed Jan. 16, 1917. Will not release conductor though insulating units are broken.

1,374,562. Control Apparatus; Arthur J. Hall, Wilkinsburg, Pa. App. filed Dec. 2, 1916. Cooling tower for liquid rheostat.

1,374,564. Recuperative System for Alternating-Current Commutator Motors; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 9, 1916. For alternating-current motors of inducing-field commutator type.

1,374,565. Alternating-Current Commutator Motor; Rudolf E. Hellmund, Swissvale, Pa. App. filed Jan. 5, 1917. Single-phase motors having commutated rotor winding.

1,374,591. Electric Heater; Edwin N. Lightfoot, New York, N. Y. App. filed Jan. 9, 1920. Radiant.

1,374,606. Printing Telegraphy; Harry Pfannenstiehl, East Orange, N. J. App. filed June 8, 1917. Receiving apparatus.

1,374,630. Selecting Mechanism; Erwin P. Bancroft, Brooklyn, N. Y. App. filed July 10, 1917. Printing telegraph.

1,374,639. Electric Heater; Henry Dicks, New York, N. Y. App. filed Nov. 3, 1919. Radiant.

1,374,640. Welding; Ethan I. Dodds, Pittsburgh, Pa. App. filed July 21, 1920. Welding of closures to boiler sheets.

1,374,647. Arc Incandescent Electric Lamp; Edward A. Gimingham, London, Eng. App. filed Oct. 15, 1915. Has appearance of ordinary incandescent lamp.

1,374,658. Electric Fan; George H. Hohnsbeen, Minneapolis, Minn. App. filed Feb. 24, 1919. Fan and heater.

1,374,679. Degasifying Process; John B. Pratt, Schenectady, N. Y. App. filed March 15, 1920. Removal of gas from electrodes.

1,374,688. Transmitter; Frank E. Summers, Memphis, Mo. App. filed May 12, 1919. Variable contact.

1,374,689. Air-Conditioning Process and Apparatus; Anthony P. Torrey, North Glenside, Pa. App. filed April 27, 1920. For sterilizing dehydrating dryers.

1,374,690. Battery-Charging System; Oliver C. Traver, Schenectady, N. Y. App. filed May 12, 1920. For disconnecting generator when voltage drops below voltage of battery.

1,374,693. Electric Heater Having Heating Fabrics; Francois E. B. Vernet, Paris, France. App. filed May 11, 1920. Weft of resistance wire and warp of asbestos thread.

1,374,711. Arc-Welding Composition; James C. Armor, Pittsfield, Mass. App. filed Aug. 30, 1919. Flux.

1,374,727. Protective Device; Henry G. French, Schenectady, N. Y. App. filed Oct. 25, 1919. Induction type.

1,374,733. Electrical Transmitting Apparatus; Henry K. Harris, Westminister, London, England. App. filed Oct. 17, 1917. Advertising device.

1,374,766. Electric Incandescent Lamp; Haruhiko Ozaki, Yokohama, Japan. App. filed Oct. 19, 1918. Filament support.

1,374,802. Electric Furnace; Edwin Appleby, Chicago, Ill. App. filed Nov. 19, 1919. For manufacture of calcium carbide.

1,374,826. Protective Device; Elmer E. F. Creighton, Schenectady, N. Y. App. filed March 9, 1917. For lines of communication paralleling transmission lines.

1,374,832. Vacuum-Tube Base; Harold P. Donle, Meriden, Conn. App. filed Sept. 27, 1919.

1,374,856. Regulator for Dynamo-Electric Machines; Bennett M. Leece and Harry C. Branch, Cleveland, Ohio. App. filed Aug. 15, 1917. For automobile.

(Issued April 19, 1921)

15,089 (reissue). Radio Telephony; Carl R. Englund, East Orange, N. J. App. filed March 5, 1918. Modulated portion of high frequency wave radiated.

1,374,916. Electrolyte for Storage Batteries; William Gardiner, Chicago, Ill. App. filed June 9, 1919. Solid or semi-solid.

1,374,918. Current-Density Indicator; Edwin Heil, Wichita, Kan. App. filed March 10, 1919. For plating or electrolysis.

1,374,929. Synchronizer; Henry I. Larson, Milwaukee, Wis. App. filed Nov. 3, 1919. Master clock.

1,374,935. Automatic Temperature Regulator for Electrically Heated Devices; Donald H. McGogy, Portland, Ore. App. filed May 3, 1919. Controlled by thermostat.

1,374,948. Electrical Indicating Device; Rudolph S. O'Neil, London, England. App. filed March 1, 1920. For ships.

1,374,976. Electrolytic Cell; Herbert L. Allen and Kent R. Fox, Portland, Me. App. filed June 1, 1920. For increasing active area of cathodes and anodes.

1,374,998. Insulator; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Feb. 14, 1918. For high-voltage lines.

1,375,007. Insulated Squirrel-Gage Winding; Austin Kimble, Wausau, Wis. App. filed May 12, 1919. Electroplated on core.

1,375,012. Electric Battery; David Pepper, Philadelphia, Pa. App. filed Nov. 29, 1919. For flashlights.

1,375,018. Motor; Camillo Savino, New York, N. Y. App. filed Aug. 30, 1920. Reciprocating electric motor.

1,375,034. Trolley Retriever; Antoinette A. Cohen, Birmingham, Mich. App. filed Aug. 11, 1919.

1,375,050. Apparatus for the Treatment of Rheumatism, Gout, Sciatica, Neuralgia and Similar Ailments; Joseph Krauer, Heaton Chapel, England. App. filed May 1, 1916.

1,375,059. Signal System; Alfred E. Meyer, Cincinnati, Ohio. App. filed Feb. 11, 1918. Alarm or watchmen's time recorder.

1,375,072. Method of and Means for Assembling Core Laminations; Charles Atkins, Cincinnati, Ohio. App. filed Jan. 19, 1916. Improved clamp.

1,375,084. Electric Heating Element and Method of Making the Same; John W. Cox, Erie, Pa. App. filed Feb. 3, 1919. To heat a hollow tube.

1,375,124. Brush Holder; Walter J. Warder, Jr., Chicago, Ill. App. filed Jan. 17, 1918. Self-righting brush and holder.

1,375,133. Armature Insulation; Jasper F. Cullin, Detroit, Mich. App. filed Sept. 16, 1920. Means for insulating windings of armatures from each other and from cores.

1,375,145. Electric Burner; Coral V. Funderburg, Yellow Springs, Ohio. App. filed May 19, 1919. For stoves.

1,375,152. Trolley-Wire Hanger; Edward Heydon, Indianapolis, Ind. App. filed Nov. 24, 1919.

1,375,161. Motor and Dynamo Construction; Clyde W. Landers, New York, N. Y. App. filed April 16, 1920. No commutator.

1,375,192. Dynamo; Ernest A. Watson, Coventry, England. App. filed March 31, 1920. For automobile.

1,375,194. Electric Heater; Alfred G. Werner, Omaha, Neb. App. filed Dec. 30, 1919. Supported in socket.

1,375,202. Dry Cell; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed Aug. 11, 1919. Process of applying coatings to inside of zinc can.

1,375,209. Telephone Mouthpiece; John Chefer, Chester, Pa. App. filed Aug. 31, 1920.

1,375,230. Telephone Exchange System; John N. Reynolds, Greenwich, Conn. App. filed March 29, 1917. Automatic switching.

1,375,253. Spark-Plug Intensifier; Alfred A. Jackson, Denver, Col. App. filed Sept. 18, 1919. Auxiliary gap.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LINCOLN, ME. — Electrically operated machinery will be installed in the proposed worsted mill of the Lincoln Worsted Company, to be built at a cost of $100,000. A machine shop will also be erected. The company was recently organized with a capital stock of $600,000. L. J. Coburn is manager. F. A. Petterson, 16 Central Street, Bangor, is architect.

FALL RIVER, MASS.—The Fall River Electric Light Company has been granted permission to construct underground conduits on various streets of the city.

WINCHESTER, MASS.—Plans are being prepared for the construction of a one-story power house at the local plant of Beggs & Cobb.

Middle Atlantic States

ITHACA, N. Y.—Considerable electrical and mechanical equipment will be required for the four-story and basement chemical building to be erected by Cornell University on East Avenue, to cost $2,000,000. Henry R. Kent, 141 Broadway, New York City, is engineer.

LONG BEACH, N. Y.—The Long Beach Power Company, Park Street, has awarded a contract for the construction of a one-story power plant, to cost about $125,000 with equipment, to Johnson & Molitor.

NEW YORK, N. Y. — The New York Edison Company, Irving Place and Fifteenth Street, is having plans prepared for the construction of a substation at Fortieth Street and First Avenue, to cost about $200,000. W. Whitehill, 12 Elm Street, is architect and engineer.

NEW YORK, N. Y.—Electric traveling cranes, hoisting and conveying machinery will be installed in the new piers now under construction by the city at a point between Tompkinsville and Clifton, S. I. A total of twelve new piers will be constructed at a cost of about $20,000,000. They will vary in width from 125 ft. to 290 ft. and in length from 1,030 ft. to 1,200 ft. It is proposed to have the structures equipped and ready for service early in fall.

PERRY, N. Y.—The Perry Light Company has been granted permission by the Public Service Commission to erect an electric power plant. Distribution lines will also be built for service to various sections of Genesee Falls Township.

ST. GEORGE, S. I., N. Y.—The Department of plants and structures, Municipal Building, New York, is having preliminary plans prepared for the construction of the proposed municipal electric power plant at the Ferry Terminal, St. George, to cost about $1,258,000. City Commissioner Grover A. Whalen is in charge.

NEWARK, N. J. — Negotiations are under way between the Broad Street Improvement Association and the City Commission for extensions to the street-lighting system on Broad Street reaching to the Lackawanna Railroad station on the north and Lincoln Park on the south.

GETTYSBURG, PA.—The Adams Light & Power Company is being organized for the purpose of erecting an electric power plant with transmission and distribution lines to furnish service in the northern section of Adams County. The districts to be served by the company include Bendersville and York Springs Borough, Menallen, Tyrone, Hamilton, Huntington, Butler, Latimore and Reading Townships.

HARRISBURG, PA.—Considerable electrical and mechanical equipment and refrigerating apparatus will be required in connection with the proposed cold-storage plant to be built by the American Cold Storage Company on South Second Street.

PITTSBURGH, PA. — Arrangements are being made by the Philadelphia Company for an issue of $10,000,000 in bonds for its subsidiary, the Duquesne Light Company, the proceeds to be used for extensions, improvements, etc.

WATSONTOWN, PA.—Preliminary estimates are being made and surveys are under way with a view of constructing an electric light and power station to serve the manufacturing industries in Watsontown. The present plans include furnishing electricity to the borough.

CUMBERLAND, MD.—Plans are under way for the construction of a group of buildings, including an electric generating plant, for the Paragon Motor Car Company, Connellsville, Pa., at Cumberland. The cost, including macninery, is estimated at $1,000,000.

PIEDMONT, MD.—The Piedmont Electric Light & Power Company has entered into agreement with the Edison Electric Illuminating Company, Cumberland, for a supply of electricity to serve Westernport, Luke and Piedmont.

MORGANTOWN, W. VA. — The North American Coal Company, Maidsville, near Morgantown, contemplates the reconstruction of its power house and motor building recently destroyed by fire.

WASHINGTON, D. C.—Bids will be received by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing the following: Until May 20, Brooklyn, Schedule 7,977—10,000 lb. electric welding wire; Schedule 7,996—f.o.b. 25 motor-generators. Until May 31, Portsmouth, Schedule 7,964—miscellaneous quantity of motor, generator and control equipments.

North Central States

UNION CITY, MICH.—Bids, it is understood, are being received by the Council of Union City for the construction of a hydro-electric plant to cost about $150,000. Holland, Akerman & Holland, 166 East Liberty Avenue, Ann Arbor, are architects.

CLEVELAND, OHIO.—An ordinance has been submitted to the City Council authorizing an expenditure not to exceed $18,000 for electric lamps for the division of light and power.

MIDDLETOWN, OHIO.—Plans have been approved by the Chamber of Commerce for the installation of an ornamental lighting system on several streets in the business section of Middletown.

CAMBRIDGE CITY, IND.—The Wayne Utility Service Company has been organized with a capital stock of $25,000 for the purpose of supplying electrical service in Cambridge City and surrounding towns. C. M. Haworth, Clementine Overman and Wilfred Jessup are interested in the company.

GEM, IND.—Bids, it is reported, will soon be received by the secretary of the Gem Electrical Service Company for furnishing all materials and for the construction of a single-phase transmission line and distribution system to supply electricity in Gem. Gem has no post office.

DAHLGREN, ILL.—Fuller & Beard, engineers, Chemical Building, St. Louis, Mo., have prepared plans for extensions to the municipal electric light and power plant.

ROCKFORD, ILL.—The West End Improvement Association is considering the extension of electric light service in that district.

HURLEY, WIS.—The City Council is considering the installation of an ornamental lighting system in Hurley.

GRISWOLD, IOWA. — The question of submitting to the voters a proposal to issue $50,000 in bonds for a municipal power plant is under consideration.

IOWA FALLS, IOWA. — Petitions are being circulated asking the City Council to call a special election to submit to the voters a proposal to issue $150,000 for the construction of an electric light plant. The Community Club is interested.

NEW HAVEN, MO. — Bids will be received May 20 for improvements to the municipal electric light and water system, including the construction of a power house and the installation of a 30-hp. semi-Diesel fuel oil engine; 25-kva., three-phase, alternating-current generator with exciter and switchboard panel; 75 gal.-per-minute motor-driven turbine pump for 260-ft. total head, or alternate bids on double-acting type of pumping unit for 50 gal. per minute; moving and re-erecting old machinery and oil storage tank. Fuller & Beard, Chemical Building, St. Louis, are engineers.

ST. LOUIS, MO.—The Board of Estimate and Apportionment is considering calling an election to vote on the proposal to issue $10,000,000 in bonds for street and sewer improvements and for the completion of the electric street-lighting system.

LAWRENCE, KAN.—The State Board of Administration is having plans prepared for the construction of a two-story power house, 120 ft. x 180 ft., to cost about $100,000. R. S. Gamble, 1415 Fillmore Street, Topeka, is architect.

MINNEAPOLIS, KAN. — Bonds to the amount of $60,000 have been voted for the construction of a municipal electric light plant. A. D. Tood is clerk.

Southern States

GIBSLAND, LA.—The installation of an electric light plant in Gibsland is contemplated. H. Houck is interested.

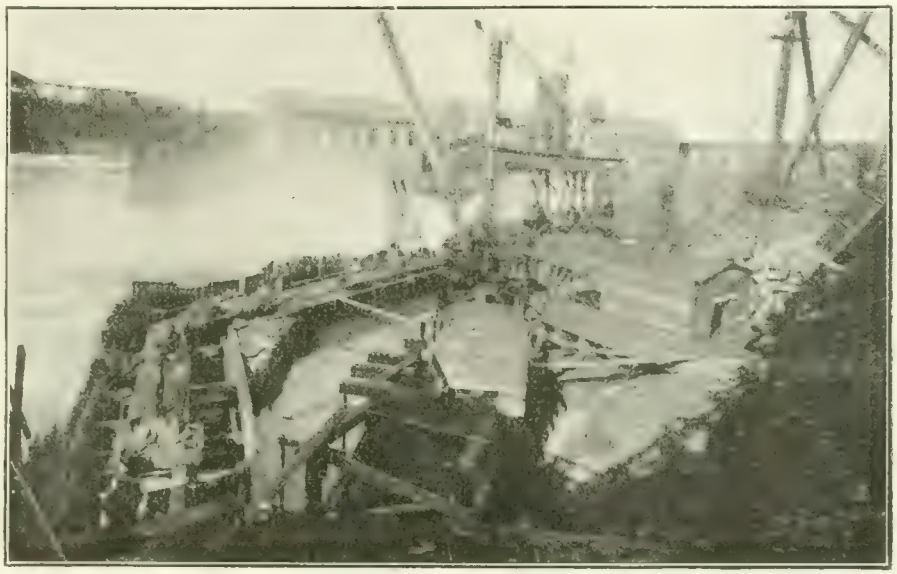
FULLERTON, CAL.—The Board of City Trustees is arranging for the installation of a new ornamental lighting system on Spadra Street and other thoroughfares in the business district.

LOS ANGELES.—The Little Rock Power & Water Company has applied to the State Water Commission for permission to utilize waters from the Little Rock Creek, Los Angeles County, to be used in connection with a hydro-electric plant to be erected at a cost of about $680,000.

PASADENA, CAL.—Bonds to the amount of $50,000 have been voted for extensions to the municipal electric plant on Glenarm Street. The plans provide for erection of a building and the purchase of a boiler.

SAN BERNARDINO, CAL. — The City Engineering Department is considering the erection of a municipal hydro-electric plant. Application has been made for water rights to permit a plant of about 5,000-hp. capacity.

WOODLAND, CAL.—The City Trustees have awarded a contract to the Municipal Improvement Company of Oakland for the installation of an electrolier system in the



WASHINGTON WATER POWER SPOKANE RIVER PROJECT

In the foreground is shown the cofferdam being built on the south bank of the middle channel of the Spokane River. A 14,500-hp. wheel will be installed.

LITTLE ROCK, ARK. — The Arkansas Light & Power Company is considering extensions to its power station. The plans provide for the installation of machinery to double the present output of the power house.

Pacific and Mountain States

ILWACO, WASH.—A company is being organized with a capital stock of $70,000 for the purpose of extending an electric lighting system from Knappton to north beach towns. J. W. Howarton of Ilwaco is interested.

WALLA WALLA, WASH. — Application has been made by K. G. Harlan for permission to appropriate 150 sec.-ft. of water from Walla Walla River for the development of 3,500 hp. for commercial purposes, at a cost of about $300,000.

WENATCHEE, WASH. — The construction of a new power transmission line from the Great Northern Railway Company's electric plant, 10 miles above Leavenworth, in Tumwater Canyon, has been started. Negotiations, it is reported, are under way by which the Puget Sound Power & Light Company is to take over the power interests of the Great Northern Railway Company and also serve the entire community with electricity for commercial purposes.

BANKS, ORE.—Steps have been taken by the Banks Commercial Club to secure electrical service for the town of Banks.

SALEM, ORE.—L. H. McMahan has applied for permission to appropriate 300 sec.-ft. of water from Mill Creek to develop 1,500 hp. for commercial purposes. The cost is estimated at $50,000.

city and lighting Main Street from West to East Streets with "Marbelite" lamp standards. The cost is estimated at $21,000.

WHITE SULPHUR SPRINGS, MONT.—Richard T. Ringling has applied to the Federal Power Commission for authority to construct a 50-ft. dam and a 1-mile pipe line to power house to develop 400 hp. in Meagher County.

POWELL, WYO.—At an election to be held May 10 the proposal to issue $17,000 in electric light bonds will be submitted to the voters.

Canada

MONCTON, N. B.—According to the decision reached by the New Brunswick Electric Power Commission, Moncton will be supplied with electricity generated at Musquash and Lepreaux Falls, by means of a 66,000 volt transmission line to be erected. Contract for the construction of the power house at Musquash, it is reported, will be awarded in a few days. C. O. Foss is engineer of the commission. P. H. & C. H. Mitchell, Toronto, are consulting engineers.

LONDON, ONT. — The Public Utilities Commission contemplates extensions to the ornamental street-lighting system in London. The commission has also authorized E. V. Buchanan, general manager, to proceed with the purchase and installation of underground cables on Dundas and Richmond Streets, for which conduits have been already laid.

TORONTO, ONT. — The Hydro-Electric Commission, University Avenue, contemplates the construction of a radial substation on York Street, to cost about $200,000.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill. Annual convention, Buffalo, N. Y., May 9-11.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, Salt Lake City, Utah, June 20-25.

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Chicago Conventions of 1885 and 1921

THIS year the convention of the National Electric Light Association in Chicago will afford an opportunity for many of its still living charter members to recall the historic circumstances of the first meeting in that city, thirty-six years ago, on Feb. 25, 1885. The comprehensive program of 1921 which was published in the ELECTRICAL WORLD of last week embraces the varied phases of an industry that touches the business and social affairs of 110,000,000 people. It reflects the vision of the small group of N. E. L. A. founders whose conception of electric service has been worked out in such a conspicuous way in the system of the Commonwealth Edison Company as to make Chicago an interesting observation point to all central-station men. Although less comprehensive in its scope, the N. E. L. A. program of 1885 in Chicago dealt with the needs of the central-station industry to meet demands then in sight which are today only multiplied by its present magnitude and complicated service requirements. Little did Chairman George S. Bowen at the first convention realize that he was uttering a classic remark when he asked this question in his opening address: "Can any man who has money to buy an electric light plant put it into operation, run it successfully and declare a dividend?" The discussions on this and allied subjects this year, amid historic surroundings, should attract an attendance of the younger executives who have been struggling with the problems of the local communities which will exceed all records of the eight previous Chicago meetings.

New York's Commission and Politics

NEW YORK'S Governor in the few months he has been in Albany has achieved much. He has insisted on economy in state expenditures and by consolidations and pruning has applied the acid test to political incompetency and waste. In these respects he has shown himself an excellent executive and an unusual governor. Naturally, in haste to fulfill preelection promises, performance, however good, often falls short of intention. On the whole, the Public Service Commission law as revised is good, but the appointees so far must be accepted on faith. Evidently experience in public utility affairs did not count in their preferment. But a body composed of five Republicans appointed for a term of ten years at a salary of $15,000 a year and removable only by impeachment or legislation seems to us to offer an excellent opportunity for Democrats when they come into power to legislate the commission out of office and appoint five of their political faith. Thus the commission is thrust wholly into politics and all that that means. The only fortunate part of the affair is that the personnel which actually deals with public utilities is virtually unchanged.

Electric Trucks on the Streets of Chicago

THERE is yet a tendency among engineers to regard the electric street truck in the light of its early operating days. Caroming around the highways and by-ways with bolts and nuts dropping by the wayside, batteries giving out at inopportune times, and various other failures often associated with pioneer development, the first "electric" may not have left a very wholesome operating record. However, to compare the old electric street truck with present-day equipment is to compare the old "one-lunger" gas car with present twin sixes.

Times have changed, and it would be well for electrical men themselves to realize the promising untouched field that lies before the modern electric vehicle. That this recognition is coming is shown by an article in this issue which deals with the growth of the electric truck business in Chicago. There the central-station company has seen the possibilities of this class of equipment, which fills a very definite place in the industrial and commercial development of a city and is helping to develop the business. Actual figures have shown that the electric vehicle is a real competitor of the gas car in short-haul, frequent-stop service. For this service it is conservatively estimated that 35,000 vehicles could be absorbed in Chicago alone. The 4,000 which are already operating produce a revenue of $400,000 annually for the Commonwealth Edison Company. The load occurs at an off-peak time and can be served at an attractive rate which at the same time brings a good return. What has been done in Chicago is also being done in New York, Boston, Philadelphia and other centers where central stations are wide awake to the opportunities of new business.

Need of a Fixed Price for Wiring

ANYTHING that affects the prosperity and happiness of the local electrical family is very much the concern of the central-station company. Therefore the suggestion which "Kassandra" makes on another page of this issue is worthy of careful thought. The contractor, he says, should have a fixed price for all the ordinary run of small wiring jobs. He should save the time he now spends in estimating work on which the profit is too small to pay for the estimator's time. He should quit haggling over price and cutting profits

under pressure of the buyer's argument. There is much truth in this. All enlightened business men today have adopted the policy of fixed price; yet too many contractors still allow the customer to question the price on a wiring job. Here is a place where leadership by the utility manager may render a real service to the local electrical men. The contractors need a little guidance and help to enable them to make the practice of fixed prices a recognized standard among builders and home owners.

Water-Power Regulation in Japan

APROPOS of the application of the federal water-power act it is not without benefit to become acquainted with the manner in which similar situations are handled elsewhere. In the current issue Charles B. Hawley gives a most instructive report of the regulations enforced by the Japanese government. In Japan all water powers are regarded as in the public domain, so that regulations affecting them apply to every hydro-electric enterprise. Local self-government is carried somewhat further than has been found advisable in the United States by the requirement that negotiations must be made with the local authorities on all agreements outside those affecting property acquired by eminent domain. The information required in the applications for concessions is rather notable, for not only is pretty complete evidence as to the financial backing of the scheme required, but also the completion of all the preliminary surveys up to the point where an exact financial estimate of the situation can be made. When the concession is granted work must be begun within one month and completed, unless the time be extended for good cause, within two years.

These provisions insure not only the complete working out of the project beforehand but the actual accomplishment of the financing of the scheme. In other words, the imperial government will not grant concessions to promoters who hope at some time in the future to interest somebody who knows somebody else who has real money.

The Persistent Power-Factor Problem

SINCE motors have become a bigger and bigger factor in central-station load, power factor has become a more and more serious puzzle. It has often been considered in our columns and from many points of view, but the paper by C. J. Russell in this issue throws some new light on the practical side of the situation. In particular he gives the results of definite measurements in large industrial establishments which show the source of trouble with exceptional distinctness. While over-motoring is always with us, it is on the whole a considerably less serious matter than intermittent use, which results in a very low average power factor even when the characteristics of the motors are altogether satisfactory. Again, it turns out that in some plants low power factor is greatly influenced by bad starting conditions, generally due to squirrel-cage motors improperly used with insufficient starting equipment or none at all.

The electric service company thus has to face the certainty of furnishing a considerable amount of idle current, sometimes at bad points in the load curve, using up station and line capacity without proper recompense. The big problem is how best to effect a proper charge for this thankless service. In this country there has been no general agreement as to method, although commonly the motor charge is based on an assumed average power factor, nearly always higher than the motors give in practice. Now and then reactive current is segregated by a second meter and charged for directly or indirectly. In general all rates are based on the direct inclusion of factors convenient or easily measured, while the other factors, for varied reasons, are taken by general average. Given enough statistics of the customers' loads and measures, one could make a plausible schedule of rates nominally based on the area of their windows or their last year's income taxes. But in the case at hand it is certainly highly desirable to find the most convenient and direct way of recouping the central-station company for its increased service.

There are clearly too many possibilities in the causes and character of low power factors to include them all in a comprehensive and comprehensible formula, and the solution, as usual, resolves itself into the judicious choice of the straightforward facts upon which to base a power schedule. And this virtually turns upon methods of metering. With both kilovolt-amperes and kilowatts measured, it should be comparatively easy for the central-station company to fix upon a fair average price for reactive kva. and apply it as an additive charge. Given a good kva.-hour meter—practically an ampere-hour meter—an equally fair average could be reached. If anything, the latter method would be the simpler, and either would give the customer the benefit of any improvement in his practice. The French plan described by Mr. Russell is ingenious, but might fall foul of the same legal difficulty here that put the very reasonable two-rate meter out of service. In simplicity the kva. measurement for motors and the kw. measurement for lights would make a good combination, but the real problem is how to settle upon a concerted plan of action equally fair to all concerned—a problem all the more serious when interconnection is taken into account. For this involves the same question between companies that now stands between the central station and its customers—a very grave matter indeed in considering a superpower trunk line. Concrete data on the real cost to the station of providing and delivering reactive power should be gathered and formulated as soon as possible.

Responsibility of Utility in Improving Home Lighting

ALTHOUGH the line of least resistance in extending the use of electric service in the home lies in promoting electric lighting, extending the use of adequate and appropriate lighting equipment still remains the most neglected phase of the business-building activities of most central-station companies. It seems to be considered that electricity is sure to be used for home lighting, and that fixtures therefore become a necessity and that their selection and installation may be left to the judgment of the customer. Whether this attitude on the part of central-station companies springs from carelessness or from ignorance of its effect on the degree of satisfaction that the completed installation will give, it is a deplorable one. The average home owner when selecting lighting units simply follows

custom and buys fixtures similar to those in his neighbors' homes or such as appeal to him as "stylish." The resulting lighting conditions are the greatest impediment to the progress of the industry.

Fixtures are found in common use of the "candle" variety, designed after the models of centuries ago, which were evolved as types affording the best support to the candles. The proper place for these types is a museum, where as examples of the constructive thinking of former days they might inspire present-day designers to appreciate the importance of independent thought in preparing fittings as well adapted to the modern illuminant, electricity, as those of old were to the light sources of their day. It must be recognized, too, that the incandescent lamps of today require a different treatment from the carbon lamps of yesterday. Wrongly installed, the large modern units are injuring the eyes, nerves and dispositions of many who misuse them, and they do not even serve the commercial purposes of augmenting the revenue of electric light and power companies, because, annoyed, perhaps unconsciously, by their brightness and alarmed by their energy-consuming characteristic, householders do not turn on the light till absolutely forced to do so and turn it off again at the earliest moment. Moreover, with the development of the tungsten lamp half or more of the lighting sockets in most pendent fixtures have become superfluous.

It is the responsibility of the central-station company to promote the use of the proper designs of fixtures, the proper sizes of lamps and the proper distribution of light, in accordance with the modern science of illumination. The properly educated customer will probably consume more electricity and buy more lamps in lighting his house than he did before, but he will get real value for his money in the increased ease of seeing, reading and working. Under such circumstances, the electric light bill in the household expense budget, which is comparable in amount with the cost per month of cream used in coffee, will be transferred to the pleasure column, and there will be a direct reward to the companies in return for a better service rendered which if not actually shown in increased income will certainly help toward bringing about right relations with the customer.

Rural Business Must Stand on Its Own Feet

UNPROFITABLE extensions are sometimes hard to guard against, particularly in new fields where the future growth of the territory is hard to foresee. This difficulty has been a big one in the rural service situation. It was faced earlier in the irrigation problem of the Rocky Mountain and Pacific Coast regions. The safeguards that have been built up as the result of experience are recounted elsewhere in this issue in an article analyzing the principal features of some of the Western irrigation schedules. In taking up such problems the assumption is ordinarily made that the business must first be taken on with some loss that will be later covered by the growth of the demand. This assumption has generally proved correct in urban territory, but has not worked out in rural sections, because the possibility of very rapid growth does not exist.

In rural territory the number of consumers per mile that can be obtained is decidedly limited. If this were not so the territory would cease to be rural. With the limitation of the number of consumers the fact of a high investment per consumer must be recognized. The only directions in which growth can be expected are the extension of lines and the increasing of individual consumption. Extension of lines does not materially lower the average investment cost per consumer, and the education of the consumers to the larger individual use of energy is a slow process, particularly as it must proceed hand in hand with the development of farm machinery that will utilize electric power to the fullest extent. Too great dependence on future growth to make rural extensions profitable is therefore a serious error. The fact seems to be that the fundamental development places the business in a class by itself, and unless the principle of making other classes of business bear the development cost is admitted as correct, rural business must be made to stand on its own feet from the start. The irrigation experience of the West seems to justify proceedings in this way, and irrigation practices will bear careful study in the solving of the farm problem.

Valuable Contribution on Multiple Telephony and Telegraphy

A PAPER that makes a notable contribution to the subject of multiple telegraphy and telephony, by E. H. Colpitts and O. B. Blackwell, is concluded in the May *Journal* of the American Institute of Electrical Engineers. It is shown that line conductors may be worked at higher traffic densities by the use of carrier currents of suitable frequencies. The method thus far has proved particularly economical for long toll lines where it is important to make maximum use of the large investment in line equipment.

Four essential principles are involved in the system discussed: First, impressing one or more modulable frequencies on the line; second, the modulation of such a frequency over a certain frequency range in accordance with signals to be transmitted; third, the preservation of the modulated frequency range in the prescribed channel, by the use of suitable filters therein, and, fourth, the demodulation of this prescribed channel frequency range in the receiving apparatus. The filtering employs the principle of resonance. The modulation and the demodulation employ dissymmetrical action, or non-linear characteristics. All four of these elements, except the filtering, depend upon the use of vacuum tubes and are illustrations of vacuum-tube engineering.

Since the objects of the system are to make one pair of wires capable of serving for a considerable number of telephonic and telegraphic circuits, a number of different sets of apparatus must be concentrated upon each pair of lines, and the sets must be maintained in independent good order. There would be fewer lines and linemen, but more instruments, mechanics and electricians. Hence more technical skill is demanded in the stations. Incidentally, each pair of lines in such a system would have to be carefully insulated, balanced and transposed, so that a greater amount of attention would have to be paid to the installation and upkeep of the conductors.

The paper contains a wealth of new technical material and shows evidence of a vast amount of research, design and construction.



Franklin Thomas Griffith

A public utility executive who for a number of years has fought for water-power legislation that will permit the economical development of Western resources

WHILE the engineer of the West, noted for his creative imagination has distinguished himself by epoch-making achievements in design and construction, it has often remained for the analytical mind of the lawyer, executive and economist to carry the engineer's work to fruition. This Franklin T. Griffith has done. First as attorney he made great strides in codifying laws governing the development of water powers, and later as president of the Portland (Ore.) Railway, Light & Power Company he has been applying his sympathetic understanding of human nature to smooth the way for the utility in best serving the public. When the national water-power laws were being formulated, the experience and advice of Mr. Griffith were widely sought, and he gave largely of his energy in constructive thought on this legislation. Then and since, as chairman of the water-power development committee of the National Electric Light Association, he has untiringly worked to bring about far-sighted interpretations of these laws with workable rules and regulations so that the most beneficial results shall be gained.

Mr. Griffith was born in Minneapolis, Minn., in 1870, but before long moved to California, where he attended the public schools. As a boy he began to work in the paper-manufacturing industry and soon became familiar with every phase of that business. At the same time he took up the study of law and by close application in his extra hours he became qualified for admission to the bar in 1894, at which time he opened a law office in Oregon City. During the next five years he was city attorney and legal adviser for paper-mill interests and the Portland General Electric Company, a predecessor of the Portland Railway, Light & Power Company. For these companies he handled all matters pertaining to water-power leases and rights. It was during this period that a water code was being advocated for the State of Oregon, and his years of intimate knowledge of this subject caused him to play a leading part in the enactment of the code, which was adopted in 1909.

In 1909 he opened law offices in Portland, continuing to act as attorney for the Portland Railway, Light & Power Company. This closer touch with the affairs of that company led to his election as its president in June, 1913. Since becoming president there has been a period of lean years for public utilities. Nevertheless Mr. Griffith has held to his firm belief that better times are in store, and he has done much in promoting a more favorable public sentiment toward utilities and in bringing about a recognition by the public of the need for granting utilities rates sufficient to meet increased operating expenses.

In 1920 he was elected vice-president of the National Electric Light Association. He was later elected president of the Northwest Electric Light & Power Association, which is now active in a cooperative movement to secure a wider appreciation of the fundamental position of the hydro-electric industry in the West.

How Should Power Factor Be Handled?

Rates Should Take Into Consideration Added Service Rendered When Reactive Power Is Supplied—Over-Motoring Not the Sole Cause of Low Power Factor—Foreign Countries Have Good Method of Approach

By CHARLES J. RUSSELL*
General Commercial Manager Philadelphia Electric Company

TWO FORMS of service are being supplied by the central station to the user of alternating-current load, one of which consists in the supply of active power and the other in the supply of magnetizing current, this latter form of service often being supplied without reference to its amount or to the expense involved. Some attempts have been made to designate the amount of gratuitous service which will be supplied along with the paid-for service, but in this country there has been no standard set.

Both capital and expense are involved in the production and delivery of reactive power to any customer. The amount of capital depends upon the capacity required, and the expense depends upon the distance and conditions of transportation as well as the number of kilovolt-ampere-hours required. These two variables affect the cost of service, and as they may be of material importance as between customers they should have careful consideration.

The central-station company may continue to supply magnetizing current in the future or it may decide to limit such supply. On the other hand, it may decide to compel the customer to supply all or a part of the magnetizing current necessary for his operation. Such decisions are of great economic importance on account of their relation to the cost of service. It is the further belief of the author that uniform treatment of this economic factor is of the utmost importance to the central-station industry.

EXISTING PRACTICE IN THIS COUNTRY

In this country the diversity of opinion upon the subject of power factor has found expression in a great variety of regulations and rates covering alternating-current power installations.

One point of uniformity and importance may be noted in all these regulations—namely, the designation of some standard lower than unity power factor to which the installation must conform, either as an average condition or at the time of periodic tests. This standard varies among companies from 70 per cent to 95 per cent and with some companies covers the same range according to the size of the installation or demand. In virtually all cases the rate structure is such that service is supplied below the standard under a penalty. In only a few cases is a bonus provided in the rate for a power factor better than the standard, and it may be said consequently that in general practice the standard represents the point at which the price of energy is a minimum.

Some of the newer as well as a few of the older rates recognize the additional expense involved in supplying more than a certain percentage of reactive power by increasing the kilowatt-hours charged for when the power factor is below the standard. No case in this country has come to the attention of the author where a direct charge for reactive power is included in a rate for power service.

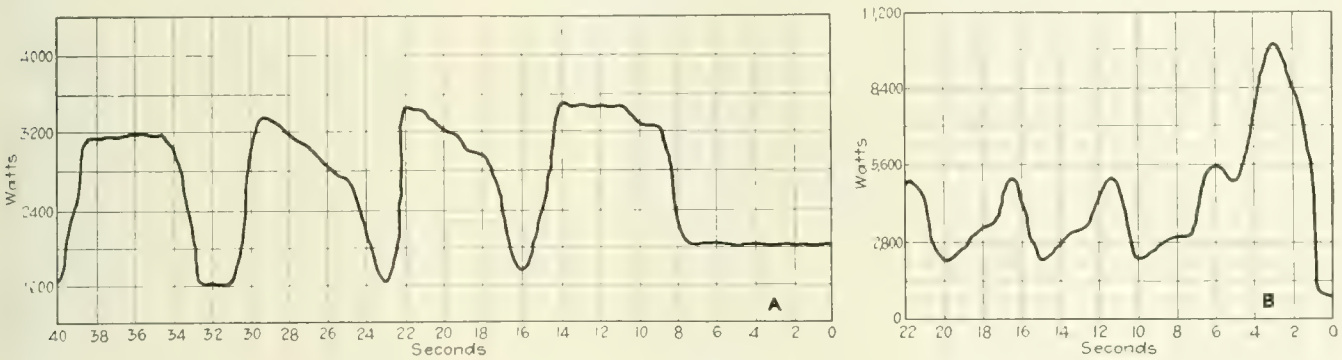


FIG. 1—CYCLIC DEMANDS FOR POWER CONSTITUTE A MORE SERIOUS CAUSE OF LOW POWER FACTOR THAN OVER-MOTORING

ENFORCEMENT OF POWER-FACTOR REGULATIONS

Power-factor regulations have not been generally enforced in this country principally on account of the lack of standard practice in measurement. The practical difficulties met with and the necessity for the development of standard methods and instruments have been reviewed so fully in articles appearing in the ELECTRICAL WORLD that further discussion on these points is not necessary. The present tendency is in favor of the use of watt-hour meters connected to measure the reactive power, the power factor being determined by the relation of the reactive power to the active power registered by the regular watt-hour meters. The installation of printometers in connection with the meters registering reactive power as well as with those measuring active power presents a very satisfactory method of obtaining data from any installation.

The results from a large number of tests made in this manner by the Philadelphia Electric Company present

*As chairman of the power factor committee, Association of Edison Illuminating Companies, and through years of study of this question for the Philadelphia Electric Company, Mr. Russell is highly qualified to speak with authority on the subject of power factor.—EDITOR.

A French Contract that Equitably Handles a Variable-Power-Factor Demand*

Art. 1. The power will be furnished by the supply company continuously, day and night, including Sundays and holidays, in the form of three-phase current at 25 cycles, without interruption except for causes beyond its control and subject to reserves and exceptions as mentioned in Article 2.

Art. 2. The voltage of the power measured at the incoming service shall be as constant as possible; it shall in no case be below 5,200 volts nor above 5,650 volts. The voltage variations allowed above shall be neither sudden nor repeated but shall occur slowly and progressively, the voltage at outgoing bus of the generating station remaining constant. The installation of the customer shall be made and operated in such a manner as not to interfere in any way with the service to the other customers of the supply company.

Maximum Demand Fixed

Art. 3. The maximum power which the customer will be entitled to draw is fixed at 815 kva. No addition to the installation increasing the total power above fixed of 815 kva. shall be made without previously securing a special agreement in writing from the supply company.

Art. 4. The power shall be delivered inside of a high-tension vault, well inclosed and dry, provided by and at the expense of the customer. The supply company will provide and install a service between its line and said vault and will install therein the following equipment at its own expense: A switch on each phase; two meters with their transformers and accessories; one indicator of maximum amperes per phase; all connections, bus and conductors, insulators and other necessary equipment up to the entrance to the vault.

The indicators of maximum amperes will be installed one on each phase; the reading of each of these instruments shall be added, and in order to determine the power in apparent kilovolt-amperes an average voltage of 3,200, corresponding to the average voltage between phases of 5,500 volts, shall be taken. The supply company reserves the right to replace at any time it so chooses these ammeters with one or more recording instruments. The above equipment will remain the property of the supply company. For the rental and upkeep of the above equipment the customer will pay the supply company the sum of —— per month. The agents of the supply company shall have the right of access to the said high-tension vault and to the above-named equipment at any time. Any interference with the exercise of this right may be penalized by a severance of the power supply to the customer. The meter will be accessible without the necessity of entering the high-tension vault. One of the keys of the vault will be left with customer.

Art. 5. In addition to the price of the kilowatt-hours of true energy used, the customer shall pay for all reactive power consumed. The reactive energy shall be measured with a special meter calibrated in units corresponding to the kilowatt-hours in such a way that the cosine of the angle (phase-angle difference between voltage and current) being equal to 0.707, the meter will register as many units of reactive power as the meter of true power registers kilowatt-hours. To simplify computation of bills, instead of charging the reactive energy at a different rate per kilowatt-hour, 30 per cent of the kilowatt-hours registered by the special meter shall be added to kilowatt-hours of true power consumed and the total shall be called kilowatt-hours of "complex energy." This complex energy

THE power rate consists chiefly of two elements: a rate for complex energy and a demand charge based on the highest kva. load during the year. Complex energy is determined by adding one-third of the reactive hours registered to the kilowatt-hours. There is also a coal clause which is based on the complex energy used.

(which will be reduced to the kilowatt-hours of true energy every time the phase angle between current and voltage is zero) shall be paid by the customer to the supply company at the tariff rate of —— centimes per kilowatt-hour.

In case the customer shall change his installation so that the cosine of the phase angle shall permanently remain between 0.9 and 1.0, the reactive energy metered shall not be billed, but shall be charged whenever this condition is not fulfilled. The meter of reactive energy shall be provided with a device preventing its operation in a reverse direction.

The rate of the power supplied shall consist of two elements: (a) A rate of —— centimes per kilowatt-hour of complex energy as defined in the preceding paragraphs; (b) a stand-by charge of —— francs per year per kilovolt-ampere of maximum apparent power demand to be paid monthly in twelfths, the kilowatt-hours of maximum demand to be determined as follows:

The maximum apparent power for the purpose of billing the stand-by charge shall be the highest reading registered throughout the year by the instruments (ammeters and voltmeters). To determine the monthly stand-by charge the highest indication from the first of the year to the time of each reading shall be taken. During the month of January of each year an adjustment shall be made of the charges made for the twelve preceding months, based on the highest reading of kilovolt-amperes registered.

Art. 6. In addition to the charges named in the preceding article, the supply company shall be indemnified by the customer for any increase in cost of coal. This indemnity shall be at the rate of —— centimes per kilowatt-hour of complex energy for each one franc increase in cost of coal above —— francs per ton. The above cost of coal shall be the average cost of coal f.o.b. the stations of the supply company for each period of three months during the year. These average prices shall, until new order, be those fixed by the fuel administration in charge of the distribution and allocation of coal to the public utilities.

For simplicity of accounting, the above indemnity shall be billed each month and shall be included in the bill for kilowatt-hours of complex energy supplied; and in case of non-payment of this indemnity the customer shall be liable to the same conditions as for the non-payment of complex energy. The indemnity shall be billed monthly on the base of the average cost of coal prevailing in the preceding three-month period. In the month following each quarterly period the increase or decrease in the difference in cost of coal shall be billed and settlement effected within fifteen days. However, and by special mutual agreement, during the first ten months of this contract the indemnity for increase of coal prices shall be charged and added to the kilowatt-hours of true energy instead of kilowatt-hours of complex energy.

Minimum Consumption Guaranteed

Art. 7. The customer guarantees to the supply company an annual minimum consumption of 600,000 kw.-hr. of complex energy and any shortage in this consumption shall be paid for at the rate of —— centimes per kilowatt-hours. During the first and last year of this contract the above guarantee shall be reduced to the pro rata of the number of days of the contract. In case of strike, complete or partial, or of fire, it is understood that the above minimum consumption of kilowatt-hours shall be waived to the extent of the pro rata of days involved.

Art. 8. In case of disagreement as to the interpretation of this contract, the matter shall be brought before the courts of jurisdiction of the department in which the service is situated, or if the parties hereto prefer, shall be amicably settled by arbitration. All additional taxes over and above the present ones hereinafter levied and affecting the cost of the commodity supplied under this contract shall be borne by the customer.

*Translated by George Roux.

some valuable information upon the power factor in typical installations. In connection with instantaneous tests made of individual motors used in various industrial operations the data are especially illuminating as to the power factors found in ordinary practice.

OVER-MOTORING NOT SOLE CAUSE FOR LOW POWER FACTOR

Let us first consider the common statement that the outstanding cause of low power factor is the excessive capacity of the motors installed for carrying on industrial operations. This statement is based to a great extent upon the practice of individual drive, which has been widely advocated and very gradually adopted. There can be no doubt that there are many installations in which over-motoring has been practiced, but the results of a very large number of tests in Philadelphia show that the alleged abnormal size of motors may be traced directly to two causes—namely, the requirements for high starting torque and the heavy demands at maximum loads which do not exist during a large percentage of the working day.

The capacity of any motor is naturally determined by the estimated maximum of power required for its operation. The load cycle of industrial plants is seldom such as to require the maintenance of maximum power requirements throughout the working period. The questions of inertia, friction, weather conditions and human fatigue all have a bearing upon the relation between maximum and average power requirements during a working day. It is a well-known fact that most industrial operations are cyclic in power demands, ranging from a minimum to a maximum over intervals of from a fraction of a second to longer intervals.

Fig. 1A is a reproduction of a graphic record made by a high-speed specially designed instrument. The chart shows the current consumed by a 5-hp. motor during a forty-second interval in which four non-automatic cutting operations were completed. It will be noticed that the power demands had a range of more than 50 per cent of the maximum. As the reactive power required over this interval varied but slightly it can readily be seen that the average power factor of this motor will be much lower than would be the case if the power demand were a straight line at the maximum.

Fig. 1B is also a graphic chart from a non-automatic operation, showing the current consumed in starting a lathe with work in place, making two cutting and one boring operation and cutting off. This chart also shows a wide variation in power demands during the cycle of these operations, and that the average power factor of the motor will be materially lower than that anticipated from its maximum demand for power.

The two operations illustrated in Figs. 1A and 1B are typical of many found in the metal and woodworking trades. It is consequently evident that other influences besides over-motoring affect the power factors found in industries where continuous cyclic changes in the demand for power occur. In fact the load factor of any motor measured over the hours it is in operation determines the power factor. In practice load factors of from 50 to 60 per cent during the hours of full operation are quite common. Several tests made on plants with absolutely correct motoring show power factors of from 70 to 75 per cent.

The printometer tests made with watt-hour meters, one set registering kilowatts and the other connected to measure reactive power, bring out a number of interesting and important points in connection with the question of method and time of power-factor measurement.

Fig. 2A is a graphical representation of the printometer results on a typical day in a pressed-metal plant. Synchronous apparatus is operated continuously in this plant for corrective purposes, and the result is an aver-

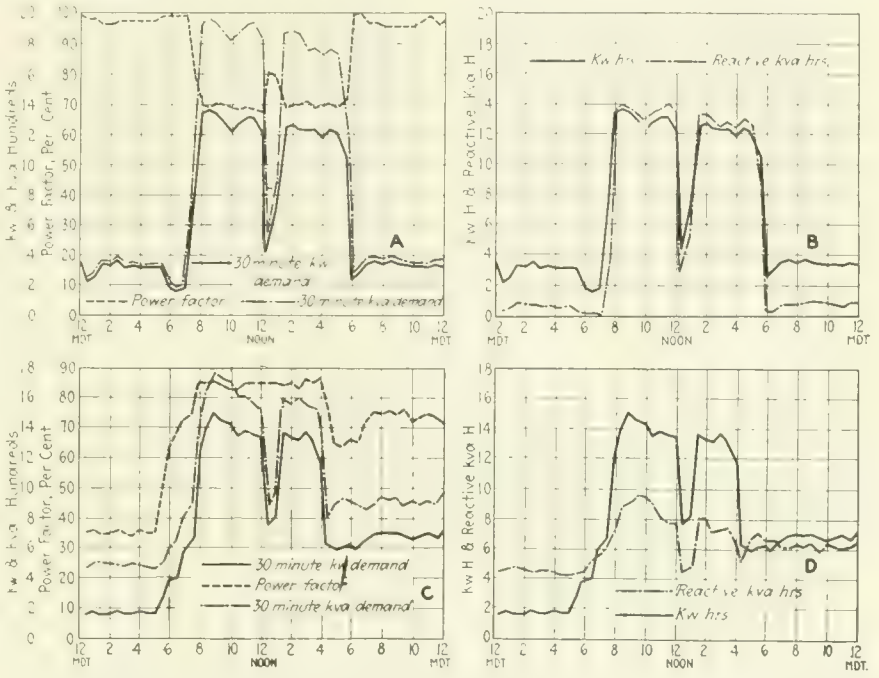


FIG. 2—WHILE THE AVERAGE POWER FACTOR IS THE SAME FOR BOTH OF THESE INSTALLATIONS, THE DEMAND FOR REACTIVE POWER IS QUITE DIFFERENT

In A are shown the printometer records for operations in a pressed-steel plant, while B shows the reactive kilovolt-ampere hours and kilowatt-hours required in the same plant. Similarly C and D show the load conditions in a steel-working plant.

age power factor considerably higher than that existing during the period of maximum demands. The maximum thirty-minute kva. demand occurs at 8:30 a.m. and exceeds the maximum kw. demand, which in this case is simultaneous, by 44 per cent. In fact the average thirty-minute kva. demand over the period of heavy load exceeds the average thirty-minute kw. demand by almost 44 per cent, the power factor ranging close to 70 per cent during that period. Owing to the use of synchronous machines the average thirty-minute kva. demand over the twenty-four-hour period exceeds the average thirty-minute kw. demand by about 29 per cent, and the average power factor for the day is a little over 80 per cent.

Fig. 2B shows the relation between the reactive kilovolt-ampere-hours and the kilowatt-hours derived from the records on which Fig. 2A is based. It will be noticed that the reactive power during the period of heavy load is virtually equal to the active power, whereas during the period of light load the synchronous apparatus has supplied a large proportion of the necessary magnetizing current, with the result that the total

reactive power (kilovolt-ampere-hours) is about 81 per cent of the total kilowatt-hours.

The chart shown as Fig. 2C is taken from printometer records of a typical day in a large steel-working plant, and this with the accompanying Fig. 2D illustrates a condition, as far as results are concerned, precisely opposite to those shown in Figs. 2A and 2B.

The installation shown in Figs. 2C and 2D includes quite a large capacity of synchronous motors. It will

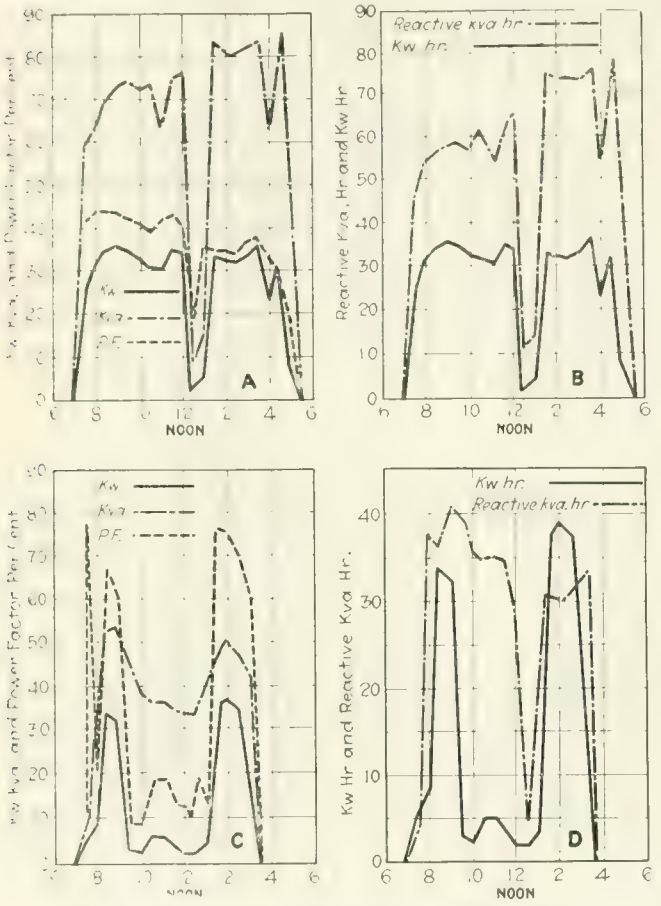


FIG. 3—POWER FACTORS DO NOT VARY ACCORDING TO THE DEMANDS AS SHOWN BY THESE LOAD CONDITIONS

Load conditions in a textile plant are shown in A and B, while C and D show power requirements of a woodworking establishment. Note the difference in power factor due to varying demands and different grouping of machines in operation.

be noted that the maximum thirty-minute kva. demand, which occurs at 9 a.m., exceeds the maximum thirty-minute kv. demand, which is simultaneous, by only 16 per cent. In fact the excess of the kva. demand over the kw. demand during the period of heavy load is about on that order. Because of the smaller use of synchronous motors at night the average thirty-minute kva. demand over twenty-four hours exceeds the average thirty-minute kw. demand by 30 per cent.

Fig. 2D shows the relation between the reactive power kilovolt-ampere-hour and the kilowatt-hour. This shows that during the period of heavy load the reactive power is much less than the active power, but that during the hours of light load the excess of reactive over active is such that in the twenty-four-hour period the kilovolt-ampere-hours are 83 per cent of the kilowatt-hours, differing but slightly from Figs. 2A and 2B.

From these two sets of figures may be drawn the entire story of the question of time and method of measurement. In both cases the results under power-factor regulations dealing with average power factors are almost the same. In the first case the customer has required large capacity and a large ratio of reactive power during the hours of heavy load. In the second case the capacity and ratio of reactive power have been relatively large during the hours of light load.

Figs. 3A and 3B are drawn up from the printometer figures for a textile plant. The maximum thirty-minute kva. demand on this day occurred at 4:30 p.m. and exceeded the thirty-minute kw. demand, which is shown at 3:30 p.m., by 142 per cent. The average thirty-minute kva. demand over the period of test is 133 per cent greater than the average thirty-minute kw. demand. The curve of kw. demand is typical of many textile plants, the morning maximum seldom being equaled until 3 to 3:30 p.m.

Fig. 3B shows the relation between the active and reactive power, the reactive kilovolt-ampere-hours being more than 200 per cent of the kilowatt-hours. The power factor of many textile plants is very low. One of the most modern and best equipped shows a maximum power factor of 78 per cent, with an average of about 70 per cent.

Figs. 3C and 3D illustrate the power conditions in a woodworking establishment. The maximum thirty-minute kva. demand occurs at 9 a.m. and exceeds the maximum thirty-minute kw. demand as shown at 2 p.m. by a little less than 40 per cent. The average thirty-minute kva. demand over the period of test is almost 120 per cent greater than the average kw. demand. Fig. 3D shows the relation between active and reactive power. The reactive kilovolt-ampere-hours are almost 200 per cent of the kilowatt-hours. These results are interesting as showing the difference in power factor during the day due to varying power demands and different groupings of machines in operation. Maximum demands for power on the various machines installed in a plant of this character are usually of short duration, and there may be a material interval between these maximums.

The charts herewith reproduced are selected from a large number taken in typical installations of various size. A careful study of their important characteristics will throw much light on the question of power-factor measurement. Industrial power factors do not vary in accordance with the demand, but may have considerable variation according to the combinations of the apparatus which creates the demand. Average power factor determined by continuous registration may not give the central-station company a correct answer on the points which are really of importance.

Two measures are necessary in order to give sufficient data to deal with existing power factors in industrial installations. The first is the excess of the kva. demand over the kw. demand. The second is the relation between kilovolt-ampere-hours and kilowatt-hours during the period of normal operation.

Foreign Rates on Basis of Complex Energy

In considering the question of foreign practice relative to power-factor regulations and measurements three points are evident which have had a great influence in the present condition of affairs. The first of these is the fact that many of the foreign power developments consist of relatively small water-power plants. To generating stations of such a nature power factor is a most important subject. The question of regulation and rates has been thoroughly discussed in European countries for many years. As a matter of fact Professor

Arno urged ten years ago international action on a proposed formula to fix the price relation between active power and reactive power. The second point which has had an influence upon the power-factor situation abroad has been the relation between the demands for power and those for light, the former in many cases being far in excess. The third point was the great demand for power during the war, which resulted in an intense drive to make available every kilowatt of capacity.

Existing practice may be said in general to represent the following standard methods:

Stand-by charge based on kilovolt-amperes.

Time of measurement—usually that of the greatest kva. demand in the year.

Energy charge—price per kilowatt-hour for active power plus reactive power at a variable figure.

There is quite a variation in the power factor specified as standard in the rate schedules abroad, the figures covering about the same range as in this country. It may be of interest in this connection to mention the prevailing German practice of establishing the standard power factor at 80 per cent. For power factors other than 80 per cent the following percentages of additions or reductions in the kilowatt-hours are made: Unity power factor — 9.37 per cent; 90 per cent — 3.37 per cent; 70 per cent + 6.75 per cent; 50 per cent + 24.5 per cent.

There has been quite a general tendency abroad to charge per kilowatt-hour, while in some cases there is an additional charge per kilowatt-hour when the reactive power is more than 75 per cent of the active power and a reduction per kilowatt-hour when the reactive power is less than 75 per cent of the kilowatt-hours.

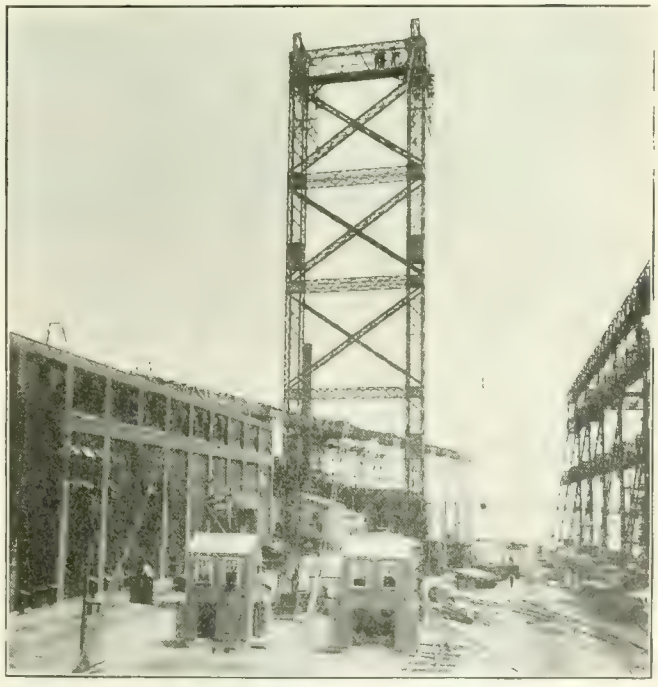
In Marseilles and vicinity the standard power factor is established at 85 per cent and the standard power contract specifies that for any variation in power factor the kilowatt-hours billed will be automatically increased or decreased from the hours consumed. With unity power factor the kilowatt-hours are decreased for billing purposes 7.8 per cent, at 95 per cent power factor 4.1 per cent, and at 90 per cent 1.9 per cent. For power factors below the standard the kilowatt-hours are similarly increased. For the purpose of simplifying the reading and computation of the complex energy charge a special meter has been devised consisting of two meter elements in one case, each with its own dial, one registering the active and the other the reactive power. The shafts of these two elements are, through a differential and a train of gears, connected to a third dial which registers the resultant kilowatt-hours for filling purposes. At the power factor selected as standard the third dial measures precisely the same as the kilowatt-hour dial; for lower power factors it registers more and for higher power factors less in accordance with a table of percentages designated in the agreement with the customer. The statement is made that these meters are being adopted by several of the large central stations in France. The advantage of direct and simultaneous readings of active and reactive power, thus making it possible to determine the customer's power factor over any given interval of time, makes this meter of particular interest.

One point worthy of consideration has been brought out by the interconnection of a large number of moderate-sized systems in the water-power sections of Europe—namely, that power factor is one of the most important questions in the interchange of power. It is possible that future developments along this line in the United States may cause renewed interest in the subject.

The work done by the special joint committee of the American Institute of Electrical Engineers and of the National Electric Light Association is widely known. The work done and now under way in the Association of Edison Illuminating Companies has not had such wide publicity. A special committee appointed by President Walter H. Johnson of this association is now gathering data and information abroad as well as in this country for a later report on power factor. The special committee of the Association of Edison Illuminating Companies requests general consideration of the subject and the co-operation of all interested in power factor.

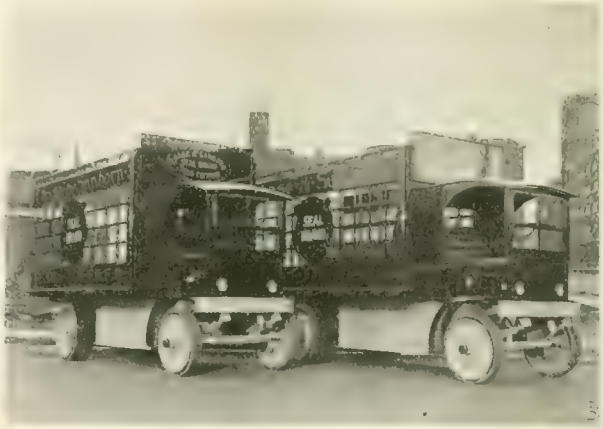
Electric Cableway Helps Build Scout Cruisers

SCOUT cruisers for Uncle Sam's navy are being built at the Fore River yard of the Bethlehem Shipbuilding Corporation, Ltd., with the aid of the electric cableway shown in the accompanying photograph, said to be the first of its type to be installed on the North Atlantic Coast. The comparatively narrow space available for handling plates and other materials over the shipway shown led to the selection of this type of equipment in place of the usual traveling crane and boom hoist. Two cableways are provided, each having a lifting capacity of 3 tons at a rate of 200 ft. (61 m.) per minute, with a forward or aft movement of 600 ft. (183 m.) per minute. Each is driven by a 50-hp., 250-volt direct-current motor, controlled by an operator stationed in a cabin at the head of the shipway and directed by electric bell signals from an observer whose post is on a tower on the cruiser structure. The cableways are supported on head and tail towers 145 ft. and 102 ft. (44 m. and 31 m.) high respectively, the span between towers being 700 ft. (215 m.). The entire erection job was accomplished in three weeks, including the electrical installation.



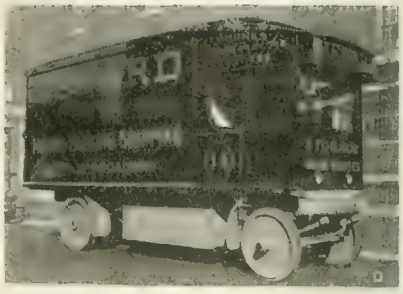
CABLEWAY AT FORE RIVER YARD, BETHLEHEM SHIPBUILDING CORPORATION, LTD.







Diversified Industries Are Using Electric Trucks for Light and Heavy Work





E





A—Nationally known firms such as the United Cigar Stores Company have adopted the electric vehicle.

B—Chase & Sanborn make coffee deliveries with "electrics."

C—Well-known clothing manufacturers such as Hart, Schaffner & Marx are moving their product with battery power.

D—Modern electric trucks are not limited as to body sizes but can compete when bulky loads are to be handled. The Hebard Storage Warehouse Company handles all classes of moving work.

E—Sixteen ice-cream companies are using or have on order about 200 electric delivery wagons. The fleet of the Anderson & Gooding Ice Cream Company is shown.

F—The National Tea Company operates a truck fleet for city delivery work.

G—In work where loading and unloading are slow jobs the demountable body increases the truck efficiency. The Hartman Furniture & Carpet Company employs such a scheme with "electrics."

Electric Truck Gaining Favor in Chicago

Commonwealth Edison Company Garage System a Factor in the Growing Use of This Vehicle—Consumption of Energy Compared with Amount Taken by Commercial and Residential Customers



IN CITIES WHERE THE USE OF ELECTRIC VEHICLES HAS BEEN FOSTERED THE ELECTRIC LOAD HAS PROVED DECIDEDLY WORTH WHILE

IN CHICAGO there are more than 4,000 electric vehicles in operation. Of these about 90 per cent obtain their power from the Commonwealth Edison Company and by so doing produce a revenue of almost $400,000 per annum for the company. The income derived from electric vehicles is sufficient to pay one month's dividend on the capital stock of the company, although it is only 1 per cent of the total income. These facts serve to emphasize the value of the electric truck as a producer of revenue, and revenue derived almost entirely between the hours of 10 p.m. and 6 a.m., or in other words without making any additional demand upon the generating station.

Chicago's central-station company has not adopted a battery rental or exchange system such as has come into vogue in other cities where the electric vehicle has made rapid headway. The company has, however, adopted a garage service which has acted to encourage the use of the electric vehicle among those who were at first somewhat skeptical or who had neither the inclination nor the facilities to care for their own trucks. The company has, further, supported the electric truck manufacturers by offering a favorable power rate for off-peak charging, by encouraging charging stations in strategic locations and by maintaining a department for fostering interest in electric trucks and tractors.

Good Revenue for Size of Connected Load

Two outstanding facts wherever the electric truck is largely used are that as a form of connected load the truck is insignificantly small and that as a producer of revenue the load is, none the less, worth while. The average electric truck represents a connected load of about 6.9 kw. Because this load comes on during the off-peak period between 10 p.m. and 5 a.m. it produces no problems in the way of increased generator capacity. The load being comparatively small but long and steady—about six continuous hours nightly—the total monthly kilowatt-hour consumption is considerable.

Chicago's electric vehicle fleet, large as it is, gives so small a connected load that, with all trucks charging, the load can hardly be distinguished on the twenty-four-hour load curve. Only on the two feeders supplying the two largest garages is the load noticeably apparent. Yet this same load is bringing in a revenue to the Commonwealth Edison Company of approximately $400,000 annually.

The average monthly consumption per electric vehicle in Chicago is 700 kw.-hr. The average Chicago residence consumes 34.3 kw.-hr. per month, and the average store or commercial customer consumes 165 kw.-hr. per month. In other words, the electric truck uses in one night almost as much current as the average residence uses in an entire month, with the very great difference that the truck makes its demand upon the central station when other demands are minimum.

Large as is Chicago's electric truck fleet, comparatively, it is only a small proportion of what it might be. Upon a conservative estimate, there is a potential demand for 35,000 electric vehicles in the Chicago territory. In other words, only about 11 per cent of the possible electric truck users are actual users.

A study of electric truck applications in Chicago shows that certain lines of business particularly have been quick to turn to the electric delivery truck. Ninety-five per cent of the electric vehicles sold are repeat orders, which is one explanation for the large number of vehicles owned by single concerns. Another explanation is that economies by a competitor necessitate similar economies by those that follow the same line of business. The Commonwealth Edison Company has carefully investigated the various lines of business and their

Electric Vehicles Contribute $400,000 to the Yearly Revenue of the Commonwealth Edison Company, Chicago

THE average monthly consumption per electric vehicle is 700 kw.-hr. as compared with 35 kw.-hr. for the average residential load and 165 kw.-hr. for the average commercial installation. An average of installations shows that each truck represents a connected load of 6.9 kw., which is low compared with the average energy consumption per truck. As the load is entirely off peak, the business is very attractive.

According to conservative estimates, there is a potential demand for 35,000 electric vehicles in Chicago, although at present only 4,000 are in operation. As shown in the accompanying table, certain lines of business have taken up electric transportation more extensively than others. Short-haul, frequent-stop work such as that for the department store or the grocer is especially the field of the "electric."

Although the electric vehicle users receive a low off-peak rate, still the total yearly revenue is $400,000. More than half of this revenue is from street trucks.

AVERAGE MONTHLY ENERGY CONSUMPTION FOR TRUCKS IN DIFFERENT LINES OF BUSINESS

Business	Size of Truck (Capacity)	Kw.-Hr. per Month
Waste-paper collection	2 tons	1,000
	5 tons	1,200
Wholesale hardware	3½ tons	1,300
Teaming, short hauls	5 tons	1,000
Teaming, short hauls	3½ tons	1,200
Ice delivery	3½ tons	1,000
	5 tons	1,100
Steel delivery	1½ tons	600
	2 tons	1,000
Wholesale grocery	5 tons	1,200
Wholesale candy	2 tons	750
	5 tons	850
Retail candy	½ tons	250
Retail fish delivery	2 tons	800
Pie and confectionery	1 tons	350
Bakeries	½ tons	700
Passenger transfers and buses	12 passengers	600
	22 passengers	700
Laundries	750 lb.	500

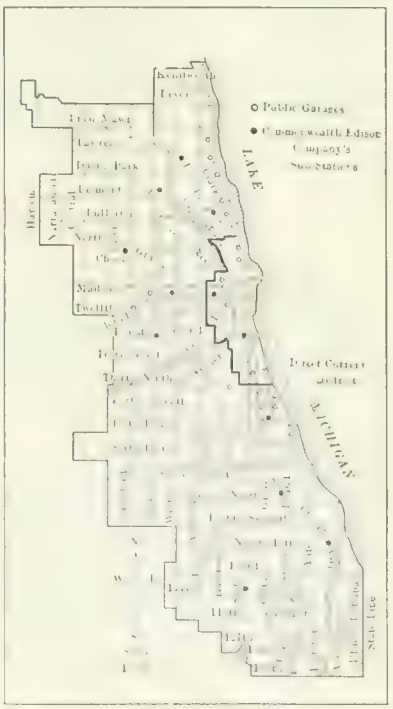
BUSINESSES IN WHICH USE OF ELECTRIC TRUCK HAS INCREASED PARTICULARLY

Business	Number of Companies	Number of Trucks
Bakeries	6	131
Breweries	6	33
Central station	1	164
Coal and Ice	3	40
Ice cream and dairy	16	136
Department stores	7	448
Civic bureaus	2	5
Express and transportation	4	91
Furniture dealers	2	4
Grocers, confectioners	6	152
Laundries	11	31
Restaurants, caterers	6	15

NUMBER OF ELECTRIC VEHICLES; AVERAGE ENERGY CONSUMPTION, REVENUE AND MISCELLANEOUS DATA

Number of electric street trucks	1,450
Number of electric passenger cars	2,500
Number of electric industrial trucks and tractors	450
Total electric vehicles	4,400
Average daily energy consumption, per vehicle (kw.-hr.):	
Street electric trucks	30
Passenger electric cars	10
Industrial truck and tractor	10
Approximate number of days vehicles are used, estimated	275
Percentage of total on Commonwealth Edison Company's service	90
Average cost per kw.-hr. (cents)	2½
Revenue:	
Street trucks	$239,250
Passenger cars	137,500
Industrial trucks and tractors	24,750
Total annual revenue	$401,500

characteristics so that every truck sold upon its recommendation represents a truck well placed. Every repeat order is economy proved and satisfaction obtained. The accompanying table is indicative of the diversified lines of business in which the electric vehicle is multiplying because of its economy. This table is not necessarily correct to date, because the past few weeks have shown considerable activity in the purchase of "electrics." One rather significant fact in connection with Chicago's electric truck fleet is that the lighter class of deliveries—those of ice-cream makers, bakeries, laundries, etc.—have made especially rapid headway during the last year. For example, one year ago there were thirty-four trucks delivering ice-cream or milk for seven dealers. Today there are 136 trucks owned by sixteen dairy and ice-cream concerns. Within the last few weeks fifty additional trucks have been ordered, one order for twenty-five being placed by a company already owning thirty-five trucks. Laundries have also increased the number of trucks employed for their deliveries, the majority of laundries appearing to find the ½-ton and 7,500-lb. (3,400-kg.) trucks best adapted to their needs. Eighteen months ago three laundries were operating five trucks. Today eleven laundries own thirty-one trucks.



CONVENIENT CHARGING STATIONS AID IN DEVELOPING ELECTRIC VEHICLE BUSINESS

Bakeries consitute another class of large user of light trucks, there being more than six bakeries with 131 trucks in actual use at the present time. The Schulz Baking Company, already owning forty-one trucks, has placed an order within the last few weeks for another fifty-eight. Even with these pleasing results, less than 10 per cent of the Chicago bakeries that could operate electric trucks to advantage have adopted them.

Ice delivery also offers the electric truck a good field of work. The energy rate is minimum as the majority of the trucks are charged through the same meter as that which measures the energy for ice making.

Garage Service Feature of Truck Development

The Commonwealth Edison Company has maintained a garage service for owners of electric trucks for about three years. The original purpose of this service was to relieve the truck owner of the responsibility of maintaining his trucks and charging the battery. The company has three large garages, one at Lake View, one at Garfield Boulevard and Lowe Avenue and one at Morgan and Adams Streets. The first two of these are used mostly for Commonwealth Edison Trucks. The latter was built expressly to serve truck owners and to encourage the use of electric vehicles.

This garage has proved so successful and the number of trucks now in use on the west side has increased

so rapidly that there is a waiting list of almost 100 trucks that cannot now be accommodated on account of lack of garage space. Originally intended for about 160 trucks, the garage is actually housing 200. There are 128 charging plugs, which means that 128 vehicles may be charged at one time. This corresponds to a load of about 850 kw.

For its garage service the Commonwealth Edison Company charges a fixed sum for garage and a fixed sum per kilowatt-hour furnished the truck during the month. The garage service comprises housing, washing, oiling and inspection and is charged for at the rate of 25 cents per square foot of space occupied per truck. The energy rate is 5 cents per kilowatt-hour. Repairs and insurance are not included in the garage charge.

Transportation costs for the different lines of business have been quite closely determined by the Commonwealth Edison Company. The average kilowatt-hours per day or month are known very closely. Therefore soliciting custom on the basis of purchased garage service is simply a matter of definitely stating the monthly cost. This ability to predetermine the economy of the electric truck has been an immense help in increasing the electric fleet. Another benefit of garage service is that truck owners are relieved of all responsibility in the maintenance of their trucks; they can buy maintenance service for lower cost and of better quality than they could themselves obtain.

Charging Facilities Are Well Distributed

A generous distribution of battery-charging stations has helped the growth of Chicago's electric fleet. There are at present thirty-seven charging stations scattered advantageously about the city, the number and location keeping pace with the increase in electric vehicles. Twelve out of the thirty-seven are maintained by the Commonwealth Edison Company at its various substations and garages, the remaining twenty-eight being at public garages. The number of charging stations compares fairly well with the fifty-four stations existing in New York City, including the Bronx. Daytime charging is an infinitesimal part of the total charging load. In the main, day-time charging is employed because a truck is standing idle while being loaded and unloaded or because the driver is eating his lunch. The charge is, therefore, merely a booster charge of about one-half hour's duration which occurs while the drop in load exists on the central-station system.

Chicago's central-station company has never adopted any form of battery rental such as has been found a great incentive to the use of the electric vehicle in Hartford, Conn., and several Eastern cities. Individual truck owners may, however, rent batteries from a company maintaining this form of service. At the present time one battery company is renting batteries for 220 commercial trucks and 800 passenger cars. In the majority of cases the truck owner renting batteries has only one or two trucks, although in one case a fleet of fourteen trucks is involved.

The electric vehicle situation in Chicago at the present time is such that the central station and truck manufacturers by close co-operation have developed a fleet of trucks, tractors and passenger cars that are proving the economies claimed for them. Generous charging facilities, the prospect of sufficient garage facilities, close harmony between the various interests concerned and satisfied users all combine to encourage the much wider use of electric vehicles from now on.

Unprofitable Rural Business

Avoiding Extensions that Will Not Produce Revenue —Irrigation Business Points the Way—Mistakes in Handling This Business

THE irrigation rate schedules in use on the Pacific Coast are worthy of consideration in the rural rate problem of the East and Middle West, particularly in their provisions guarding against unprofitable business. The rates cannot in general be applied directly to the rural service of the sections east of the Rocky Mountains and particularly not to the problem in the sections east of the Missouri River, where no irrigation of any character exists. This is because the consumption of one irrigation customer may equal the consumption of several consumers such as may be found on the rural lines of the Eastern and Middle Western companies. The service feature will therefore be much more prominent in the Eastern rural business rate than it is in the irrigation rate.

There are a number of factors in the two classes of business that are common, as follows:

1. Distribution to the consumers is scattered over large areas.

2. Loads are light and investment per customer is high as compared with the ordinary run of city or town business.

3. Operating and maintenance problems are intensified by the long distances that must be covered in reading meters, correcting service troubles and handling routine maintenance.

4. Unlike the larger portion of city business, the irrigation business, especially at the inception of a new project, offers only a small ratio between cost of construction and annual revenue. It is usually a struggle to produce enough revenue from a new project to insure the payment of the operating and fixed charges, and in the past many extensions that have been made on what was considered a sufficient basis of revenue have proved losing ventures.

5. The future growth of the business is at a slow rate, and the expenditure of money that must wait for the addition of business before it can earn a return must be undertaken with extreme caution. At the same time extensions must be made in such a manner that future growth can be handled without unnecessary scrapping of investment.

The accompanying table gives a comparative statement of the main features of a few of the Pacific Coast irrigation schedules. The item of primary importance to the manager interested in rural service is the requirement as to ratio between investment and yearly revenue. In every case there is a definite return in the way of yearly revenue specified in the schedules. The consumer in most cases can advance enough money to keep the company investment to this ratio. Refunds on various bases are made, but in general these refunds are not made until there is a growth in business that will produce a revenue on the investment represented by the refund to the original consumer. This is necessary to protect the company against the assumption of an investment on which no return can be secured. One of the early errors on many of the extensions was the making of an agreement with the consumer for refunds of money advanced, on the assumption that immediate future growth of the business would care for the company investment. The almost unanimous experience

was that the growth was not realized and the company was the loser, the loss in many cases having to be made up by other classes of service. The same mistake has been made in many Middle Western projects, either directly by the refund of money advanced for construction purposes or by requiring the consumer to purchase company securities on which the regular rates of return are paid without making certain that the revenue from the business was on a proper basis.

The return on the investment must be included in the rate unless the consumer advances the money and carries his own interest, as in the case of the plan in use among a number of Wisconsin companies. (ELECTRICAL WORLD, Dec. 18, 1920, page 1205.) The provision of a proper ratio between the cost of an extension and the yearly revenue that it must produce is a rather difficult problem and may vary in different localities. The ratio in the cases under study will be found to vary from three to one to one to one. There is an open question as to whether there is any variation in costs that would account for this large variation of the ratio. This points to the necessity for careful study of the costs of service to determine what ratio is necessary to give an adequate return on the investment after all operating expenses are paid, or, stated in another way, how many kilowatt-hours must be sold at a given profit per kilowatt-hour to pay the fixed charges. It is doubtful whether this method of protection can be employed on the problem in the Middle and Eastern States because of the very small volume of energy sold, but its use indicates one method that can be profitably studied as it is not at all impossible that the development of the rural business may provide greater demands for energy due to the development of apparatus for use on the farm and the education of the farmer to a wider use of power in his work.

Another interesting feature of the irrigation situation is that, with fully as much pressure for service and as much chance for the development of rural utilities, there has been no tendency toward the formation of such bodies. Some companies require the consumers to own and maintain all taps from the main line to their premises that are on the consumers' property. Some companies have also required the consumers to own their own transformer equipment. This practice in some cases has been abandoned because the presence of a large body of equipment on the system owned by private individuals has been found embarrassing in handling maintenance and the changing service conditions that are normal on any system.

The principal mistakes in the irrigation field in past years have been due to overenthusiasm in the viewpoint of central-station men as to the rapidity of growth of the business and to failure to consider fully enough the effect on a system of business that gave a load on the system of only six months or less. Part of the lack of consideration has been due to the pressure from the community for a service that was and is vital, because in most of the western sections of the country agricultural pursuits are impossible without irrigation. While pressure for the same reason is not felt in the states farther east, it seems apparent from developments of the past two or three years that pressure just as insistent is developing. The danger of overenthusiasm in the problem of the Middle West and East is probably not so great as in the earlier irrigation problems, since financial stringency and the absorption of facilities by war conditions have combined to retard the taking of the offered business. This condition, however, brings a tendency in many quarters to ignore the problem entirely as of too little consequence in comparison with other demands made on the central station. With the pressure for rural service growing greater, there is danger in the ignoring of the problem too long and a possibility of the repetition of the mistakes made in the irrigation field under the demands of the public for service. The safeguards that have been thrown about the irrigation schedules to guard against unwise investment are those developed from rather unpleasant experience, and while they may not be followed in form in the present rural problem, they must be repeated in substance.

RURAL CUSTOMER REQUIREMENTS THAT SAFEGUARD INVESTMENTS AND WEED OUT UNDESIRABLE BUSINESS

Co. No.	Ratio Yearly Revenue to Cost	Policy Where Ratio Is Less than Required	Effect on Rates if Customer Makes Advance
1	One to one	Customer advances enough to make required ratio	Refund of one-third of monthly bills for period of five years; depend on judgment, to avoid extensions that will not make adequate return if customer advances part cost
2	Revenue 75 per cent of cost	Customer advances enough to make required ratio	None
3	Revenue one-third of cost	Where less than 337 per cent and more than 20 per cent customer may (a) advance cost of extension, (b) construct enough of extension to bring revenue to 337 per cent, or (c) guarantee 337 per cent revenue	Where customer advances cost, refund is made at rate of 20 per cent of monthly bills. If new business is connected, immediate refund of such portion as is justified is made, or if revenue is guaranteed the guarantee is reduced.
4	One to one	Customer may advance part of cost or build part of extension	Refund made as increased business connected warrants.
5	Fixed ratio varied to meet financial and power conditions on system	Customer may advance cost of extension	Refund at rate of 20 per cent of monthly bills
6	Revenue one-third of cost	Customer may advance part of cost	Refund when revenue from line warrants
7	Revenue must pay operating expense, interest, depreciation at 10 per cent and 8 per cent on investment	Customer may advance part of cost	Refund when revenue from line warrants.

ADDITIONAL PROVISIONS

Company No. 1—Company has two schedules, one providing a low kilowatt-hour rate, in addition to fixed charge, and guaranteeing maximum cost per horsepower for irrigation season. Alternate provides kilowatt-hour rate only, with maximum cost guarantee. Customer guarantees minimum revenue per horsepower.

Company No. 2—Five-year contract backed by cash deposit or lien on land.

Company No. 5—Customer required to furnish own tap lines on own property. No refund on this cost.

Company No. 7—Customer must own distribution laterals from point of delivery. Applies where consumer has several points of utilization, such as a common irrigation situation

High-Power Radio Station for Switzerland

BY SEPTEMBER next the Marconi Radio Station, Ltd., of Switzerland must have a high-power radio station installed and in service near Muenchenbuchsee, in the Canton of Berne, according to the Swiss General Telegraph Bureau, which has now submitted a report including the following details, which are to be embodied in the contract: The station must have a sending range of 2,000 m. at least, which means a so-called continental station. The duration of the concession will be for twenty-five years. Only Swiss will be employed, and all equipment and material required must be purchased of Swiss manufacturers. According to the proposed contract, the federal government may at any time, if the security and order of the country should demand it, seize the station.

Use of Several Conductors in One Conduit Reduces Current Capacity

Formula Suggested to Calculate Current per Conductor for Any Number of Conductors per Conduit — Test Basis of Tables for Various Sizes and Numbers of Conductors per Conduit Tables Showing Reduction of Current-Carrying Capacity

By HENRY C. HORSTMANN* and VICTOR H. TOUSLEY†

TESTS relative to the heating of conductors in conduit pipe were conducted in 1918‡ the results of which were published in installments in the ELECTRICAL WORLD shortly thereafter. All the tests were made with three conductors in the same pipe, all three carrying the same current. While the results so obtained fit the severest working conditions to which a three-phase system can be subjected, they will be more or less erroneous when applied to four-wire, two-phase systems, to three-wire systems provided with neutral wire carrying normally no current, and to the regular two-wire systems, as well as to wires run in parallel. The latter case especially requires attention.

It is well known that the carrying capacity per circular mil given by the National Electrical Code is much greater for small wires than for the larger ones, there being actually a ratio of about six to one between the carrying capacity of a No. 14 wire and that of a 1,000,000-circ.mil cable. In this fact lies a great temptation for the economically inclined to save copper by running two smaller wires in parallel instead of a larger one of the same capacity. The tables, for instance, allow six 400,000-circ.mil cables to carry the same current in the same conduit required for three 1,000,000-circ.mil cables. This is an increase of 20 per cent in resistance without any change in other conditions, hence considerable added heating must result.

Obviously, it would be too tedious and expensive to carry out a complete set of tests of several hundred combinations of wire similar to those described before, and it was thought that such complete tests would not be necessary if the following theoretical considerations should prove approximately true. It is a reasonable assumption that the temperature rise in any number of conductors contained within a given conduit pipe is proportional to the watts lost in the conductors, the watts lost representing the energy transformed into heat. If this assumption proves correct, it will be possible to determine the permissible amperage of any number of conductors in conduit by the formula $I = \sqrt{W/rn}$, in which W stands for the watts lost in one set of conductors, r is the resistance of one of the conductors in question and n the number of wires considered.

In order to ascertain the correctness of these assumptions, tests were made by the Commonwealth Edison Company, comparing the heating caused in fifty-seven No. 14 conductors each carrying 7.38 amp. with that in three No. 4/0 cables each carrying 225 amp. It was calculated that the watts lost in both cases would be the same and the temperature rises should therefore be about equal. A test was also made comparing the heating effect of three No. 4/0 conductors, one of which was carrying no current, with three conductors of the same size all of which were carrying current. The results are given in Fig. 1 by the three curves A, B, and C. Theoretically the curves A and B should be identical and C should have risen to D. But, as we shall see further on, there are many factors not thoroughly known which make accuracy impossible. It is thought, however, that the results are close enough to warrant the use of the formula first suggested, at least until something better is known.

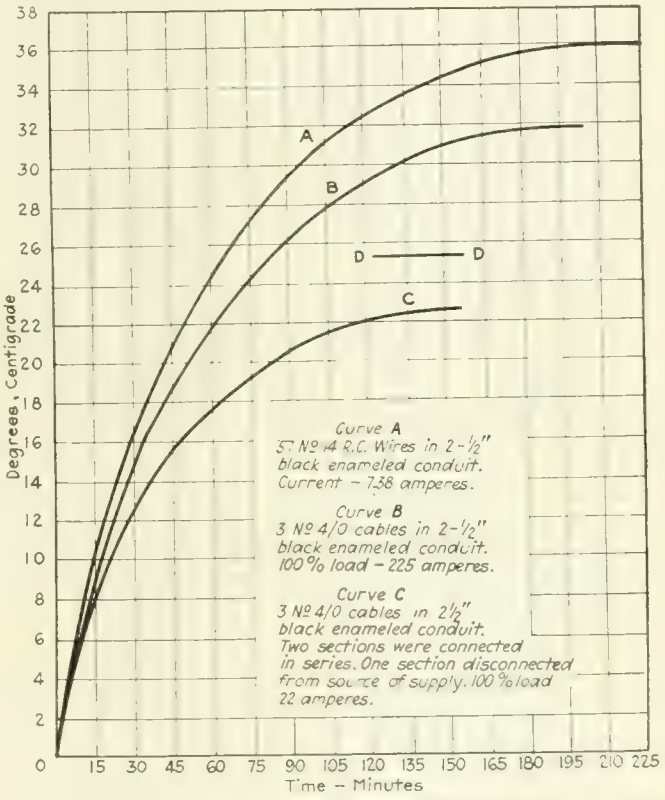


FIG. 1—ACTUAL HEATING OF RUBBER-COVERED WIRE AND CABLE IN CONDUIT

Theoretically *A* and *B* should coincide, while *C* should rise to *D-D*

In determining the carrying capacity of combinations of wires not actually tested it was thought best, first of all, to fix upon the heat-dissipating power of the different sizes of conduit. In order to do this the carrying capacities which it was estimated would bring all conductors to the same temperature were used as a basis to compute the wattage dissipated in the various sizes of conduit. To show the distinction, the National Elec-

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‡Conducted by the Commonwealth Edison Company at the request of the Department of Gas and Electricity of Chicago.

trical Code current recommendations are given in columns at the left and the estimated carrying capacities in adjoining columns of Tables I and II.

The method used to determine finally the wattage-dissipating capacity of the different sizes of conduit is explained by Fig. 2. At the bottom are the conduit sizes, each below a certain line. In the same vertical line are the various sizes of wire tested in pipe of that size. The height of the points measured from the base indicates the wattage that was dissipated in a given conduit by a given size of wire. It will be noted that there is a considerable variation. The wattage dissipation corresponded in each case with a temperature rise of 32 Fahr. (20 C.) in the conductors. The variations were probably caused by the fact that in some cases the wire actually tested was in contact with the pipe while in others it may have been lying on top of the other two wires. In other cases differences in the thickness of insulation affected the results, and in still more cases the relative space occupied in the conduit varied. Since in practice such variations will always be met, it is as well, if not better, that they should be mentioned here.

The curve given in Fig. 2 forms the basis from which all of the carrying capacities in the accompanying tables have been computed. The curve has been run rather low in order that the figures obtained might be quite safe to be used in practice. No wires were tested in 5-in. and 6-in. (12.5-cm. and 15-cm.) conduit, the curves in reference to them being extended in a direction suggested by the lower part of it. The numbers of wires given in the tables as permissible in the various sizes of conduit are calculated to occupy about 40 per cent of the space in the conduit.

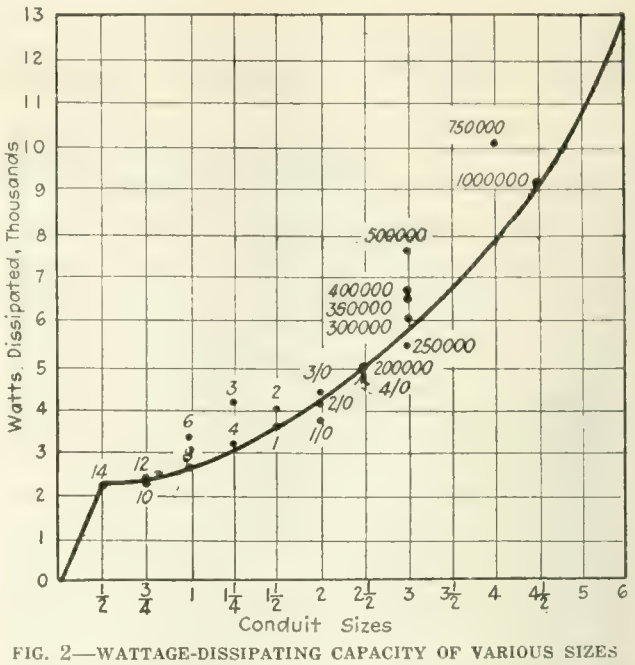


FIG. 2—WATTAGE-DISSIPATING CAPACITY OF VARIOUS SIZES OF CONDUIT

The curve drawn as an average through the points is basis of the carrying capacity given in Tables I and II.

TABLE I—EFFECT OF USING SEVERAL CONDUCTORS IN ONE CONDUIT

Comparison of estimated and National Electrical Code current-carrying capacities per conductor for from one to six conductors in the same conduit. Wires calculated to occupy about 40 per cent of space in conduit.

B. & S. Gage	N. E. Code Carrying Cap. (Amp.)	Estimated Carrying Cap. (Amp.)		Number of Wires 1	2	3	4	5	6
14	15	17	Conduit	½	½	½	¾	¾	¾
			Amp.	29	20	17	14	13	12
12	20	22	Conduit	½	½	½	¾	¾	1
			Amp.	37	27	24	19	17	16
10	25	27	Conduit	½	¾	¾	1	1	1
			Amp.	47	34	28	25	22	20
8	35	36	Conduit	¾	1	1	1	1	1
			Amp.	58	44	36	31	28	26
6	50	52	Conduit	¾	1	1¼	1¼	1½	1½
			Amp.	74	56	50	43	38	35
5	55	56	Conduit	¾	1¼	1¼	1¼	1½	1½
			Amp.	86	79	55	48	47	43
4	70	64	Conduit	1	1¼	1¼	1½	1½	2
			Amp.	96	76	62	59	53	52
3	80	82	Conduit	1	1¼	1¼	1½	2	2
			Amp.	112	86	70	60	64	58
2	90	90	Conduit	1	1¼	1½	1½	2	2
			Amp.	121	96	86	75	72	66
1	100	96	Conduit	1	1½	1½	2	2	2½
			Amp.	135	117	96	89	80	80
0	125	110	Conduit	1	1¼	2	2	2½	2½
			Amp.	159	134	118	101	99	91
00	150	130	Conduit	1	2	2	2½	2½	3
			Amp.	179	161	134	124	112	109
000	175	150	Conduit	1	2	2	2½	2½	3
			Amp.	200	179	146	138	124	122
200,000	200	175	Conduit	1¼	2	2½	2½	2½	3
			Amp.	237	197	176	152	138	134
0000	225	180	Conduit	1¼	2	2½	2½	2½	3
			Amp.	245	205	182	158	141	138
250,000	240	205	Conduit	1¼	2½	2½	3	3	3½
			Amp.	265	241	197	184	164	161
300,000	275	238	Conduit	1¼	2	2½	3	3½	4
			Amp.	288	263	214	200	194	188
400,000	325	290	Cond.	1½	3	3	3½	4	4
			Amp.	333	327	268	251	239	217
500,000	400	345	Cond.	1½	3	3	3½	4½	4½
			Amp.	405	363	297	277	288	265
600,000	450	390	Cond.	1	3	3½	4	4½	5
			Amp.	447	401	355	327	319	316
700,000	500	430	Conduit	2	3	3½	4½	5	5
			Amp.	517	468	379	382	371	339
800,000	550	465	Conduit	2	3½	4	4½	5	6
			Amp.	557	502	436	412	400	400
900,000	600	495	Conduit	2	3½	4	4½	5	6
			Amp.	591	532	463	438	424	424
1,000,000	650	525	Conduit	2	4	4	5	6	6
			Amp.	618	591	483	490	486	444

TABLE II—REDUCTION OF CURRENT-CARRYING CAPACITY CAUSED BY USING SEVERAL CONDUCTORS IN ONE CONDUIT

Comparison of estimated and National Electrical Code current-carrying capacities per conductor when different sizes and different numbers of conductors are used in conduit from 1 in. to 6 in. in diameter.

B. & S. Gage	N. E. Code Carrying Cap. (Amp.)	Estimated Carrying Cap. (Amp.)		Conduit Sizes (In.) 1	1¼	1½	2	2½	3	3½	4	4½	5	6
14	15	17	No. wires	10	17	24	40	57	88	118	151	190	237	342
			Amp.	10	8	7	6	6	5	4.5	4	4	4	4
12	20	22	No. wires	8	14	19	32	46	72	97	123	155	193	280
			Amp.	14	11	10	9	8	7	6.5	6	6	6	5
10	25	27	No. wires	...	11	15	25	36	55	85	96	120	150	216
			Amp.	...	16	15	12	11	10	9	9	8.5	8	7.5
8	35	36	No. wires	...	9	12	20	29	45	61	78	98	123	177
			Amp.	...	22	21	18	16	14	13	12	12	11	10
6	50	52	No. wires	...	...	...	9	13	21	28	36	45	56	81
			Amp.	...	...	...	33	30	26	24	23	22	22	20
5	55	56	No. wires	...	...	...	88	11	18	24	31	39	49	71
			Amp.	...	...	...	40	37	31	30	30	28	27	24
4	70	64	No. wires	...	...	...	7	10	16	21	27	34	43	62
			Amp.	...	...	...	48	43	37	35	33	32	31	28
3	80	82	No. wires	...	...	...	...	9	14	19	24	31	38	56
			Amp.	...	...	...	...	52	45	42	39	38	37	33
2	90	90	No. wires	...	...	...	...	8	13	17	22	28	35	50
			Amp.	...	...	...	...	62	52	49	46	45	43	40
1	100	96	No. wires	...	...	...	...	...	10	13	17	21	27	39
			Amp.	...	...	...	...	...	67	63	59	58	55	51
0	125	110	No. wires	...	...	...	...	...	8	11	15	19	23	34
			Amp.	...	...	...	...	...	84	78	71	69	67	61
00	150	130	No. wires	...	...	...	...	...	7	10	13	16	20	29
			Amp.	...	...	...	...	...	101	91	85	84	81	75
000	175	150	No. wires	...	...	...	...	...	...	8	11	14	17	25
			Amp.	...	...	...	...	...	...	114	103	101	99	90
200,000	200	175	No. wires	...	...	...	...	...	...	7	9	12	15	21
			Amp.	...	...	...	...	...	...	134	126	118	114	107
0000	225	180	No. wires	...	...	...	...	...	...	7	9	12	15	21
			Amp.	...	...	...	...	...	...	138	130	122	118	110
250,000	240	205	No. wires	..	.	.	.	.	.	.	8	10	12	18
			Amp.	...	...	...	...	...	...	...	149	145	143	130
300,000	275	238	No. wires	...	...	...	...	...	...	...	...	8	10	15
			Amp.	...	...	...	...	...	...	...	...	179	173	155
400,000	325	290	No. wires	...	...	...	...	...	...	...	...	7	8	12
			Amp.	...	...	...	...	...	...	...	...	219	221	203
500,000	400	345	No. wires	...	...	...	...	...	...	...	...	...	7	10
			Amp.	...	...	...	...	...	...	...	...	...	265	243
600,000	450	390	No. wires	...	...	...	...	...	...	...	...	...	...	9
			Amp.	...	...	...	...	...	...	...	...	...	...	285
700,000	500	430	No. wires	...	...	...	...	...	...	...	...	...	..	8
			Amp.	...	...	...	...	...	...	...	...	...	..	321
800,000	550	465	No. wires	...	...	...	...	...	...	...	...	...	...	7
			Amp.	...	...	...	...	...	...	...	...	...	...	370

Regulations Governing Development of Water Power in Japan*

Methods of Making Applications —Features of Concessions Limitations Imposed —State Governors Have Power to Alter Designs and Rescind Concessions—Basis of Calculations Required—Electric Companies Have Right of Eminent Domain

WITH the federal water-power act "on trial," so to speak, in this country, water-power regulations in other nations assume a special interest. Since Japan has had an imperial water-power law in effect for many years now the general procedure in that country will be related. This information is not presented as serving to indicate the regulation or procedure that should exist in this country, although the regulations of the Japanese government have numerous merits, such as giving hydro-electric companies the right of eminent domain and discouraging illegitimate promotion schemes by the completeness of information required in the application and the limitations set on time of starting and completing developments. Another interesting feature of the Japanese regulations is that they tend to amass a central compilation of data on drainage areas, stream flows, geology, rainfall and estimated construction costs that, if properly checked and verified, should be helpful in future developments.

While an electric company in Japan has almost unlimited privileges in connection with the properties of others, unfair or unnecessary occupation of private property is held in check by the damages which are assessed against electric companies for such aggression. Probably the greatest single deterrent to water-power development in the Island Empire, however, is the wide scope of authority given the state or ken governor in altering designs and rescinding concessions.

In the past, however, no abuse of this power has been experienced by the holders of water-power concessions and it is possible that this feature of the law may be modified in the near future.

Aside from what bearing they may have on our own water-power problems, the following regulations and requirements should be particularly helpful to engineers or organizations interested in securing Japanese water-power concessions.

In Japan the ownership of all water-power is vested in the imperial government. A development may be made only after a license or concession has been secured from the government. In granting such a concession the government always reserves the right to rescind it at the expiration of the initial term or at any time, if it should be considered necessary to do so in the interest of the public. Any group of individuals may make application for the use of undeveloped water-power. In case two or more applications are filed for the same power site, the government in granting concessions takes into consideration the priority of application, the purpose for which the power is to be used and also the general ability of the applicant to construct and maintain a satisfactory development.

In applying for water-power privileges two separate documents must be prepared—one for the Department of Communications—the other for the Home Department. The two applications contain substantially the same general information, but the Department of Communications requires more detailed information regarding the commercial features of the enterprise. The Home Department is more concerned with the features of construction and the methods used to determine the effect of these structures on flood control, irrigation and other interests of the people.

Applications for water-power privileges must be filed with the governor of the ken or state in which the water-power is located. Negotiations must then be carried on with the public officials in the immediate vicinity of the power site and with the governor of the state. Such negotiations include procuring agreements with the local people concerning the various community interests, such as logging, fishing, irrigation, navigation and the customary use of hot springs along the river for pleasure or health resorts. It is, however, unnecessary to purchase any riparian rights, as the required property can be acquired after the concession is obtained either by direct purchase or by virtue of the right of eminent domain conferred with the concession.

When tentative agreements have been reached regarding all the various local interests, and when the state authorities have given consent to the project, the governor signs the application and forwards it to the central government. If the ministers of the Department of Communications and the Home Department approve the application, a concession is then granted in accordance with the usual terms. Ordinarily two years or more are required to complete all these negotiations and satisfy the requirements of all concerned.

The application to the Department of Communications should be accompanied by a letter of transmittal addressed to the governor of the state in which the river is situated. The letter should request permission to use the water power and should contain a very brief description of the proposed development. It should also state the purpose for which the power is to be used. The letter should be dated and signed by all the promoters of the enterprise. A typical form of application to the Department of Communications follows:

I.—General statement, including:

1. Names of the promoters with their addresses, titles, ranks and business affiliations.

2. Proposed use of the water power and the length of time requested.

*This article has been compiled from information and data furnished by Charles B. Hawley, Consulting Engineer, Washington, D. C., who has had occasion to investigate all water powers of any size in Japan. Mr. Hawley has had exceptional opportunities to study regulations governing water-power development in Japan in connection with the preparation and negotiation of several applications to the imperial government for water power concessions.

3. District in which the power will be used.

4. Total power developed, in kilowatts.

II.—General description of the water-power development, including:

1. Name of the river and location of the various construction features, such as dam, power house, etc.

2. Statement giving the quantity of water to be used and explaining in a general way the conditions which have a bearing on the utilization of water for power purposes. This statement will discuss the amount of water, if any, required for navigation, logging, irrigation and fisheries.

3. Effective head at the waterwheels (with computation sheets).

4. Theoretical horsepower developed (with computation sheets).

5. Map showing the general plan of development.

6. Topographical maps prepared from preliminary surveys.

7. General explanation of the construction works. This will require:

(a) General statement of the entire scheme of development.

(b) Detailed description of the dam.

(c) Detailed description of the intake.

(d) Detailed description of the conduit (with computation sheets showing the loss of head in the conduit).

(e) Detailed description of the surge tank, if any.

(f) Detailed description of the penstocks.

(g) Detailed description of the power house and tailrace. This statement will also list the principal equipment in the power house.

III.—Statement regarding the hydrology of the river, giving:

1. Drainage area with maps and computations by which it has been figured.

2. Statement of the character of the drainage area, giving, in percentages of the whole, forested areas, cleared areas and improved lands. Other features of the drainage area should be discussed, such as the general topography and the geology. It is also necessary to state what crops are raised on the improved lands.

3. Rainfall of the district with tables giving available precipitation records.

4. Statement of what stream gagings have been made on the river; a résumé of stream-flow records, including the maximum flood of record, the normal yearly flood, the average annual run-off, the minimum daily stream flow, the minimum ten-day flow and the minimum sixty-day stream flow.

5. If the gaging station on this river is not in the immediate vicinity of the proposed water-power development, the stream-flow records given in item 4 should be corrected for difference in the drainage areas at the gaging station and the intake of the development.

6. Geology of the section of the river to be developed with a complete description of the dam site and the power-house site.

IV.—Estimated cost of the development. [This will include all rainfall and stream-flow records available, as well as the computation sheets used in determining the size of the tunnel, the effective head on the turbines, the theoretical horsepower developed, depth of water on the crest of the dam during flood and the flood back-water curve above the dam.—Ed.]

Features of Typical Concessions

Certain features of the water-power concessions granted by the Japanese government are peculiar as well as interesting and are given below:

V.—Grantees shall file all applications for permission to start actual construction work within six months from the day following the granting of this concession. The applications shall be filed with the governor. [Instructions regarding scale of drawings, changing design, precautions to prevent erosion and slides, fish ladders, etc., follow in actual concession.—Ed.]

VI.—Whenever a change in the design is essential for the protection of the public interest the Governor may order such alterations to be made. [Articles XI, XII, XIII, XVIII and XXIV give more specific applications of this principle.—Ed.]

VII.—The grantees shall start actual construction work within one month after obtaining the grant as set forth in Article V hereof and shall complete construction work within two years after beginning work.

1 and 2. Should the grantees be unable to start actual construction work in the prescribed period or to complete the same within the allotted time owing to causes beyond their control, the grantees may file an application for an extension of time. Such application for an extension of time shall be filed not later than one month after the occurrence causing the delay and shall not exceed one year.

3. In case the designs are altered by the order of the governor, an application for an extension of time may be filed.

4. The foregoing applications in each and every case shall be filed not later than one month after the date on which the order of such changes has been received from the governor.

5. Immediate report shall be made to the governor of the actual beginning of construction work.

VIII.—[Refers to securing permission where development involves forest reserve, national forest or areas under government supervision.—Ed.]

IX.—Whenever it becomes necessary to change the course of riverbeds, roads, bridges, hydraulic works or other construction works already in existence, the grantees before starting any construction shall first negotiate with the parties owning or connected with such works and obtain their permission for such changes. The grantees shall further report such negotiations to the governor and obtain his approval thereof.

X.—Whenever there is any possibility of injuring or damaging any irrigation or other hydraulic works or interfering with the fishing interests because of the contemplated construction works, the grantees shall before starting such construction works negotiate with the owners thereof and shall take such measures for the protection of such interests as are necessary and shall also report the procedure and conclusions of such negotiations to the governor and obtain his approval thereof.

XI, XII and XIII.—Whenever there will be injury or damage done to the natural scenery by the construction of said works, the governor may order the grantees to plant trees or take such measures as are necessary to remedy such defects. [He has similar powers in regard to the protection of river improvements, etc.—Ed.]

XIV.—The grantees are not permitted to object to any orders of the governor issued for changes or improvements that are required for the public welfare, even though such changes may cause delay in the construction work and may require changes in the designs and method of construction.

XV. and XVI [Provide for reporting completion of plant and starting operation.—Ed.]

XVII.—The addition of new promoters or the withdrawing of any promoter from the organization shall be reported to the governor, and such changes shall be subject to his approval. In like manner, any change in the representative of the organization shall be reported to the governor immediately.

XVIII.—Whenever the public interests require, the governor may order that the diversion of water from the river be stopped or otherwise limited for such period of time as is necessary for the interests of the public.

XIX.—The governor will make inspection of the entire hydraulic works, their accessories and river revetments, and when he deems it necessary may order the grantees to do additional construction work and to make necessary changes.

XX.—The grantees, upon receiving this concession, shall make reports in accordance with the regulations governing the uses of electricity for private purposes and shall make stream flow gagings, keeping tabular and graphic records of gage heights and actual stream flow, copies of which shall be forwarded to the governor's office. Stream-flow records shall be kept in conformity with the above instructions even before actual construction work is started.

XXI.—The governor may revoke this grant either in

whole or in part under the following circumstances and may, moreover, order that construction work be entirely suspended or changed:

1. If in his opinion the public interest requires such action.

2. If the grantee has not complied with all of the conditions of this grant, or with the law, or with the orders issued under the terms of this grant.

3. If he deems such action necessary on account of the condition of the river or for other causes which have transpired after the granting of this concession.

XXII.—This concession shall become null and void under the following conditions:

1. If an application is not filed for permission to carry on the construction of works to develop electric power for private use, or when such application is not approved, or when the approval of such an application is later revoked. 2. If an application is not filed in accordance with Article V hereof, or if such application is not filed within the prescribed time limit, or when such application has not been approved. 3. If construction work is not started within the time prescribed in paragraph 1, Article VII, or when the construction work has not been completed within the stipulated time.

4. If construction work is abandoned before completion.

5. If business is discontinued.

6. If the complete organization is dissolved.

7. If the corporate life of the organization has expired.

8. Upon expiration of this grant.

9. Upon failure of the company to organize properly after filing an application as set forth in Article V hereof.

10. Upon failure of the company after its due incorporation to carry out its business operations in conformity with the conditions in this concession.

XXIII and XXIV.—[Upon the expiration or cancellation of this concession, the governor may order the grantees to remove all construction and equipment, either in whole or in part, and to restore the power site to its original condition, provided that the governor may not confiscate or take over as government property the whole or any part of the construction work already made. He may change or add to these instructions.—ED.]

XXV.—The governor may himself execute this work [alterations] or order others to execute this work when, in his opinion, the grantees have failed to comply with the conditions of this concession, or if it appears that the construction work is not being properly carried out. If the governor deems an emergency exists, he may himself execute the orders which he has given the grantees in accordance with the provisions of Articles XII, XIII and XIX, or he may order a third party to execute his orders. XXVI.—The grantees shall be required to pay all expenses incurred in the execution of the orders issued in compliance with the conditions of this concession, even if such expenses result in losses to the grantees. Such losses shall be borne by the grantees, who shall not claim any indemnity. XXVII.—No rights accruing under this concession or responsibility imposed by it may be transferred or loaned to others unless permission is obtained for such transfer under the following conditions:

1. If the construction work is completed.

2. When considerable progress has been made in the work.

3. When two or more companies are amalgamated.

4. The period of this concession may not be shortened or prolonged because of any change in the organization of the company or because any transfer of its rights or responsibilities is provided for in the foregoing.

XXVIII.—Each and all of the grantees are held responsible for compliance with the conditions of this concession.







WATER-POWER DEVELOPMENTS IN JAPAN HAVE BEEN UNDER GOVERNMENT REGULATION FOR SEVERAL YEARS

Top—Rolling dam near Suruga, Japan, under repair. The repair work was carried on in January, 1918, when it was possible to divert the entire stream flow through the intake and use it for power purposes. The photographs show the Japanese type of cofferdam, which is made up of "sausage-shaped" baskets filled with stone. These rock-filled baskets are used extensively in the construction of wing dams and other works for flood control.

At left—A valuable water power in northern Japan.

At right—Stream gaging on the Miya River in northern Japan. Two low water stages ordinarily occur annually on Japanese rivers, one in January or February, the other in July or August. As a result of the very high annual precipitation in Japan, water power streams frequently yield a minimum run-off of more than 2 cu.ft. per second per square mile of catchment area.

Before construction is begun it is necessary to furnish the Bureau of Electricity of the Department of Communications with a complete description of the electrical features of the project, including the details regarding equipment to be installed. Where a plant is used to furnish power for public service purposes, 25 per cent extra generating capacity must be installed and held in reserve as a spare. This ruling may be modified in case the water-power plant is connected with a steam reserve. The Bureau of Electricity also determines what frequency shall be adopted for the proposed electric system. At present three frequencies are common in Japan, 40, 50 and 60 cycles. It is the purpose of this governmental regulation to maintain a common frequency throughout certain zones or districts.

It is also necessary to secure construction permits after much the same manner as building permits are issued in our cities. Special permission must also be received to buy and use explosives.

In Japan public service corporations as well as companies holding water-power concessions have the right of eminent domain. From a casual reading of the law conveying this right it would appear, as remarked previously, that an electric company had almost unlimited privileges in connection with the property rights of others. This is true in certain respects. On the other hand, ample damages are always assessed against the electric company, which serve as a check against unnecessary occupation of private property.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Need for Information on Treatment of Electrical Burns and Shock

To the Editor of the ELECTRICAL WORLD:

SIR: Almost every set of instructions as to first aid for electrical injury reprints the instructions for resuscitation, as is quite proper. While information about the changes that have taken place in the method of resuscitation as we have learned more about it is widely disseminated, somehow very little instruction is given with regard to the treatment of burns—which may be quite deep and cover a large area—and insufficient instruction with regard to the treatment that should be given for shock even in cases where prostration does not result at the time.

I have in mind a number of cases where men have received flash burns which covered a rather large area and which were so painful that the proper treatment in the first place meant a great deal, and cases where shock was not suggested to those who took care of the injured men simply because the latter were not prostrated at the time and even seemed rather active, though they afterward succumbed to the shock. In one case recently a man died when he was thought to be all right, not having been prostrated at all.

Picric acid is seldom mentioned, and yet the writer believes that picric acid and prepared dry picric gauze are far better than carron oil for treatment of burns. Believing as I do that these two things should receive more consideration, it is urged that the subject be investigated and that the best-known methods should have adequate publicity.

J. M. BUSWELL,
General Inspector.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Valuation of Public Utility Properties for Rate Making

To the Editor of the ELECTRICAL WORLD:

SIR: In valuations of public utility properties for rate-making purposes there seems to be considerable confusion as to just what is to be arrived at. The Supreme Court says that it is "the present fair value—what a willing buyer would pay to a willing seller."

The great confusion comes in this: What a willing buyer would pay to a willing seller is based upon what that buyer and seller guess the future earnings of the plant will be, tempered by their guess as to the future cost to reproduce the plant in its present condition. Obviously no buyer would pay, in a competitive business, much more than it would cost in the near future to reproduce the plant and business. Certainly he would not pay more than the amount on which a return is probable comparable with that from other businesses of like risk. No seller would take less than the amount on which, in his judgment, the business would in the future earn. The amount invested in the business in the past, its earnings in the past, its cost to reproduce today, have no influence except as they are an indication of the future.

But here is the stumbling block. This universal method of judging value in competitive businesses cannot be applied to a public utility for rate-making purposes, because if its value is judged from its prospective earnings, as in a competitive business, we must allow it to continue to earn on that basis in order to support the valuation thus arrived at. That is, we must continue to allow it to charge those rates which will bring it the most business at a profit just small enough to discourage competition. The yardstick proposed by the Supreme Court does not seem readily applied. No matter what may be stated by the rate-making body as the value of the plant, its market value (what would be paid by a willing buyer to a willing seller) is fixed by the earnings allowed, or prospective earnings, and the returns in similar businesses.

It seems to be time that the industry should reach an agreement on the fundamentals of what shall determine the value on which the public utility returns are to be based and what rate of return is necessary to maintain that value. Many investors and some commissions will contend for actual investment. This does not seem proper for two reasons: First, it is conceivable that a plant may be built at a time of very low cost and afterward sold on a very high second-hand market for more than its original cost. Second, it is not likely that the public will willingly continue to pay rates high enough to give proper returns on a high-cost plant after the period has arrived when a new plant could be built at a cost that would save customers a good portion of their rates.

The writer suggests as a basis for valuation the future cost of reproducing the plant and business in the present condition. The cost of reproduction new, less

depreciation, based on present and average prices, the historical cost and the actual investment should be merely bases from which to guess the future. Of course, this is merely a guess, but it is only putting the guessing up to the rate-making body, which is perhaps in a better position to study all of the factors, rather than leaving it to the buyer and the seller. The writer believes that this future cost has been quite a factor in a good many valuations, though not specifically recognized.

As to the rate of return, the writer believes that the best guide to the value of investment in a business of small risk but which requires careful study of the public is the earnings of the banks. Therefore it is suggested that the earnings of the banks of a locality be taken as the general guide as to the rate of return necessary in the public utility business of that locality. Of course, the probable decrease in value of any investment necessarily made at a time of high cost should be recognized in the item of depreciation.

F. V. GALLAUGHER.
Lake Charles Railway, Light & Water Works Company,
Lake Charles, La.

Grounding Low-Voltage Secondaries

To the Editor of the ELECTRICAL WORLD:

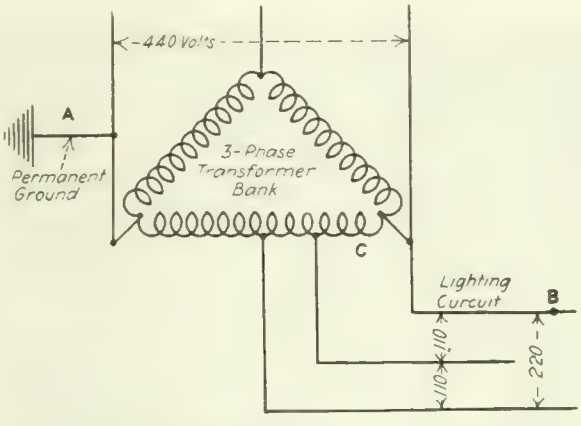
SIR: Considerable discussion as to the grounding of secondary circuits is in progress at the present time. The item on page 318 of the Feb. 5 issue of the ELECTRICAL WORLD sets forth a situation that is hazardous but which does not seem to be fully understood, the question having been raised as to how a fatality could occur in such a case. The following may help to answer some questions that are asked.

Referring to the figure showing the grounding in the above item, it will be seen that the man who grounded the lighting circuit through his body at *B* put himself directly across the 440-volt circuit and, of course, received practically the full voltage through his body. Such a condition is not necessarily fatal. Whether or not sufficient current to kill will be passed through a man's body at this voltage depends on his physical condition and the thoroughness of his contact with the ground. There is always danger that such a shock may be fatal.

In general it is pretty thoroughly established that if a man is in good physical condition a shock at full voltage from an ordinary 110-volt lighting circuit is not dangerous, though it may be so to a person with a defective heart or other organic trouble. The danger is so small that the protection secured by grounding a lighting circuit to limit the voltage to ground to the normal voltage of the lighting circuit outweighs it, and grounding for such circuits is universally recognized as good practice. As the voltage of the circuits increases the hazard to life from accidental contact increases, and it is seriously questioned whether on, say, voltages around 200 to ground the hazard to life from accidental contact with the circuit does not equal or exceed the protection against abnormal voltages on the circuit due to transformer breakdowns or accidental contact between high-voltage or low-voltage circuits. For example, if one neutral on a 220-volt, three-phase delta bank of transformers is grounded, the voltage between the grounded neutral and the third-phase wire is 110 (voltage between neutral wire and its own phase wires) multiplied by 1.73 (square root of three), or 190. On a 440-volt, three-phase bank with one neutral grounded the maximum voltage to ground is 220 multiplied by 1.73, or approximately 380 volts. Several combinations giving various voltages to ground can be readily worked out in this way.

One practice that is just now receiving a great deal of criticism is the use of auto-transformers to obtain three-wire lighting circuits from three-phase power circuits of, say, 220 or 440 volts. It is possible to have abnormal voltages under trouble conditions that may be a life hazard and are surely a hazard to apparatus on the circuit.

After a full and very lengthy discussion of the situation the Bureau of Standards Safety Code calls for grounding of circuits where voltages to ground do not exceed 150. Above that grounding is optional. The limit is purely an arbitrary one and is based on evidence



GROUNDING ARRANGEMENT THAT IS DANGEROUS

that apparently indicates it as the approximate line marking a balance between hazards due to accidental contact with the normal grounded circuit and those caused by contacts with an underground circuit carrying an abnormal voltage due to abnormal conditions. There are a great many who contend that grounding should be compulsory at considerably higher voltages to ground than 150, but the question can only be answered on the basis of evidence that is not yet available. The evidence is the study of accident statistics.

Chicago, Ill. J. LARKIN.

Checking Meter Connections

To the Editor of the ELECTRICAL WORLD:

SIR: In the April 2, 1921, issue of the ELECTRICAL WORLD W. B. Kouwenhoven refers to my article in the issue of Feb. 26, describing a simple method of connecting a three-phase meter with current transformers only and checking the connections after installation. Professor Kouwenhoven asserts that this check is not infallible and refers to his classic paper in the *A. I. E. E. Proceedings* for February, 1916, on the subject of polyphase wattmeter connections. He has evidently overlooked my statement that the meter used is of the house type with but one voltage terminal (which he designates as "class C"), for he says specifically in the paper referred to that the method of checking by opening this voltage terminal is correct for a class C meter. The particular point made in my article was the advantage of using a house-type meter on a current-transformer connection.

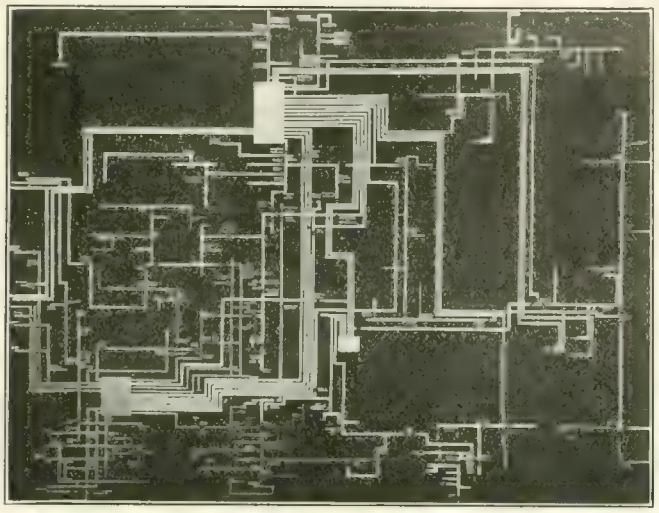
HALBERT R. THOMAS.
Southern California Edison Company,
Los Angeles, Cal.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Plug Board for Primary-Line Switching Control

CONTROL of primary-line switching in connection with routine operation, construction changes and maintenance is greatly facilitated on the system of the Cumberland County Power & Light Company, Portland, Me., by the plug board shown here, which was recently



COLORED STRIPS OF HEAVY PAPER REPRESENT LINES ON THIS SWITCHING MAP

installed at the offices of the line department. Using a base scale of about 3 ft. per mile, the 2,300-volt primaries were laid out approximately to map locations, the lines from different substations being shown in yellow, green, white and blue to speed up identification. The diagram is 10 ft. 2 in. x 5 ft. 8½ in. in length and height and consists of pine boarding, painted and varnished, on which strips of "tough check" paper ¼ in. wide are fastened to simulate three-phase lines, ⅛-in. strips of the same material being used to indicate single-phase branches. The base is of pine 1¾ in. thick and of strips 10 in. wide with joints doweled and glued, a saw scarf being cut every 3 in. and carried within ⅜ in. of the surface.

Switches are indicated by colored plugs fitting holes bored into the baseboard, and cross-overs of one line above another are represented by carrying the paper strip across the line on a semi-circular piece of ½-in. beading ¼ in. long. Line tie switches are indicated by hexagonal-headed pins painted red and green for showing closed or open circuits, and sectionalizing switches are shown as round pins half red and half green to facilitate reversal. Street intersections and unusually important buildings, etc., are indicated by tags, tie lines are numbered and primaries are lettered.

No work can be done upon the outside lines involving the opening or closing of line switches without proper orders from the headquarters office in which the plug board is installed, and all changes in line-switch openings and closings are at once made on the board to keep the status of the system up to the moment. It is planned to provide each important substation with a smaller board showing the line and switching conditions in its own distribution system to be operated in accord with the main primary dispatching board. The board eliminates the drawbacks of depending upon log sheets and daily report forms for up-to-the-minute information as to the status of lines and switches.

A. F. JORDAN and W. L. FOSS.
Cumberland County Power & Light Company,
Portland, Me.

Measuring the Resistance of Transformer Grounds

PERIODIC measurement of the resistance of 2,300/-220/110-volt transformer grounds should prove cheap liability insurance. A visual inspection will not disclose defects such as improperly soldered joints or a ground rod too short to reach the permanent moisture level. However, with an instrument such as is described below accurate measurements may be quickly made. Moreover, the device can be built with a voltmeter and a few simple parts which are usually on hand in any meter department.

On a circuit which has more than one ground this method, of course, gives the resistance of all grounds in parallel. To determine the resistance of one ground all other grounds must be removed during the test. In case there is an accidental ground on the circuit the instrument will usually detect it.

Advantage is taken of the fact that a water pipe is convenient of access on nearly all premises supplied with electric service. The resistance of the water-pipe system and the transformer grounding device, in series, can be easily determined by the use of a known resistance and a voltmeter. The diagrammatic arrangement is shown at *A* in Fig. 2. *T* is a distributing transformer supplying a secondary system having the neutral grounded. *S* is a service connection. A known resistance, *R*, is connected between the ungrounded side of the service connection and the faucet of the water-supply system. The voltmeter *V* will indicate the potential across the resistance *R* plus that across the ground and piping system in series (line potential), this resist-

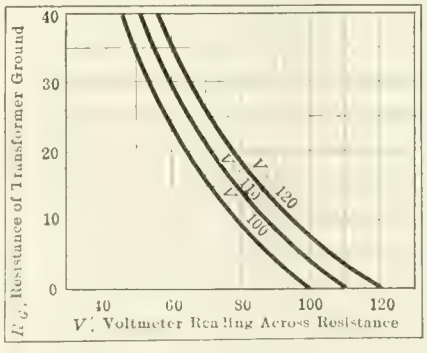


FIG. 1—RESISTANCE OF GROUNDS CORRESPONDING TO VOLTAGES ACROSS 35 OHMS IN SERIES

ance being R_G. The voltmeter V' will indicate the potential across the resistance R. Since the same current flows through R and R_G their relative resistances are proportional to the potentials across them. Therefore $R\ R_G = V'\ V - V'$, or $R_G = R\ (V - V')_{,}\ V'$. If, on making a test, it is found that R_G is less than the allowable limit for a transformer ground (25 ohms), the resistance of the transformer ground itself will be within this limit, for it is the resistance R_G less that of the piping system.

The device, to be convenient to use, should be capable of attachment to a lamp socket and should have a switch to transfer the resistance connection to the ungrounded side of the distribution system without changing connections at the lamp socket. These conditions are met by arranging the apparatus as shown at B (Fig. 2), which also does away with the use of two voltmeters.

The method of using the device is as follows: Open switch S_L and throw switch S_V down. Fasten the clip to water faucet and screw the plug into the lamp socket.

Transformer	V'	V	R_G
No. 1....	99	100	0 2
No. 2....	12	110	23o 4
No. 3....	98	110	4 0
No. 4....	88	110	9 0
No. 5....	9o	110	5 8
No. 6	86	110	10

After closing the socket switch close switch S_L in that position, which causes the voltmeter to read. This may be up or down, depending on which wire of the socket is the neutral. If the meter reads for both positions of S_L, there is an accidental ground on the conductor of the line which is not supposed to be grounded. Note voltmeter reading (V') and throw switch S_V to the upper position and read voltmeter again, obtaining line potential (V). Calculate R_G. Since the variations in line potential are usually small, time can be saved by calculating R_G for several values of V' and plotting a

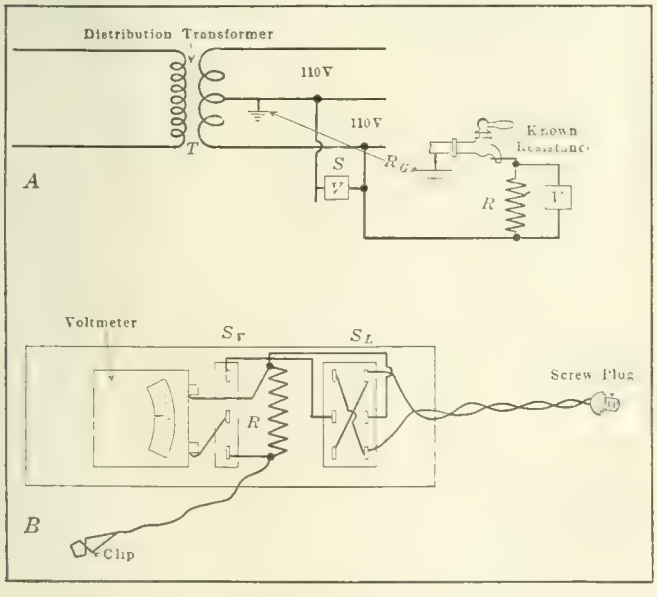


FIG. 2—CONNECTIONS FOR MEASURING RESISTANCE OF TRANSFORMER GROUNDS

set of curves, one for each value of line potential, as shown in Fig. 1.

The device, as constructed from materials which can readily be obtained at any electrical supply house, is shown in Fig. 3. The resistor is composed of a couple of radiant heater units connected in series, giving a resistance of 35 ohms. The voltmeter is an ordinary portable instrument, such as every electric power station should have on hand. The test set shown weighs 8 lb. (3.6 kg.), including the voltmeter.

On testing the transformer grounds for successive transformers along one primary main the results shown in the accompanying table were obtained.

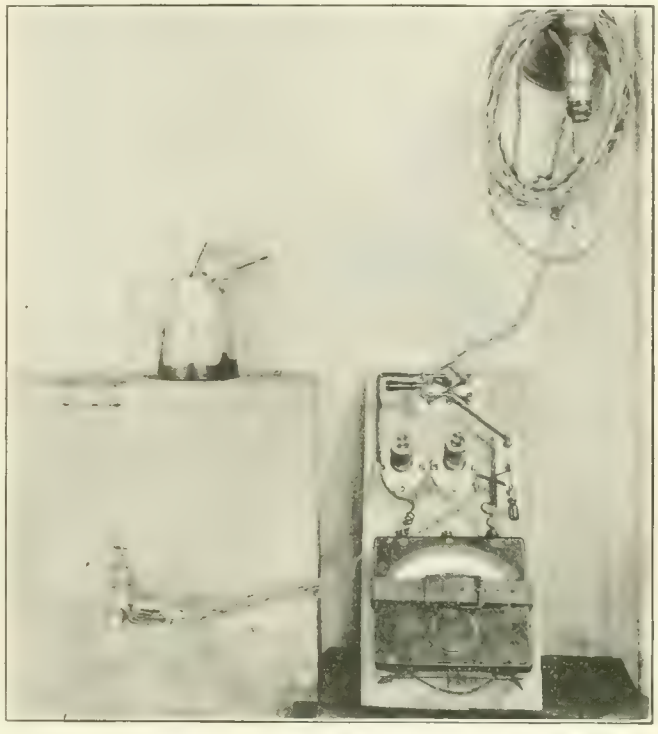


FIG. 3—INSTRUMENT FOR MEASURING RESISTANCE OF GROUNDS ATTACHED TO SOCKET AND WATER FAUCET

The furthest transformer was placed one mile (1.6 km.) from the starting point, and the entire set of tests was made in one and a half hours, including return to the starting point, the tester walking the entire distance.

ARTHUR H. FORD,
Electrical Engineering Department.
State University of Iowa, Iowa City.

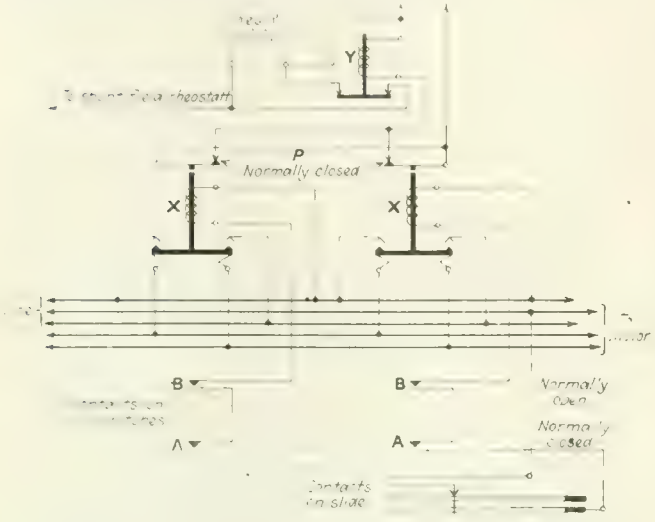
Protecting Waterwheels Against Overspeeding

IN THE parallel operation of two hydro-electric stations it was found necessary to take the governors out of service in the smaller station, the load being controlled by the larger one. This system of operation was quite satisfactory until modern equipment was installed which included the installation of automatic circuit breakers on the generator and tie line to the other station. The opening of either of these breakers would cause a total loss of power, and the wheels would attain a dangerous speed, since there was no control over the gates, which were usually set at 80 per cent of full opening. To prevent this a system of control was worked out and installed which eliminated any further danger from racing wheels and consequent excessive potential in the windings of the generator and auxiliary equipment.

In the accompanying diagram of the connections it will be noticed that the oil switches have two control contacts in series, mounted at a convenient place in connection with the operating mechanism of the oil switch, which is similar to that used for pilot-lamp indicators. The front contact remains closed at all times, except

when the switch is opened by hand and the switch handle is left in the uppermost position. As the circuit breaker is opened by the relay, the back contact *B* closes, which completes the circuit through the contact slide at the governor to relay *X*. The contacts on the slide may be set for any desired gate opening, being connected directly to the indicator on the governor. The relay *X* closes the circuit of the motor, which continues to operate until the gates are closed, depending, of course, upon the position of contacts on the slide.

It will also be noticed that the relay *Y* operates on a



ARRANGEMENT FOR CLOSING GATES WHEN WATERWHEEL OVERSPEEDS

closed circuit, direct from the exciter or exciter bus, and short-circuits the resistance *R* under normal operating conditions. However, when the coil of relay *X* is energized contact *P* opens, thus opening the circuit to relay *Y* and cutting resistance *R* in series with the shunt field of the exciter, which reduces the exciter potential and in turn lowers the alternating-current voltage.

When the motor circuit opens, owing to the contact slide opening at the governor, and the coil in relay *X* becomes de-energized, contact *P* closes, but with the resistance *R* in the circuit the exciter voltage cannot rise sufficiently to close relay *Y*. However, when once closed this relay will remain so on a potential of about 30 volts. On bringing the exciter voltage slightly above normal for an instant, by the aid of the field rheostat, relay *Y* will close, thus short-circuiting resistance *R*. The voltage may then be brought to normal and the gates regulated, completing the cycle of operation.

Keystone Elec. Construction Co. J. W. Truesdell,
Baltimore, Md. Supt. of Construction.

Estimating Peak Load on Distribution Transformers

FOR determining the peak load on transformers which supply residence lighting and range loads without going to the expense of making actual measurements, the following rule has for a number of years been used with success by the Utah Power & Light Company: For residence lighting loads assume 100 watts per customer. For range loads assume 800 watts per range. From time to time this rule is checked by actual measurement as shown in the next paragraph.

Typical results of such a check are as follows: Size of transformer, 15 kw.; number of lighting customers, 36; number of ranges, 15. Peak kw., estimated by rule: Thirty-six lighting customers at 100 watts, 3.6 kw.; fifteen ranges at 800 watts, 12.0 kw.; total, 15.6 kw. Peak by measurement, 14.4 kw. Connected load: Lighting, 23.04 kw.; ranges, 79.61 kw.; total, 102.65 kw. Ratio of peak to connected load: Estimated, 15.2 per cent; measured, 14.1 per cent.

This test was made on March 31. Had it been made in December or January, when the lighting load is highest, the estimated and actual peaks would have checked still more closely.

Paul P. Ashworth,
Engineer of Distribution.
Utah Power & Light Company,
Salt Lake City, Utah.

Value of Notching Poles Before Treatment with Preservative

ADVANCED practice in pole treating is now taking the form of notching or puncturing the outer fibers of wooden poles to obtain a deep penetration of preservative. However, the increased life to result from this treatment should be balanced against the total cost of the treatment. The damage done to the fibers should be offset by the sum of the following: (1) An increase in life to offset the lost diameter; (2) an increase in life to offset the cost of puncturing, and (3) an additional increase in the life of those poles that give a full physical-service life sufficient in amount to amortize the puncturing cost of the many poles removed for functional reasons before the end of their physical life. The functional reasons might be the need of a larger pole, moving the line to another location, replacement by underground work, etc.

Regarding the first requirement of offsetting the lost diameter, as pointed out in the writer's article on pole life in the Electrical World of Jan. 31, 1920, the strength of a pole is proportional to the cube of its diameter at the ground line. Any damage to the outer fibers therefore materially reduces its strength. The following table shows the effect of cutting a ½-in. groove around a 12-in. pole:

Diameter at Ground Line (d), In.	Cube of Diameter (d^3)	Proportional Strength, per Cent
12	1 728	100
11	1.331	77

The usefulness of a pole, aside from functional depreciation, is a matter of the strength of the remaining unrotted sound diameter. When a pole has reached one-quarter of its original strength it is about ready to be removed. On the basis of the foregoing example this point is reached when $d^3 = 432$ or when $d = 7.6$ in. The allowable penetration of rot is therefore $(12.0 - 7.6) \div 2 = 2.2$ in. The examination of more than 1,000 treated and untreated poles, upon which the article of Jan. 30, 1920, was based, showed that after the second year the penetration of rot on an untreated pole was about proportional to the age of the pole. Therefore the ½-in. groove in this instance has, in effect, reduced the life $0.5 \div 2.2 = 23$ per cent.

The two other requirements may also be computed, taking into account the local conditions of pole costs and the character of the use of the pole line, and a complete formula may be worked out. The depth of notch which gives the greatest saving in annual pole charges should be employed.

Page Golsan.
Ford, Bacon & Davis,
New York, N. Y.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Operating and Maintaining Portable Electric Drills

FOR obtaining best results from a portable electric drill it must be operated intelligently and troubles must be remedied before they become serious. A universal motor is the source of power for the drills most commonly employed. If severe sparking appears at the armature, the machine should be taken out of service at once and inspected. Grounds may be detected with a magneto ringer, and if no ground is detected in the armature, the field, switch and cable connections should be tested. An open circuit in the armature will be shown by burning between the commutator bars to which the open coil is connected. A short circuit within a coil will burn out the shorted turns and a short circuit between commutator bars will overheat the bars so shorted. A short circuit between bars may sometimes be repaired if discovered before the coil is burned by removing the foreign substance between the bars, but an open or shorted coil requires rewinding.

If the armature is built with open slots and form-wound coils, the repair can often be made economically by the average repair man if he purchases the repair coils from the maker. If the armature is built with semi-closed slots, it will probably be best to return it to the maker for rewinding. The maker's guarantee of correct rewinding is quite valuable, hence it is strongly recommended that the maker be asked to make repairs.

The fields are not apt to fail, but occasionally they are burned out by operating the tool after the armature has failed. A shorted field coil will cause overspeed or flashing when the switch is closed. Rewinding the field coils is simple provided that the coil is kept within the dimensions of the original and properly fastened in position. The best tools have windings treated with an impregnating varnish by an elaborate process which is a very good reason why a "rewind" by the maker is preferable. This feature is perhaps more important in the armature than in the field.

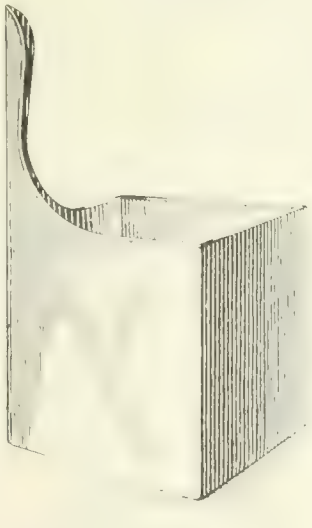
It is imperative that only such brushes be used as are furnished by the maker for the particular machine. A brush made from any material at hand may ruin the motor. Some of the effects possible are overheating from friction, sparking or high resistance. If the material is too hard, the friction and wear on the commutator are excessive, and if too soft, the mica may wear high and bring on chattering and destructive sparking. If the resistance of the brush is too low, excessive short-circuit current will cause sparking and overheating of the commutator and armature coils; and if the resistance is too high, the normal current may overheat the brush. The life of the brushes cannot be stated in ordinary terms because of the very great variation in the use of the tool. However, it is best to examine the brushes before the expiration of 200 hours' actual running time, and it will be a help to clean the commutator with fine sandpaper several times during the life of the brush. The tension on the brushes should be uniform and just sufficient to prevent arcing on a smooth commutator. A tension of at least 4 lb. per square inch of brush contact is usually necessary. Should the commutator become rough, the armature should be removed and the commutator refinished by taking a very light cut on a lathe.

The cable connection is often abused by using it to drag the tool around, running trucks over it, etc. Some cable is better than others, but all of it requires reasonable consideration, and where the tool is used in one position on production work it is recommended that the tool and cable be suspended from above with a counterweight.

The gearing of the best machines seldom gives trouble, but gears are wearing parts and should be renewed if necessary. The better class of tools are lubricated by grease, which means maximum cleanliness and minimum attention. It is good practice to replenish the grease supply as often as the tool is cleaned or inspected, which on account of the brush wear should not exceed 200 hours of service.

Van Dorn Electric Tool Company, Cleveland, Ohio.
E. L. CONNELL, Chief Engineer.

Tank Useful for Watering Batteries May Be Made from Old Jar



HANDY JAR FOR POURING WATER INTO BATTERIES

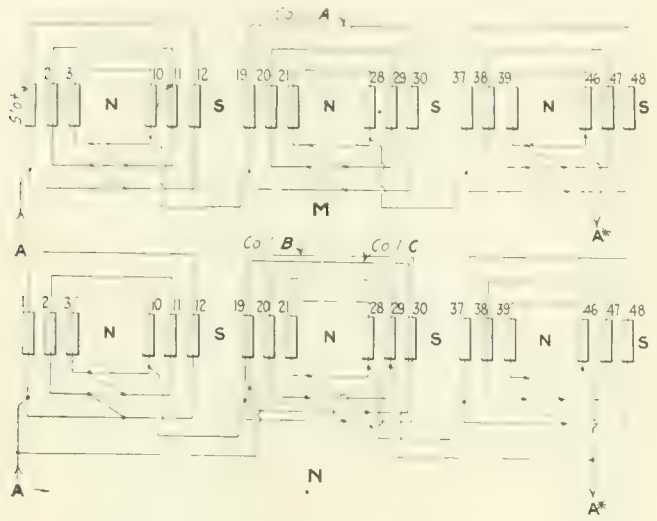
FOR adding water to batteries an old hard-rubber battery jar has proved valuable in the vehicle-battery department of the New York Edison Company. This jar is so cut as to form at one corner a neck which fits the hand comfortably. The water is poured from the opposite corner and may be concentrated in a fine stream.

This advantage and the fact that the jar is not easily broken made it preferable to the china pitcher often employed for the same purpose. Moreover, the cost may be said to be nothing as almost any shop has old jars which have been taken out of service on account of leaks, etc.

A. SHEINAUS,
Fore Battery Man, Auto Department,
New York Edison Company,
New York, N. Y.

Halving a Motor's Voltage in a Difficult Case

A METHOD of halving the voltage of a motor which saved winding a large number of coils was resorted to recently in a large New York repair shop. There were nine coils connected in series in three groups for each



TWO PARALLEL CIRCUITS OBTAINED BY REPLACING COIL *A* (IN M) WITH COILS *B* AND *C* (IN N)

phase. The problem was to divide these nine coils into two equivalent parallel paths. This was solved in the manner described in the following paragraphs.

The motor was of the squirrel-cage type and was rated at 20 hp., 220 volts, three-phase, 60-cycle, 1,120-r.p.m. It had been rewound, but in attempting to run it at no load it was found that on applying the usual 50 per cent of line voltage the motor refused to start. The voltage was then increased to the 80 per cent tap of the auto-transformer, but without any better results. Finally, after applying 220 volts with no better success, it was decided to investigate the trouble.

While connected across 220 volts and not rotating, the current in each phase was found to be approximately 20 amp., and this in itself seemed unusual, as under these conditions the current is usually in the neighborhood of three to three and one-half times rated current, which would amount in this case to about 150 amp. to 200 amp. The stator winding connections were checked and seemed to be correct. The rotor had been welded and the bearings were in good shape. The data sheet was next consulted, and this was checked against the stator winding and here the trouble was found. The stator had fifty-four slots and twenty-seven coils, concentric-wound, consisting of three pole-phase groups per phase and three coils per group, creating six poles per phase. The stator had been rewound with coils made up of twenty turns of one No. 10 double-cotton-covered wire each, connected series-star. The data sheet called for ten turns of two No. 10 wires per coil in series-star connection. It is evident that the coils were made up incorrectly, as under these conditions the motor would have had the necessary turns to operate properly on a 440-volt circuit.

Under the existing conditions the question then arose as to the best method of rectifying the trouble without entirely rewinding. It was evident that the winding would have to be reconnected two-parallel star in order to operate this motor on a 220-volt circuit. As there were nine coils in series per phase connected, as shown at *M*, it was seen that an uneven number of pole-phase groups would present a fairly difficult winding to divide into two circuits. It was finally decided to remove coil "A" shown at *M* and make up two coils of No. 10 with ten turns each and put these two coils back into the same slots, insulated from each other, to form two separate coils as "B" and "C" at *N*, this being done to the same relative coil in each of the three phases, which made it necessary to make up a total of six of these coils. The winding had 180 turns in series per phase and under the original conditions could not be divided into two equal circuits. Under the new arrangement of connections as shown at *N*, a parallel connection was obtained with ninety turns in each circuit. After reconnecting in this manner the motor was tested and was found to operate quite satisfactorily.

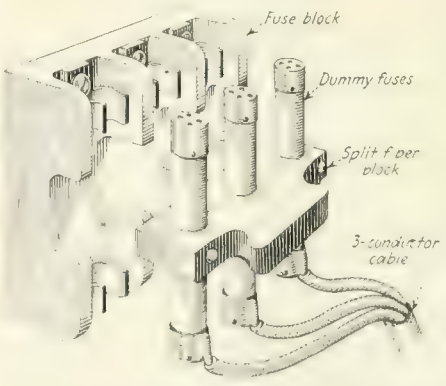
E. R. DEBMAN.

East Orange, N. J.

Non-Reversible Attachment Plug for Three-Phase Motor

FOR connecting a three-phase motor at any one of a number of locations in a Connecticut brickyard a non-reversible attachment block has been made. This is a 5-hp., 440-volt motor which operates a conveyor cable carrying bricks from the drying racks to the burning kilns, and as the work is shifted from one locality to another it is necessary to move the motor about.

If the leads become exchanged, the motor is liable to run in the wrong direction. This difficulty was overcome in a rather crude but practical manner by placing on every other post a three-pole, 600-volt inclosed fuse block about 15 ft. above ground so as to be well beyond the reach of any truck. To all these fuse blocks, eight in number, the three-wire main line is connected. A fiber block was made to clamp securely three inclosed fuses in each of which a No. 10 copper wire was soldered in place of the regular fuse and to the ferrule of each was soldered one conductor of a flexible cable leading to the motor. The fiber block is shaped to form a good grip for the hand. As the leads are all solidly connected there is no danger of reversing the motor. The line is protected by another fuse block carrying 30-amp. fuses. The leads to the motor consist of a three-wire stranded cable heavily insulated. By means of a fiber strain clamp the cable is hooked up on the post so that the pulling strain will not come on the plug connections. At the motor there are a switch and 25-amp. fuses, the cable merely making the connection to the main line.



LEADS TO MOTOR CANNOT BE REVERSED WHEN USING THIS PLUG

This one attachment plug, made up by the company's mechanic, and the eight fuse blocks cost for labor and material about $20.

H. S. RICH.

East Berlin, Conn.

Power Required for Oil-Well Drilling

THE power requirements for an electrically driven drill in use in the El Dorado oil fields of Kansas are shown in the accompanying curves. The full curve (Fig. 2) shows the total consumption for various depths, while the dotted line represents the kilowatt-hour requirement per foot of depth. The increase in power required as the depth increases is clearly shown. This is due to the weight of drilling equipment and the increased "kick" that must be applied to the line in order that the drill bit shall get its necessary rise in height from the bottom of the hole.

MATERIAL STRUCK AT DIFFERENT DEPTHS WHILE DRILLING OIL WELL—TOTAL DEPTH 2,443 FT.

Depth Drilled (Ft.)	Kind of Material Struck and Thickness of It	Depth Drilled (Ft.)	Kind of Material Struck and Thickness of It
0	10-ft. lime	1,126	27-ft. lime (hard)
10	30-ft. blue shale	1,153	3-ft. shale
40	12-ft. lime	1,156	60-ft. lime
52	20-ft. shale	1,217	9-ft. slate
72	14-ft. lime	1,227	40-ft. lime
86	121-ft. shale	1,268	50-ft. shale
207	6-ft. lime	1,319	36-ft. lime
213	73-ft. shale	1,356	25-ft. shale
286	2-ft. red rock	1,373	heavy flow gas
288	20-ft. lime	1,382	35-ft. lime
308	5-ft. shale	1,418	20-ft. shale
313	16-ft. lime	1,439	10-ft. lime
329	95-ft. shale	1,450	52-ft. shale
424	18-ft. lime	1,503	18-ft. water sand
442	53-ft. shale	1,522	47-ft. slate
495	7-ft. lime	1,570	4-ft. oil sand
502	46-ft. shale	1,574	16-ft. shale
548	19-ft. lime	1,590	15-ft. slate
567	47-ft. shale	1,605	45-ft. lime
614	9-ft. lime	1,660	12-ft. sand
623	10-ft. oil sand	1,672	6-ft. shale
628		1,678	79-ft. sand
633	7-ft. sandy shale	1,760	9-ft. shale
640	36-ft. blue shale	1,770	20-ft. lime
676	15-ft. shale	1,792	50-ft. sand
691	10-ft. lime	1,845	45-ft. shale
701	35-ft. shale	1,895	10-ft. lime
736	55-ft. lime (hard)	1,905	52-ft. shale
791	9-ft. shale	1,965	18-ft. lime
800	38-ft. shale	1,984	15-ft. shale
838	4-ft. lime	2,000	40-ft. lime
842	34-ft. slate	2,041	27-ft. sand (oil)
876	45-ft. lime	2,069	27-ft. lime
921	8-ft. shale	2,097	54-ft. sandy lime
929	30-ft. lime	2,152	142-ft. slate
959	10-ft. shale	2,297	6-ft. lime
969	10-ft. lime	2,303	11-ft. slate
979	8-ft. shale	2,314	52-ft. lime
987	4-ft. slate	2,366	2-ft. red rock
991	52-ft. lime	2,368	55-ft. shale
1,043	9-ft. shale	2,423	2-ft. sandy lime
1,049	56-ft. lime } gas	2,425	10-ft. slate
1,108	18-ft. slate }	2,435	8-ft. sand (oil)
			Total depth 2,443

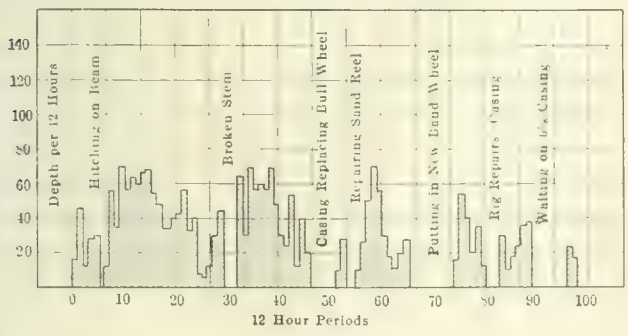


FIG. 1—PROGRESS OF DRILLING 2,443-FT. OIL WELL

Fig. 1 is a record of the progress of drilling, showing the depth drilled in each twelve-hour period. The materials through which the drill went on its downward course are listed in the accompanying table. They consisted principally of lime and shale. The actual number of drilling days was thirty-four, and sixteen days were required for repairs, making a total of fifty days. The maximum depth drilled per day was 126 ft., while the average was 72 ft. The driving motor was a 75-hp., 440-volt, three-phase slip-ring machine.

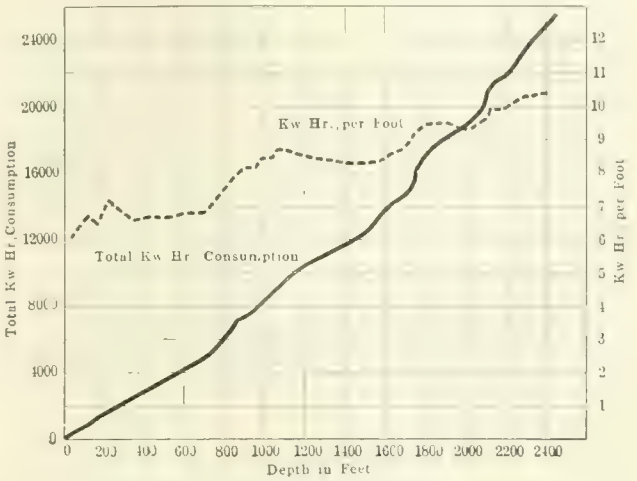


FIG. 2—ENERGY CONSUMPTION IN DIGGING OIL WELL

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Proper Fit and Correct Pressure of Brushes Help Commutation

PROPER fitting of brushes and correct adjustment of pressure are necessary to insure the longest brush life and to prevent burning commutator or slip rings. Lack of care in fitting brushes to the commutator when first installed is a common fault which has caused more brush failures than any other. The final fitting should be done with very fine sandpaper. Then, after the dust has been blown out of the machine, see that the brushes move freely in the boxes. Adjust the spring tension so that it is approximately equal on every brush, and if it is possible, run the machine without load until the brushes make good contact across their entire faces. It is not always true that a brush poorly fitted at the start will soon wear under load to form a good contact. A brush, particularly one of the carbon grades, if subjected to sparking caused by poor contact, may have its contact face so pitted that it will never wear down to a proper seat. The reason for this is plain. For instance, consider an ordinary carbon brush, rated at 35 amp. per square inch and working at 30 amp. per square inch. If the brushes are making contact on only one-fourth of their faces, the current density in this portion is raised to approximately 120 amp. per square inch, which is far beyond the carrying ability of the material. Therefore, the heat generated at these points may be sufficient to cause cratering as described.

Emphasis is placed on the need of making pressures equal on all the brushes of a machine because of the great effect pressure has on contact resistance. At a pressure of 1 lb. per square inch the contact drop, negative plus positive, of an ordinary carbon brush at 40 amp. per square inch, with a speed of 3,500 ft. per minute, may have a value of 2.2 volts, while at 3 lb. per square inch the contact drop may be only 1.5 volts. The contact resistance has accordingly been decreased in the proportion of 1.5 to 2.2. Since current divides

inversely proportional to the resistances of parallel circuits, it is readily seen how unequal the current distribution will be among brushes which have widely varying pressures. It is strongly recommended to adjust spring pressures by the aid of a small spring scale, reading the pressure at the instant the pressure arm leaves the top of the brush. A trouble which depends on this same principle is caused by operators installing more than one grade of brush on the same commutator. In general, different grades have different contact drops, hence mixing grades on the same machine will often have the same result as unequal brush tension.

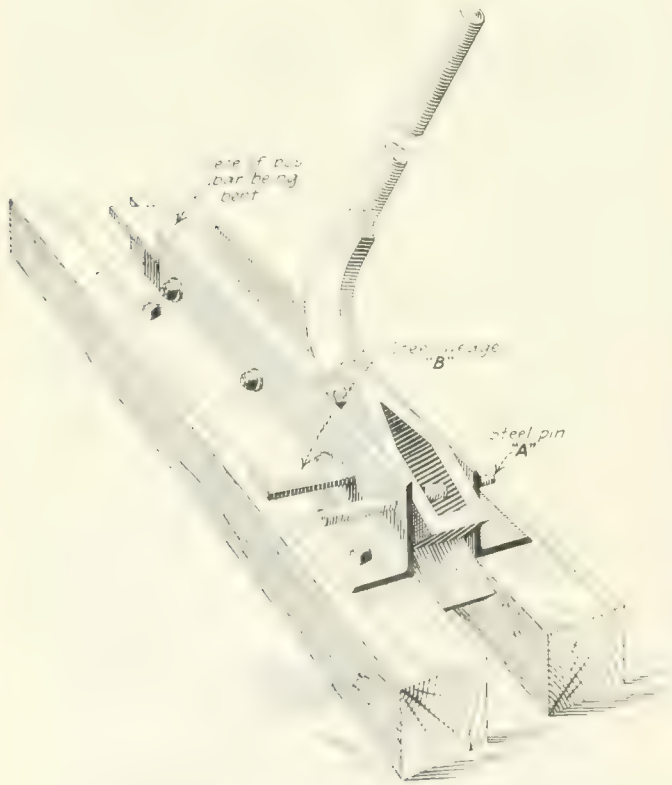
Brush holders should be set at the proper angle. Trailing brushes work best at 15 deg. or less from the radial position. Leading brushes of the reaction type should be 30 deg. to 40 deg. from the radial position.

Morganite Brush Company, New York, N. Y.

A. L. Heath, Engineer.

Busbar Bender Which Does Quick and Effective Work

A BUSBAR bender that is very speedy and at the same time makes perfect bends is shown in the accompanying drawings. By referring to the assembly drawing it is seen that the bar to be bent is laid in the bending frame and held by the steel wedge *B*, which passes through both sides of the frame. The bending lever is pivoted on the steel pin *A*, and by exerting a downward pressure on the handle of the bending lever

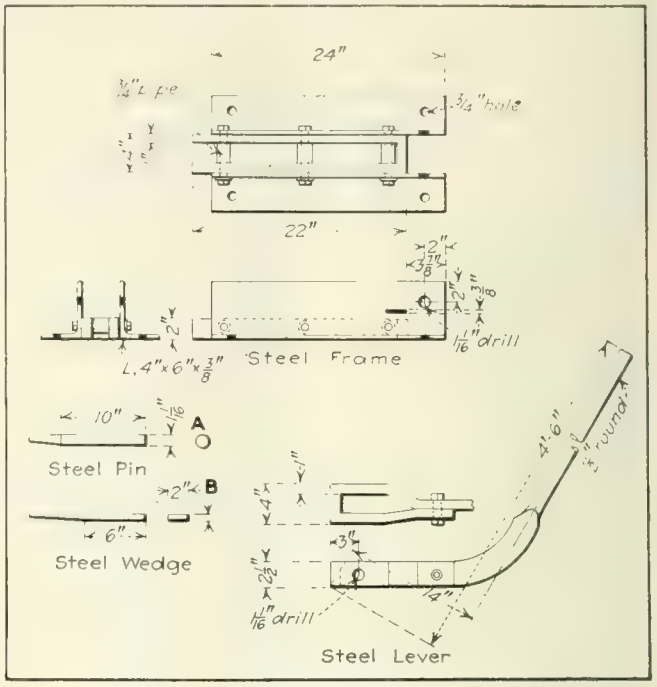


THIS BENDER WILL ACCOMMODATE BUSBARS UP TO ½ IN. X 4 IN. IN SIZE

any degree of bend can be obtained. A bender of this type is suitable for all bars up to ½ in. in thickness and 4 in. in width.

For bending busbars many devices have been developed, the most common of these being the V-block and the inverted V-block between which the bar is placed.

The pressure is usually applied with a small hydraulic jack. The great drawback to the use of this bender is the length of time necessary to complete a



DETAILS OF PARTS OF BUSBAR BENDER

bend and reset the blocks. The lever type of bender described here overcomes these objections, and after some practice even an inexperienced man can turn out good work.

R. H. N. Lockyer.

Bonnington Falls, British Columbia.

Motor Requirements for Meeting Unusual Service Conditions

MANY times the engineer of a plant in casting about for a motor suitable for an unusually severe service is somewhat at a loss to know the salient points of various types of motors with respect to their ability to survive the task of operating the exceptional drives. From experience gained in a plant using 25,000 hp. in motors it is evident that there are ways to decrease the number of motor failures by avoiding certain general features of design which have been found to create excessive maintenance charges.

In locations where carbon, excessive moisture or dust, such as soda ash, lime or caustic, which will combine with moisture to produce a low-resistance chemical solution, is present, it is not desirable to use a partly closed slot construction of the stator. An open slot, with form-wound coils taped and varnished before installation, should be used. In a partly closed slot motor the wires are slipped in the slot singly and the ends of the coils are taped up to the point where the wires enter the slot. For this reason it is very difficult to prevent carbon or chemicals from breaking down the joints of the insulation at the point of entrance.

Metallic wedges for retaining the coils in the slot have sometimes given trouble where the motor is subject to heavy overloads. These wedges are usually of light-weight material and sometimes warp out of place because of excessive heating and bind the rotor

so that the motor must be dismantled and the wedges removed.

In locations subject to an excessive amount of dust, with particular reference to dust having a high percentage of water chemically combined, it has been found desirable to eliminate the sheet-iron plates placed in the end bells for the purpose of deflecting the cooling air around the coils. The end bells should be as open as possible, otherwise the dust will build up around the coils and shut off the cooling air altogether. Too much confidence should not be placed in air ducts in stator laminations for ventilation of motors of 50 hp. and under. Usually an excessive amount of dust will clog them very easily.

For the above reasons concerning dust, and since oil and dirt cannot always be eliminated from the ordinary installation, frequently the coil ends become covered with a thick coating of dust which cannot be removed by blowing. For such an installation it has been found unwise to use a motor with a temperature rise of 50 deg. C.

On many pump drives provision cannot be made for taking care of the thrust of the pump except by the bearings of the motor. In selecting a motor for such a drive a clearance of at least 2 in. should be obtained between the rotor parts and the end bells to take care of the lateral wear of the bearings.

In motors of 15 hp. and up it is a decided advantage to have deep rotor bars designed to assist in ventilating the motor, as quite often fans attached to the spider are broken and remain unnoticed for some time. Rotor bars which are not welded or silver-soldered to the end ring give an unusual amount of trouble where the motors are subject to sustained overloads or in the presence of any oxidized dust which can find its way between the bars and end rings. Often a year will elapse before a motor will begin to show signs of a serious drop in speed, owing to high resistance joints in the rotor, but in cases where high temperatures in the motor exist for some length of time a rotor failure usually occurs in a short period.

In considering wound or slip-ring rotors it is very desirable, when the size of motor will warrant it, to use bar coils which may be taped and varnished before insertion in the rotor slots. The wire coils of more than one turn in partly closed slots are open to much the same objection as applies to partly closed slot stators in that they often fail when subject to excessively moist conditions or certain chemical materials.

Many slip-ring rotor failures may be traced to the improper application of slip-ring brushes, because the use of a brush too high in metallic or copper content invites trouble. The dust gets in between the coils and is very difficult to blow out. Sooner or later a leakage path is established by these metallic particles and a motor failure occurs. It is best to always refer such brush application problems to either the maker of the motor or the brush manufacturer for their recommendations.

The modern tendency in oil-well covers is to use a pressed or stamped metal cover secured by screws. In changing motors and when changing bearing bushing these screws seem to be invariably broken off, and it becomes quite an item of maintenance expense to tap the broken screws out and replace the missing lids when there are a large number of motors in the plant. The desirable construction seems to be a rather small opening covered by a cast lid with a substantial hinge.

In medium-size motors using two oil rings the inner ring is often put in from the inside of the end bell. With this construction, it is very difficult to maintain any sort of collar in place to seal the space between the end bell and the shaft. In the large motors it appears desirable to split the bearing housing in two halves and in the smaller motors to insert the ring through the opening in the top of the bearing housing. After one of these collars is broken, or when it cannot be kept in place, it is extremely difficult to prevent oil from being sucked out of the bearing housing by the fan action of the rotor. In many machines the oil overflow spout is not sufficiently protected from damage by belts, and when knocked off it is seldom discovered until the bearing has been ruined. Often it has been necessary to remove the oil overflows and substitute pipe plugs in order to prevent the unexpected draining of the oil well by a broken overflow.

The foot lugs of a motor should be extra strong in cases where a motor must be shifted from one location to another very often. It does not take a very severe bump to knock off a lug when a motor is slipped off a low foundation to the floor by careless mechanics. When a foot lug is broken it is very difficult to secure the motor to its foundation or sliding base, and welding is not always satisfactory. It is usually necessary to strip the winding out of the frame in order to make the weld.

It is not always possible to foresee every condition which may arise in connection with a new motor application, but by the careful selection of the proper characteristics of motor structure and design to suit the operating conditions, an endless repair bill may often be avoided. The writer believes, however, that the motor designers of today are keenly alive to the problems of maintenance and operation of their motors and are always glad to co-operate in adapting their equipment to meet unusual conditions.

St. Louis, Mo. J. ELMER HOUSLEY,
Electrical Engineer.

Lumber Stacker Decreases Cost of Handling Lumber



STACKS LUMBER 26 FT. HIGH AT LESS EXPENSE THAN HAND PILING

A SAVING of 25 to 35 per cent in the cost of piling lumber in some yards of the Northwest has been effected by the use of the lumber stacker illustrated herewith. The machine not only saves time but will pile lumber to a height of 26 ft., or nearly twice the height possible by hand stacking, thus reducing the storage area required by nearly half.

A ½-hp. motor drives two endless chains to which arms are attached at intervals for elevating the lumber. The machine is portable, weighs 1,900 lb., and the height of the towers is 30 ft. In actual operation the elevator will pile lumber at the rate of 6,000 ft. per hour. W. C. HESTON.
Portland Railway, Light & Power Company,
Portland, Ore.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Why Not Fixed Prices for Wiring Jobs?

BY KASSANDRA

IN THE old days no storekeeper had fixed prices for his goods. Then the idea came in, and today a store without fixed prices, a store where the buyer and storekeeper haggle and trade, is a sign of backward civilization. At the present time, in fact, there are very few businesses of any character that do not operate on the fixed-price basis. The utilities are obliged to do so by law, but even if they were not they would have fixed prices just the same. For imagine the New York Edison Company or the Edison Electric Illuminating Company of Boston, for instance, entering into a discussion with each customer as to the price per kilowatt-hour. As well imagine Wanamaker or Jordan-Marsh or Marshall Field operating on any but the fixed-price basis.

The utilities may have been forced by law to have fixed prices, but there is no law requiring stores to have fixed prices. The reason the big and successful stores have fixed prices is because it pays. If a store could have a minimum price marked secretly on each article and then let the salesman try to get all he was able, it could apparently double its net profit if the average mark-up were only 10 per cent. But without the fixed price, without the confidence of the customer, the overhead and cost of selling go up so fast as to wipe out all the gain. So progressive business men have established and standardized the policy of fixed prices.

The electrical industry, I believe, is suffering today because electrical wiring has not been put upon a one-price basis. The contractor still risks his profit by adapting his price to fit the job. Yet there is no real reason why a contractor cannot make a fixed price on most of his work as well as any other business man.

Some jobs, say wiring a big factory or a ten-story building, are so big that it pays to figure out each item, but this isn't true of the ordinary small jobs which make up the bulk of a contractor's business. On a hundred-dollar job the net profit, including overhead, is, or should be, something like $30. The wiring contractor can no more afford to spend time haggling over the price than a furniture dealer can afford to waste time haggling over $100 worth of furniture. With the still smaller jobs—say, for instance, the adding of convenience outlets to a house already wired—certainly there is no margin for cutting a price of $25 to suit a customer. The wiring contractor should have his fixed price for fixtures or switches, just as much as for flatirons or percolators or fuses or lamps. He may need several prices to take care of ordinary outlets (fixtures extra) and so much for a receptacle, or so much more if a new circuit is needed instead of adding the outlet to an existing circuit. He must have one fixed price for concealed work and another for wood or metal mending. The wiring and labor costs are so nearly the same that he can afford to average it, and by averaging and quoting a fixed price he can cut down the time spent in trading and haggling, and reduce his overhead but not his profit.

Let a wireman try advertising "convenience outlets put in ordinary locations at $..... each, including standard receptacles," and he will forge ahead of his haggling competitor just as the fixed-price store gets ahead of the store whose owner spends one dollar of his own time to get fifty cents in higher price. For the ordinary man would rather pay $6 or $8 for each new outlet and feel reasonably sure that this is the same price that others are paying to that wireman than to trade and haggle and pay a little less. On a fixed price he feels surer of quality. On a haggled price there is always a doubt as to whether the quality has not been skimped. A fixed price, however, does not mean that all the wiremen have the same price any more than fixed prices in groceries mean that every grocer has the same price. The high-class wireman should have a higher fixed price than the poorer wireman and can get it. He need not fear price cutting, because, although the poor wireman who announces a high price and then secretly cuts it may get one or two jobs, he will disappear just as the old-fashioned haggling store has disappeared and left the fixed-price store of today as the standard. The good store knows that some customers take more of the salesman's time than others, that some deliveries cost more than others, but it also knows that a fixed price which is the same to all pays best.

The wiring contractor, I believe, can establish a fixed price for, say, 95 per cent of his small jobs other than the repair jobs. It will pay the central-station company well to advocate this policy and aid the wiring man to work out and establish such a practice.

Why Customers Should Invest in Utility Securities

IN ANNOUNCING the plans for offering its preferred stock to customers the Atlantic City (N. J.) Electric Company issued a statement to the local newspapers explaining why its securities are a good investment. Part of the company's argument was as follows:

"Every one around here knows the Atlantic City Electric Company and every one realizes how absolutely necessary it is to the daily life of Atlantic City and to the other communities it serves. But here is a fact that most folks do not know. Over 1,400,000 citizens of the United States have invested their money in the electric light and power business—it is believed a greater number than have invested in any other class of securities except Liberty bonds.

"Why? Because the securities of the electric light and power business have proved to be safe and because the dividends have been paid regularly, year after year. Our customers and other residents may now secure such an investment on very reasonable terms."

Rural Rates Should Be Based on Value of Service

DECLARING that many existing rural lines are being operated at a loss and advocating the adoption by central stations of a rate which would be based largely on the value of the service rather than the kilowatt-hours used, N. T. Wilcox of Keokuk, Iowa, presented some interesting statements on the cost of rural service before the recent meeting of the Missouri Association of Public Utilities at Kansas City. He pointed out that in most cases an analysis of rural service discloses that cost conditions surrounding such service are materially greater than for town service.

Mr. Wilcox continued:

In reality the rural system is furnishing a valuable service and the customer is paying for a few kilowatt-hours instead of for the commodity that he is purchasing, which is a valuable service. The minimum charge exacted, if it exists at all, is absurdly small and no reflection of the actual value to the customer. Those who have grown up with the industry and have been consistent optimists and boosters are so because they realize that adequate and proper service, because of its many possibilities in practical application, is or at least may be an actual money maker for the customer as well as for the distributing company. Money can be made for the farmer even when the total charge for this service is many times the amounts popularly supposed to represent the sums possible to be obtained for rural service.

The statement that a good, well-managed, 160-acre farm in the Middle West can well afford to pay $50 per month for complete electric service at the present time may seem decidedly optimistic. But may we not venture to say that ten years hence this statement will be considered a most reasonable one? Let us consider the many practical applications of electric power to farm requirements. In the house we have lighting, cooking, refrigeration, fans and ventilation, cream separation, churning, water pumping and many other conveniences which go to lighten labor and make life pleasant. In the farmyard or about the place we may have electric power for lighting, grinding feed, sawing wood, pumping, cold storage, milking and various miscellaneous labor-saving applications where electric power is conceded to be superior to other powers.

A careful and competent analysis will reveal a possible saving of labor costs surprisingly large. It will also be discovered that in many cases the farmer can afford to pay $50 per month for service and out of his advantage still have another $50 yet for his own use as a result of utilizing this service, saying nothing of the fact that unlike labor the electric power is on the job and ready to do its part at any time during the twenty-four hours' time without a hint of strike or asking for an increased wage. The efficiency is also uniform instead of variable according to the health or mood of the laborer.

Educational work and good salesmanship, as well as common sense, together with commercial sense and energy, are required to succeed in really selling rural service. Time will also be required to develop this business, although much less than formerly owing to the general acceptance of the advantage to be derived from superior service. The point we desire to emphasize is that an opportunity is present for those men who recognize the fact that the supply of electricity to outlying and sparsely settled districts is a valuable service and to be charged and paid for accordingly. Territory must be carefully mapped out and studied in advance and careful and consistent plans of campaign laid out in order to insure success. Rates for service must be carefully considered beforehand. Inadequate hit-or-miss methods must not be tolerated. Twelve hundred to twenty-four hundred dollars per year per square mile served is all that we can probably expect from strictly farm service in the Middle West, at least so long as the farms average in size as large as at present.

Hamlets and small towns here and there will, however, tend to increase the totals. When we consider that a good-sized town, covering 10 square miles, can be made to supply an income of as high as $15,000 or $20,000 or more per square mile and at high load factor, we can readily see why the kilowatt-hour is the basis of charge in town and why the charge for service is of secondary consideration in this instance. In the country, however, we will be able to sell at most not more than 4,000 kw.-hr. or 5,000 kw.-hr. per month per square mile, probably less. It is evident from these considerations that the farmer must pay for his own transformers and meter equipment and for service—not for kilowatt-hours at the rates generally prevailing.

How shall we meet these conditions and assure an adequate and reasonable return for service rendered? It is quite evident that we cannot sell entirely on a kilowatt-hour basis, although we need a meter to check abuse and waste. It is also quite evident that we cannot read meters every month and furnish the same detail and expensive service required in town with its consequent high cost per customer. Automobile and truck service for country districts run up expense and must as far as possible be avoided. The low return per mile also means that we must have the lowest possible construction costs consistent with service. This construction must be such as not to subject the customer to any except quite unusual interruptions for the reason that the whole foundation of the business rests on satisfactory service. If we have poor lines and poor maintenance and supervision, we shall not be rendering the valuable service for which we should demand and receive an adequate return.

To allow comparatively low rates for the service we must have the best possible development of the territory served. This means intensive and energetic work so that the time required to develop may be reduced to a minimum, also satisfactory line construction such as will prove really economical in the long run and afford the satisfactory service that will be required to develop and hold the business.

Assuming that the working voltage for the main trunk lines is 33,000 and that branch lines are 6,600 volts, for the purposes of this estimate and of outlining the situation in a rough way, we approximate costs as follows:

	Per Mile
Trunk lines, including right-of-way, etc.	$3,000
Side lines	$1,200 to 1,500
Taps	1,000

In figuring costs something must be added for engineering, supervision, general and overhead expenses and interest during construction. Estimates generally lack these items, which may account for some wonderfully low estimates that have been reported.

Assuming that the territory served contains an average of four 160-acre farms per square mile and that only 50 per cent of possible customers are obtained, then the transmission-line costs, outside of allowance for generating plant, would appear somewhat as follows:

Proportion of trunk line investment per farm inside of district served	$140.00
Proportion of side lines and taps	860.00
Total	$1,000.00

Fixed charges, taxes, depreciation and interest at 15 per cent would be $150 per year, or $12.50 per month.

To this should be added at least $1 to cover patrolling and necessary meter reading. With 100 per cent development—that is with every farm served—the charge of $12.50 would possibly be reduced to $7 or $8 per month per customer, but as this cannot be expected for some time to come, the latter figure has not been used.

The above should be the minimum charge per farm before any allowance is made for kilowatt-hours used either in doing work on the customer's premises or for energy losses in lines, transformers, meters, and so forth. It is assumed also that the farmer will pay for his own meter, transformer, switch and, if necessary, lightning arresters, as well as for all lines on his own premises. In totaling these figures we are assuming a capacity of 5 kw. per customer and that each customer would require about 36 kw.-hr. per year for meter and transformer losses. In this

case we have assumed 1,200 kw.-hr. per year per kilowatt of capacity, or 6,000 kw.-hr. per year for each customer.

A summation of the above figures, together with kilowatt-hour figures for each customer, gives transmission-line charges of $150 a year plus $300, the price of 6,000 kw.-hr., at 5 cents per kw.-hr., or a total charge of $450 a year or $37.50 a month.

A 5-cent rate has been assumed, but this rate will vary materially for different locations. How many farmers are paying this amount? If they are not paying this amount, how much are we actually losing on this kind of service when we charge only $2 to $5 per month minimum?

This paper has been written in the hope that it would serve to bring out the important difference between farm service and city kilowatt-hour charges and to emphasize the fact that rural distribution is essentially based upon a valuable service—not on kilowatt-hours sold. Those who have analyzed these problems, especially as to costs, will realize the necessity of education and helpful suggestions. Well-constructed, not necessarily expensive, distributing lines, if periodically and intelligently inspected, entail comparatively low costs for patrolling and inspection and are most economical. Good construction always means low maintenance. This remark especially applies to the high-tension insulators. The 33,000-volt trunk lines, if used, will of course require more attention than the lower-voltage distributing lines, but if good construction and high-grade insulators are used—say a 50,000-volt insulator—this attention should be comparatively small.

From the nature of things most rural lines must be financed by the people benefited. Generally speaking, many lines are too poorly constructed and maintained to be worth more than the amount usually charged to the customer, but in this discussion of the problem we are considering a businesslike plan which will insure continuous service and which will be profitable alike to the customer and to the company furnishing the service. The mistake made by the average company supplying rural service is in failing to appreciate the fact that the service has a definite and appreciable value which, if properly demonstrated, will result satisfactorily to all concerned.

Central-Station Office Fits Local Architecture

THE thick adobe walls and mission bells of New Mexican architecture are followed in the design of the office of the Santa Fé (N. M.) Water & Light Company. Although the building has no show window,



UNUSUAL DESIGN OF CENTRAL STATION OFFICE AT SANTA FÉ, N. M.

this apparent disadvantage is offset by a display of appliances arranged in the front part of the general office space, where customers paying their bills are reminded of the advantages of electric service.

Illuminated Directory for Central-Station Office

AN ATTRACTIVE illuminated directory is installed at the offices of the Narragansett Electric Lighting Company, Turks Head Building, Providence, R. I., directly opposite the elevator entrances to the company's headquarters. It is designed in panels, with raised letters indicating the room numbers and titles



ATTRACTIVE OFFICE DIRECTORY OF PROVIDENCE COMPANY

of various officials and the locations of departments and divisions. Art glass is used behind raised glass letters, with a total installation of 156 25-watt, 250-volt lamps, set in troughs of six outlets each, back of the glass, to give uniform distribution. Directional arrows are provided in red and room numbers in green, the names of officials and departments being in clear glass backed by white glass. Apart from its directional usefulness it affords a dignified and effective advertisement of the company to passengers using the elevators of the building.

Public Utility Good Will Through Public Schools and Libraries

OFFICIALS of the Indiana Public Utility Association have started an educational campaign through the high schools and the public libraries of Indiana. Work now has been started on the compilation of a series of pamphlets which will describe separately the public utilities of the state. The first pamphlet will deal in a general way with the development of public utilities as a whole. The remaining seven will tell more in detail of the various utilities. Each pamphlet will go into the history of the public utility in question, giving data on its growth, and other information regarding its development from the time of the organization of the first plant until the present time.

Letters were sent out recently to 204 public libraries and 128 high schools asking if they cared to put the pamphlets in their institutions. Three days after the letters had been sent eighty-six replies were received from the libraries and fifty-eight from the high schools, and they all were favorable.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Developments in Conversion Apparatus for Edison Systems.—T. F. BARTON and T. T. HAMBLETON.—A detailed comparison is made between the characteristics of a field-controlled and a synchronous-booster type of converter as follows: (1) The field-controlled type is said to have higher efficiency. (2) Successful commutation over the voltage and load range of the field-controlled converter is obtained without the use of relays or special rheostats. (3) Better ventilation and accessibility are points in favor of the field-controlled converter. (4) Cost is in favor of field-controlled converter for a voltage range not to exceed 10 per cent (5 per cent above and below). (5) Saving in floor space is in favor of the field-controlled converter. (6) The synchronous-booster converter allows operating at unity power factor at the collector rings over its range of voltage; also it can be designed at additional cost to hold unity power factor at the transformer primary. (7) The synchronous-booster converter can be designed for a large voltage range, while the field-controlled is limited to approximately 10 per cent. (8) When starting from the direct-current side it is not possible to change the alternating voltage of the field-controlled converter for synchronizing, and the direct-current supply should be shifted immediately before closing the alternating-current circuit. This method of synchronizing is desirable on the synchronous-booster converter as well. (9) The field-controlled converter is characterized by simplicity. The synchronous booster may be excited either by direct current in the field coils or by reactive current in the armature. The field winding may therefore be omitted and the field structure somewhat reduced. It is not practicable to furnish as much excitation through the armature as through the field windings, and therefore this type of booster has a smaller voltage range. A type of converter called by the authors "dynarotor" is a machine in which alternating-current and direct-current windings, electrically separate, are placed on one core. The application of motor generator sets to three-wire Edison systems is also discussed, and it is said that converting apparatus lends itself readily to automatic operation. The author suggests that automatic operation might readily be extended on three-wire systems.—*Journal A. I. E. E.*, March, 1921.

Generation, Transmission and Distribution

Mechanical Calculation of Overhead Lines.—There are a great many different methods known for the calculation of the mechanical strength of overhead lines. Most of these methods have been carefully investigated by the French technical commission, and their investigation has resulted in the adoption as standard of the methods and formulas given in this article. Bearing in mind the customary temperature limits, wind pressures and additional forces, a formula is given to determine maximum span and sag. Then follows detailed information for the approved calculation of wooden poles, concrete poles and towers. The section on reinforced-concrete poles is very interesting and complete. Such a collection and adoption of standard methods of calculation, where there is more than one way to reach the result, must be of great help in progressing toward complete standardization.—*Revue Générale de l'Electricité*, March 12, 1921.

The Frequency Problem in the Steel Industry.—B. G. LAMME.—The standard frequency of 25 cycles for steel-mill plants was adopted, the author says, many years ago, when the conditions were such that this frequency more nearly met the steel-mill requirements than was possible with 60 cycles. With the coming of large central stations for the general supply of electric service of all kinds the frequency of 60 cycles has come into more general use. In consequence, in considering the purchase of power from the large supply companies, the steel mills are now confronted with the problem of utilizing 60 cycles to best advantage in plants which were initially designed for 25 cycles. Various possibilities for utilization of 60 cycles in such plants are given, and the advantages and disadvantages of each are discussed briefly. It is recognized that the whole matter is too complex and contains too many varied elements to allow an entirely satisfactory general solution.—*Journal A. I. E. E.*, April, 1921.

Traction

Economic Aspects of Railway Electrification.—A. H. ARMSTRONG.—The author considers the electrification of railways from the point of view of a possible remedy for the difficulties now confronting rail transportation. —*Journal of Franklin Institute*, April, 1921.

Installations, Systems and Appliances

Regulation of Electric Steel Arc Furnaces Using Movable Electrodes.—W. G. MYLIUS.—A discussion of the difficulties of operating arc furnaces for melting steel, particularly when melting cold scrap. and of the kinds of arc current regulators which have been devised to maintain some function of the power input constant, such as current, voltage, watts or a combination of these. Difficulties caused by the weight and inertia of the electrodes are considered and the phenomena of "hunting" is explained. A new form of electrode regulator is described and illustrated which will operate with greater precision and at higher speeds than previous types and thus overcome the difficulties of "hunting."—Paper presented before American Electrochemical Society, April 21, 1921.

Electric Furnaces for Non-Ferrous Alloys.—H. W. GILLETT.—A tabulation in great detail of all the electric furnaces now in operation in the United States melting non-ferrous metals, giving the kind of furnace, users and capacity per heat. There are 323 in 144 different plants, with a capacity of 193 tons per single heat and

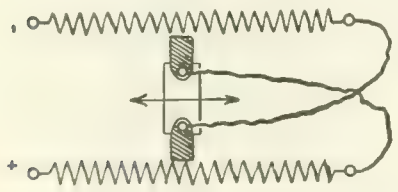
using 42,350 kw. The article also tabulates the composition of the alloys worked in the different furnaces and the special work for which each type of furnace is best adapted and discusses briefly the construction, advantages and disadvantages of each type.—From paper presented before American Electrochemical Society, April 21, 1921.

Electrochemistry and Batteries

A New High-Capacity Storage Battery.—C. W. Hazelett.—Description of a very thin-plate storage battery having about three times the exposed surface per pound of material compared with any other commercial battery. The electrical output per unit weight of lead and active material is 50 to 200 per cent higher than that of the standard types, and it is less subject to mechanical defects and variability. Batteries may be rebuilt by shipping charged elements wrapped in paper, the separators between the plates not allowing them to dry out in transit.—From paper presented before American Electrochemical Society, April 21, 1921.

Units, Measurements and Instruments

Resistance Regulators with Saving in Resistance Material.—R. Richter.—In the usual method of voltage or current regulation by means of variable amounts of resistance cut into the line, parts of the resistance material are cut out or short-circuited, so that some of the material is idle. The ratio of unused to used



RHEOSTAT FOR UTILIZING ALL OF THE RESISTANCE MATERIAL

resistance becomes greater when the limits of regulation become wider. Consequently the heating of the resistance is always localized to a certain portion of all the resistance used in the regulator. The arrangement is, therefore, inefficient. The new method described in this article divides all the available resistance into two or more equal branches, and the contacts are so arranged as to permit of a gradual change from series to parallel connection of these branches, using always in every position of the lever or glider *all* the resistance material. The number of necessary contacts is twice the number in the usual method, but they carry less current. For three-phase regulation a better use of the resistance material may be obtained by arranging the contacts to change gradually from delta to star connection. To still greater advantage this method of regulation may be used for tap connections on transformers or generators by substituting parts of the windings for the resistances.—*Elektrotechnische Zeitschrift,* March 10, 1921.

Explanations of the Stroboscopic Method of Slip Measurement.—C. Breitfeld.—This short article explains why in many cases the method of determining the frequency or the percentage slip of a motor which consists in illuminating a sector painted on the shaft of the generator or motor by an arc light fed by the same circuit does not give actual values. Two such cases are mathematically explained. Besides taking certain arithmetical precautions, the author says that it is essential to use in the arc lamp two absolutely identical carbons; otherwise an electric valve action is likely to take place, giving only half the actual value. This is of such great importance that the author suggests using always two halves from one carbon rod.—*Elektrotechnik und Maschinenbau,* Feb. 27, 1921.

Telegraphy, Telephony and Signals

Repetition of Signals on Locomotives.—F. Limon.—A system used by the French State Railways is described which gives the engineer a warning signal and also makes a record of it if he passes a closed semaphore. The transmission is operated by wireless waves emitted from a stationary signal post at the side of the track, which in turn is operated by a rail contact set in conjunction with the semaphore. A short horizontal antenna is installed at the signal post and at the two sides of the locomotive. A small spark coil and gap is used as a wave generator. The detector is of the coherer type.—*L'Electricien,* March 15, 1921.

New Type of Condenser Antenna.—S. R. Winters.—The practical use of a condenser antenna is particularly adapted to wave lengths below 400 m. as shown by the radio-communication section of the Bureau of Standards. In some cases the condenser antenna assumes the form of an extensive screen. Directional characteristics of this type of antenna are also discussed.—*Wireless Age,* April, 1921.

The Lafayette Radio Station.—S. C. Hooper.—A description of the high-power radio station built by the American Navy Department near Bordeaux, France, and later turned over to the French government. The principal engineering features of the station are eight self-supporting steel towers, each 820 ft. (250 m.) in height, the antenna system and the transmitting equipment consisting of 1,000-kw. arcs complete in duplicate. The Poulsen type of arc equipment is used and the "L" type of antenna, consisting of No. 3 silicon-bronze cable, has been installed.—*Electric Journal,* April, 1921.

Carrier Current Telephony and Telegraphy.—E. H. Colpitts and O. B. Blackwell.—This paper briefly outlines the history of the development of carrier multiplex telegraphy and telephony. The fundamental principles underlying particularly the newer developments of the art are then discussed. Consideration is likewise given to the propagation characteristics of open-wire lines, including those containing intermediate lengths of cable. Commercial types of apparatus and actual installations are described and a brief statement is made as to further applications of the art.—*Journal A. I. E. E.,* April and May, 1921.

The Heterodyne Receiver.—J. V. L. Hogan.—The heterodyne receiver is said to make use of a local source of energy which is combined with the signal-producing effects of the received electromagnetic waves, which may be amplified for ready interpretation. This system is ascribed to Fassenden and the present development of the device is described.—*Electric Journal,* April, 1921.

A System of Railway Traffic Control by Telephone.—T. F. Lee.—The author deals particularly with the control of freight traffic, asserting that the telegraph control at one time almost universally employed is gradually giving way to various control systems depending on telephones. He says that especially efficient instruments and various forms of signaling from one instrument to another have been developed for this purpose. These instruments are described in the article.—London *Electrician,* April 1, 1921.

Books of Technical and Industrial Interest

DAS KUGELPHOTOMETER. By Richard Ulbricht. 110 pages, 34 illustrations. Munich: R. Oldenburg.

This book gives a full historical account of the development of the use of the hollow-sphere photometer, together with complete mathematical derivations of formulas used for measuring light intensities with such apparatus. The author, being the inventor of the widely used sphere photometer, was honored by the V. D. E. in that his name has been linked with the method he devised, standardized for all light measurements on arc lamps in 1907 ("Ulbricht'sche Kugel"). In ten chapters the subject has been covered very thoroughly. Detailed directions are given on the proper painting of the interior of these spheres, based upon mathematical conclusions and practical experience.

THE STANDARD ELECTRICAL DICTIONARY. By T. O'Conor Sloane. New York: Norman W. Henley Publishing Company. 768 pages, 477 illustrations.

This is a new and enlarged edition of a well-known electrical dictionary. A new section has been added in alphabetical order, so that the reader who does not find the term he seeks in the main section can often find it in the added section. This plan has enabled the volume to be enlarged without recasting all the original material, a great economical advantage in these days of heavy printing costs. The total number of words and terms defined in the book is about 4,000. A large amount of work must have been expended in their accumulation. There are two kinds of electrical dictionaries; namely, those adapted to the needs of technical readers and those adapted to the needs of non-technical readers. This book belongs mainly to the second kind. It will, however, be of service to the electrical public as well as to the general public.

READINGS AND PROBLEMS IN STATISTICAL METHODS. By Horace Secrist, Ph.D. New York: Macmillan Company. 427 pages.

An interesting and useful volume written by a real authority on the subject. Intended primarily as a textbook and laboratory assistant, it presents the various statistical methods in a simple manner, rendering the work suitable for general use as well as for the classroom. The book was written to be used in conjunction with the author's "Introduction to Statistical Methods," but either of these volumes may be used separately or for general purposes. The first portion of the book is an interesting explanation of the meaning and application of statistics and statistical methods. The explanations are entirely practical and drawn from busy industrial life. Following this is a study in the collection of statistical data. The discussion of questionnaires and points to be considered in their use is especially applicable to the electrical industry. If every questionnaire sent to this industry were studied carefully in accordance with the directions given in this book, valuable data would be gained at a minimum of time and expense. Tabulation and analysis of the collected data take up the third portion of the book. The last 100 pages consist of an almost entirely theoretical discussion of averages, dispersion, "skewness" and correlation. Perhaps one of the most appreciated additions to the volume, from the standpoint of the laboratory instructor, is the list of review questions and problems which concludes each chapter.

SPACE AND TIME IN CONTEMPORARY PHYSICS. By Moritz Schlick. New York: Oxford University Press. 88 pages.

This is a good translation of a well-known book on the Einstein theory, written from the philosophic viewpoint. The author supports Einstein in the proposition that the world is a four-dimensional space-time manifold, and that the geometry of this world is non-Euclidian. He goes on to present the doctrine that force has no real existence in our world. In particular, there is no such real thing as gravitational force. Bodies only appear to be attracted toward the center of the earth and toward one another. They really are moving freely in distorted or non-Euclidian space, and it is the distortions of the space in the neighborhood of matter which give rise to the observed gravitational phenomena. Moreover, space is not infinite but is limited in a specific manner, the volume of the total world space being a very large definite number of cubic centimeters. This Einstein doctrine is presented in a very plausible manner. From a purely mathematical standpoint it has much to recommend it. From a philosophical standpoint it has also many advantages. From an engineering standpoint it offers many difficulties in the way of realization. Yet one has no right to deny a hypothesis merely because it is difficult to visualize. The book presents the arguments of a mathematical hypothesis with the minimum amount of mathematical symbols.

ENGINEERING ELECTRICITY. By Ralph G. Hudson. New York: John Wiley & Sons, Inc. 190 pages, 288 illustrations.

An excellent elementary textbook of electrical engineering, particularly with reference to the generation and distribution of power by electricity. The book has been prepared primarily for technical students not specializing in electrical engineering, but it may also serve as an introductory text for electrical engineering students. The illustrations are mostly diagrammatic. The illustrations of apparatus and machinery are grouped together at the end—a somewhat novel procedure which has certain advantages. The mathematical treatment is of the engineers' type. That is to say, elementary calculus is utilized as a descriptive device only. The excellent rule is followed of having the unit in which each equation is expressed written along with and immediately after the equation. This makes the formulas much more easily grasped. The work is divided into seventeen chapters on the following subjects: Direct-current circuits, electromagnetism, electromagnetic induction, the direct-current dynamo, direct-current measurements, alternating-current circuits, alternating-current measurements, three-phase alternating currents, the alternating-current transmission line, the synchronous generator, the synchronous motor, the synchronous converter, the mercury-arc rectifier, the transformer, the three-phase induction motor, the alternating-current series commutator motor, illustrations of electrical apparatus and tables. The treatment is clear and logical, and a good index completes the book.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Convention Plans Rapidly Nearing Completion

PLANS for the National Electric Light Association convention are rapidly shaping up. A large number of papers and reports are now in the hands of the printers and already quite a few have been printed. Some of the reports this year are very voluminous, especially the report of the committee on prime movers, which will probably exceed 400 printed pages.

Some places in the program which appeared in last week's issue of the ELECTRICAL WORLD, page 1065, not then definitely arranged for have been filled. It was announced this week that James A. Perry, president of the National Association of Railway and Public Utility Commissioners, and E. I. Lewis, newly appointed member of the Interstate Commerce Commission and formerly of the Indiana Public Service Commission, would deliver addresses on topics of their own choosing at the general sessions.

Some Large Financing by Electric Utilities the Past Week

DURING the past week three electric light and power utilities did some very large financing.

The Philadelphia Electric Company disposed of the unsubscribed balance of a five-million-dollar issue of 8 per cent preferred stock at par.

The Connecticut Light & Power Company brought out $6,500,000 of first and refunding mortgage 7 per cent sinking-fund gold bonds, series A, and due in thirty years, at 95, yielding 7.4 per cent.

Approximately 8 per cent is the yield on the five-million-dollar issue of the Milwaukee Electric Railway & Light Company twenty-year 7½ per cent refunding and first mortgage gold bonds, series A, which came out this week.

Utah Supreme Court Denies Rehearing in Special Contract Case

THE Supreme Court of Utah has denied the application of the Utah Copper Company and seventeen other large users of electric power for a rehearing in connection with its decision on Feb. 25 sustaining the Public Utilities Commission of Utah in the special contract case, whereby all existing special power contracts of the Utah Power & Light Company customers in Utah were declared discriminatory and ordered placed on standard schedules. The case was appealed to the Supreme Court by the consumers on the ground that the commision had no authority to change any of the terms of the contracts because they were entered into prior to the creation of the commission.

In denying the rehearing the court made it plain that it was not deciding as to the fairness of the rates, but as to the right of the commission to change the terms of existing contracts. The denial of the rehearing leaves the way open for appeal to the United States Supreme Court.

The Supreme Court of the state has issued to the Utah Copper Company a writ of review of the proceedings of the commission leading to the increase of the power schedules of the Utah Power & Light Company. The Utah Copper Company is the power company's largest consumer. It is expected that other large consumers of power will also join in the proceedings.

Exemption of Utility Securities from Federal Taxation Urged

PROHIBITION of the issuance of tax-exempt government issues so as to enable regulated industries to dispose of their securities and raise badly needed money was declared vital to the lives of public utilities by Philip H. Gadsden of Philadelphia in a statement on revision of federal tax laws made last Tuesday before the Senate finance committee. Mr. Gadsden appeared as chairman of the joint tax committee representing the American Electric Railway Association, the American Gas Association and the National Electric Light Association. He declared emphatically that public utilities do not seek to evade taxation but merely desire better conditions under which to market their securities that they may be able to provide badly needed extensions and betterments for their properties.

Since public utilities are regulated as to operation as a class and compelled to give service at fixed prices regardless of economic conditions it is only fair, he declared, that they be considered as a separate class in legislation governing taxation. He urged the appointment of a special sub-committee to make a thorough study of the public utility tax situation.

Two features of the securities situation on which Mr. Gadsden laid especial emphasis are that persons upon whom public utilities must depend very largely for new money—those subject to a surtax of over 3 per cent—no longer will buy public utility securities because they find tax-exempt 5 per cent government securities better investments.

Moreover, the only persons who under the present tax laws find it profitable to buy public utility securities are those whose incomes are less than $10,000 a year. Their combined savings are only $116,000,000, or about $1,884,000,000 less than is required annually by the public utilities, including steam railroads, electric railways, gas, electric light and power plants to make their betterments and extensions.

"The most serious question which confronts public utilities," Mr. Gadsden said, "is their inability to secure the necessary new capital required by them annually in competition with tax-exempt municipal securities. Owing to the high income tax and surtaxes an anomalous situation has been brought about where a municipal bond bearing 5 per cent will yield a greater

return to the investor than a public utility security would pay. It can be shown that a taxpayer or an investor who pays a surtax of over 3 per cent cannot afford to invest his money in public utility securities in preference to municipal securities. In other words, only that class of investors in this country who have an income not exceeding $10,000 can under our present tax laws afford to invest their savings in public utility securities.

"Under the law public utilities are limited to a return on their investment of not over 8 per cent. It is clear, therefore, that they cannot issue securities agreeing to pay more than that amount for any long time. Unless they can pay over 8 per cent they cannot compete with exempt municipal and state securities. The result of this situation is that inevitably these extensions and betterments cannot be made. Service would slow down and become unsatisfactory and there would be a growing demand on the part of the public for the acquisition of these utilities by municipalities on the ground that they could borrow money at not over 5 per cent. In other words, while the political policy of this country is firmly and definitely opposed to municipal and government ownership of utilities the taxation policies of our government are forcing it whether we want it or not. Unless this policy of exempting municipal securities is discontinued we shall rapidly drift into practical socialism, which in its essence means ownership of everything by the public.

"Now, what is the answer? The answer is that, first, we should follow the advice of Secretary Mellon in his recent letter to the chairman of the ways and means committee and forbid the issuance of any more tax-exempt securities by anybody."

Arkansas Utilities Men Consider Education of Customers and Efficient Combustion

ADOPTION of methods to familiarize the public with the plans and the operating routine of the utilities serving it was advocated before the opening session of the Arkansas Utilities Association at Hot Springs, Ark., on Wednesday, by J. E. Farnsworth, vice-president of the Southwestern Bell Telephone Company, who declared this to be one of the best tools that can be used in a campaign of education. He asserted that the old idea that courtesy costs nothing was an error and that the motto of "Never do something for nothing" was a serious mistake. Courtesy costs time and effort and in many cases direct expenditure of money, while the items of service that bring no direct return in money are an important part of the work of every utility. Both are duties that every utility owes to the public that it serves, and the effort is paid for in public good will that means more than money returns. Mr. Farnsworth said that the training of a few individuals in an organization in public relations methods was not sufficient. Some way of passing the specialized knowledge of the few through the entire organization must be developed. Employees must be educated in the essentials of the business to impart to them an interest that cannot be expected if they know only their own particular job. Disloyal employees must not be tolerated. Supervising employees must keep in close touch with public officials and take part in all public activities.

W. G. Shurgar of Little Rock discussed efficient fuel combustion, placing the responsibility for inefficient use on the manager of the plant, the superintendent and the fireman. The manager is to blame for not seeing that efficiently designed plants are supplied and then for not insisting that efficient operation is insured. The superintendent is responsible for not knowing all possible sources of waste and for the lack of constant checking to know that waste is being prevented. Intelligent men must be obtained for the firing force, because the work is not common labor but a chemical operation requiring intelligence to carry out. Items of loss can be audited, and Mr. Shurgar urged the establishment and careful maintenance of detailed records that would reveal the wastes that occur. Discussion brought out the importance of keeping boilers clean and all equipment in first-class condition.

The convention continued through Thursday, and on Friday and Saturday the association joined the first annual convention of the southwestern Geographic Division of the National Electric Light Association, of which the Arkansas association is a part.

Co-operative Municipal Development of Water Powers Voted Down

THE California Legislature has killed a bill which was intended to permit municipalities to band together in the development of hydro-electric power. This privilege was desired by several groups of California cities which wished to join together and develop some of the available water-power sites in the high Sierras and distribute the power among the cities contributing to the financing.

Although this bill has been defeated at this time, there is every likelihood that it will again be called up as there are many municipalities in California officials of which are anxious to undertake municipal ownership of the local power systems. The proponents of this measure have pointed as an example to the city of Los Angeles, which has already developed some power sites and which is active in plans for further developments, particularly on the Colorado River.

Jobbers' Hot Springs Program of Broad Nature

ARRANGEMENTS for the annual convention of the Electrical Supply Jobbers' Association at Hot Springs, Va., have been completed. An interesting program has been prepared and includes the following papers of broad interest: "Co-operative Methods in Upbuilding the Industry," by M. H. Aylesworth, executive manager National Electric Light Association; "Looking Forward," by W. L. Goodwin, assistant to the president of the Society for Electrical Development; "Does the Electrical Jobber Have Any Responsibility in the Safety Movement?" by Andrew MacLachlan, secretary of the Square D Company; "Co-operation," by Herman Plaut, representing the Illuminating Engineering Society; "The Straight Path," by Samuel A. Chase of the Westinghouse Electric & Manufacturing Company, and "The Romance of Niagara's Electric Power," by George S. Anderson of the publicity department of the Niagara Falls Hydro-Electric Development Company.

An open meeting will be held May 25 and meetings of the various divisions and a general meeting will be held on the following days. On May 27 there will be held a general meeting at which the work of the association will be discussed.

Units for Wire and Cable Literature

WITHOUT attempting to standardize, the sub-committee on wires and cables of the A. I. E. E. standards committee has taken a vote of its members to show their preference in the matter of units used in wire and cable literature. The sub-committee was of the opinion that it would be undesirable to attempt to standardize in such a matter on the basis of opinions expressed by its members only and thought it would be better to extend the inquiry before coming to a decision. The result of the ballot is as follows:

Metric units should be used for thermal properties and dielectric stresses as follows:

Temperature	C°
Heat resistivity	C° per watt-cm.^{3}
Heat conductivity	Watts-cm.^{3} per C°
Heat resistance	C° per watt-cm.
Heat conductance	Watt-cm. per C°
Dielectric stress	Kilovolts per cm.

The thickness of insulation should be expressed in sixty-fourths of an inch.

Dielectric losses should be expressed in watts per foot.

The megohms and capacity constants should be based upon 1,000 ft.

Mechanical properties such as tensile strength and elongation should be expressed in pounds and inches.

More Changes in California Railroad Commission

THE resignation of F. R. Devlin as president of the California Railroad Commission has been announced and became effective May 1. To replace Mr. Devlin the Governor has appointed H. S. Benedict, at present a member of the State Board of Control. The chief hydraulic engineer of the commission, C. H. Loveland, also tendered his resignation, which took effect May 1. With these changes the personnel of the commission will be materially different from that of last year, as on Jan. 1 C. H. Powell was appointed to take the place of President E. O. Edgerton and during the last two months G. S. Jacobs, assistant chief engineer, also resigned.

Mr. Devlin had been president of the California Commission since the retirement of Mr. Edgerton and had been a member of the commission for six years. He has retired to resume the practice of law. Mr. Loveland had been with the commission for the last seven years and during that time was active in matters relating to domestic water and irrigation projects. He will enter private practice as a consulting engineer in projects involving the development of the state water resources.

Very Little of Idaho Power Possibilities Developed

NINETY-FOUR per cent of the undeveloped water power of the State of Idaho is controlled by the federal government through its ownership of lands which will be affected by its development, according to a statement recently made by W. R. Putnam, vice-president and general manager of the Idaho Power Company. Mr. Putnam said that Idaho has a potential water power of 6,110,000 hp., of which approximately only 100,000 hp., or 1.6 per cent, has been developed.

"Almost all of the developed hydro power in Idaho has been developed in the southern part of the state," he said. "In that portion of southern Idaho starting at American Falls on the east and extending to the northwest corner of the state, where the Snake River leaves the state, there has been developed 66,700 hp. The ultimate capacity of the power developments that can be made on the Snake River between these two points is in excess of 400,000 and probably amounts to 500,000 hp., so that about 15 per cent of the total power in this immediate territory that can be developed is now developed and utilized.

"The use of hydro power in this portion of Idaho doubled in the three years from 1907 to 1910. It again doubled from 1910 to 1915, and has doubled once more in the years since 1915, and a careful study indicates that the normal use of power in this territory will again double in the next nine years, and that at the end of that period there will be approximately 70 per cent of the total power possibilities of this immediate territory unused."

Steel-Mill Power Costs Distributed on Machine-Hour Basis

ELECTRIC power costs are distributed on a machine-hour basis at the plant of the Tioga Steel Company, according to a statement made by W. H. Boyce in a discussion of "Power Distribution in Industrial Plants" at the May 7 meeting of the Philadelphia Section, Association of Iron and Steel Electrical Engineers. Departmental requirements are metered, and the distribution is arrived at by taking the connected horsepower for each department, and with the running hours as a basis the final percentages of the consumption are figured.

Records of motor failures classified and checked against departments have been found helpful in maintaining departmental electrical efficiency, R. B. Gerhardt, Bethlehem Steel Company, asserted in his discussion of record forms.

Other subjects which were discussed at the meeting were: "Resistance Materials," by Walter Kennedy, Worth Steel Company, and "Dynamic Braking for Crane Motors," by G. W. Richardson, American Bridge Company.

Officers elected for the coming year were G. H. Schaeffer, Carpenter Steel Company, chairman, and W. C. Kennedy, vice-chairman. This meeting was the last technical session of the Philadelphia Section until fall. The annual outing will take place on June 4 at Valley Forge.

Comprehensive Foreign Trade Program Urged

EVERY phase of the world's export business is covered in the foreign trade program unanimously adopted last week at Cleveland at the close of the eighth annual convention of the National Foreign Trade Council. Copies of the program were sent to President Harding, members of his Cabinet, senators and representatives.

Credits, exchange rates, taxation, tariffs, the merchant marine, domestic transportation, consular service, parcel post and numerous other things are discussed in the program, which is really a composite of all of the recommendations of the four days of the convention.

The United States is a creditor nation and must import heavily, the program declares. There must be

created adequate facilities for drawing upon surplus American investments in order to furnish long-term credits. The creation of financial institutions under the Edge law to facilitate extension of long-term credits is urged.

Substantial reductions in the cost of living are declared to be essential if production costs are to decrease to the point where American goods may again compete in price with foreign goods.

The program voices its appreciation of the work of trade publications and the daily press in the dissemination of accurate foreign news.

Colorado Federal Court Insists that Public Does Not Own Utilities

WHAT might be regarded perhaps as an ultra-conservative view of the property rights of public utilities as opposed to the view that they are the creatures of the public, which may bend them to its will, was taken by the United States Court of the District of Colorado in a recent decision by which it granted to the Denver Tramway Company an 8-cent fare, or 2 cents more than the fare allowed by city ordinance, and enjoined the municipal authorities from interfering with the collection of the higher rate.

"The property that is in these street-car lines, electric light plants, telephone systems and other utilities is as much the property of the stockholders as a man's house is his property, and the public has got to leave it alone. They must treat it fairly and the courts are here to see that they do," the court said. "The public doesn't own that property any more than I own your coat. The only right and power it has over the companies is to regulate the rates after they are authorized to do business, and in that regulation the public has got to act judicially and fairly and allow the public utility a fair return on its investment.

"We have got to get away from this idea that has been planted in the public mind that because there is a street-car system in our town or an electric light system the public can take it and use it just as it pleases. It is pure destruction; it is anarchy; it is an utter disregard of the rights of property, and this government cannot continue on the cultivation of any such fundamental error in the minds of the people."

Illinois Commission Bill Before Legislature

AN INCREASE in membership and an increase in salaries are two of the important developments in the Illinois Public Utility Commission situation. These developments became known when the main features of the administration bill to carry out Governor Small's campaign pledges were recently made public. The title of the commission under this bill would become the "Illinois Commerce Commission," and the body would consist of seven members as against the present five. Salaries would be $7,000 per year.

The commission would be forbidden to abrogate franchise agreements between a municipality and a utility if such agreements were made as a consideration for the franchise. Standards of service would be fixed, and in case of failure to meet such standards utility rates could be fixed on the quality of service furnished.

At any general election, on petition of 5 per cent of the voters, the question of home rule could be submitted and carried by a majority of the total vote cast at the election. A majority of those voting on the subject would not carry the proposition. City authority would supersede the commission on the adoption of home rule except as to reports and accounts and as to financial transactions. If home rule is rejected it cannot be resubmitted in less than two years, and when a city has surrendered home rule it cannot be resumed in less than two years. A municipality adopting home rule can obtain the aid of the commission, and in disagreements upon matters of regulation the parties are authorized by agreement to submit the dispute to the state commission in place of the courts.

J. M. Wakeman Resigns from Society for Electrical Development



J. M. WAKEMAN

ANNOUNCEMENT is made by W.W. Freeman, president of the Society for Electrical Development, that at a meeting of the board of directors of the society held in New York on May 10 James M. Wakeman tendered his resignation as general manager of the society, which was accepted, effective as of Sept. 1, with leave of absence granted from June 1. Mr. Wakeman has served as general manager of the society from the commencement of its activities and has rendered most valuable services to the society and the industry in that capacity.

The directors of the society are unanimous in their expression of regret that Mr. Wakeman finds it necessary to withdraw from the executive direction of the society's activities, and their heartiest wishes will follow him into his future field of effort. A committee was appointed to draw up a suitable resolution to express the appreciation of the directors.

The resolution which the committee drew, and which was passed unanimously, reads as follows:

"The board of directors of the Society for Electrical Development, in accepting the resignation of James M. Wakeman, its general manager from the date of its organization, desires to enter on the minutes its full recognition and appreciation of the very valuable, comprehensive and enthusiastic work given by him to the society. Mr. Wakeman has been constant and industrious in his efforts and has won for himself not only the sincere commendation of the board as a whole for the conscientious and able performance of his duties, but is entitled to and receives the personal respect, esteem and good wishes of every member. The standing and influence of the society today are to be largely attributed to the splendid and faithful efforts of Mr. Wakeman, and the directors of the society take pleasure in so stating as part of the minutes of this meeting."

Effective June 1, William L. Goodwin, assistant to the president, will assume charge of both the office and field activities of the society.

Sprague to Receive Franklin Medal

FRANK J. SPRAGUE, pioneer in the field of electric traction, has been selected as this year's medalist by the Franklin Institute. Presentation of the Franklin medal will take place in Philadelphia the afternoon of May 18, at which time Mr. Sprague will read a paper entitled "Electric Traction—A Review." The other Franklin medalist this year is Prof. Charles Fabry of the University of Paris, France. His paper is entitled "Studies in the Field of Light Radiation."

Both Mr. Sprague and Prof. Fabry, together with General Pershing, will receive at the same time certificates of honorary membership into the institute.

New England Central-Station Men Cheer Industrial Heating Lecturers

ROUSING cheers welcomed the manufacturers' representatives who journeyed to Boston this week to conduct an industrial electric heating course at the Engineers' Club, under the auspices of the power division of the New England Division of the N. E. L. A. The group of meetings was opened on Tuesday morning, May 10, by V. M. F. Tallman, chairman of the Commercial Section of the New England Division, and John West, chairman of the power division, presided. The idea of the course is the outgrowth of the recommendations of the power division at the Kineo convention last fall. New England central-station companies, with few exceptions, have felt a need for more comprehensive knowledge of the development and applications of industrial electric heating apparatus in competition with other methods. The Boston meetings aim to bring before power engineers and others interested the latest information available upon the design, application and results of installation of this class of apparatus. Later it is hoped that many New England utilities will send representatives to manufacturing plants to continue the instruction begun at Boston. The sessions were conducted by some of the foremost electric heating experts in the country. The following manufacturers' representatives were scheduled to preside over the various sessions: E. N. Lightfoot, engineering manager industrial heating department, Cutler-Hammer Manufacturing Company, New York; Wirt S. Scott, manager industrial heating section, Westinghouse Electric & Manufacturing Company, Mansfield, Ohio; Harold Fulwider, manager department of industrial heating sales, General Electric Company, Schenectady, N. Y.; Henry Gieseke, engineer electric furnace department, Ajax Metal Company, Philadelphia, and F. D. Goode, sales manager Electric Boiler Corporation, Cambridge, Mass. More than sixty attended the opening session.

Swiss Railway Electrification Making Fast Progress

THE Swiss Federal Council, according to advices from the ELECTRICAL WORLD'S Swiss correspondent, has recently appropriated 100,000,000 francs for further electrification of the federal railways. The federal authorities have also been asked to grant a concession for the construction of a huge hydro-electric plant at Andermett-Wassen, including a storage lake of 250,000,000 cu.m. capacity, which would permit the development of at least 200,000 hp.

Early in April the first trial trains of the St. Gotthard electrification were run on the mountainous section from Biasca to Bellinzona, the energy being supplied by a single group of machinery in the Riton works, where three turbine-generators are alternately used. The large power station at Amsteg has been completed and the machinery is being installed. By the end of the year the entire plant will be ready. The mild winter facilitated the work of electrification, and it is expected that the whole section from Bellinzona to Lugano and Chiasso will be ready for electric traffic by the end of October. By that time also the double-track line from Giubasco to Sasso will be completed, so that by the end of the present year the entire line from Arth-Goldau to Chiasso, the Italian frontier station, about 200 km. in length, will be operated by electricity.

The total length of railways in Switzerland electrified from the beginning of 1918 up to the end of 1920 comprised 280 km. of state railways equipped with single-phase alternating current and 68 km. equipped for three-phase alternating current; the Berne-Dehrets railways, of which 113 km. is equipped for single-phase alternating current and 22 km. for three-phase alternating current, and the Rhaetic railways, 122 km. in length, employing single-phase current. On the Rhaetic railways eight trains are now running daily from Landquart to Thusis and six from Landquart to Chur.

Dollar Charge for First Kilowatt-Hour Disallowed

A CHARGE of $1 for the first kilowatt-hour per month in the lighting rates of the Amesbury Electric Light Company has been disapproved by the Massachusetts Department of Public Utilities in a decision following an appeal of the selectmen and others against the company. In November, 1920, the company put into effect a schedule of rates starting with $1 net for the first kilowatt-hour per month used in commercial lighting installations and ranging from 15 cents per kilowatt-hour between 1 kw.-hr. and 20 kw.-hr. to 12 cents net above 61 kw.-hr. per month, with a minimum charge of 75 cents per month. Pleading the need of increased income, the company held that a uniform increase in the prices per kilowatt-hour would be inequitable as between the lighting customers, on account of expenses attributable to the number of customers supplied rather than to their respective energy consumption. When the company established the initial rate of $1 the commission holds that it confounded the so-called "customer" and "demand" factors in allocating expenses. The commission is of the opinion that the present initial dollar charge should be discontinued and that it is not necessary or expedient to modify it so that it shall include only the "customer" charge. In recommending a rearrangement of the schedule for trial without prejudice the commission recognizes the possibility of a reopening of the rate question for the consideration among other things of a "service" charge. It is ordered that beginning June 1 the lighting schedule shall be, net, 16 cents per kilowatt-hour for the first 40 kw.-hr. per month, 14 cents per kilowatt-hour for the next 40-kw.-hr., and for all in excess of 80 kw.-hr. 12 cents. A minimum charge of 75 cents per month is permitted.

An interesting feature of the case was the company's method of establishing the initial rate. It did this by taking all operating expenses of the last fiscal year

save the cost of energy purchased and of maintaining and renewing street lamps, together with an allowance for depreciation of lines, transformers and meters, less rentals of lines and equipment, and apportioning this sum as between lighting and power customers in proportion to the feet of wire in the circuits serving each group. The cost apportioned to the lighting customers was then divided by the number of such customers and the quotient by twelve, with the result of $1.05. This, with the cost of the energy supplied, the company assumed to be the cost to it of the first kilowatt-hour delivered to each lighting customer a month. The commission, however, expressed its lack of conviction of the reasonableness of this method of allocation.

Municipal Plant Withdraws from Motor Merchandising

ANNOUNCEMENT is made by Commissioner Ira S. Davisson of the Tacoma (Wash.) municipal light department that the department will withdraw from the business of selling and renting motors. The motor business has been profitable, making a return of about 12 per cent, but Commissioner Davisson declares that the local electric dealers' ability to care for the demand for motors and their willingness to co-operate with the city in the promotion of business make it advisable for the city to discontinue the service. The city has $49,000 invested in motors now out on rental and has $12,000 worth of motors in stock. The sale of electric ranges and light globes will be continued, but the light department is considering the discontinuance of free lamps to commercial customers.

No Immediate Reduction of Interest Rates Looked For by Bankers

THAT liquidation has not yet proceeded to a point that will make possible a reduction of interest rates during 1921, or at least before the end of the year is near, was one of the opinions expressed by John S. Drum, president of the American Bankers' Association, in presenting at a session of the executive council of this body held in Pinehurst, N. C., recently the results of an economic survey made by the association.

Mr. Drum said that the survey "has shown that the great economic problems that confront us today fall into two broad classes, which may be expressed in the terms of the problems of production and those of costs and markets." Commenting upon the extent to which readjustment from war conditions has been accomplished he said: "The weight of opinion is that this readjustment, this tendency toward stabilization, will not be accomplished in the year or the two years that lie just ahead of us."

On the labor situation Mr. Drum asserted that "the survey shows that notable exceptions to the tendency toward wage reduction are apparent in the building trades and among railway employees. Many replies point out that the wages of railway employees and men engaged in the building trades will be reduced when there is a realization that it is not wages per day but wages per year that count."

After discussing the question of cancellation Mr. Drum said: "Summing up, majority opinion is that of the four principal problems affecting domestic markets those involving cancellation and the inclination to hold goods and raw materials rather than to take losses, while still serious, are moving toward solution." He went on to discuss the views elicited by the questionnaire in regard to foreign trade and the necessity of the United States helping Europe and other foreign countries to buy if business is to go forward in a normal way in those countries and if the United States is to have a larger market for its products.

One-tenth of Ohio's Population Interested in Utility Securities

HOW widespread the ownership of public utility securities is becoming may be judged from a report of the Ohio Committee on Public Utility Information made public recently. According to the report there are slightly more than 112,000 Ohioans who own public utility securities. Considering the families and dependents of these 112,000 investors, this means that close to one-tenth of the population of Ohio is financially interested in the progress, development and protection of the state's public utility companies.

There are 23,000 Ohioans who are owners of electrical securities. The savings of 42,000 residents of the state are invested in telephone securities; 22,000 have invested in the gas industry, 20,000 in electric traction and 900 in water companies.

French and American Colleges to Exchange Technical Professors

AS THE result largely of the initiatory efforts of the late Dr. R. C. Maclaurin, president of the Massachusetts Institute of Technology, an arrangement has been made by a committee representing Columbia, Cornell, Harvard, Johns Hopkins, Pennsylvania and Yale Universities and the Massachusetts "Tech" to "exchange" technical professors with the French University Administration in the same manner that professors of literature, history, law and other subjects have for years been exchanged. Dr. A. E. Kennelly, professor of electrical engineering at Harvard and the Massachusetts Institute of Technology, has been selected as the first American representative and will lecture before French schools in the coming school year. The first representative of France will be Prof. J. Cavalier, rector of the University of Toulouse.

The president of the American university committee having this matter in charge is Director Russell H. Chittenden of Yale, and the secretary is Dean J. B. Whitehead of Johns Hopkins.

Engineering Council Appeals for Support of Pending Patent Legislation

RESIGNATIONS in large numbers are crippling the United States Patent Office to the point of disorganization and are creating conditions that threaten American industrial enterprise and invention, according to a statement issued this week by the American Engineering Council of the Federated American Engineering Societies. The council appealed for support of pending patent legislation which provides increases in salaries to check the exodus of employees from the Patent Office to private employment. In a little more than one year, it was stated, 110 of the force of examiners, numbering 437, have resigned. During the first three weeks of the Harding administration six highly trained experts left to accept salaries two or three times as great.

"Uniform System of Accounts for Electrical Corporations" Ready

THE "Uniform System of Accounts for Corporations," prepared by the committee on statistics and accounts of public utilities of the National Association of Railway and Utilities Commissioners and recommended for adoption by state commissioners at the annual meeting of the association held at Washington in November, 1920, has been printed in a revised edition and is ready for distribution. This edition contains an appendix explanatory of the amendments and modifications to the uniform system that have been made by the National Electric Light Association.

English Interests Finish 100,000-Hp. High-Head Plant in Spain

ACCORDING to G. W. Caldwell of San Antonio, Tex., chief engineer of the Ebro Irrigation & Power Company, Ltd., that corporation has just finished the construction of the first unit of a great hydro-electric plant in the province of Catalina, Spain, about 100 miles from Barcelona. By means of a dam 804 ft. high waters of the Noguera Ballaresa River have been harnessed. The company is composed of the same British interests that constructed and operate the great hydro-electric plant of Necaxa, Mexico, of which Dr. F. S. Pearson of New York, who lost his life in the sinking of the Lusitania, was the head.

The most modern hydraulic and electrical equipment has been installed, and the 100,000 hp. now developed at this station is taken to Barcelona and its adjoining industrial district over 110,000-volt transmission lines. The power development is the fourth of the hydro-electric projects of the Ebro Irrigation & Power Company in Spain. The storage reservoir is 30 miles or more long, and the project is to have an ultimate capacity of 200,000 hp.

Kansas City to Have Record Automatic Substation System

WHAT is asserted by the manufacturers to be the largest system of automatic stations on record will soon be put in operation in Kansas City, Mo., by the Kansas City Light & Power Company. The entire Edison system of the city is to be controlled from a series of five automatic stations, each containing two synchronous converters operating independently. The automatic switching equipment and the machines are to be furnished by the General Electric Company.

These five substations will be all fed from a central steam generating plant through a network of radial feeders. The capacity of the generating station at present is 60,000 kw., but the ultimate capacity is expected to be more than 150,000 kw. The Edison system will have an approximate capacity of 15,000 kw.

The supply will enter each station at 13,200 volts, 60 cycles, three-phase, and will be converted to direct current by two machines in each station. Of the ten machines eight are rated at 250 volts, 6,000 amp., the other two being rated at 250 volts, 9,000 amp. Each machine will be equipped with an automatic switching equipment, so that in case the line normally feeding it fails for any cause power is immediately fed to it from another line. On return to normal conditions the machine is automatically switched back.

Safety Engineers to Discuss Safeguards for Electrical Hazards

ELECTRICAL hazards and their safeguards are the topic for discussion at the May 27 meeting of the American Society of Safety Engineers, to be held at the Engineering Societies Building, New York. Three papers, two of which will be illustrated with lantern slides, will be presented. The papers are:

"High-Tension Electric Generation and Transmission," by C. O. Van Dannenberg and W. W. Samuels, electrical engineers the J. G. White Engineering Corporation.

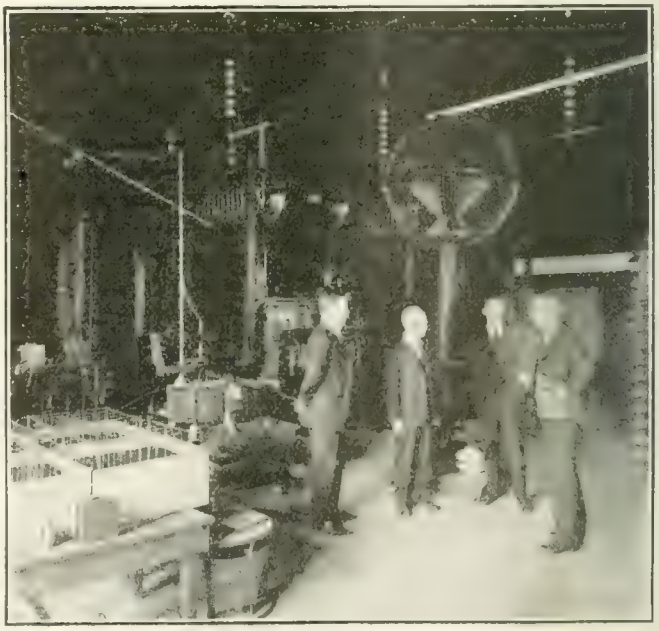
"Electrical Hazards of Terminal Equipment of the New York Central Railroad Entering New York City," by H. S. Balliet, assistant terminal manager Grand Central Station.

"Small-Motor Problems and Industrial Control," by L. E. Smith, General Electric Company.

New Hampshire Commission Reduces Plymouth Company Rates

FOLLOWING reductions in the price of fuel and acting upon its own initiative the New Hampshire Public Service Commission has ordered a reduction in the maximum rate of the Plymouth Electric Light Company from 20 to 18 cents per kilowatt-hour. During the war the commission authorized the company to charge a maximum of 25 cents per kilowatt-hour, based on coal at about $17 per ton, and recently a reduction to 20 cents was made. The present price is related to a fuel cost of about $10 per ton. The minimum charge has been reduced from $2 to $1.50 per month.

Where 220000-Volt Transmission Problems Were Solved



JUST a corner of Prof. Harris J. Ryan's high-tension laboratory at Leland Stanford Junior University, where was solved the insulator and other problems of 220,000-volt transmission. During April the N. E. L. A. 220,000-volt transmission committee worked here, four of whom were photographed. They are, reading left to right, R. Wilkins, Pacific Gas & Electric Company; Prof. Ryan and H. Michener, and R. J. C. Wood. Southern California Edison Company.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Wireless Telephony in Great Britain.—The first installation of wireless telephony for commercial purposes in the United Kingdom was put into operation at Liverpool recently between the head offices of the Mersey Docks and Harbor Board and the Mersey Bar lightship, 12 miles away.

Spreading Information on the Utilities.—The Indiana Public Utility Association has got out a special bulletin, entitled "A Half-Century Miracle," which gives data on the public utilities of the state for the purpose of debates, lessons in oral English and current-topics classes.

New Mexican Commission's Enlarged Scope.—The State Corporation Commission of New Mexico should no longer be numbered with the bodies which have no jurisdiction over electric light and power companies, an act passed by the Legislature at its last session having given to it a certain degree of control over public utilities.

Lighting New York's Town Hall.—The new Town Hall of New York City, a civic auditorium held in trust for the citizens, is lighted as regards its main assembly room, seating 1,500, by an indirect system providing soft and artistic illumination. Energy for the building's 2,500 lamps and 250 hp. in motors is supplied by the central-station company.

Radio Service Between Chicago's High Schools.—Chicago's twenty-two high schools are, according to the *Wireless Age*, to be equipped with radio-telephone and radio-telegraph instruments. This school system, the first of its kind, will be installed at a cost of about $50,000 and will make it possible to transact virtually all inter-high-school business by radio. Stations have already been established at two of the schools, the telephones having a day range of about 100 miles for the transmission of intelligible speech and the telegraph instruments a day range of approximately 200 miles.

Metric System Gains Ground in the Orient.—At a recent session of the French Academy of Science it was announced on the authority of the director of the Bureau of Weights and Measures of Tokyo that the Japanese Parliament had made the adoption of the metric system compulsory in Japan. The system was made legal in that country in 1893, but heretofore the native measurements and the English system have had equal rights with it. In China and in Siam laws paving the way toward the obligatory adoption of the metric system have been in effect since 1913 and 1912 respectively, and the preparatory period in the case of China will expire in 1923. Thus in a few years a large part of the Orient is likely to have officially adopted the method now finally indorsed by Japan.

Improved Lighting for Kansas City's Streets.—The lighting committee of the Chamber of Commerce of Kansas City, Mo., has made recommendations which have as their object making Kansas City the best-lighted city in the United States within two years. The plan advocated involves the discontinuance of all gas lamps on the city's streets and entering into a contract with the Kansas City Power & Light Company for the illumination of all streets, boulevards and viaducts, 600-cp. units to be used in the downtown districts and 400-cp. units in outlying sections. All-night lighting of every street is urged. The committee declares that "the gas lighting now so much in use in Kansas City is a disgrace to any community, and its apparent cheapness does not offer any excuse for its use." It is also asserted that "little or nothing is to be gained by the city owning its street-lighting system at this time."

Electricity and Mushrooms.—Electrical energy is now playing a part in the cultivation of mushrooms, according to the *Edison Monthly*, which quotes the manager of a mushroom plantation started in a former brewery in the Borough of the Bronx, New York City, as saying: "We are really experts in making weather which is best suited for mushroom growth. Sunshine, wind, rain, moisture, fog, heat, cold and even lightning are at our command and in our control. With the help of science we have been able to operate our mushroom plantation 365 days in the year, something never attempted before in this country." Although the mushroom farm was started in the brewery cellars, it now occupies also all the upper floors, and the possibility of growing mushrooms in such surroundings is said to be due entirely to an application of electricity, of which the method is for the present being kept a secret.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E. Annual Meeting.—The annual meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York City, on May 20. The result of the annual elections will be announced and the report of the board of directors presented.

A. I. E. E. Section Meetings.—Transmission at 220,000 volts will be discussed at a meeting of the San Francisco Section, A. I. E. E., on May 27, Prof. Harris J. Ryan giving the main paper. At a Baltimore Section meeting on May 20 J. T. Corrin of the Pittsburgh Transformer Company will discuss transformers. The Akron Section will meet on May 25.

Electric Supply Jobbers' Association.—M. H. Aylesworth, executive manager of the N. E. L. A.; W. L. Goodwin, assistant to the president of the Society for Electrical Development; Herman Plaut, sales manager of L. Plaut & Company, and other representatives of the electrical industry will address the meeting of the Electrical Supply Jobbers' Association to be held at Hot Springs, Va., on May 25-27.

Engineers' Club of Philadelphia.—On Tuesday, May 17, Axel Malm, president of the Federal Engineering Company, will speak at the club luncheon on "Business Methods of European Engineers Compared with Those of American Engineers." The annual meeting of the club will take place on the evening of the same day. Among affiliated society meetings next week are those of the American Welding Society on Monday and the Illuminating Engineering Society on Friday.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Pittsburgh, May 14.

A. I. E. E. Section Meetings — Cleveland, May 17 (dinner); Baltimore, May 20; Akron, May 25; San Francisco, May 27.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21. (For program see issue of May 7, page 1066.)

National Electric Credit Association—Richmond, Va., May 19-20.

A. I. E. E. Annual Meeting—New York, May 20.

American Society of Mechanical Engineers—Chicago, May 23-26. (For program see issue of May 7, page 1069.)

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

American Society of Safety Engineers—New York, May 27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3. (For program see issue of May 7, page 1065.)

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

What Are Navigable Waters?—The Supreme Court of North Dakota has held, in Roberts vs. Taylor, that in determining the status of an inland lake in that state the test of "navigability in fact" is not confined to a capacity for use in commerce of a pecuniary value, but may be extended to capacity for use for purposes of navigation for pleasure, public convenience and enjoyment, and that a lake used for boating and hunting is navigable and the title to its bed vests in the state. (181 N. W. 622.)*

Employer Liable for Defective Insulation, Though Not in Control of Grounded Wire.—Where a repairman working on an insulated platform was killed by an electric shock from a defectively insulated feed wire, the Supreme Court of Missouri has held (Sudmeyer vs. United Railways Company of St. Louis), the master's liability for the defective insulation is not defeated by the fact that the accident could not have occurred unless the man was in contact with a grounded wire, the master not being in control of such wire, since the defective insulation and the grounded wire were concurring causes. (228 S. W. 64.)

Liability for Death from Wires Charged to Prevent Theft of Copper.—In Evans vs. Oskaloosa Traction & Light Company the defendant appealed from a verdict holding it responsible for the death of a workman engaged in removing iron pipe from the mine of a coal company (intervener in the suit). It appeared that service to the mine had been discontinued, but that the electric company kept its 11,000-volt wires charged to prevent theft of the copper. These wires were strung on poles 22 ft. above the ground, but the upper end of a long pipe which the deceased was handling came into contact with them, causing his death. The Supreme Court of Iowa found that the plea that the electric company did not have notice that a person lawfully employed might come into contact with the wires could not absolve it, in the face of its knowledge that the mine was to be abandoned, that machinery had been removed therefrom, that the process of dismantling had started and that the electrical energy was no longer desired for the operation of machinery. Whether the electric company was negligent in turning on the current without notice to the coal company was for the jury to determine. (181 N. W. 782.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Illegal Commission Procedure Alleged in North Dakota.—The North Dakota Board of Railroad Commissioners consists of three members, and the question has arisen (State of North Dakota vs. Union Light, Heat & Power Company) whether an order signed by two of the commissioners is valid, the third commissioner asserting that adequate opportunity had not been afforded him to participate in consideration of the case. The order, it is alleged, was never adopted by a majority of the board at any regular or special session, and the city of Fargo, whose interests were involved, did not have a hearing. Pending a final determination of this issue, the Supreme Court of North Dakota has permitted the Union company and the Red River Power Company, which is also concerned, to collect surcharges authorized by the disputed order, subject to refund in the event of its being ultimately declared invalid.

Under Colorado Constitution Municipality Can Control Rates in Opposition to State Commission.—The Supreme Court of Colorado has determined, in City of Fort Collins vs. Public Utilities Commission, that under the state constitution and the "home-rule amendment" a municipal corporation has power to assume the regulation of rates, because such a body may assume whatever power the Legislature may grant. The question, the court holds, is not whether the sovereign power is precluded from fixing rates, but whether when the people of the state by constitutional amendment have given such power the Legislature can take it away. The fact that the Fort Collins charter was adopted after the passage of the home-rule amendment was held not to affect the issue, the proposition that this amendment was intended to give authority to regulate rates to some cities and not to others being, in the language of the court, "almost incredible." (195 Pac. 1099.)

Electrically as a Dangerous Element —When Appellate Court May Hold Damages Excessive.—In affirming a verdict for damages because of the death of a lineman from electric shock (Nichols vs. Hines, Director General of Railroads) the Appellate Court of Indiana declared: "That electricity is a dangerous element is a fact so firmly established and well known that so to assume and state in an instruction where dangers arising from its use are involved is not error." Regarding a plea to reduce the amount of damages as excessive the court said: "In order to hold that the damages assessed are excessive it is not sufficient to say that in our opinion they are too high and that we would have given a less amount had the matter been submitted to us as an original question. In order to justify us in reversing the judgment on such ground the amount of damages assessed must appear to be so outrageous as to impress the court at first blush with its enormity." (130 N. E. 140.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

To Charge Town Containing Plant and Town Served by Transmission Alike Is Discriminatory.—A rate for electric power service to a community served by means of transmission lines no greater than the rate at the town where the energy is generated is, the Missouri Public Service Commission has found, discriminatory, the burden upon the utility caused by the existence of the transmission lines being a proper factor in fixing rates.

Customer Ownership of Meters Not Approved.—A meter, in the view of the North Dakota Board of Railroad Commissioners, is as much a part of the property of the utility company as any other instrument of its plant or distribution system, and as such should be owned and maintained by it on the same basis as any other part of its capital equipment, ownership of meters by consumers offering a possibility for discrimination between the renter of meters and the owner thereof.

Relation of Load Factors to Diversity of Use.—This relationship was recently discussed in the following terms by the Public Utilities Commission of Utah, in connection with commercial rate making for the Utah Power & Light Company: "If a particular consumer among many operates above the ideal load factor, such consumer is not making use of his portion of peak capacity in relation to the total water he is using, because he is taking relatively less installed capacity than is the case at ideal load factor, and, if operating at less than the ideal load factor, such consumer is using relatively more than his portion of peak capacity in relation to the total water he is using. However, as an abstract proposition, very high load factors may or may not allow of diversity in a commercial sense. It depends upon the form of load curve and method of measurement and duration of peak. Again, at lower load factors, a corrective factor for diversity of use is allowed for the reason that consumers of these lower load factors do not, as a matter of fact, establish their maximum demands simultaneously. Hence the sum of all maximum demands established by different customers will be greater than the simultaneous demand that the utility must meet. The plant capacity may therefore be less than the sum of all individual maximum demands. The consumer should, therefore, benefit by a reduction from the fixed costs found applicable to system costs at low load factors."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

William States Lee, vice-president and chief engineer of the Southern Power Company, Charlotte, N. C., has been elected president of the Piedmont & Northern Railroad, succeeding the late Z. V. Taylor. Under Mr. Lee's direction as vice-president, the Piedmont & Northern Railroad has been built up since 1911 to a system that operates 130 miles of high-speed electric railway at 1,500 volts direct current, for general freight and passenger traffic, taking power from the Southern Power Company's system. Mr. Lee has been associated with engineering construction in the South for nearly twenty-seven years and has been responsible for the engineering work of the Southern Power Company since its organization in 1905. During this time he has designed and constructed eight hydro-electric plants and four steam stations, with an aggregate rating of 280,000 kva., in connection with which 201 outdoor substations and more than 2,000 miles of high-tension transmission lines are operated. The standards he has devised through experience in pioneer design and installation of power transmission equipment have been largely reflected in the practices of other large companies. He is also widely recognized as a pioneer and leader in the electrification of Southern industries. About a year ago Mr. Lee established a consulting engineering office in New York City which works in conjunction with the large engineering staff he maintains in Charlotte. Mr. Lee was born in Lancaster, S. C., on Jan. 28, 1872, and was graduated from the South Carolina Military Academy in 1894. His early experience was with the Anderson Water, Light & Power Company, Anderson, S. C., where he was engineer in charge of the construction of the Portman Shoals hydro-electric plant. There he placed in service in 1898 the first 11,000-volt generator to be installed in America. His work ever since has been characterized by initiative and originality. Other details of Mr. Lee's engineering career were given in the ELECTRICAL WORLD for March 20, 1920, page 699.



W. S. LEE

John P. Mallet has recently become affiliated with the Connecticut Dynamo & Motor Company, Irvington, N. J. For six years Mr. Mallett was designing engineer for the Westinghouse Electric & Manufacturing Company and for eight years chief engineer of the Northern Electrical Manufacturing Company. During the last few years he has been engaged in consulting engineering work, devoting most of his time to the designing of special electrical apparatus.

Earl E. Whitehorne, who has been confined to his home for several months owing to illness, is rapidly recovering his former strength and vigor. The next few months he plans to spend in recuperation in the mountains of Virginia. During this period he will devote some time, however, to special editorial work for the ELECTRICAL WORLD and *Electrical Merchandising* as contributing editor.



E. E. WHITEHORNE

Mr. Whitehorne's work as an editor for thirteen years, and more recently as an editorial writer and as a business counselor to electrical manufacturers, electrical jobbers and central-station companies on sales promotion programs, is well known to the electrical industry, and his many friends will be glad to learn that he is now sufficiently strong to devote some time to active duties again.

P. M. Hatch has recently been appointed superintendent of light and power of the El Paso (Tex.) Electric Company, where he has supervision of the commercial department, the electrical engineering for the company and the operation and maintenance of the generating stations, substations and lines. Mr. Hatch has had a broad experience in engineering, operation and management of various properties of Stone & Webster, the general managers of the El Paso company. He was born in Boston in 1888 and was graduated from Tufts College in 1910. Immediately he went to Port of Spain, Trinidad, British West Indies, where he worked for the Trinidad Electric Company, Ltd., first as apprentice and later as chief engineer of the generating station. In addition he looked after maintenance of the street cars. In 1912 he became associated with Stone & Webster in their Savannah (Ga.) office, where he did considerable engineering work. In December, 1914, he was sent to Ponce, Porto Rico, as general superintendent of the Ponce Railway & Light Company. In February, 1916, he was made manager of the company, remaining until he entered the army as first lieutenant in the Ordnance Department. Upon his discharge in March, 1919, he was for a short time placed on statistical work in New York, but was soon transferred to the office of the manager of the Southwestern district of Stone & Webster at Savannah, Ga. In January, 1921, he was transferred to his present position.



P. M. HATCH

R. S. Daniels, electrical engineer with the Washington Water Power Company for fifteen years, has left for Berkeley, Cal., to take a position as assistant to the chief engineer of the California-Oregon Power Company of San Francisco. The company operates a number of plants in southern Oregon and northern California. Prior to his departure

a dinner was tendered to Mr. Daniels by the Spokane Section of the American Institute of Electrical Engineers, of which section he has been chairman during the last year.

H. R. Noack has been elected vice-president of the Pacific States Electric Company, well-known jobber on the Pacific Coast, in recognition of the constructive work he has done in the promotion of high-tension transmission construction. Mr. Noack was graduated



H. R. NOACK

from the University of California with the class of 1898 and became associated with John Martin in the selling of electrical apparatus. When this firm was succeeded by Pierce, Roeding & Company he had charge of the sales of transmission and railway equipment. Later, when that firm sold out to the Aluminum Company in 1916, he became connected with the Pacific States Electric Company in charge of the high-tension transmission department. Mr. Noack recently closed with the Anaconda Copper Company an order for 10,000,000 lb. of copper wire for the Pacific Gas & Electric Company. This is said to be the largest single order for copper wire ever placed in this country.

E. C. Marshall, formerly treasurer of the Southern Public Utilities Company, has been elected president of that company to succeed the late Z. V. Taylor. Mr. Marshall has been treasurer of the company since its organization in 1913 and has been closely associated with Mr. Taylor in the direction and development of its properties. He first became associated with the Southern Power Company in the capacity of auditor in its early days. In 1910, when the Southern Power Company began to acquire the utilities at Charlotte, Winston-Salem, Greenville, Anderson and surrounding sections, Mr. Marshall was associated with the management of these properties, and in 1913, when the merger of the utilities serving these towns resulted in the organization of the Southern Public Utilities Company, Mr. Marshall continued as treasurer and was closely associated with Mr. Taylor in their management. The election of Mr. Marshall as president is in line with the policy of the company consistently followed by Mr. Taylor to seek within its own organization men to fill higher positions.

Walter C. Strunk has tendered his resignation in the mechanical research and construction division of the motive-power department of the Interborough Rapid Transit Company, New York City, to accept a position in the stoker division of the Westinghouse Electric & Manufacturing Company, Lester, Pa. Mr. Strunk was born in Reading, Pa., in 1885 and was graduated from Swarthmore College in 1909. In the same year he started work with the Metropolitan Street Railway Company, New York City, in the training school for college men. After spending two years in the school he entered the electrical department. In 1912, when the New York Railways Company was reorganized, he was made an assistant engineer in the motive-power department of the Interborough Rapid Transit Company and New York Railways Company. His work up to 1917 was in the economics division. Since that time he has been in charge of all tests and research work in connection with mechanical power station equipment.

C. W. Whiting has been appointed manager of the municipal lighting system at Wakefield, Mass.

H. J. Moulton, whose appointment as district manager of the Southern California Edison Company at Redlands, Cal., was recently announced in the ELECTRICAL WORLD, was born in Seymour, Ind., in 1879 and spent his early life in Massachusetts. He came to California in 1903 and was employed by the American Bell Telephone Company until 1907, when he entered the commercial department of the Southern California Edison Company as



H. J. MOULTON

power salesman. Mr. Moulton was appointed assistant district manager of the Redondo district in July, 1920, and promoted to be district manager at Redlands on Jan. 1, 1921, succeeding P. S. Miner.

Oscar H. Perkins, sales manager of the Stuart-Howland Company, Boston, has been elected president of the Municipal Electric Light Association of Massachusetts.

J. J. Ashworth, who was appointed general manager of the Canadian General Electric Company, following the resignation of Senator Frederic Nicholls as president and general manager to become chairman of the board of directors, has been associated with this or-



J. J. ASHWORTH

ganization for the past thirty-three years. In 1888 he joined the Edison General Electric Company, Toronto, as engineer, and when that company was absorbed by the Canadian General Electric Company, Ltd., he joined the engineering staff of the latter company. In 1895 he became associated with the contracting department and in 1903 was made sales manager. In 1908 he was appointed assistant to the general manager, and he has since worked closely in association with Senator Nicholls. Mr. Ashworth rendered valuable service in organizing war production, and in 1919 he was elected a director of the company.

R. P. Payne has been appointed head of the household appliance department of the Northwestern Electric Equipment Company, St. Paul, Minn., to succeed B. C. Holst, who has become associated with W. N. Matthew & Brother, Inc., St. Louis.

Frank H. Freeman of the Anaconda Copper Mining Company has recently been appointed general sales manager of the Illinois Wire & Cable Company, weatherproof-wire manufacturer of Sycamore, Ill. Mr. Freeman assumed his new duties on the first of April.

Randolph E. Tyler, for fourteen years district representative of the Shelby division of the National Lamp Works, has been placed in charge of the lighting department of the Schimmel Electric Supply Company. This is part of the plan for expansion recently announced in connection with removal of this firm to its new and enlarged quarters at 526 Arch Street, Philadelphia.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Some General Conditions that Indicate an Upward Turn

IT SEEMS apparent that a turn for the better and a change in business sentiment are indicated in some items of general business news. In April the failures showed a falling off for the first time in a great many months. Dun's, Bradstreet's and all of the large banks are now seeing hopeful signs in current business conditions. Federal Reserve Bank discounts are being lowered. This is occasioned by easier money and in turn has the effect of making money still easier, following which building prospects become brighter.

The number of idle freight cars is decreasing; although the decreased number is made up entirely of freight cars, nevertheless, if more coal was being moved, is it not indicative of a belief on the part of industry that greater production is soon due? This is not the time ordinarily for an increased shipment of coal, and coal is not ordinarily stored for more than thirty to sixty days.

Almost all business commodities are now down to a level which, while not in all cases equal to the pre-war level, still is of sufficient lowness to warrant resumption of activities on a fair scale. Steel is down and steel wages with it. The only item that is seen to be up is the item of freight, and pressure is now being brought to bear on that. It would not be unreasonable to expect lower freight rates within the next sixty days.

Non-employment in April was about the same as in March. Some industries show great lack of employment, but many industries show that non-employment is lessening. The indications are that from now on the numbers of unemployed can be expected to decrease.

There seems to be one answer—that business is now on the beginning of the floodtide. He who waits until the tide is full to cultivate this business will probably find that he has lost the momentum of being carried along on the wave. As a matter of fact, if he waits he may find that he will merely be left high and dry.

Code Wire Sales Higher than Mill Orders Suggest

IN CONSIDERING the present volume of business in the rubber-covered-wire market and the volume consumed this year to date, figures show that during the month of April about 27 per cent more code wire was used than was used in March. An estimate of the amount of code wire that will have been consumed over the first five months of this year places it at about 67 per cent of that consumed over the same time in the last five years, excluding the extraordinary early business of 1920. These figures are interesting in view of the present wire market, which is generally characterized as quiet.

From the wire manufacturer's standpoint the amount of orders on his mills does not check up with these figures, probably by 50 per cent. This is because the trade has absorbed much more code wire than the distributers and jobbers have recorded from the mills. The jobbers have reduced stocks to what they consider a low level, but have not replenished.

The call for large-size solid and for circular-mil sizes has been relatively light compared with that for Nos. 8 to 14, but in the industrial sections of the Middle West the larger sizes are becoming more active. New England industries too are awakening. This is the time of year when wire consumption can be expected to show improvement. Building activity, residential, commercial and municipal, has shown a marked increase during April and was even noticeable during March. From the plans on foot at the present time it bids fair to bring more business to the wire market as the summer progresses. Labor difficulties, it is true, are holding up construction in several centers, but progress as a whole is upward.

In checking up the estimate shown in the ELECTRICAL WORLD of Jan. 1, 1921, of 1,700,000,000 ft. of code wire produced in the United States during 1920, the recent figures of the Underwriters' Laboratories, Inc., give a consumption of total code wire in the States during 1920 of 1,694,935,390 ft.

New England Business Showing Hopeful Signs

ADMITTING the opportunity for great improvement in the New England business and manufacturing field, there are not lacking evidences of increasing demand for electrical and other products which bear out the opinion that trade is on the mend. Recessions take place, it is true, but an acute observer of conditions in the industry pointed out to a representative of the ELECTRICAL WORLD on Monday that each setback is less extensive than formerly. In many lines business is spotty, but none the less the buying public is a substantial purchaser of electrical service, domestic labor-saving conveniences and personal necessities of higher grade.

The liquidation of labor is proceeding slowly but surely, and there is no question that retail trade is responding to price movements downward. The textile industries exhibit improvement in woolen manufactures and in some cotton lines, where overtime is found necessary. Rubber-tire production is busier, two of the larger concerns now operating on three eight-hour shifts. Unsettled conditions appear in the leather field, and the metal industries are running on part time in the main. Twenty-four representative department stores reported to the Federal Reserve Bank 40 per cent more business in March than in February of this year. It appears that less credit is now required to finance the same volume of trade as compared with a year ago. Building operations are increasing, on the whole, and the declaration of the open shop by Boston builders after months of fruitless negotiating has been followed by a partial resumption of work on suspended jobs and in some cases by an excess of applications for work above the places open. Railroad traffic is light, and the financing of transportation needs, as elsewhere, is a difficult problem.

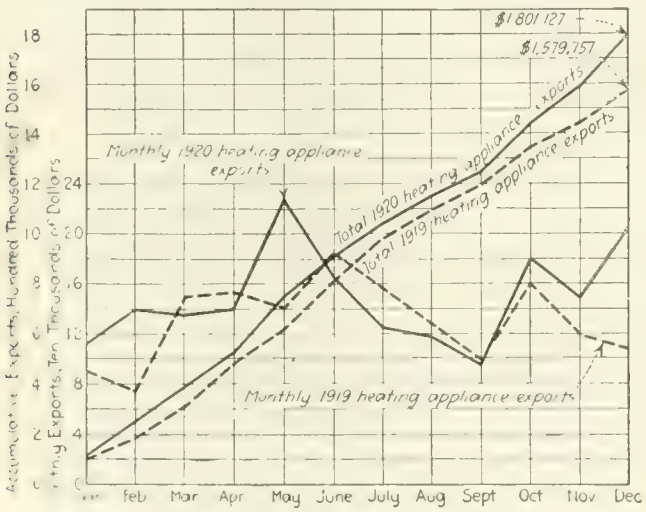
In the electrical field the central-station industry is doing a substantial business, some companies reporting marked increases in periodical outputs of energy sold compared with a year ago. Domestic appliance sales have been active, and vigorous merchandising is yielding good fruit. Electrical machinery makers are running considerably below capacity, but some good orders are reported and one electric pleasure-car concern is booked to capacity until fall. Contractor-dealers and jobbers are widely reporting a better feeling in trade. Schedule material factories are running on about half time. A fair trade is being handled in street-lighting equipment and in mercantile and domestic fixtures. Motor business is off at present, but electric accessories for automobiles are in good demand. Earnings of hydro-electric companies have held up remarkably well. Two large new central stations are

under construction in New England, and reductions in the cost of wire have had some effect in stimulating distribution system construction. Few failures have occurred in the electrical field, and the outlook is better now than for many months.

Exports of Heating and Cooking Apparatus Grow in 1920

DURING the twelve months of 1920 the United States exported $1,801,127 worth of electrical cooking and heating apparatus. This shows an increase of 14 per cent in value over the exports of 1919, 162 per cent over those for 1918 and 43 per cent over 1917. In 1920 heating and cooking apparatus accounted for 1.75 per cent of total electrical exports, in 1919 the percentage was 1.75, in 1918 it was 1.14, and in 1917 it was 2.26 per cent of the total.

May was the highest month for these exports in 1920, while June held that place in 1919. The volume fell sharply



INCREASE OF 14 PER CENT IN 1920 OVER 1919 EXPORTS

in each of those two years until September, which showed a substantial recovery.

As showing the disposition of the market, Canada took the greatest amount, with $346,409 worth. This was well ahead of Norway, but Norway dropped considerably below her receipts of the year previous. Australia, England, Argentina and Brazil were all close together, but in 1919 Japan came in in third place. The first eight countries in 1920 were the highest eight in 1919 also but did not hold the same relative rank.

British South Africa and Peru followed Uruguay in 1920

1920 AND 1919 HEATING AND COOKING APPARATUS EXPORTS

Country	Value of 1920 Exports	Value of 1919 Exports
Canada	$346,409	$313,632
Norway	197,980	274,438
Australia	138,516	78,565
England	133,990	95,174
Argentina	132,847	94,655
Brazil	132,334	64,790
Mexico	112,451	64,776
Japan	78,942	115,108
New Zealand	62,715	55,305
Cuba	52,771	56,901
Spain	44,500	26,534
British India	32,934	11,656
China	30,610	22,266
Netherlands	30,496	13,378
Uruguay	29,614	50,424
74 Countries importing under $25,000 each	243,988	242,195
Total exports of heating and cooking apparatus	$1,801,127	$1,579,797

and were also in the ranking in the previous year, but in 1920 they were below the $25,000 mark, which was used as a base both years. British India, China and the Netherlands came into this class in 1920. These fifteen countries above $25,000 received a total of $1,557,139 in heating goods in 1920, while in 1919 they took $1,337,602. The seventy-four countries receiving less than $25,000 in 1920 took in $243,988 worth, while in 1919 they took $242,195. It is interesting to note that the fifteen leading countries increased their purchases 16.4 per cent in 1920 over 1919, while the countries using the rest of the exports increased less than 1 per cent.

It is noticeable that many of the foreign countries have heating and cooking rates which permit of the use of their hydro-electric energy in this way over long periods of time and at a very low cost.

These figures were compiled by the ELECTRICAL WORLD from data gathered by the Bureau of Foreign and Domestic Commerce.

Loom Prices Steady, Though Demand Is Light

ALTHOUGH demand for non-metallic flexible conduit is reported as being very light throughout the country, manufacturers' prices have held steady for several months. The last reduction that occurred was one increasing the discount allowed jobbers by fifteen points, a cut of 30 per cent, made the first of the year. Buying has remained at a low point, with both jobbers and manufacturers for the most part carrying sizable stocks and endeavoring to reduce inventories.

Producers have been cutting down their inventories on loom by decreasing production. One of the largest manufacturers has not operated this department since the first of the year and still has a considerable quantity of material on hand. Other manufacturers have curtailed operation in somewhat like proportion.

The general view expressed as to the outlook for business in this line is that conditions will remain considerably below normal for some months to come. The present price of loom is considered to be on a firm basis with cotton about as low as it can well go, but the reaction of the building construction industry thus far has been disappointing.

The Metal Market Situation

THE copper market has developed a stronger, more confident tone recently with a corresponding slight firming of prices. This is largely a result of the improved statistical position of the market. It is reported that wire drawers have displayed more interest than has heretofore been the case, but the total demand for copper is still small. Prompt, May and June deliveries are held at 12.75 cents per pound in some quarters, but other producers hold June at 13 cents. July is held at 13 to 13¼ cents. In the outside market prices are fully as high if not more so.

The lead market has developed a strong situation due to advances abroad that bring the cost of importation over 5 cents per pound. The "official" New York price has again jumped and is now 5 cents. There is very little buying of zinc, but there is also so little selling pressure that the tone of the market is steady.

Among the scrap metals the demand is quiet but nevertheless developing a little. Scrap lead continues to advance in line with the parent metal.

NEW YORK METAL MARKET PRICE

	May 3, 1921	May 10, 1921
Copper	£ s d	£ s d
London, standard spot	71 5 0	72 0 0
	Cents per Pound	Cents per Pound
Prime Lake	12 75—13 00	13 00—13 25
Electrolytic	12 75	12 75
Casting	11 75	12 12½
Wire base	14 50—15 00	14.50—15 00
Lead, trust price	4 50	5 00
Antimony	5 25	5 25
Nickel, Ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	11 00
Zinc, spot	5 45	5 40
Tin	31 62½	31 87½
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 00—10 50	10 00—10 50
Brass, heavy	5 50— 5 75	5 50— 5 75
Brass, light	3 75— 4 00	3 75— 4 00
Lead, heavy	3 75— 3 90	4 10— 4 37½
Zinc, old scrap	2 87½— 3 00	2 87½— 3 00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

ALTHOUGH the general feeling in industry is slowly but steadily getting better and general economic conditions are pointing upward, better buying has not yet been felt in the electrical industry in all sections of the country. Improvement is shown in the Northwest, Southwest, Intermountain and New England States, particularly in building construction; but in the Middle Atlantic States, in the Chicago territory and to some extent in the South the buying shows little improvement. In the South, however, better ordering is reported by jobbers of material for use in July and August. Farm-plant sales and refrigeration equipment are good there.

Most buying, though, is to replenish already low stocks, and shipments are favorable for this. Wire and armored conductor prices are softer in New York, and some makers of flatirons have just lowered their lists. Collections continue slow.

NEW YORK

Jobbers have apparently made up their minds that business will continue slow throughout the summer and are acting accordingly. Little or nothing is being bought, except what is needed to replace stock, and attention is being devoted to cleaning out the slow-moving items. Except for stocks of wire, inventories are generally in pretty good shape.

The first break in the direction of another general cut on heating devices has been made, one manufacturer announcing a 15 per cent reduction. There is little likelihood that price cutting will stimulate business, however. Rubber-covered wire is quoted down to new low levels in this territory, as is also armored cable, but demand is no better. Spring buying of household appliances such as vacuum cleaners and washing machines has been disappointing, and fans have not started to move. A number of houses, however, despite the quiet market, report a slight improvement in the general situation.

Conduit.—Some stocks are small, others are good, but demand continues only fair. Current prices quoted in lots of 2,500 ft. are as follows: ½-in. black, $60 to $67; ½-in. galvanized, $67 to $72.60; 1-in. black, $116 to $131.60; 1-in. galvanized, $125 to $141.80 per 1,000 ft.

Flexible Armored Conductor.—Demand is very small and stocks are down pretty well too. From $60 to $62.50 per 1,000 ft. is quoted this week on No. 14, two-wire, double-strip, in lots of 1,000 ft.

Fans.—Large supplies are held by jobbers, and these have hardly started to move at all as yet.

Wall Cabinet Boxes.—Jobbers' stocks are small, but one-day shipments can be obtained. Manufacturers report that demand is light. Prices have remained steady the past month, the recent drop in steel prices having been anticipated by decreases of 45 to 50 per cent thus far from the peak price.

Lamp Cord.—This market shows absolutely no activity, while stocks are spotty. In 1,000-ft. lots No. 18 cotton, twisted, sells for $13.75 to $18.50, and parallel from $16 to $19.75.

Rubber-Covered Wire.—Prices are tending lower, with a large house this week selling No. 14 single-braid in 10,000-ft. lots at $6.75 per 1,000 ft. and others ranging up to $7.70. Demand remains light and stocks are good.

Fuses.—Good supplies are held of all types, but sales are quiet. In standard packages, non-renewable, N. E. C., 30-amp. fuses sell for about 9 cents each.

Washing Machines.—Prices are steady, though very few are being sold and the number carried in stock is kept down.

Vacuum Cleaners.—Demand is not very active this spring, though some sales are being made. There is a prejudice against ordering in very large quantities apparently. Prices are steady.

Heating Devices.—Certain manufacturers have changed their list prices on flatirons so that they now vary from $7.75 to $8.50. These include Hot Point, Westinghouse and American Beauty. In the latter case the reduction amounts to 15 per cent.

CHICAGO

Although dullness in the market is wholly unrelieved, many factors are developing which point to an early change. An important ruling by the Federal Reserve Bank in the Seventh District effects a reduction of 1 per cent in the discount rates, 6½ per cent now being the charge on commercial and industrial paper and trade acceptances.

As has been the case for some weeks, prices have but small effect on volume of business just now. The unsettlement in the building trades persists, and all large work is thereby suspended. The commission investigating conditions in the construction industry is still at work, and naturally but few projects are showing any progress until these matters are adjusted. General industrial conditions continue to improve in that the stockyards and printers' strikes have been terminated and forces in all manufacturing plants are being very gradually augmented.

Collections remain very slow, as the retailer is not only making few sales but is being compelled to grant extensions on time payments. Conversation with several large installment furniture stores develops the fact that their collections have been gradually improving since a low point established in the first week in April.

Bare Copper Wire.—Although the market on bar copper is off a fraction, the quotation on wire remains unchanged. In quantities of 1,000 lb., No. 8 is quoted at 16 cents per pound. This price is subject to shading on large lots. Business in bare wire has been good in comparison with trade in other commodities, but this week it is again quiet.

Insulated Copper Wire.—A drop of ½ cent per pound has been noted in the past ten days, base on triple-braid weatherproof now being 17½ cents. This makes No. 6 wire 18½ cents per pound. Even at this low figure few sales are being made. No. 14 rubber-covered is variously quoted at $7.50 to $7.75 per 1,000 ft. in 5,000-ft. lots.

Conduit.—The tie-up in building has put a decided damper on trade in conduit, demand being at a minimum and price changes apparently unable to stimulate the call. In 5,000-lb. lots ½-in. black is quoted at $62 per 1,000 ft. In larger lots prices are subject to negotiation.

Flexible Armored Conductor.—Demand remains at a low ebb, this commodity also being affected by building conditions. Prices remain unchanged, the two-wire, No. 14, being priced $62 per 1,000 ft. in 5,000-ft. lots.

Poles.—New prices on Western poles have induced many inquiries, although but few large transactions are reported.

Line Hardware.—Inquiries are becoming quite numerous, and with the advent of excellent weather some orders are being reported.

Heating Appliances.—Dealers report that with the slight improvement which has been noted in the employment situation there is a little increase in retail demand. The feeling still holds on the part of the public that prices are too high, and this feeling is shared to a certain extent by the dealers themselves. Flatirons and toasters continue to be the best sellers in the line.

Washing Machines.—Intensive selling efforts continue to bring proportionate results. A very large percentage of sales are of the higher-priced machines, on deferred payments, probably because these high-priced machines are better advertised and more consistently pushed by retailers.

BOSTON

A persistently better feeling is evident in trade, although as yet increases in the volume of business are irregular. Stocks have been further reduced in many lines, but deliveries are in general excellent for the demand existing. Prices have not moved much in the past week, barring unsteadiness in wire and flexible armored conductor. Building contracts fell off considerably compared with the previous week, but a decided improvement can be seen in actual construction under way, notably in Boston and around Hartford. Collections remain slow, but are holding their own from week to week at present. New factory construction is announced for Winthrop, Me., in replacing structures recently destroyed by fire.

Wire.—Weakness in prices is the feature of a moderate demand. Rubber-covered No. 14 was selling at Boston Monday at $7 per 1,000 ft. in 5,000-ft. lots to $8.25 for smaller quantities. Weatherproof base was 16 cents, with a quiet market and good stocks.

Flexible Armored Conductor.—Unsteady prices exist, running from $65 per 1,000 ft. in 5,000-ft. lots downward to $60 or lower on a pinch in larger quantities, in order to move accumulated stocks.

Dry Cells.—Small-quantity prices in a leading make are announced to be $1.35 higher per 100 than formerly. The No. 6 cell brings $44.35 per 100 in lots of 12 to 50, and in lots of 50 to 125, $40.35 per 100. A fair trade is being handled, with renewals active.

Lamps.—Business is lower in volume than a year ago, but distributers find a good staple demand existent. Stocks in all types and sizes are good. Sign lamps are moving more actively, relatively, than most other types.

Metal Molding.—Several good orders were handled last week in this material. It is plentiful in supply and prices are firm.

Motors.—Few motors are moving in the market compared with normal business.

Porcelain Insulating Material.—Demand is easy, with prompt deliveries for offered business. "Nail-It" knobs sell for $27 per 1,000 in barrel lots and 3-in. tubes for $9.50. High-tension line insulators are not as easy to obtain as low-tension fittings.

Schedule Material.—Some jobbers are prepared to buy substantially if price concessions come, it is said on good authority. At present only moderate sales are being handled and representative factories are running on about half time.

Lamp Cord.—Easy conditions prevail as to deliveries, with quiet demand and a typical price of $18 per 1,000 ft. in 1,000-ft. lots, No. 18 cotton-covered.

Rigid Conduit.—Moderate quantities are being required for sub-normal building construction work. Stocks are satisfactory on the whole, and prices reflect recent downward tendencies in the steel industry. For 5,000 lb. or less 1-in. black pipe sells at $131.20 in Boston.

ATLANTA

The announcement of the Sixth Federal Reserve District that the discount rate would be reduced has been received as a hopeful sign by all lines of business, and the general conclusion is that this reduction will serve to stimulate business throughout this district.

There is a well-defined opinion among the electrical jobbing trade that conditions will have approached quite normal by July or August, and the more progressive firms are laying out schedules anticipating this condition. This has taken the form of orders for material that they feel will be first to move and in which they have allowed stocks to become depleted for several months past. The spell of unseasonable weather that has been prevalent in this section for the past ten days has served to check the seasonable demand for electrical specialties and has materially interfered with agricultural activities.

Farm-Lighting Outfits.—The taking over by state and counties of small schools has caused considerable activity in this line, it apparently being the intention of the school authorities to consider seriously the installation of moderate-size farm generating outfits, especially in the larger rural schoolhouses. Sales and inquiries are reported as quite good, while stocks are at present ample; though shipments are slow. A price reduction of 10 per cent was announced recently.

Industrial Motors.—Small ice plants and the installatic of an unusual number of refrigerating plants are moving a fair volume of the moderate-size apparatus. Inquiries are coming in from the industrial plants, but as yet few orders have materialized. Stocks are in good condition and shipments excellent.

Meters.—These continue dull, the only movement of note being in the 5-amp. and 10-amp. sizes, except in the case of the large central-station companies. Stocks are reported ample, with shipments satisfactory.

Oil-Engine Generating Sets.—The issuance of bonds by several of the smaller municipalities is stimulating sales and inquiries in this line, especially in Florida and sections of southern Alabama, the interest being centered over a range in size of from 25 kw. to 200 kw.

Rigid Conduit.—Another small drop in market quotation is reported, averaging 5 per cent. Only a fair volume of sales is reported. Jobbers are placing respectably sized orders for stocks in anticipation of renewed life in the near future.

Poles.—It is reported that producers have been forced to accumulate heavy stocks at point of shipment, owing to the failure of the trade to make purchases in anticipated volume. Purchases are confined to immediate requirements only, central-station companies avoiding the accumulation of more than current supplies.

Wire.—A further slight reduction in this line is to be noted this week, weatherproof now being on a 16½-cent base and rubber-covered on a 16-cent basis. The volume of orders is small, sales of Nos. 6, 8 and 10 weatherproof and 14 rubber-covered being in the majority.

ST. LOUIS

Business unquestionably is improving for retailer, jobber and manufacturer in every industry. This is the general report. With some it is normal, with others still quite slow, but every one reports substantial improvement in April over the average since the first of the year. This is particularly true with the electrical jobbers. The increase in their case cannot be especially attributed to any one line of goods carried, as a gradual and healthy improvement in demand is found in almost every item. Former overstocks now are about in line.

Some improvement in construction is noted, but a vast amount is being withheld until building costs shall be lower. It is considered improbable that much reduction in labor will be obtained until the latter part of this year or the first of next year. A number of the building trades have been successful in securing contracts with the employers for another year without the expected 20 per cent reduction, and it seems to be the tendency among the contractors to waive the reduction in order to get what business there is available. Apparently to justify prices for materials, the St. Louis Material Dealers' Association has asked the Attorney-General to make an investigation of its activities. Kansas City is reported to have a building boom, but this is principally for residences, and the general attitude of business is to wait for lower costs.

New power business is at a low ebb, but a healthy number of inquiries are reported. Kilowatt-hour sales in St. Louis continue to show larger monthly totals than for the same months last year by more than 5 per cent.

Meters.—One jobber reports a good business throughout the Southwest due to expansion on the part of central stations. Prices are firm and stocks are in healthy condition.

Poles and Cross-Arms.—Continued improvement in demand is reported, which is due principally to transmission extensions by the utilities. Moreover, a good volume of in-

quiries is being acted upon, and the indications are for a good business all summer.

Wire.—No. 14 rubber-covered shows increased sales, but the other sizes are lagging. Almost all quotations for all kinds and sizes of copper wire are on a 16-cent base. Special cases will be found where lower quotations are made to reduce a heavy stock in some particular kind.

Knobs and Tubes.—The prices are reported to be steadier now, as some of the large stocks held locally have been considerably reduced. Demand is still low. The price of "Nail-it" knobs ranges from $24 to $28 per 1,000 and 2½-in. tubes from $8 to $8.75 per 1,000.

Dry Cells.—Good sales and healthy stocks are reported. In barrel lots the regular cell is selling at 38 cents, but there is reported on the market a cell priced at 28 cents.

Fans.—Retailers report that the "advance guard" is in the market for fans. Jobbers advise that retailers are buying but not heavily, as they are waiting to see what weather the month of June brings forth. Local stocks are low, but the jobbers are buying conservatively.

Washing Machines. — Retailers and jobbers report increased sales of washing machines.

Motors.—Local jobbers report large stocks and slow movement. The demand from the industrials is expected to be improved by fall. At present a tremendous overstock of fractional-horsepower motors is reported.

Flatirons.—While retailers report fairly good sales, they are apparently buying conservatively in the expectancy of a reduction in the wholesale price, which is the same as it was a year ago. Reductions in retail prices have had a tendency to promote consumer purchasing.

SAN FRANCISCO

The labor situation occupies the center of the stage. In the first place the seamen's strike has tied up coast and oceangoing traffic. There has been some violence, and all signs point to a bitter strike unless a nation-wide decision restores the situation. In the second place, the building trades unions, having refused to accept a wage reduction of 7½ per cent, advised by a board of arbitration, a general walkout has been ordered. In San Francisco all large buildings under construction are reported to be tied up, and although the electrical crafts are not directly affected, within the next week they will be automatically out of employment. Stock conservation is being vigorously practiced by the local jobbers, fast-moving stocks being ordered in smaller amounts and slow-moving items being followed in the way of special sales effort and substitution where possible.

Within the past month excursions have been made to the Pacific Gas & Electric and to Great Western Power projects at Lake Spaulding and Lake Caribou respectively to explain better to bankers, representative public men and members of the electrical fraternity the magnitude of the schemes and their importance in the general prosperity of the state.

Rubber-Covered Wire.—Prices are still tipping, No. 14 single-braid solid being offered to dealers in 5,000-ft. quantities at prices ranging from $7.20 to $7.75 per 1,000 ft. f.o.b. Coast cities. Local stocks are very good. April was a better month than March, although both run considerably less than the corresponding months of last year.

Sewing Machines.—This is the season of greatest drive on sewing machines, and an increased movement of stocks is reported. Electrical dealers themselves are still to be "sold" on sewing-machine merchandising, for their sales do not approach the proportionate sales on washers and vacuum cleaners. The larger buyers seem to be holding off in expectation of price decreases.

Heating Material. — Prices of heating material have dropped, with virtually all the manufacturers participating in the general decrease. Hot Point irons, No. 6, are listed at $8, subject to previous quantity discount; Westinghouse at $7.75; Western Electric, No. 6½, also at $7.75, while the American Beauty, No. 6½, now lists at $8.50. These new prices will undoubtedly stimulate buying.

SEATTLE—PORTLAND

Both jobbers and dealers in Seattle, with very few exceptions, report that sales for the first week in May show no change over any one week during April. The predicted increase in sales volumes for spring months has not materialized and from present indications will not do so. The contributing factors for this condition are mainly nonemployment, wage slashing, reduction in working forces in industrial and business institutions and the lack of building of real consequence. However, this last factor is showing improvement, especially during the past two weeks, in Seattle, where contracts for structures totaling considerably over $2,000,000 have been awarded. These contracts call for a high school, two apartment houses, a department store and two theaters. Residence construction is keeping up well, and this condition is expected to continue throughout the summer and fall. Tacoma reports state that during the month of April more permits for residences were taken out than in any single month for ten years. Unquestionably in the Puget Sound districts the real-estate market is improving, the most encouraging sign being in the number of transfers of down-town properties which are to be used by purchasers for locations for expanding business.

Electrical jobbers in the Portland field state that business is showing an increase and that while this is not great it indicates a trend in the proper direction.

In Portland contracting in small work continues fairly active, but larger contracts are scarce. Fixture business, owing to the increasing amount of residence construction, is showing satisfactory increases. Retail stores in Portland report everything very quiet, with a continued downward tendency. Throughout the entire Northwest, generally speaking, collections are more or less difficult and liquidation of debts and bank loans is slow. Efforts are being made to operate on the smallest possible stocks.

Vacuum Cleaners.—To meet spring requirements, in Seattle and Tacoma particularly, an improvement in demand has been noted during the past few weeks.

Schedule Material.—An increasing amount of construction, both residence and business buildings, is serving to move heavy stocks. This demand is expected to show constant increase throughout the summer and fall.

SALT LAKE CITY—DENVER

That conditions should be much improved by next fall, particularly from the farmer's point of view, is indicated in the prospect for big crop yields. The acreage in some crops will be materially less than a year ago, owing to high cost of production, but the promise of heavy yields is very encouraging. Wages paid to farm help are at least 50 per cent under the standard wage of a year ago.

The wool outlook is little improved, with growers still holding their clippings for prices that at least approximate the cost of production. A vigorous co-operative movement in the way of pooling this wool promises to bring alleviation in the near future. Growers are still making a frantic effort to get loans to tide them over the period of demoralized markets. Country banks are interceding for their clients in appeals to the banks of the larger centers, and they are meeting with indifferent success. There are abundant signs of activity in building and construction lines. Hardware dealers, for example, report that last week showed the biggest volume of business of any week for the entire year. The lumber trades also report steady improvement. Many homes are under construction. With the advent of fair weather dealers report a noticeable improvement and feel confident of a good summer ahead.

Washers.—There is not much activity reported. Jobbers are overstocked and dealers are reluctant about ordering in sizable quantities.

Cleaners.—In this line it is a different story. Cleaners are selling well. In certain popular makes jobbers are hard put to it to keep their dealers amply supplied. They report a turnover of stocks in some instances every two weeks. Retailers are placing good-sized orders. Price guaranteeing also affects vacuum cleaners.

Hollow Ware.—The general movement in cooking appliances has been slow and unsatisfactory.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Buildings for Grindle Fuel Equipment Company

The Grindle Fuel Equipment Company, 1901 South Rockwell Street, Chicago, is offering, subject to prior sale, the unsold portion of $500,000 in 7 per cent cumulative and participating preferred stock at a par value of $50 a share, together with a bonus of one share of common stock. The proceeds of this sale will be used for additional working capital and for the construction and equipment of a new two-story factory building and a one-story foundry building. The plant will be used for manufacturing and demonstrating coal-handling machinery and equipment and coal-pulverizing equipment, in addition to gray-iron castings for the market.

Newark Jobber Puts Out First Issue of Trade Letter

Devoting itself to the electrical interests of New Jersey, the Newark Electrical Supply Company, 223 Market Street, Newark, has issued Volume I, No. 1, of *Nelectra-Grams* of trade news and gossip. In this issue the company records an upward swing of business which made itself felt in April and states that it has received from every direction reports of a slow but perceptible increase in buying.

More Details to N. E. C. A. Richmond Program

Following a tour of Washington, D. C., on Wednesday, May 18, including an address by D. R. Crissinger, Comptroller of the Currency, on "The Economic Problem," the National Electrical Credit Association will proceed to the Hotel Jefferson in Richmond, Va., for its twenty-second annual convention set for Thursday and Friday, the nineteenth and twentieth. During the period time is given for trips through historical country.

In Thursday's program William L. Goodwin, Society for Electrical Development, will lead the discussion on the "Sales Manager's Viewpoint of the Credit Department"; W. J. Drury, sales manager of the Western Electric Company, leads the discussion on the "Effect on Sales of a Rigid Credit Policy." "Better Business Methods" has been assigned to J. A. Corcoran, General Electric Company, and the discussion on "Present-Day Credit and Collection Problems and How to Meet Them" is to be led by T. J. Whearty, National Carbon Company. The annual dinner on Thursday evening will be addressed by John M. Miller, president of the First National Bank, Richmond; William L. Goodwin and Albert H. Elliot, secretary Pacific Coast Association.

To J. S. Thomas, Elliott-Lewis Electric Company, Philadelphia, has been assigned the discussion on "Is the Credit Man a Business Builder?" which is scheduled for Friday morning. James A. Loring, secretary New England Association, will lead the discussion on "Handling the Slow and Embarrassed Customer," and time will be given to association problems, marketing household devices, etc. This program is somewhat fuller than that published on April 16.

From information received as to the members who will attend, it seems there will be the largest and most enthusiastic gathering that has ever been seen at an annual meeting of the association. Was there ever a time more suited to credit discussions than right now?

Larger Quarters for Flexible Coupling Manufacturer

The move of the Thomas Flexible Coupling Company, manufacturing engineers, from Warren, Pa., to Dunkirk, N. Y., was necessitated by the rapid growth of the business, according to one of the officers of the company. The new plant at Dunkirk is 40 ft. x 200 ft., on the main line of the New York Central, and is being equipped with the machinery best suited for its particular class of work. It is expected to begin operations by June 1.

The secretary states that the company has every reason to be optimistic, as business in its line is not at all bad. When conditions in general return to normal, and they are doing so very rapidly, he asserts, the company will be in a position to manufacture on a service basis with equipment for a large amount of new business.

Gear Manufacturers Progress in Standardization

The American Gear Manufacturers' Association, which closed its annual meeting in Cincinnati on April 30, adopted as recommended practices by the association the reports of several committees. Uniform cost accounting was recommended as an important step in the coming year's program.

Special emphasis was laid on standardization of steel roller chains for transmission purposes, particularly in the matter of interchangeability; certain features in spur and bevel gears for industrial use were adopted as standard, and consideration was given to reports on railway gears and pinions, herringbone gears, keys, keyways, shafts, sprockets, etc.

F. W. Sinram, Van Dorn-Dutton Company, was re-elected president of the association; R. P. Johnson, Warner Gear Company, was elected first vice-president; B. F. Waterman, Brown & Sharpe Manufacturing Company, was elected second vice-president, and Frank D. Hamlin, Earle Gear & Machine Company, was re-elected secretary and treasurer, The executive committee was increased from nine to twelve members to take in all branches of the gear-making industry. The fall meeting will be held in Rochester, N. Y.

Time Extended on New York Edison's Sign Show

Before the first day of the New York Edison Company's Electric Sign Show was over the exhibitors were so satisfied with results that they asked and received permission to extend the time of closing from 6 o'clock to 10 o'clock in the evening and the duration of the exhibit from May 7 to May 11. The original hours were from 9 a.m. to 6 p.m. and the dates from May 2 to 7 inclusive. Not only signs but also the latest in lamps, flashers, color caps, time switches and other accessories were shown.

The success of the show was assured from the first not only by the interest displayed but by the orders taken by the exhibitors. The attendance was exceedingly good in spite of inclement weather, and manufacturers are desirous of having the idea followed in other cities. Not the least interesting aspect to the central station was the spectacular effect of the motion of color, and as in other exhibitions it was especially noticeable in this case that visitors to the show had ample opportunity to see and inspect the various socket household appliances occupying otherwise unused spaces in the showroom.

Two New Divisions Added to Wood Electric Company

The Harry I. Wood Electric Company, Louisville, Ky., manufacturer and jobber in electrical supplies, has added a farm-lighting division and an appliance division, both in charge of R. C. Bryce. Not only will the "Universal" light plant be promoted but also a good deal of attention will be devoted to the installation of units of the semi-Diesel type for larger municipal requirements.

In the appliance end Mr. Bryce will handle the "Mola" electric washer, the "Universal" electric washer, a complete line of Hamilton-Beach products, a complete line of "Edison" appliances, "Simplex" ironers, "Bee" vacuum cleaners and other home devices. The company hopes with sound business methods and service to extend its dealer connections beyond its present territory of Kentucky, Tennessee and southern Indiana.

New Salt Lake City Electrical Manufacturing Company

Articles of incorporation have been filed by R. Ackerman & Company, Salt Lake City, organized for the purpose of dealing in and manufacturing various kinds of electrical equipment. The company has a capital stock of $100,000, divided into 1,000 shares of a par value of $100. Shares subscribed for by the various incorporators are paid for by the acquisition of the assets of the Kaiser, Ackerman, Gardner Company, valued at $14,000, to which the new company is successor, and certain other contributed assets. The incorporators are R. Ackerman, president; J. B. Ambler, vice-president; L. J. Riter, secretary-treasurer, and others.

British Standardization in Cable Soldering Sockets

The British Engineering Standards Association, 28 Victoria Street, London, has issued a standard specification for electric cable soldering sockets. It deals with sockets for cables from 0.0018 sq.in. to 1 sq.in. sectional area and has been prepared at the request of the Institution of Electrical Engineers. The specification includes definitions and clauses relating to the material and dimensions of cast and wrought lug sockets and clamp sockets and their clamps. At present there are only two types of sockets standardized.

Attention is directed to the care which should be taken to insure that the cable should fit the hole in the sockets without too much clearance, so that the current will not have to traverse an undue amount of solder. For each size of cast lug socket a maximum diameter of hole is specified, and for use with smaller cables a smaller hole should be used. In the case of wrought lug sockets made from copper tubing it is not so easy to overcome this difficulty.

In the case of clamp sockets there are only nine sizes, and the actual diameter of the hole to be bored for each size of the cable is specified. The question is of chief importance when the maximum current is being carried.

American Radium Files Complaint on Infringement

The American Radium Company, 7 East Forty-second Street, New York City, filed a bill of complaint in the Southern District Court of New York on April 26 for the infringement of its United States patent No. 789,812, originally granted to Dr. George F. Kunz, New York City, on luminous composition.

This equity suit is brought against the Hipp, Didisheim Company, Inc., and Hippolyte Didisheim and Henri M. Didisheim. The bill of complaint shows that it is also aimed at the partnership Hipp, Didisheim & Brother as the predecessor of the company, which was formed in April, 1919. Luminous composition is being used for pendent switches, push-buttons, etc., in the electrical field

Secretaries Hughes and Hoover Indorse China Trade Act

Both Secretary of State Hughes and Secretary of Commerce Hoover, according to advices from the Department of Commerce in Washington, have indorsed the China trade act, a bill designed to place American business in China on an even competitive basis with the business of Great Britain, France and Japan. "The matter is one of great importance to the preservation of the trade and investments of our nationals in China," says Secretary Hoover in a letter. "The act is intended to establish a federal incorporation law for local China business in such a manner as to give our citizens an equality of opportunities with other nationals."

Mr. Hoover explained that the object of the act is to offer a form of American corporation law that would rank with the British law in its protection to stockholders and would give American business in China a prestige which it does not now possess. The proposed act also provides freedom from United States taxes to such corporations upon such part of their business as is wholly conducted in China and outside of the United States.

The bill has been passed by the House and has been sent to the Senate.

Power Specialty Company Expands Sales Offices

The Power Specialty Company, manufacturer of Foster superheaters, economizers and oil stills, has opened additional offices in the Reliance Building, Kansas City, Mo., and in the Linz Building, Dallas, Tex. The Kansas City office is in charge of William F. Meyer and the Dallas office in charge of M. W. Brown.

The Newport News Battery & Electric Company, Newport News, Va., is planning to install additional machinery at its plant.

The Allen-Bradley Company, 284 Greenfield Avenue, Milwaukee, announces the removal of its Cleveland office from the Citizens' Building to the Bangor Building, 942 Prospect Avenue. The Cleveland office is in charge of H. A. Stevenson, who is assisted by W. L. Jaeckel.

The World Lighting Appliance Company, 108 West Fortieth Street, New York City, has filed notice of increase in capital stock from $15,000 to $50,000.

The Bates Company, New York City, announces the removal of its engineering offices from 2 Rector Street to 74 Dey Street, where it will occupy the first and second stories.

The Lytle Electric Company, Memphis, Tenn., has applied for amendment to its charter to increase the capital stock from $10,000 to $25,000.

The Non-Breakable Battery Cell Company, Oconto Falls, Wis., recently incorporated with a capital stock of $30,000, has leased quarters in an existing factory and is purchasing equipment.

The French Battery & Carbon Company, Madison, Wis., has increased its capital stock from $675,000 to $1,750,000. The company, it is understood, contemplates increasing the capacity of its plant. James B. Ramsey is president.

The Olive Hill Refractories Company, Ashland, Ky., recently organized, contemplates the construction of a new plant with daily output of about 30,000 firebrick and other refractory shapes. John F. Hagar is president.

The Keller Pneumatic Tool Company, Grand Haven, Mich., has removed its Chicago branch to the Transportation Building, 624 South Dearborn Street. The salesroom and service station will be on the main floor. A complete stock of tools and parts will be carried. J. C. Campbell is district manager.

The Mattison Machine Works, Rockford, Ill., announce the removal of their New York office from 110 West Fortieth Street to 602-603 Times Building, Broadway at Forty-second Street.

The Cortlandt Engineering Company, Paterson, N. J., announces the removal of its offices from 11 Park Avenue to 193 Ellison Street, Paterson.

The Uehling Instrument Company, 71 Broadway, New York City, manufacturer of fuel-saving equipment, has removed its Chicago office to the Great Northern Building, 20 West Jackson Boulevard. Uehling CO_2 recording equipment and other boiler instruments will be on display in this office. Walter C. Lange, until recently with the New York office, has been appointed manager of the Chicago office.

The Superheater Company, New York City, has removed its offices from 30 Church Street to 17 East Forty-second Street.

The Michigan Stamping Company's new address is Mack Avenue and Terminal Railroad, Detroit, Mich.

The Lunkenheimer Company, Cincinnati, Ohio, announces the removal of its Chicago branch from 188 North Dearborn Street to 568 West Washington Boulevard.

The Sampson Manufacturing Company, 4244 West Lake Street, Chicago, manufacturer of electric and gas fixtures, has completed plans for the erection of a one-story plant, 40 ft. x 125 ft., on West Lake Street, to replace a building recently destroyed by fire.

The George H. Gibson Company, New York City, consulting engineers, specializing in commercial research and advertising of technical products, announces the removal of its offices from the Tribune Building to the Hide and Leather Building, 100 Gold Street.

Foreign Trade Notes

BRITISH CABLE MANUFACTURER EXPANDS WORKS.—In the 1920 report of the British Insulated & Helsby Company the profit for the year amounted to £349,713, an increase of £12,024 over 1919. Except for a coal strike and labor demands which closed the works for three weeks, the plants at Prescott and Helsby were busy throughout the year, and the present state of the order book is quite satisfactory. Present high costs of manufacture and inability to give certain delivery, owing to labor unrest, prevented the company from taking orders, which are now being placed abroad. Foreign trade can only be retained by a reduction in the cost of production, and although a decrease in wages would have a most beneficial effect, another and very important element has to be considered—namely, increased efficiency in the mechanical means of production. There has, therefore, been carried out a reorganization of the works. What are practically three new factories have been built and fitted with all the latest appliances and the power plant has been enlarged. Facilities for handling raw material and finished products have been much improved, while other departments have also been dealt with. These changes should cheapen production. The company has been working under the improved conditions for two or three months, and while it is feeling the beneficial results of the changes generally, it is noteworthy that all the latest types of special high-tension cables of very long lengths can be turned out.

SWISS COMPANY'S OPERATIONS IN RUSSIA.—The Swiss Company for Electrical Enterprises, at Glarus, Switzerland, a large holding company interested in a number of foreign electric establishments, has just published a report about the extensive electric plants of the Petrograd Electric Company. It seems that the works at Petrograd and Moscow have been in operation to a certain extent and that even some enlargements of the Moscow plant have taken place. The works at Lodz, also belonging to the Petrograd company, are being worked by the Polish authorities, who mean to operate this plant independently of the Petrograd company. The Lodz electric works have booked large orders of late and the prospects are very satisfactory. The Petrograd and the Moscow establishments are in the hands of the soviet government.

SUPPLIES WILL BE NEEDED IN SALVADOR.—The market in Salvador for electrical supplies is developing, according to a report from the Guaranty Trust Company. The municipality of Santiago de Maria and the city of Berlin, both in the Department of Usultan, have recently let a contract for an electric light plant.

REBUILDING LAMPS IN SCOTLAND.—According to advices from the British Consulate General in New York premises have been acquired in Paisley by the Scottish Electric Lamp Repairing Company for the establishment of this new industry in Scotland. The method of repair is to take a lamp of which the filament is worn or broken, cut out a small part of the glass, put in a new incandescent element, exhaust the air and weld up the glass again, the repaired lamp being virtually equal to a new one, while the cost is a fraction of that of a new lamp. The industry was commenced under patent protection by the Allies' Electric Repairing Company of Hammersmith, London, which has thoroughly tested and proved the soundness of the method and has now accorded the new company sole rights for Scotland.

SIEMENS & HALSKE'S 1919-1920 REPORT.—Siemens & Halske are now issuing their report for the business year 1919-1920. The combine with the Deutsch-Luxemburgische Bergwerks- und Hutten-Gesellschaft is now completed. The business year was fraught with economical uncertainty and the scarcity of raw material and coal could only be overcome toward the end of the year. After the last strike of the Berlin metal workers labor disturbances did not occur to any appreciable extent and the efficiency of the workmen increased, the good effect of piece work making itself felt. The expenditure in wages and salaries for the concern as well as for the Siemens-Schuckertwerke was 479,000,000 marks against 70,000,000 marks in 1914. This expenditure is estimated to run up to 1,000,000,000 marks in 1921. On Oct. 1, 1920, the company entered into a joint-interest combine with the Gelsenkirchener Bergwerks A.G., the Deutsch-Luxemburgische Bergwerks un Hutten A.-G. and the Electricity Company Schuckert & Company. The balance sheet shows a gross profit of 25,779,000 marks.

GERMANY'S EFFORTS TO REGAIN NORWEGIAN TRADE.—Germany is making great efforts to regain the Norwegian market for her electrical industry. According to a report from Christiania, Germany supplies at present about 25 per cent of all electrical machinery imported into Norway. At the same time imports from the United States in 1920 amounted to $2,165,000 worth of electrical materials and apparatus. The large importations from Germany are chiefly due to the depreciation of the German mark. Some of the large German electrical manufacturing concerns have recently opened branch offices at the Norwegian capital.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A mercantile firm in Spain (No. 34,796) desires to purchase and secure an agency from manufacturers only for the sale of electrical copper-wire bars for laminating; also copper blocks for laminating (weight to be in accordance with specifications), copper and brass in all forms, etc.

A firm in Mexico (34,797) desires to purchase a complete automatic call-telephone equipment, including receivers, transmitters, switches, 2 miles of wire, batteries, insulators, etc., for a six- to ten-party system.

An American firm with representatives and offices in China, Manchuria and Siberia (No. 34,799) desires exclusive agencies for lighting plants, power plants, etc.

An inquiry has been received from a business man in Chile (No. 34,803) for catalogs and full descriptions of fire and police alarm systems suitable for a city of 500,000 inhabitants.

New Apparatus and Publications

BOILER CLEANER. — The Automatic Boiler Cleaner Company, New Orleans, has placed on the market a mechanical boiler cleaner for any type and size of boiler.

SIGN RECEPTACLE. — The Manufacturers'—Distributing Company, 30 Church Street, New York, is bringing out a new porcelain sign receptacle, the No. 54 "Mandico," all metal parts of which are of brass or copper.

FIXTURE STUD.—S. R. Fralick & Company, Chicago, have placed on the market a new fixture stud, known as the "Kwikon No-bolt" stud.

ENGINEERING CATALOG. — The seventh annual edition of "Sweet's Engineering Catalog" has been published by Sweet's Catalogue Service, Inc., New York City, listing in its 1,251 pages "materials, equipment and supplies relating to practical construction, equipment and maintenance of all projects of an industrial or engineering nature."

WINDOW LIGHTING. — The Ivanhoe Rainbow Window Lighting Equipment of the Ivanhoe Regent Works of General Electric Company, Cleveland, embracing color lighting for show windows is on the market.

CONVEYORS. — The Lamson Company, 100 Boylston Street, Boston, is distributing an eight-page leaflet describing its different types of conveyors.

ROTARY PUMP. — The Exeter Machine Works, Inc., West Pittston, Pa., have recently placed on the market a new "Exeter" rotary pump (Feuerheerd Patents).

LUBRICATION.—"Turbine Lubrication," Part 2, is the subject of the leading article in the April, 1921, issue of *Lubrication*, published by the Texas Company, 17 Battery Place, New York City.

STOKERS.—The Combustion Engineering Corporation, 11 Broadway, New York City, has issued bulletin C-2, describing the Coxe stoker. The company is also distributing two pamphlets, one entitled "Use of Pulverized Coal Under Central Station Boilers" and the other "Powdered Coal Application to Four 2640-Hp. Boilers."

New Incorporations

THE GEORGETOWN ELECTRIC LIGHTING COMPANY, Georgetown, N. Y., has been incorporated to operate a local light and power system. C. D. Brown, A. A. Watson and E. L. Andrus are interested in the company.

THE SLATON LIGHT COMPANY, Slaton, Tex., has been organized to operate a local electric system. Foster Carroll and L. H. Fuller are interested in the company.

THE TOMPKINS COUNTY POWER CORPORATION, Ithaca, N. Y., has been incorporated with a capital stock of $20,000 to install and operate an electric light system in certain sections of Tompkins County. The incorporators are W. E. Towner, E. F. English and H. H. Brown, Ithaca.

THE LELAND ELECTRIC COMPANY, Dayton, Ohio, has been incorporated with a capital stock of $10,000 to manufacture fractional-horsepower motors. George H. Leland is interested in the company.

THE DIXIE LIGHT & POWER COMPANY, Walton, Ky., has been incorporated with a capital stock of $20,000 by Robert W. Jones, William Brittenhelm and Charles Ransler.

THE LA ELECTRIC & FIXTURE WORKS, 1910 South Main Street, Los Angeles, Cal., has been organized to manufacture electric fixtures, etc. Capitola La Touche, 2006 South Union Avenue, heads the company.

THE SALTVILLE (VA.) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000. J. K. Wilson is president and E. C. Scott is secretary.

THE COMMUNITY POWER COMPANY, Petersburg, W. Va., has been incorporated with a capital stock of $50,000 by A. J. Welton, H. W. Sites and Charles J. Zell.

THE NESCO ELECTRIC SERVICE COMPANY, New York, N. Y., has been incorporated with a capital stock of $75,000 to manufacture electrical apparatus. The incorporators are N. Xenakis and J. C. Papadopoulos, 2033 Broadway.

THE H. L. ELECTRIC COMPANY, New York, N. Y., has been incorporated by M. L. Wack and O. I. Jubelsohn, 36 East Eighth Street. The company is capitalized at $10,000 and proposes to manufacture electrical equipment.

THE WILLYS LIGHT HOME EQUIPMENT COMPANY, Fremont, Ohio, has been incorporated with a capital stock of $10,000 by M. G. Throves, A. J. Vickery and J. L. Patterson.

THE ALP ELECTRIC MANUFACTURING COMPANY, 325-27 East Ferry Street, Newark, N. J., has been incorporated by Mauritz Larsen, Eric H. Anderson and Walfred A. Peterson. The company is capitalized at $100,000 and proposes to manufacture electrical products.

THE SPERLICH & UHLIG COMPANY, Detroit, Mich., has been incorporated by J. Herman Uhlig, Edward F. Wunch and Herman A. Sperlich, 44 Colorado Avenue. The company is capitalized at $300,000 and proposes to manufacture electrical appliances and equipment.

THE ELECTRO HEATER COMPANY, Silver Springs, Md., has been organized to manufacture lighting and heating equipment. Harry E. P. Baden, Silver Springs, and Jay L. Benedict, Washington, D. C., are interested in the company.

THE ELECTRICAL BATTERY & WELDING COMPANY, 2426 Prairie Avenue, Chicago, Ill., has been incorporated by George L. Kyle, C. L. Gotschall, A. C. Flynn, Paul T. Lamoreaux and J. E. Hurtubise. The company is capitalized at $10,000 and proposes to manufacture storage batteries, armatures, dynamos, ignition systems, etc.

THE LOGAN MACHINE & ELECTRIC COMPANY, Logan, W. Va., has been incorporated by S. S. and C. F. Smith and H. E. Steele, Logan. The company is capitalized at $25,000 and proposes to manufacture electrical equipment, machine parts, etc.

THE NEWBERRY ELECTRIC CORPORATION, Los Angeles, Cal., has been incorporated by R. C. S. Pilsbury, J. N. Hayes and D. D. McFarlane. The company is capitalized at $200,000 and proposes to manufacture electrical products. H. C. Galloupe, 1326 Washington Building, heads the company.

Record of Electrical Patents

Notes on United States Patents

(Issued April 19, 1921)

1,375,256. IGNITION APPARATUS FOR AVIATION ENGINES; Auguste Maire, Argenteuil, France. App. filed Aug. 9, 1917.

1,375,276. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Dec. 28, 1918. Trunk-line circuits.

1,375,277. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed June 5, 1919. Machine switching.

1,375,278. INCLINE INDICATOR; William S. Clayton, Vancouver, B. C., Canada. App. filed Sept. 5, 1918. For aviation.

1,375,281. TELEGRAPH SYSTEM; George C. Cummings, East Orange, N. J. App. filed May 28, 1918. Simultaneous transmission of messages over one line.

1,375,306. BATTERY ELECTRODE; Lorenz Maisel, Madison, Wis. App. filed Oct. 11, 1918. Container type.

1,375,309. ELECTROGALVANIZING MACHINE; Constantine G. Miller, Chicago, Ill. App. filed Feb. 3, 1920. Improved feeding mechanism.

1,375,317. PROCESS FOR FORMING SECONDARY-BATTERY PLATES; John M. Peterson, Dawson, Minn. App. filed Sept. 18, 1918. Planté type.

1,375,319. ELECTRIC MOTOR GENERATOR FOR STARTING AND LIGHTING GASOLINE AUTOMOBILES; Frank B. Rae, Cleveland, Ohio. App. filed June 7, 1915.

1,375,330. MANUFACTURE OF METALLIC SODIUM; Albert W. Smith and William R. Veazey, Cleveland, Ohio. App. filed July 16, 1917. Electrolytic.

1,375,351. CALL-DISTRIBUTING ARRANGEMENT FOR TELEPHONE PLANTS; Gotthilf A. Betulander, Sodertorns Villastad, Sweden. App. filed Nov. 23, 1920. Automatic or semi-automatic.

1,375,357. ELECTRIC WATER HEATER; Cyrus M. Bosworth, Lakewood, Ohio. App. filed Feb. 7, 1920. Resistance element in water circuit.

1,375,360. APPARATUS FOR VULCANIZING RUBBER; Wilbur B. Burke, Cleveland, Ohio. App. filed Feb. 16, 1916. Electric heating element.

1,375,367. DETECTOR SIGNAL; Sidney Dawson, Chicago, Ill. App. filed May 31, 1917. Thief detector.

1,375,393. HIGH-FREQUENCY MOTOR ALTERNATOR; George A. Johnstone, Chicago, Ill. App. filed Oct. 7, 1918. Field wireless telegraph.

1,375,405. APPARATUS FOR TESTING CAPACITY OF ELECTRIC CONDUCTORS; William H. Martin, New York, N. Y. App. filed Jan. 22, 1918. Loaded telephonic cable circuits.

1,375,412. ELECTRICAL COLLECTOR; Jacob M. Olinger, Springfield, Ohio. App. filed Oct. 27, 1919. Trolley.

1,375,414. APPARATUS FOR TESTING CAPACITY DEVIATIONS AND UNBALANCE OF ELECTRIC CONDUCTORS; Harold S. Osborne, New York, N. Y. App. filed Jan. 22, 1918. Loaded telephonic cable circuits.

1,375,437. LONG-DISTANCE SIGNAL AND CONTROL SYSTEM; Walther Akemann, Essen, Germany. App. filed Sept. 3, 1920. Synchronously acting, transmitting and receiving system.

1,375,438. LONG-DISTANCE CONTROL AND SIGNAL DEVICE; Walther Akemann, Essen, Germany. App. filed Sept. 3, 1920. Synchronous movement of pointers.

1,375,447. MEANS FOR AMPLIFYING CURRENTS; Lee de Forest, New York, N. Y. App. filed June 24, 1913. Reproducing sounds from magnetic sound records.

1,375,461. INDUCTION MOTOR; Austin Kimble, Wausau, Wis. App. filed May 12, 1919. Each bar consists of a core of high-reactance metal and a sheath of low-impedance metal.

1,375,465. DEVICE FOR CONVERTING SOUND OR OTHER VIBRATIONS INTO VARIATIONS IN AN ELECTRICAL CIRCUIT; Charles R. Moore, East Orange, N. J. App. filed May 18, 1918. Mine detector.

1,375,474. PHOTO-ELECTRIC APPARATUS; Walter O. Snelling, Allentown, Pa. App. filed July 9, 1920. Light-sensitive selenium cells.

1,375,481. POWER MODULATOR FOR RADIO-TRANSMISSION; Harold D. Arnold, East Orange, N. J. App. filed Aug. 23, 1915. With a minimum of distortion.

1,375,486. ELECTRICAL SYSTEM AND CONTROL THEREFOR; Arthur R. Bullock, Lakewood, Ohio. App. filed Aug. 2, 1917. For rectifying alternating current.

1,375,508. ADVERTISING AND OTHER DEVICE; Henry K. Harris, Westminster, London, England. App. filed Aug. 14, 1917. Parts brought into successive positions.

1,375,516. ELECTRIC ALARM SYSTEM; Christian J. Jenne, San Francisco, Cal. App. filed Nov. 2, 1916. Fire, burglar and police alarm.

1,375,518. CIRCUIT-RESTORING RELAY; Charles W. Kautz, Jr., Lancaster, Pa. App. filed Jan. 27, 1919. Predetermined number of automatic restorations.

1,375,544. ELECTRIC EMBOSSING-PLATE HEATER; Sidney M. Weatherly and Howard J. Stach, Hartford, Conn. App. filed Aug. 16, 1918.

1,375,550. SEPARATOR FOR STORAGE BATTERIES; William Best, Kansas City, Mo. App. filed Dec. 10, 1919. Slate separator.

1,375,586. POCKET HAND LAMP; John Graves, Madison, Wis. App. filed Nov. 8, 1919. Novel switch.

1,375,587. POCKET HAND LAMP; John Graves, Madison, Wis. App. filed Nov. 10, 1919. Novel switch.

1,375,591. TROLLEY; Ludwig W. Kaempf, Fort Scott, Kan. App. filed Feb. 24, 1920.

1,375,596. MANUFACTURE OF PERBORATES; Johann K. Langhard, Fredriksstad, Norway. App. filed Feb. 6, 1920. Electrolytic.

1,375,599. TROLLEY-WIRE HOLDER; Frank Madrak, Duryea, Pa. App. filed May 2, 1918.

1,375,615. ELECTRIC FURNACE; Cesare Soncini, Pont St. Martin, Italy. App. filed April 12, 1920. For melting material in crucibles.

1,375,631. PROCESS OF SEPARATING AND REFINING METALS; Gustaf Haglund, Falun, Sweden. App. filed Dec. 5, 1918. Complex ores.

1,375,632. DRY CELL; Carl Hambuechen, Belleville, Ill. App. filed June 15, 1918. Means for spacing elements.

1,375,647. DEPOLARIZING BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed Aug. 22, 1918. Copper oxide depolarizer.

1,375,654. BINDING POST FOR STORAGE BATTERIES; Joseph J. Flood, East Orange, N. J. App. filed April 3, 1920. Connecting means between cover and post.

1,375,658. DYNAMO-ELECTRIC MACHINE AND BRUSH-HOLDER DEVICE THEREFOR; Clarence F. Gilchrist, Toledo, Ohio. App. filed July 9, 1917. Ready assembly and adjustment.

(Issued April 26, 1921)

15,094. REGENERATIVE BRAKING; George H. Hill, Schenectady, N. Y. App. filed Oct. 15, 1918.

1,375,675. SIGNALING METHOD AND SYSTEM; Edwin H. Colpitts, East Orange, N. J App. filed Feb. 5, 1917. Between anchored balloon and ground.

1,375,687. APPARATUS FOR ELECTRIC WELDING; George H. Forsyth, Chicago, Ill. App. filed May 3, 1915. Over an extended area.

1,375,691. SELECTIVE SWITCH; Charles L. Goodrum, New York, N. Y. App. filed Sept. 8, 1917. Automatic telephone.

1,375,692. MACHINE-SWITCHING DEVICE; Charles L. Goodrum, New York, N. Y. App. filed Feb. 24, 1919. Automatic or semi-automatic telephone.

1,375,695. OVEN; Marshall W. Hanks, Mount Vernon, N. Y. App. filed Jan. 30, 1920. Electrically heated.

1,375,699. WEDGE OR KEY FOR SLOTTED DYNAMO-ELECTRIC MACHINE ELEMENTS; Max J. Ilg, Nuremberg, Bavaria, Germany. App. filed May 27, 1915. Magnetic.

1,375,707. TUNING OF DIAPHRAGMS FOR GENERATING OR RECEIVING SOUND WAVES; Louis V. King, Montreal, Quebec, Canada. App. filed April 1, 1919.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

MALDEN, MASS.—The Malden Electric Company has applied to the Department of Public Utilities for permission to issue 5,340 shares of stock at $125 a share, the proceeds to be used for the construction of a new plant and system, etc.

PLYMOUTH, MASS. — The Plymouth Electric Company has applied to the Department of Public Utilities for permission to issue $100,000 additional stock, the proceeds to be used for additions and extensions to its plant.

DOVER, N. H.—The Twin State Gas & Electric Company has arranged for a note issue of $1,000,000, part of the proceeds to be used for improvements and extensions to its plant and system. Samuel Insull is president.

Middle Atlantic States

NEW YORK, N. Y.—The Department of Public Markets, Municipal Building, is considering the construction of a new terminal market, including an electric power plant, refrigerating and ice plant, etc., to cost about $5,000,000.

NIAGARA FALLS, N. Y. — The City Council contemplates the installation of an ornamental lighting system on First Street from Cherry Street to Niagara Street. Electrical service is furnished by the Niagara Falls Power Company.

PENN YAN, N. Y.—The Yates Electric Light Company is considering furnishing electrical service in Branchport, Pulteney Landing on Lake Keuka, and in the village of Prattsburg.

MILLVILLE, N. J.—The City Commission has authorized W. E. S. Temple, city electrical engineer, to prepare plans for a municipal electric plant.

AMBRIDGE, PA.—The Columbia Steel & Shafting Company, Carnegie, plans to build a new local plant. Considerable electrical equipment will be required. Th cost is estimated at about $3,000,000. Hopkinson & Schaeffer, 500 Marion Building, Cleveland, Ohio, are architects.

EAST BROOK, PA. — A committee has been appointed to confer with the New Castle Electric Company in regard to extending its electrical service to East Brook. Louis Round is manager of the company.

LANGSHORNE, PA. — The Langshorne Electric Light & Power Company plans to abandon its plant and erect a transmission line from Langshorne to connect with the system of the East Pennsylvania Gas & Electric Company, Bristol.

PHILADELPHIA, PA.—H. H. Kline, architect, 1612 South Fourth Street, is preparing plans for the construction of a new one-story power house to be used in connection with a dye works at 5100 Lancaster Avenue. Bids, it is understood, will be asked at an early date.

PHILADELPHIA, PA.—Bids will be received at the office of the Constructing Quartermaster, Frankfort Arsenal, Philadelphia, Pa., until May 17, for the installation of an electric lighting system in the new experimental shop building.

PITTSBURGH, PA. — Application has been made to the Public Service Commission for a merger of thirty-seven electric companies operating in Clarion, Armstrong and other adjoining counties, with the West Penn Power Company, which will allow the latter to extend its facilities and operations throughout this district. The company has also applied for permission to acquire the entire capital stock of the Clarion Electric and Red Bank Electric Companies.

WILMINGTON, DEL.—The City Harbor Commission contemplates the construction of new terminal wharves and docks to cost

about $1,750,000. Electrically operated hoisting machinery, electrical traveling cranes and other such equipment will be required.

BALTIMORE, MD.—Engineers employed by the city to investigate the waterworks system have submitted a report to the Water Bureau recommending the erection of a new electrically operated pumping plant near Lake Montebello, to cost about $[illegible].

WASHINGTON, D. C.—Bids will be received at the office of A. L. Flint, general purchasing officer, the Panama Canal, Washington, D. C., until May 25, for furnishing steel rope, copper cable, electric range, dry batteries, dynamometers, magnet wire, fuses, commutator resurfacers, cable grips, motors, plugs, etc. Blanks and information relating to this circular (1448) may be obtained from the above office or the offices of the assistant purchasing agent, 24 State Street, New York City.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, Washington, D. C., until May 26, Circular PR 6840-3ACP, for storage batteries in lots from 1,200 to 2,500 and in lots from 300 to 1,500; also metal cases for storage batteries in lots of from 300 to 750.

WASHINGTON, D. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids for furnishing the following: Until May 27, Puget Sound, Schedule 7989—miscellaneous quantity of wire and cable; Portsmouth, Schedule 8022—eight each motors and controllers.

North Central States

DETROIT, MICH. — The Ford Motor Company has been granted permission by the Council to erect a high-tension transmission line between its River Rouge and Highland Park plants.

COLUMBUS, OHIO.—Plans are under way for the construction of a new power plant at the Ohio State University, to cost $380,000 with machinery. Carl E. Steeb is secretary.

LOUISVILLE, KY.—The Louisville Gas & Electric Company recently acquired land, and plans eventually to make large additions. No work will be started this year.

PADUCAH, KY. — Contract has been awarded to the Paducah Electric Company for the installation of a new lighting system in the downtown district of the city.

WHITE HALL, ILL.—The construction of a municipal electric lighting plant to cost about $75,000 is under consideration. H. W. Roodhouse is a member of the city board.

WONEWOC, WIS.—The Baraboo Valley Utilities Company, Wonewoc, contemplates the erection of a transmission line from Elroy to Kendall, New Lisbon and Camp [illegible] a distance of between [illegible] and 70 miles. The project may include the construction of two new power houses. A. P. Gale is secretary.

KANSAS CITY, MO.—Steps have been taken by the Fifteenth Street Commercial Club to raise funds for the installation of an ornamental lighting system on a portion of Fifteenth Street.

MARYVILLE, MO.—The Maryville Electric Light Company plans to double the output of its plant. New equipment, including a 600-kw. turbine and steam condensing apparatus, will be installed. The cost is estimated at about $30,000.

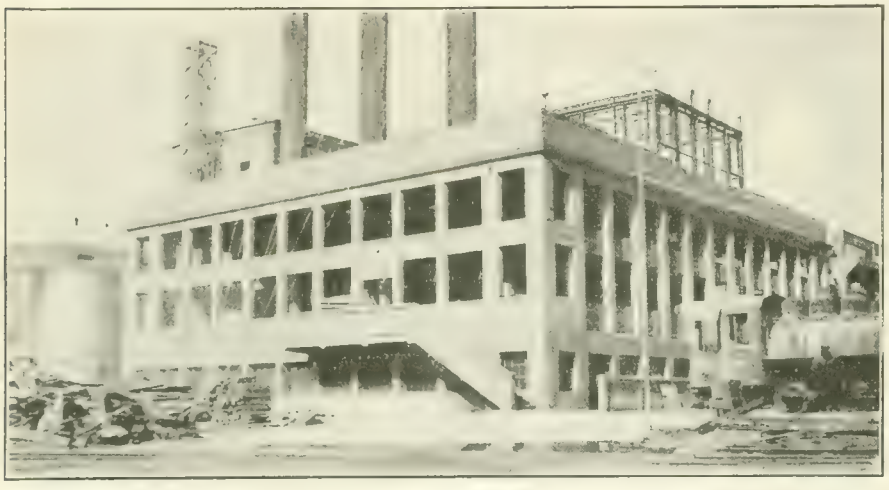
UNIONVILLE, MO.—Bonds to the amount of $85,000 have been voted for an electric light and water plant and filtration system.

WESTPOINT, NEB.—At a special election to be held May 24 the proposal to issue $58,000 in bonds for the construction of a municipal light and power plant will be submitted to the voters.

WILSONVILLE, NEB.—The proposal to issue $20,000 in bonds for the erection of an electric transmission line to connect with the municipal light plant at Cambridge is under consideration.

Southern States

ASHEVILLE, N. C.—The French Broad River Development Company, Henderson, is planning to build new hydro-electric power plant on the French Broad River in the vicinity of Asheville, with an initial capacity of 10,000 hp. J. H. Pratt, Chapel Hill, is engineer.



NEW WASTE HEAT BOILER PLANT OF SOUTHWESTERN PORTLAND CEMENT COMPANY, EL PASO, TEX.

This plant is now in operation, and it is proposed later to add additional generating equipment

BLOWING ROCK, N. C.—W. L. Alexander contemplates the installation of a power plant to develop 50 hp. for lighting purposes. Laundry equipment will also be installed.

WINSTON-SALEM, N. C.—The city has entered into contract with the Southern Public Utilities Company for the installation of a new street-lighting system consisting of 350 lamps of 150 cp., 220 lamps of 250 cp. and 250 lamps of 400 cp. The contract also provides for ornamental lighting system in the business section of the city.

AUGUSTA, GA.—Plans, it is reported, have been prepared by Lockwood, Greene & Company, 101 Park Avenue, New York City, for the city of Augusta for electrification of canal. It is proposed to organize a company to be known as the City of Augusta Power Corporation, and to issue $5,000,000 in bonds for the project.

CORDELE, GA.—Bonds to the amount of $40,000 have been voted for the construction and equipment of an electric light and power plant. W. G. Webb is engineer.

MORRISTOWN, TENN.—The Council is considering an issue of $15,000 in bonds for extensions to light and water systems. J. J. Thompson is town recorder.

DE QUEEN, ARK.—An independent light company will be organized in De Queen, with a capital stock of $50,000. The present plans provide for the erection of a transmission line by the Dierks Lumber & Coal Company from its plant at Dierks to De Queen to supply the new company with electricity.

WELEETKA, OKLA.—Plans are under consideration for additions to the local electric light plant. C. C. Long & Company, 1300 Colcord Building, Oklahoma City are engineers.

EL PASO, TEX.—The city planning committee of the Chamber of Commerce has indorsed recommendations relative to the installation of an ornamental street-lighting system in the business district of El Paso.

Pacific and Mountain States

SEATTLE, WASH.—The Lighting and Power Department, it is understood, has issued a call for bids for furnishing 315 miles of copper or aluminum wire for the proposed transmission line from the Gorge Creek plant to Seattle. C. F. Uhden is chief engineer of the Skagit hydro-electric project.

STEPTOE, WASH.—The Steptoe Light & Power Company has been granted a franchise by the commissioners of Whitman County to erect a transmission line from Steptoe to Elberton, where it will connect with the Washington Power Company's line from Spokane.

WENATCHEE, WASH.—The Royal Development Company has applied to the Federal Power Commission for two small power installations on tributaries of Phelps Creek in Chelan County. Each plant will consist of a low diversion dam and a short length of pressure pipe to a 100-hp. plant to be situated at the mouth of two mines. James Naughton is president.

YAKIMA, WASH.—Residents of Naches Heights and other adjoining sections of the Tieton power project plan to erect a transmission line to secure electricity from the Pacific Power & Light Company.

PORTLAND, ORE.—Reconstruction plans and improvements under way and contemplated on the interurban lines of the Portland, Railway, Light & Power Company within the next few months will cost more than $200,000. This is exclusive of the reconstruction of a large wooden trestle at a cost of $150,000.

LAYTON, UTAH.—The Utah Light & Power Company has filed application with the Public Utilities Commission for a certificate of convenience and necessity to serve the town of Layton.

PROVO, UTAH.—A. N. Taylor of Provo has filed application with the state engineer for an appropriation of 20 sec.-ft. of water from the Provo River. The diversion works will consist of a dam in each branch of North Fork Creek, a diversion channel about 21,300 ft. long, and two Pelton-type waterwheels. Plans provide for the development of 2,227 hp. for distribution in Utah and Wasatch Counties.

WALES, UTAH.—A fifty-year franchise has been granted for the erection of an electric transmission line from Wales to the plant of the Big Springs Electric Company, Fountain Green.

BURLEY, IDAHO.—The Department of Interior has approved of a contract by which additional electric power will be obtained during the summer for the government project at Minidoka. The contract provides for the lease of the power house of the Boise project on the Boise River and the transmission of electricity from there to Milner over the lines of the Idaho Power Company. The Reclamation Service will erect a transmission line from Burley to Milner and install a substation to transform power received from 40,000 volts to 30,000 volts.

Canada

TORONTO, ONT.—The private bills committee of the Ontario Legislature has passed a bill authorizing the city to install a cable for the civic railway at a cost of $31,650.

WALKERVILLE, ONT. — The Utilities Board contemplates extensions to the hydro-electric plant to cost about $95,000. A. E. Cook is secretary.

CHARLOTTETOWN, P. E. I. — The Prince Edward Island Light, Heat & Power Company, capitalized at $2,000,000, is applying for a provincial charter to supply electricity to all parts of the island from one large central power house.

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New Plans for the Society for Electrical Development

IT IS a very significant and interesting thing that the board of directors of the Society for Electrical Development has adopted a new policy of expansion and broader service. These men are acknowledged leaders in the four branches of the industry. Their judgment is good; their word is good. Therefore, when they say that the society is to be reorganized under the leadership of William L. Goodwin and to go ahead to achieve the broad aims with which it was originally conceived we can believe it and be glad. The society unquestionably has the opportunity to be of great usefulness to electrical men of every class. Mr. Goodwin's well-proved genius both as an educator and a man who gets things done gives promise that the work will be carried through with breadth of vision and with clarity of purpose. The definite plans which are outlined in this issue show that the broader economic function of the society is to be emphasized and expanded, and such service will be of direct aid and benefit to every city. The society brings to Mr. Goodwin a machinery for vastly strengthening the influence of the great work which he has been doing to build up better business methods and encourage a broader vision in the inter-relations of the electrical industry. Mr. Goodwin brings to the society a quality of leadership that will stimulate the interest and strengthen the support of a greatly increased and vitalized membership. It is a fortunate and a very practical combination that should be productive of real, tangible progress.

Edison's Test of Education

BY THE criticisms of the long list of questions compiled by Thomas A. Edison as a test of the eligibility of applicants for positions in his East Orange works a wide diversity of opinion as to what a college graduate should know has been divulged. If it was the purpose of Mr. Edison to test the efficiency of the college curriculum, we cannot indorse the method he employed. If, on the other hand, he aimed to test the kind and extent of the applicant's reading, his power of observation and the retaining power of his memory, the test is sufficiently comprehensive to be fair. From this standpoint it would effectively reveal a disposition to "bluff" and make wild guesses as compared with a disposition to be specific and accurate in expressing facts and ideas. Aside from these viewpoints, Mr. Edison's questions have definitely raised the question, What is education? We agree with the comment of one critic that frequently the college graduate believes his diploma is a certified check on the bank of wisdom, while in fact it is simply an invitation to open an account. For this class of men Mr. Edison's questions have provided an effective means of introspection that can be used by non-college men as well as by those who have earned a college degree. If the result has induced the purchase and a new study of the dictionary, the encyclopedia and works of history, a great good has been accomplished. It is a good thing to take stock of our ready knowledge from time to time, and if Mr. Edison has furnished the incentive, his great genius should receive another credit mark. When a realization is brought about of the importance of looking thoughtfully at life and its practical problems, of mentally cataloguing information for ready reference and of regularly adding to the storehouse of knowledge as periodical inspections and experience show a lack of it, then and only then can any one lay claim to education, whether he be a college man or one who has been less fortunate.

Need for Executive-Engineer-Banker in the Industry

FINANCIAL problems which have harried the electric light and power industry for the past decade indicate that we need something besides a knowledge of electricity in this business if it is to be a success. We lack a friend at court in the person of a banker who combines with a knowledge of banking an intimate knowledge of the electric light and power business and its possibilities. Had we possessed a few men of that type in our great national banking institutions, some of our problems would have been a trifle easier; for when we have to pour our story into ears not attuned to electricity and appeal to hearts of flint for the wherewithal to expand the business, not only is the task made much harder in degree but the actual results fall far short of the necessity. Moreover, in dealing with city officials or with the public the word of such a banker is of much avail. Imagine a utility in Podunk in need of funds. It applies to a well-known national bank for a secured loan. The executive-engineer-banker visits the city and, let us say, finds the proposition worthy from all points of view. He makes known to the Mayor of Podunk that his bank, known by name in every home in the land, is considering loaning the Podunk Electric Company one million dollars to be expended for additions and betterments. "Will the company get a fair deal?" he asks the city fathers, for under no other circumstance would his bank be willing to advance the money. The answer, if the utility is deserving at all, is certain. This is but one angle. Now, the utility business is important enough and its financial requirements are large enough to warrant some of our great banks having on their executive staffs specialists versed in our business. With men who can reason understandingly about public utilities and the necessity of sound financing in connection with their proper development and expansion, both the

banks and the utilities would be better equipped for conducting their respective businesses. The need certainly is there and should be brought to the attention of the leading bankers by public utility officials.

Increasing Range of Knowledge of Electric Properties of the Air

AIR is the most widely used of all insulators, but notwithstanding the volume of research as to its electric properties little is known as to their ultimate nature. With most of the experimentation that has been conducted a rough trail has been blazed, and it is only in recent years that research has developed any exact and general laws. These experiments have shown the great importance of the density of the air on spark-over, corona and other forms of breakdown, and quite simple laws have been found to apply.

Air density is dependent on both pressure and temperature, and since the former is more readily controlled in experimental studies, variations in density have for the most part been effected by variations in pressure at approximately constant temperature. New data are now offered on the influence of temperature by Messrs. Whitehead and Lee in a paper in a recent issue of the *Journal* of the American Institute of Electrical Engineers. They show that the laws of corona formation as heretofore accepted have the same form within the new region explored, although there is some indication that beyond the ranges more commonly met in practice there may be changes in the values of the constants. Continuous potentials were used and differences between positive and negative corona observed by others are found to be even more marked in the new range. The value of such experiments lies not so much in the possibility of immediate application of the results as in the additional contribution made toward a more complete knowledge of the laws governing electric breakdown.

Design Data for Operators of Synchronous Machines

DESIGN data are commonly regarded as of interest or value to the designing engineer only, but obviously such data are also of almost equal importance to the engineer who selects machines to meet his requirements. A good understanding of the effects of speed and kva. rating upon weight, cost and efficiency is essential. Moreover, the man having control of operation becomes a better operating engineer if he has a fair understanding of electrical machine design.

In the design of any permanently adopted series of electrical machinery each factory ordinarily establishes a system of classification and division of parts, so as to facilitate the construction of successive sizes. It is also customary to prepare data sheets, often in the form of curves, by the aid of which a designer is able to select the most satisfactory combination of elements and qualities for the purpose in view.

Theo. Schou, in his article on this subject appearing in this issue, shows a number of curve sheets of this kind. By consulting these curves not only the designer but the operating engineer can estimate the probable weights, efficiencies and excitations for synchronous machines up to 1,000 kw., when running at assigned speeds in revolutions per minute. Although this series of curves pertains, strictly speaking, only to a particular make and series of synchronous machines, yet it is evident that it must also apply more or less closely to any make and series of machines of the same general type.

It is instructive to observe how much depends upon the speed of rotation in the cases represented by the curve sheets. The effect of an increase in speed in a machine of given kva. output is always to raise the efficiency, lower the weight and reduce the excitation within the range of speeds carried by the diagrams.

Resourcefulness of the Engineer Under Adverse Conditions

IT IS not often in these days that a new generating station possesses any conspicuous individuality as distinguished from others of approximately the same size. Perhaps standard construction would have been the fate of the new Delaware station of the Philadelphia Electric Company if war conditions had not intervened and compelled somewhat radical departures which in the long run will probably more than justify themselves. At the beginning of the war the urgent and tremendous call for industrial power was very strongly felt in the Philadelphia territory, and the Philadelphia Electric Company promptly set about meeting whatever demand might arise. As in many other instances, it was clear that a considerable part of the rush demand might be for a relatively short time, but on the other hand it was indubitable that in the natural march of events the new construction would merely forestall a little the inevitable permanent demand for more power. The site chosen was on the Delaware River in the middle of the Kensington industrial district, close to its load center, and particularly well situated for the supply of coal and condensing water.

The design and specifications were ready and all preliminary arrangements made for a structural steel building, when the lid was clapped on the steel supply and something else had to be done under pain of indefinite loss of time. Hence the engineering department turned around and redesigned the whole equipment for reinforced concrete instead of steel. Here was where the primary difficulty appeared, for the situation demanded fairly compact construction and reinforced concrete will not stand the loadings permissible with steel. Therefore very careful adjustment to the new conditions was required. Construction was started, only to be slowed down by unavoidable conditions until the war was over; and almost a year beyond the armistice passed before the final program of construction was entered. By this time the reinforced-concrete construction had gone far enough to make it uneconomical to change back to steel, even though this metal was becoming available at that time.

The boiler equipment is worth more than a passing mention. The engineers looked ahead in the matter of furnaces and set the boilers well up, providing a very large furnace volume. The steam pressure is set at 250 lb. and the superheat will range from 170 deg. to 220 deg. Fahr. Fifteen retort underfeed stokers are assigned to each boiler. The big combustion chambers provided are planned with two objects in mind—first, the increased economy at high ratings and, second, provision for possible future conversion to fuel oil or powdered coal. Change to either of these fuels can be made without great modifications of the present arrangements, and either may very possibly become an important factor in station operation long before the new equipment has neared the span of reasonable use.

Concrete construction made somewhat difficult the provision of very large overhead bunkers. For this reason the coal-unloading provisions were exceptionally complete. The supply pier is big enough to allow four 1,000-ton coal barges to be tied up on each side, while just out in the river is an available island on which 200,000 spare tons can be stored. The barges are unloaded by duplicate grab buckets, electrically operated, which discharge into duplicate hoppers. Electric separators pick out casual iron before it stalls the crushers, and from the crushers the coal goes over duplicate belt conveyors to cross belts that run over the firing aisles.

The auxiliaries are divided between turbine drive and motor drive, there being duplicates of every important pump. The general rule has been to take no chances and to carry the principle of duplication virtually from one end of the plant to the other. In general, one set is motor-driven and the other turbine-driven, but occasionally there is a duplex drive. Each boiler is equipped with two individual induced-draft fans. One fan will carry the load up to 175 per cent of its rating, and the other will carry the load up to the limit of more than 300 per cent.

The Delaware station is certainly a first-class example of the finesse of the engineer when he is apparently cornered by adverse building conditions.

Another Example of the Economy of Electric Heat for Industrial Processes

THE peculiar usefulness of electric furnaces in the field of industrial heating has made itself amply evident in a good many fields. Core baking, tempering, annealing, japanning have all been successfully performed by electrical means, and the fundamental reasons for success have been in each case substantially the same. The complete control of temperature and the possibility of duplicating conditions with each succeeding charge have so quickened the operations and reduced the amount of inferior work that the question of cost of the heating agent has absolutely dropped out of sight as inconsequential, although it has been proved in every case to be reasonably low.

With the old enameling furnaces operated by coal oil or gas it had proved extremely difficult to maintain and hold steadily to the necessary temperature of about 1,700 deg. Fahr. Mufflers would sag or break, sulphur or fumes would work in and injure the enamel, so that shutdowns and loss of production proved somewhat serious. While the electric furnace built on the ground and with the box-type heating costs more to install and to run than the older types, it permits from 30 to 50 per cent more charges per hour and 25 per cent more stock for each charge. There is substantially no maintenance expense and no loss of production due to maintenance.

Furthermore, the absolutely steady heat which is provided and the perfect control greatly improve the average quality of the product, so that from a practical standpoint enameling can be done in such a furnace more cheaply than in any other. The guarantees on temperature maintained and demand made when the furnace was started up were readily met, while the guaranteed production of eight pounds of material per kilowatt-hour was greatly exceeded and the length of the operating cycle was cut in two.

This experience furnishes just another chapter of the same old story of the immense efficiency of electric heating from the standpoint of actual production. No other source of heat is so easy of application and so completely dependable as to results.

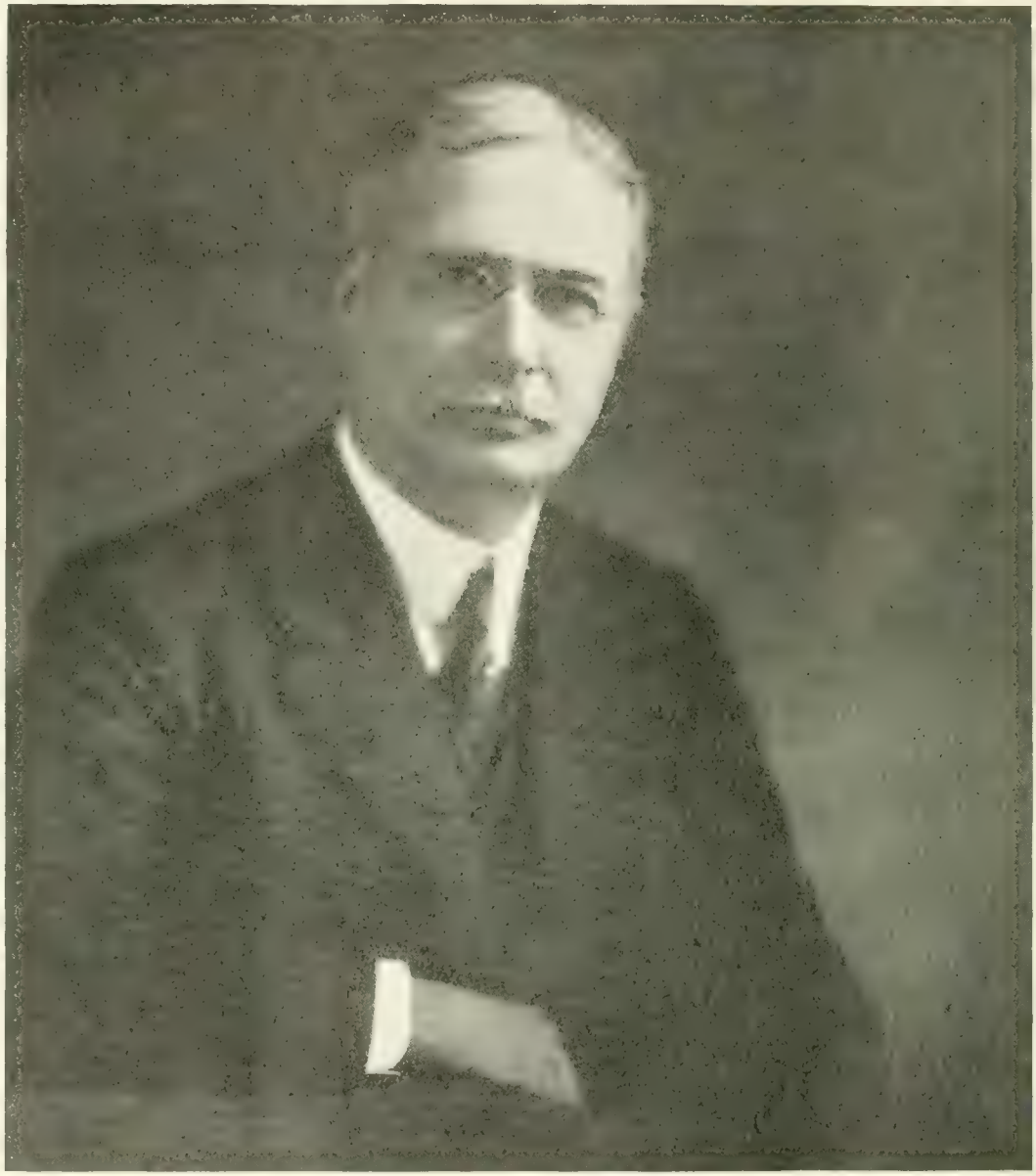
A British View of Our Turbine Practice

SOMETIMES it is a good thing to hear from a source somewhat outside of local engineering discussions what those who are taking a bird's-eye view of American practice really think of us and our lines of action. Just such constructive information is furnished in a paper presented recently before the British Institution of Electrical Engineers by Mr. Baumann taking up somewhat in detail the modern steam-turbine problem.

Looked at in a large way, development has on the whole been toward the maximum possible size at the greatest available speed. This combination, other things being equal, means some improvement in economy and a material difference in first cost per unit of output. In the driven machines there is, as we all know, some difficulty after large sizes are reached, for the reason that the combination of immense speed and high output favorable to the turbine is unfavorable to the generator when pushed to the point necessary in directly driven turbine practice. For ordinary frequencies the single unit for both turbines and generators has been pushed up to about 30,000 kw. to 35,000 kw., at which point the increasing difficulties of the situation have tended to call a halt. The composite units of 60,000 kw. and 70,000 kw. look rather promising. An interesting feature to which Mr. Baumann calls attention, particularly with reference to English and Continental practice, is the increasing use of mechanical reduction gear to unite the good qualities which come from rather high turbine speed and moderate dynamo speed. The gain in efficiency in the smaller machines seems to be very well established.

Striking features of the data presented by the English observer are those which relate to effects of pressure and superheat on ultimate economy. There has been a steady improvement in turbine efficiency, so that the questions now raised pertain to ultimate rather than to ordinary values. At the present time pressures of 350 lb. per square inch and final steam temperatures up to 750 deg. Fahr. are not uncommon. The problem of the future is to extend one limit or the other or both. Final temperature is getting at present to a point where the resisting power of hot materials must be taken seriously into consideration. Pressure by itself has reached a point where it is not altogether easy to design high-efficiency turbines, and the higher the pressure the more difficult it becomes. Mr. Baumann's deductions are that doubling the pressure from the present limit will actually slightly decrease the final efficiency, while doubling the superheat will slightly increase it.

It looks very much as though further advances are likely to come through improvements in material rather than increase in thermodynamic efficiency. It certainly does not pay to work for bigger or more efficient units at a reduction of the factors of safety. After all, as Mr. Baumann estimates, the cost of the turbines in large units today is only about 9 per cent of the total cost of the big power station, and it most emphatically does not pay to take chances with continuity of service for a modest saving in first cost over this small figure.



Edward Bennett Rosa

Scientist of marked ability, chief physicist of the Bureau of Standards, and author of the plan for national safety standards conceived while developing the National Electrical Safety Code

THERE was lost to the electrical industry this week a man whose name will ever be linked with the progress of the art. It is with deep regret that the death of Dr E B Rosa, since 1910 chief physicist of the United States Bureau of Standards, is recorded. He died at his work Tuesday afternoon. As a pure physicist alone he by his accomplishments and studies won for himself a place of honor among the foremost scientists of the day. But he was more than that. He was an executive, guiding carefully and intelligently the work of more than a hundred technical assistants and was immediately responsible for building up the electrical division of the bureau. Of late years he gave a great deal of consideration to what might be called practical sociology. In this work he was more deeply interested, probably, than in anything that has gone before. He approached it from the point of view of making electricity safe. The details of what is now known as the National Electrical Safety Code were worked out in the bureau's electrical division under his supervision. Dr Rosa subsequently expanded the safety movement to such an extent that the bureau is now working on a national program of safety codes covering gas, the protection of head and eyes, aviation, logging and sawmills, mining, foundries and other activities. In all of these undertakings he always invited the co-operation of the industry affected in order to give full consideration to the viewpoint of that industry.

Some of the scientific work done under his supervision by the electrical division of the bureau may be mentioned to indicate the high order of his endeavors. This work includes the redetermination of the ratio of the units of electrical measurement, the measurement of the electrochemical equivalent of silver, invention of new methods for measuring capacity and inductance, calculations of electrical characteristics of coils, specifications of the international candle, and electrolysis research.

Dr. Rosa was born in Rogersville, N. Y., in 1861 and was graduated from Wesleyan University, Middletown, Conn., in 1886. Five years later he received his doctor's degree from Johns Hopkins University. He returned to Wesleyan as a professor of physics, where he invented a number of measuring instruments, besides conducting important investigations in dielectric measurements, alternating-current wave forms, electromagnetic units, etc. In 1901 he joined the Bureau of Standards as a physicist. He was a fellow of the American Institute of Electrical Engineers, a former director of the Illuminating Engineering Society and was one of the most active members of the American Engineering Standards Committee.

Dr. Rosa had been a member of the International Electrical Commission, was honorary secretary of the International Electrical Congress held in San Francisco in 1911, and in 1913 was elected to the council of the French Physical Society.

Compact Reinforced-Concrete Generating Station at Philadelphia

180,000-Kw. Station Designed and Built Under War-Time Difficulties with Rather Unusual Coal-Handling Facilities and Furnace Construction—Supply of Boiler-Feed Water and Duplication of Auxiliaries Divided Between Steam and Electric Drive

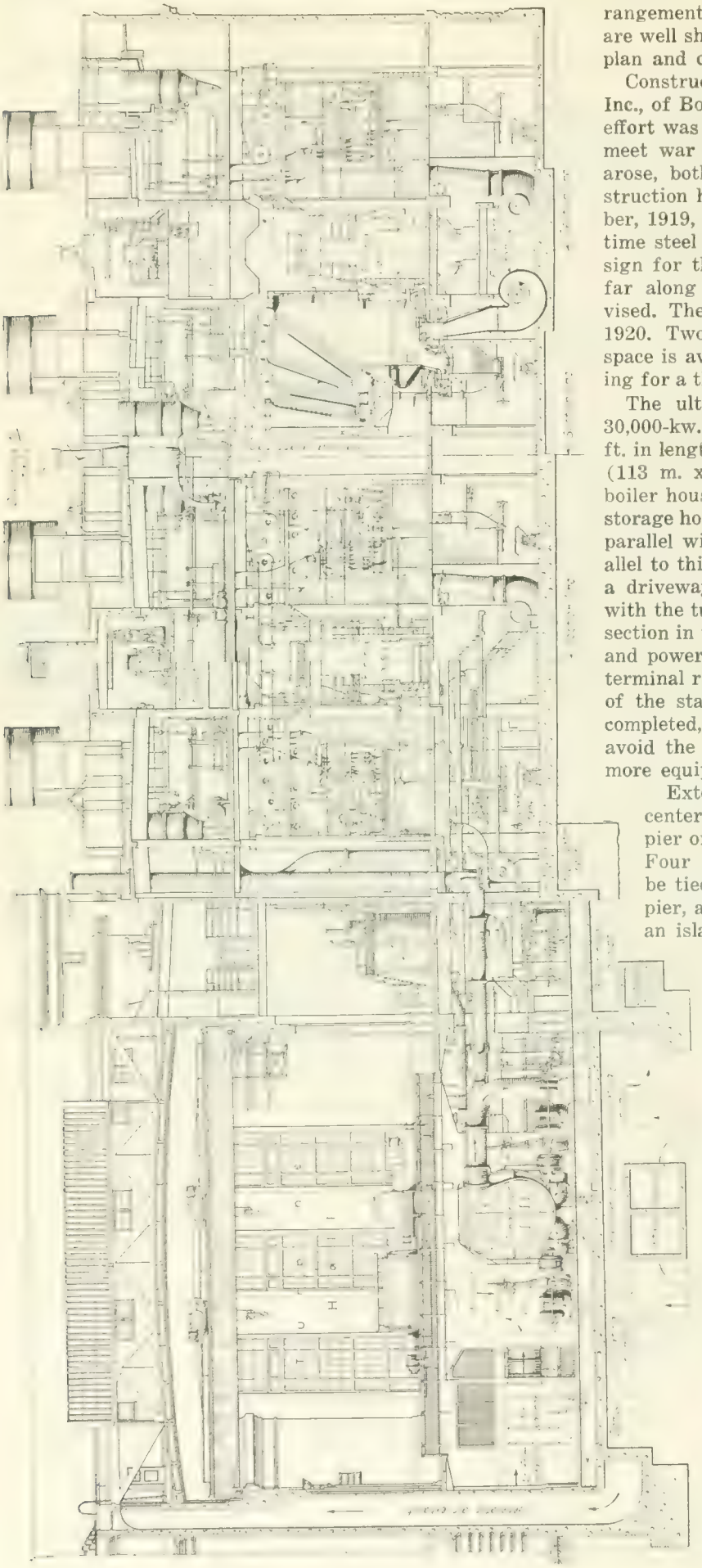


GENERATING-STATION design is becoming so standardized that little can usually be found in new plants that is radically different from others built about the same time. However, in the new Delaware station of the Philadelphia Electric Company some departures from usual practice have been made that should be of considerable interest to other companies which may have to build stations under similar conditions. Delaware station is particularly interesting because serious obstacles imposed by market conditions and building space were overcome in its design and because special attention was devoted to preserving continuity of operation under almost any operating condition, involving even a change to oil or powdered fuel. Among the features of the mechanical part of the station are the use of reinforced concrete instead of structural steel in the building structure, the high rating per unit of ground area, the coal-handling facilities, the furnace construction, convertibility of furnaces to oil or powdered-fuel burning, provisions for assuring reliable auxiliary service and method of supplying boiler feed. These and other features will be discussed in this issue, while important characteristics of the electrical part of the plant will be presented in a later issue.

Like all progressive companies, the Philadelphia Electric Company is continually planning for the future and had a development involving the Delaware station laid out long before there was any thought of the European war. Two stations were planned—one to be the station considered in this article for supplying the rapidly growing industries in the Kensington district on the Delaware River; the other, to be known as the Chester station, for supplying the southern portion of the city. The two plants were to be interconnected ultimately to serve the entire community, if necessary using older stations as relays. When the war came, with its unprecedented demand for power to supply shipbuilding yards, machinery manufacturers, textile mills and other Philadelphia industries, the Chester station was well along, but the Delaware station was not under construction yet. Owing to the emergency, however, the completion of the design and specifications was pushed. By the fall of 1917 arrangements for building the plant were made and orders for most of the material and equipment had been placed, but, like other companies which were willing and ready to provide greatly increased power facilities during the war, the Philadelphia Electric Company could not obtain the necessary structural steel to construct the plant as first designed. Undaunted by this obstacle, the engineering department of the Philadelphia Electric Company and John T. Windrim, the architect for the building, undertook to redesign the station with reinforced concrete instead of structural steel.

Designing for Concrete Not a Simple Task

Since there were only 5 acres of total ground space available and only 3½ acres could be used for the building, the problem of using reinforced-concrete construction in place of the structural steel was not a simple task, especially in view of the low unit stresses allowable in this type of design. In general the problem was to make the station as compact as possible without exceeding the permissible structural loadings. Consequently a balance had to be made between types and sizes of equipment that could be supported without so filling the building with concrete columns and foundations that insufficient room for equipment would be left. Certain things, like boiler, turbine and crane loads, could not be reduced much, hence the reduction of building height, bunker weight, etc., afforded about the only opportunity for minimizing unit loads. Ar-



OPERATION ON THE UNIT PRINCIPLE AND DUPLICATION OF AUXILIARIES ARE FEATURES OF THIS STATION

rangements which were made to solve the problem are well shown in the accompanying exterior view, plan and cross-section of the station.

Construction was started by Stone & Webster, Inc., of Boston, the contractors for this plant, and effort was made to hasten its completion and thus meet war needs, but new and repeated obstacles arose, both financial and otherwise, so that construction had to be postponed. Not until September, 1919, could construction be resumed. By that time steel was more readily available, but the design for the reinforced-concrete structure was so far along that it could not be economically revised. The first unit was put in operation October, 1920. Two 30,000-kw. units are installed now and space is available in the present part of the building for a third unit.

The ultimate station, which will contain six 30,000-kw. turbo-generators and will measure 373 ft. in length by 367 ft. in depth by 91 ft. in height (113 m. x 172 m. x 27 m.), will consist of two boiler houses next to the river and separated by a storage house. On the land side of these buildings, parallel with the river, is the turbine hall. Parallel to this in turn but separated by the width of a driveway is the electrical bay. This is joined with the turbine hall from the second floor up by a section in which are the battery room, station light and power room, offices, control room, and circuit terminal room. As may be observed from the plan of the station, only about half of the station is completed, the arrangement making it possible to avoid the investment in the entire building until more equipment is needed.

Extending out from the bulkhead along the center line between the two boiler houses is a pier on which stands the coal-unloading tower. Four 1,000-ton to 1,500-ton coal barges may be tied up in the space along each side of the pier, and a further coal reserve is available on an island which is approximately opposite the station and on which several hundred thousand tons of coal can be stored.

Because of the fact that the coal bunkers over the boilers had to be made relatively small to keep the unit loadings on the reinforced-concrete columns within safe limits, it was particularly important in this station that there should be no interruption in unloading of coal and delivery to the bunkers. Therefore duplicate coal-handling facilities were provided between the coal barges and the bunkers.

The coal tower is equipped with electrically operated boom hoists, with 1½-ton grab buckets for unloading from each side of the pier. They are operated from control rooms in the upper floor of the tower, from which points the barges may also be moved

alongside the pier by means of an electrically operated barge-hauling machine and a cable to which the barges are fastened. From the two 30-ton hoppers into which the buckets discharge, the coal goes by gravity onto picking tables, where large foreign material is removed, and thence to crushers over magnetic pulleys, which remove the smaller pieces of metal such as scrap iron, bolts, etc. The crushers discharge onto two traveling inclined-belt conveyors which run above the pier and transfer their load to cross belts over each firing aisle. The inclined conveyors are equipped with weightometers, which weigh all the coal passing into the station.

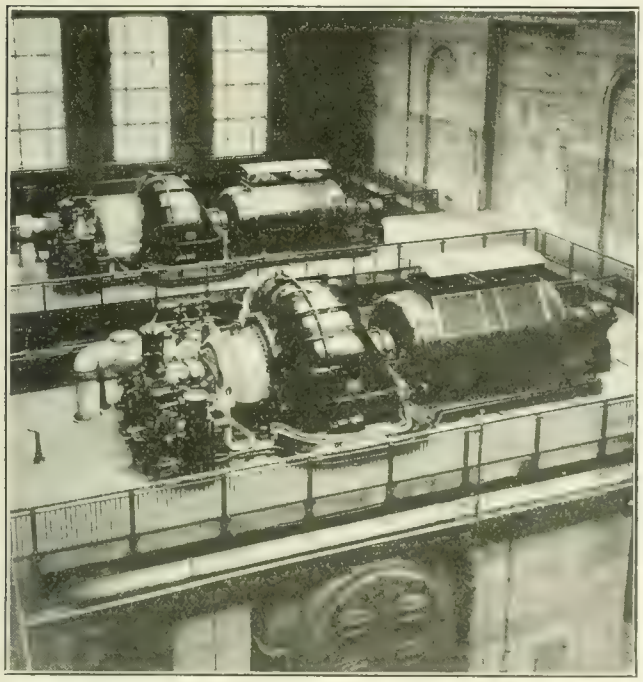
Coal for either receiving hopper can be delivered to either one of the crushers, and the crushers can in turn discharge directly to either one of the inclined-belt conveyors. The inclined-belt conveyors are also so arranged that either conveyor can deliver its coal through cross conveyors to any one of the four bunkers in the two boiler houses. A fire wall is provided between the two inclined conveyors, and the conveyor tunnels are well ventilated to minimize fire hazard.

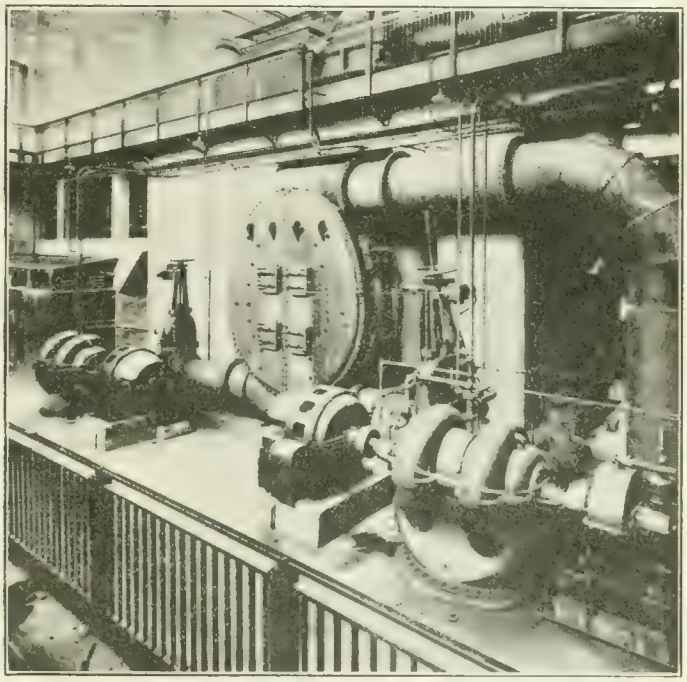
The bunkers into which the cross belts distribute their load have a capacity of about 88 tons per boiler. Such small bunkers were considered feasible, however, because of the proximity of the coal-storage yard, the possibility of storing coal barges each side of the pier, the duplicate coal-handling facilities and the proximity of the Port Richmond Coal Terminal, through which nearly all coal is delivered to the system. To guard still further against any possible interruption of coal delivery to the boilers, a one-man trolley with grab bucket is installed over each bunker so that coal may be transferred from one section of the bunker to any other section, and arrangements will be made for elevating coal dumped from railroad cars or automobile trucks to the picking tables in the coal tower.

Eight Stirling boilers, each having 15,080 sq.ft. (1,387 sq.m.) of heating surface and 3,950 sq.ft. (363 sq.m.) of integral economizer surface, are installed, although twenty-four will be provided ultimately. The boilers are set unusually high, the upper drum being about 33 ft. (9.6 m.) above the floor level. With the construction employed, the unusually high furnace volume of 4.8 cu.ft. (1.3 cu.m.) per rated horsepower is obtained. The boilers and auxiliaries are installed to permit operation at 330 per cent of boiler rating. The steam pressure is 250 lb. gage (17.5 kg. per sq.cm.), and the superheat will range from 170 deg. to 220 deg. Fahr. Fifteen-retort, special-width underfeed stokers with double-clinker grinders are installed under each boiler. The projected grate area is about 0.2 sq.ft. (186 sq.cm.) per rated boiler horsepower. Direct-current motors are used to drive the stokers and are mounted below the firing aisle.

Other interesting characteristics of the boiler room are the individual forced-draft fans for each boiler, duplicate induced-draft fans, breechings on the roof running to stacks which serve three boilers each, provisions for supplying boiler-feed water, the boiler instrument and control boards and the test boiler for working out constants to guide the operators.

One induced-draft fan is sufficient to serve one boiler up to 175 per cent of rating. Above this load two fans are required. No provision has been made for interconnecting forced-draft air ducts, stoker drives or fan motors because the advantage gained is not considered worth the expense. It is always possible to start up another boiler if necessary, working the remaining boilers at overload until the incoming boiler is placed on the line.



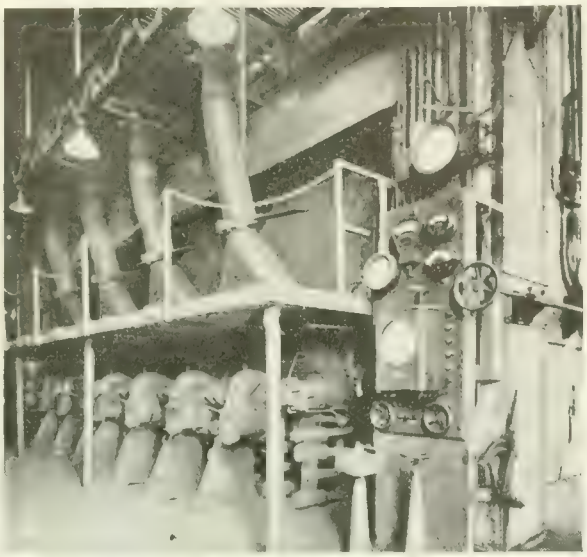


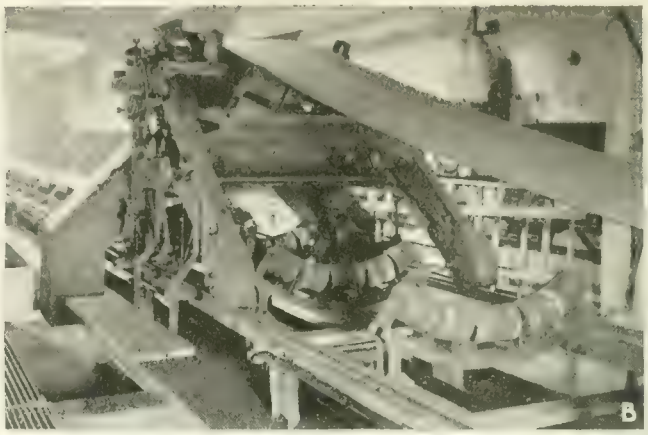
EACH 30,000-KW. TURBO-GENERATOR IS SUPPORTED ON AN ISLAND FOUNDATION; ON THE RIGHT IS THE ARRANGEMENT OF CONDENSER AND CIRCULATING PUMPS EMPLOYED

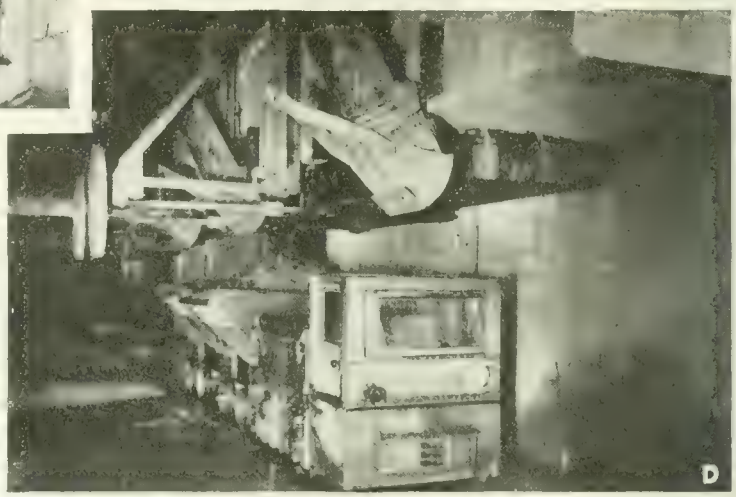
HIGH AND SPACIOUS FURNACES

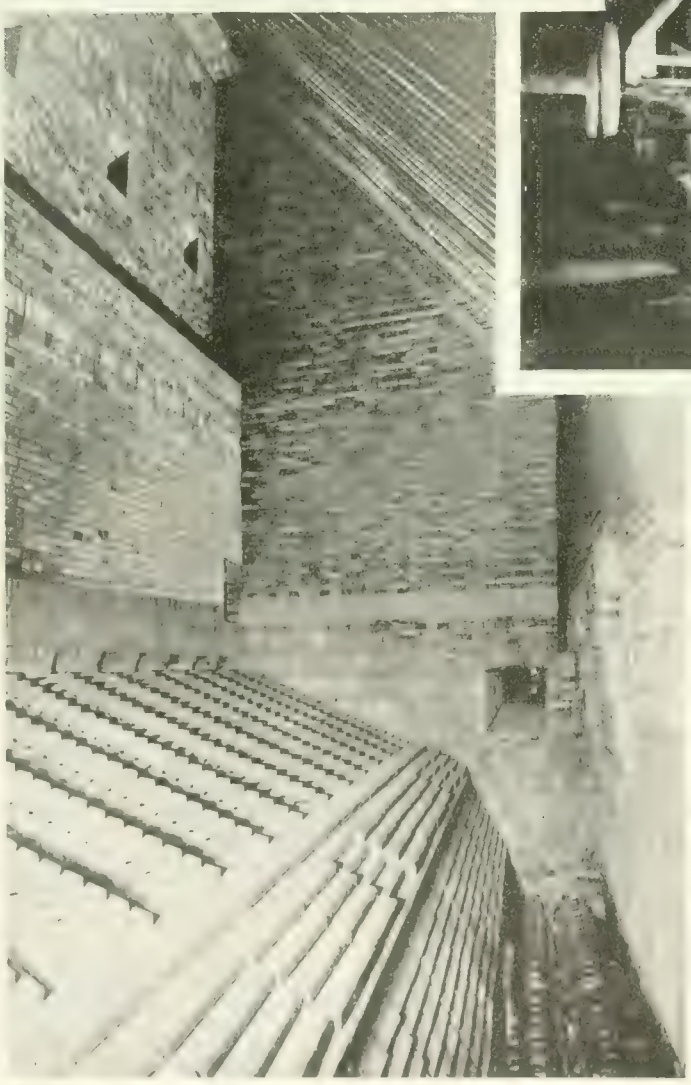
The furnace construction is the most interesting mechanical feature inside the plant. As previously mentioned, the combustion chambers are unusually high and spacious. Consequently very high economy can be obtained even at high boiler ratings since more complete combustion can take place before the gases strike the tubes. Another feature of the furnaces is that they may be readily adapted to burning oil, powdered an-

Provisions for Handling Fuel and Products of Combustion at Delaware Station











A—One of the 1,500-hp. boilers with instrument and control board close by.

B—Coal distributer in one of the cross conveyors over one of the bunkers.

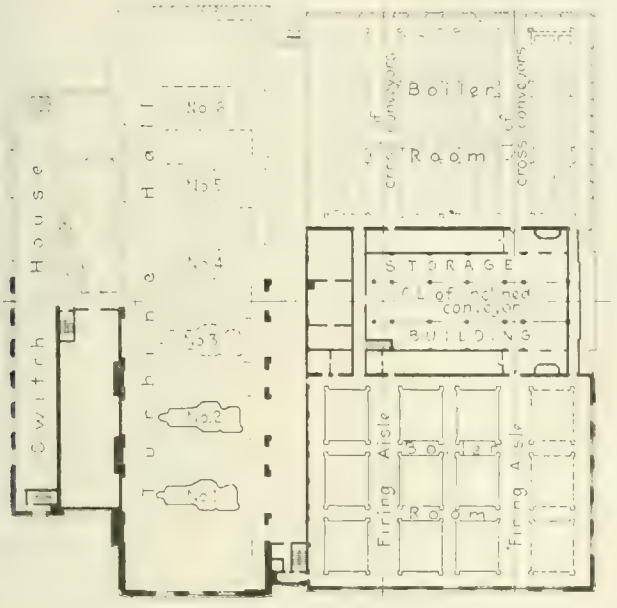
C—Interior of one of the furnaces showing stokers below and first bank of tubes above.

D—Storage-battery hauled cars below ash hoppers.

E—Breechings leading to stacks.

thracite or powdered bituminous coal. Methods of converting the furnaces without greatly changing the present installation are indicated by the accompanying cross-sections.

Serious consideration was given to convertibility of the furnaces because it is believed that burning of powdered fuel may eventually be a very desirable method of firing coal at this station, while the burning of fuel oil would be considered even now if it could be



LAYOUT OF EQUIPMENT FOR 180,000-KW. STATION

made available under advantageous contracts. If powdered fuel is ever used, the preparatory equipment such as pulverizers and driers could be installed on the pier or in the present storage house between boiler rooms.

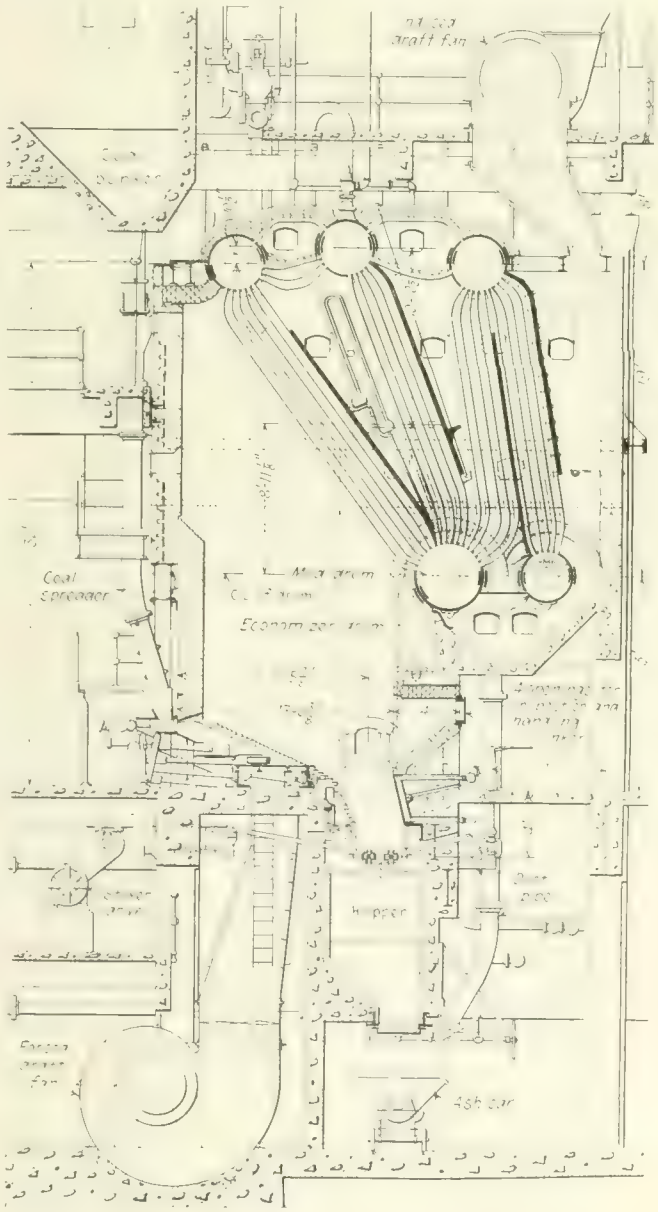
Aside from the foregoing characteristics, the furnaces have the following points of interest: A very wide throat just back of the stokers which will prevent clinkers arching across the cinder grinders; the provision of doors for observation of fire condition and handling of clinkers at the back of the furnaces within very close range of the clinker grinders, and the support of the major portion of the front boiler wall on structural steel separate from the stokers. Steel casings were not considered necessary because it was believed that with 13¾ in. (33.6 cm.) of well-laid firebrick on the interior of the furnace and 8½ in. (21.2 cm.) of red brick outside, with an air space between, radiation and air leakage could be kept at a minimum.

Under each furnace is a 1,000-cu.ft. (28-cu.m.) reinforced-concrete ash hopper to be fitted with air-operated gates discharging direct into 1½-cu.yd. (1.14-cu.m.) ash cars. When the station is completed duplicate skip hoists will be provided to which the ash cars will be hauled by storage-battery locomotive and dumped. The hoists will elevate the ashes to hoppers from which they may be discharged into barges, railroad cars or motor trucks.

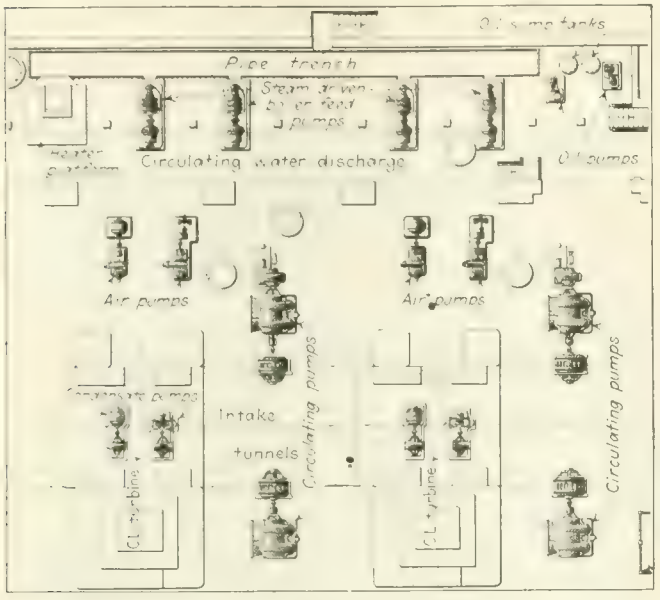
Boiler-Feed Water System

The normal boiler-feed water supply is the condensate from the main units. This condensate passes first through the waterbacks in the boilers, where its temperature is raised about 10 deg Fahr, then directly to open feed-water heaters. In the line to the feed-water heaters are surge tanks of large capacity for storing the condensate at times when the demand for feed water is less than the amount of condensate being pumped into the system. Normally the surge tank is kept more than one-third full. As the water-level drops below normal a float valve operates to admit filtered river water. In case of trouble in the filtered water system a long-range float valve, which is inserted in a standpipe on the filtered water system, operates to admit city water into this system. This gives duplicate sources of supply for make-up water. In addition to these normal sources of supply there is an emergency connection which by manual operation will admit unfiltered river water into the feed-water system.

Plans are now being made for the installation of a water-treating system to supply pure water for make-up purposes and thus protect the boiler tubes against scale and to cut down as largely as possible the losses due to boiler blowdown. The boiler-feed pumps are equipped with pressure regulators which control their output, and the boilers have automatic feed-water regulators on one end of the feed-drum, while the opposite end of the feed drum is connected through a hand-



UNUSUALLY LARGE COMBUSTION CHAMBERS ARE PROVIDED



SECTION OF FLOOR BELOW TURBINES INDICATING DUPLICATION OF AUXILIARIES

operated valve so that in case of trouble on the automatic regulator it will be possible to operate the boiler by hand regulation.

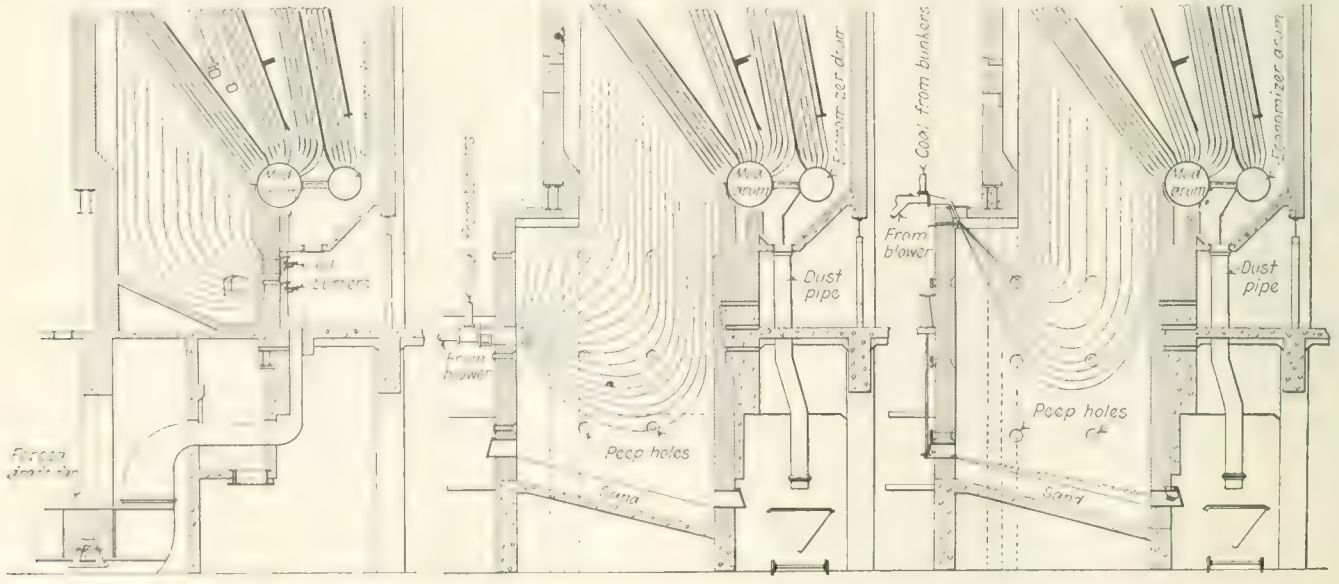
Main Units and Their Auxiliaries

The arrangement of the main turbo-generators, condensers and various auxiliaries is clearly indicated by the general plan of the station and the plan of a section of the turbine room basement. Two 30,000-kw., 13,200-volt, 60-cycle, 1,800-r.p.m. generators are now installed, and, as mentioned before, four additional ones will be installed ultimately. The units are placed on island foundations—*i.e.*, the only floor around them is that necessary in attending to the particular machine and in passing between machines. Under the main turbo-generators and supported on multiple-coil springs are the condensers, each having 50,000 sq.ft. (4,600 sq.m.) of surface. Below these in depressions in the basement floor are the duplicate cooling condensate pumps rated at 1,500 gal. per minute each. Duplicate air pumps are provided at one side of each condenser. The boiler-feed pumps, of which there are four turbine-driven units rated at 1,000 gal. per minute (two for each feed-water heater), are also installed on the turbine-room basement floor. Various other pumps, refrigerating and other equipment are installed in a pump room several feet below the auxiliary floor. As will be observed from the plan of a section of this floor, all important auxiliaries are in duplicate and, except for the boiler-feed pumps, consist of one motor-driven and one turbine-driven unit. In the case of the circulating pumps duplex drive is furnished.

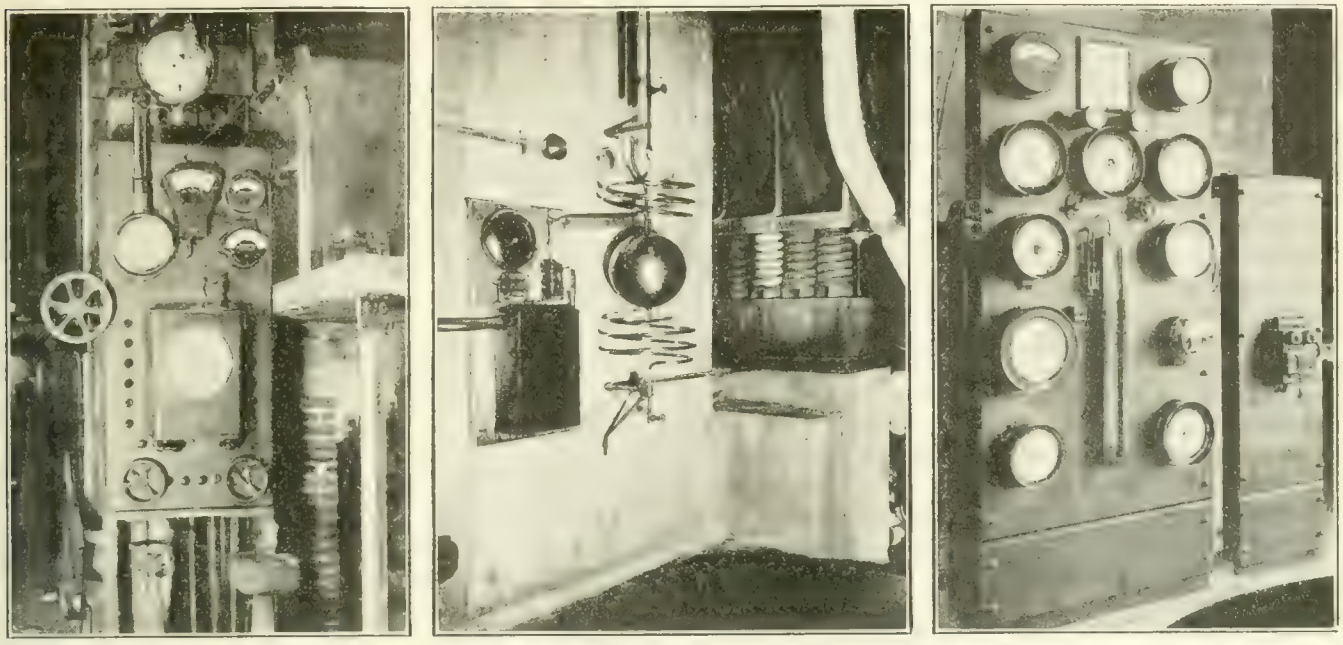
Circulating water for the surface condensers is supplied directly from the river through a screen basin in which are installed six vertical screening elevators. These screens are so installed in the screen house that they can be lifted out and removed from the building for repair or renewal. From the screen basin the water passes through duplicate concrete tunnels to the circulating water pumps. One pump on each main unit draws its supply from one of these tunnels and the other pump takes its supply from the duplicate tunnel. This allows the plant to be operated even though one of the tunnels may be taken out of service for repairs or cleaning. The discharge from the pumps now installed all goes into a single concrete discharge tunnel. The final arrangement will allow for three of the units to discharge into one tunnel and the other three to discharge into a duplicate tunnel. The two tunnels will join in the center of the turbine hall, from which point they will run side by side to the bulkhead, where they will discharge under the coal pier. On the side of the pier between the mouth of the discharge tunnel and the screen basin is a baffle wall of sheet piling which will force the warm discharge water so far out into the river that no recirculation is likely to occur, which would result in raising the temperature of the incoming circulating water.

Heat Balance

When the auxiliary system was designed for this plant it was determined to provide the necessary equipment to insure boiler-feed-water temperatures of about 210 deg. Fahr. to give protection against pitting of the economizer tubes and piping because of air which might be entrained in the water. At that time the only prac-



THE PRESENT FURNACES MAY BE ADAPTED TO BURNING OIL, POWDERED BITUMINOUS OR POWDERED ANTHRACITE AS SHOWN



BOILER-ROOM INSTRUMENT AND CONTROL BOARD; CONDENSER HIGH-WATER ALARM; TURBINE ROOM INSTRUMENT AND CONTROL BOARD

ticable way of removing this air was by raising the temperature of the water in the open feed-water heater to the boiling point. Investigations, however, were then under way which if successful would make it possible to operate the boiler-feed system at lower temperatures, with a resulting increase in boiler efficiency. For this reason considerable thought was given to a method of obtaining a heat balance which would allow for reliable and efficient operation with feed water at any temperature between 140 deg. and 212 deg. Fahr.

Keeping in mind the reliability and operating economy obtainable as well as the item of investment, it was decided to install the condenser auxiliaries in duplicate. It was further arranged that one of each type of auxiliary would be motor-driven and the other turbine-driven. In the case of the circulating pumps one pump for the unit was driven by motor and the duplicate pump is arranged with a duplex drive, so that if the load is being carried on the motor-driven pump and there is any failure in the electrical supply the steam end will automatically pick up the load.

For obtaining the proper heat balance the base steam requirements for any desired boiler-feed-water temperature can be obtained through the use of the steam-driven boiler-feed pump together with the required number of steam-driven condenser auxiliaries. Fluctuations in normal operation can be offset by regulation of the steam load carried on the duplex circulating pump. The regulation of the feed-water temperature with this arrangement is entirely under control of the man responsible for the operation of this section of the plant apparatus. A bleeder connection has been provided at the eleventh stage in the main turbines, but with the flexibility obtainable with the system as designed it is expected that this method of obtaining heat balance will not be used.

As in the boiler room, the instruments and control are grouped for convenience of operation. In line with modern central-station practice, the number of boiler-room and turbine-room instruments is considerably greater than a few years back, the additional equipment being considered essential to economical operation.

For the information presented in this article the ELECTRICAL WORLD is indebted to Joseph B. McCall, president of the Philadelphia Electric Company; W. H. Johnson, vice-president, and W. C. L. Eglin, chief engineer.

Connecting Overhead Circuits to Underground Cables

Single-Conductor Cables Used by the Detroit Edison Company to Connect Underground and Overhead Lines Without Arresters

BY A. A. MEYER
The Detroit Edison Company

OPEN-WIRE overhead-transmission lines, owing to their great exposure across country, are not immune in certain climates from troubles arising from lightning or atmospheric disturbances. Joining an underground cable to an overhead line naturally jeopardizes the cable also, and to a very great extent because the cable affords a good path to the earth for any discharges passing along the line. With lines of higher voltage such troubles are aggravated.

Experience has shown that a so-called stroke of lightning hitting an overhead line gets its relief sometimes by puncturing the cable insulation. It has also been observed that such puncturing occurs usually at a point in the cable not very remote from its junction with the overhead line. In other words, a high-voltage or steep-wave front disturbance will not travel very far through a lead-incased cable. The discharge into the cable, according to its magnitude, is either dissipated without damage or else relieved by puncture of the insulation close to the end at which the discharge entered, usually within 200 ft. (60 m.) from the cable terminal.

Quite frequently lightning arresters are advocated or installed at the junction points between the underground cables and overhead lines. The efficacy of such arresters is not to be argued here. Moreover, the

installation of arresters on high-tension line junctions with 24,000-volt cables is not always so satisfactory and so practicable from an operating standpoint as might be desired.

Some trial installations were made on the Detroit Edison Company's transmission system, involving direct connection of a 24,000-volt underground cable to an overhead line through short sections of special single-conductor cables of high-grade insulation, and omitting the lightning arrester at the junction point. In these installations the standard three-conductor lead-incased cable, having an insulation of $\frac{3}{32}$-in. x $\frac{7}{32}$-in. (7.1-mm. x 5.5-mm.) paper over No. 2/0 copper conductors, was terminated in a manhole about 200 ft. or 300 ft. from the cable pole and spliced to three single-conductor lead cables, which were carried from this point to the overhead connection. The insulation on this single-conductor cable is $\frac{21}{32}$-in. (16.6-mm.) paper, or about 31 per cent more than that separating each of the conductors from the sheath in the three-conductor cable. The increased amount of insulation is somewhat experimental and was determined largely by present limitations in the manufacture of cables of such size.

There is no doubt that the extra insulation should withstand high-voltage disturbances many times normal voltage. Then, if a lightning charge happened to seek a path into the cable, it might be absorbed or dissipated through the capacitance of the cable conductor, which, having high insulation, would suffer no damage. Of course, it must be admitted that lightning discharges are very unwieldy quantities to deal with and sometimes may be beyond the insulation limitations that can be provided. By placing only one conductor within a sheath it is practicable to increase the insulation considerably over that of a three-conductor cable, the diameter being limited to that of the duct orifice. This feature of extra insulation is probably the greatest factor in minimizing the danger of puncture to a cable. There are also other merits of single-conductor cables worthy of mention.

In a three-conductor cable each conductor is necessarily installed eccentric to the lead sheath, and the stress on one conductor to ground due to a high-voltage transient is therefore not uniformly distributed around the conductor. The potential gradient through the insulation is much greater on the side nearest the lead sheath, and the stream-line stresses are correspondingly more concentrated on the same side. In a single-conductor cable the conductor is concentric with the lead sheath, and the stresses therefore are uniformly distributed around the conductor. The chance for puncture from a high-voltage transient is therefore minimized considerably in a well-insulated single-conductor cable.

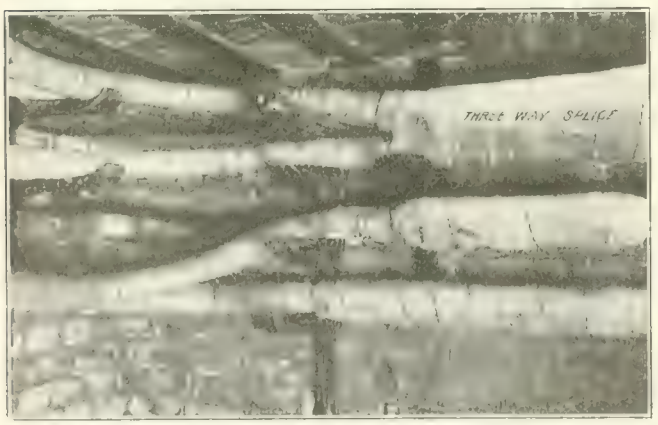


FIG. 1 — MANHOLE SPLICES OF THREE SINGLE CABLES TO A THREE-CONDUCTOR 24-KV. CABLE OFFER NO DIFFICULTIES

Owing to the concentric arrangement of the conductor within the lead case of a single-conductor cable, the capacitance is somewhat increased over that of an eccentrically placed conductor, as in three-conductor cable. In the present installation the capacitance of the special single-conductor cable is about 10 per cent higher per running foot than that of one conductor in the standard three-conductor cable. This means that the voltage stress to ground from a discharge into the cable sustained for a short time is correspondingly less on the single-conductor cable because of the greater capacitance and more rapid dissipation. Greater capacitance and more insulation, therefore, both protect the cable against possible damage from a lightning discharge.

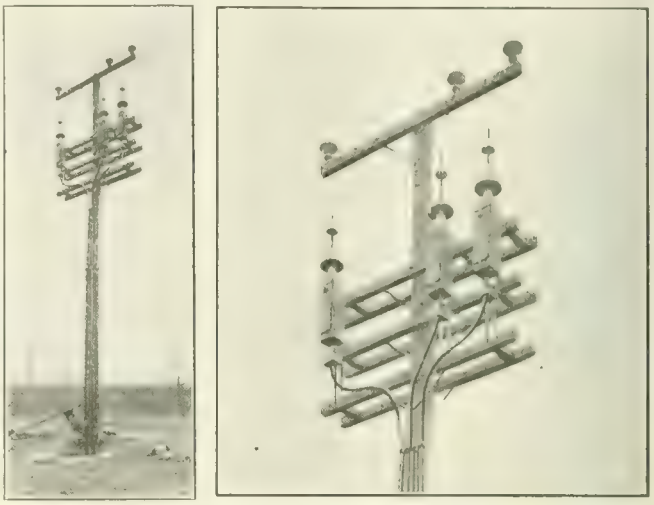


FIG. 2—SINGLE-CONDUCTOR CABLE CONNECTION TO 24-KV. OVERHEAD LINE

End bells are rectangular cast-iron boxes with hand-hole covers and roof-entrance bushings designed locally.

There are also some practical advantages in the use of single-conductor cables. It is much easier to provide and install suitable outdoor end bells for single-conductor cables than for a three-conductor cable of this voltage. The splice of a three-conductor cable to three single-conductor cables presents no difficulties, especially when it can be made in a manhole. In Fig. 1 such a completed splice is shown installed in a manhole, the splice nearest the roof being the one referred to. The three-single conductor cables are readily trained up a pole to the cable bells placed most conveniently with respect to the overhead lines. Fig. 2 illustrates one of the installations on a 40-ft. (12-m.) pole. The end bells are of local design and consist of rectangular cast-iron boxes with hand-hole covers and roof-entrance insulators. A paper-taped splice is made in each bell and the usual method of filling the bell with black compound is followed.

About four of these installations have been put into service so far, the first one having been in use since December, 1920. In this short period several lightning disturbances have occurred without damage to the present installation. However, during the coming summer, with its accompanying electrical storms, the behavior of these installations will be watched with a great deal of interest.

Legal and Financial Aspects of Superpower Plan

Superpower Survey, Advisory Board and Legal and Financial Advisers Discuss Problems Affecting the Carrying Out of the Enterprise Preliminary to Completion of Final Report of the Organizing Body

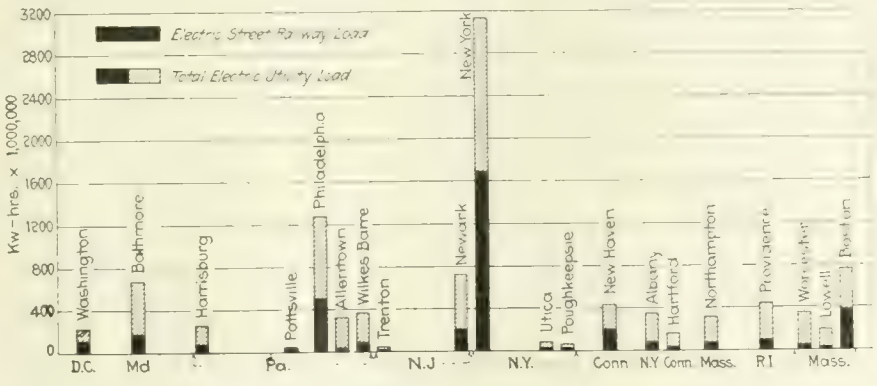
PRIOR to completing its final report on June 30, the Superpower Survey held a meeting in New York on May 13 at which members of its advisory board and several guests were invited to discuss the physical, legal and financial phases of the problems under consideration. Prof. L. P. Breckenridge, chairman of the advisory board, presided. W. S. Murray, chairman of the Superpower Survey, discussed the physical features, E. G. Buckland, vice-president, New York, New Haven & Hartford Railroad, the legal aspects and W. S. Barstow, president, W. S. Barstow & Company, the financial phases. In addition to those just mentioned, the following were present: Dr. George Otis Smith, Director of the United States Geological Survey, which is conducting the Superpower Survey; Gen. Guy E. Tripp, chairman of the board, Westinghouse Electric & Manufacturing Company; Thomas E. Murray, president of Thomas E. Murray, Inc., consulting engineers; H. I. Harriman, president, New England Power Company; A. J. Sheldon, Lee Higginson & Company; M. W. Alexander, chairman National Industrial Conference Board; C. L. Edgar, president of the Edison Electric Illuminating Company of Boston; George Gibbs of Gibbs & Hill, consulting engineers; Colonel Charles Keller, Board of Engineers for Rivers and Harbors; Arthur D. Little of Arthur D. Little, Inc., chemists; James H. McGraw, president McGraw-Hill Company, Inc.; J. H. Pardee, president J. G. White Management Corporation; Walter Thayer, Pennsylvania Railroad; Henry Flood, Jr., engineer-secretary Superpower Survey.

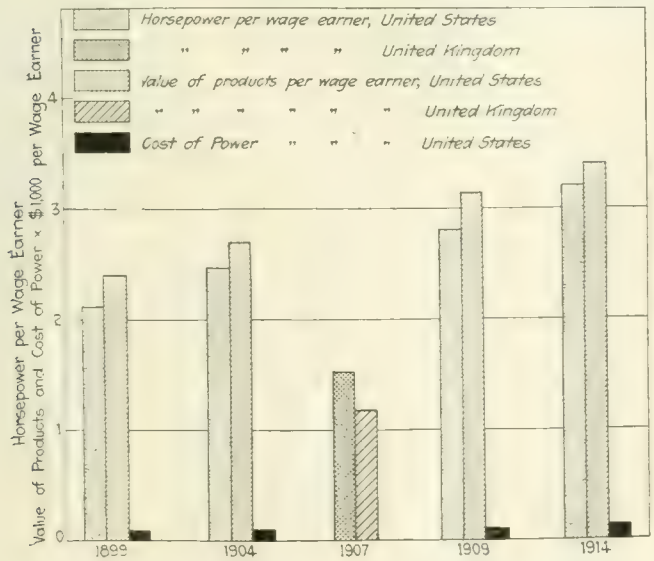
A very interesting discussion followed the presentation of the three phases of the superpower study. Features of this discussion are reported in what follows.

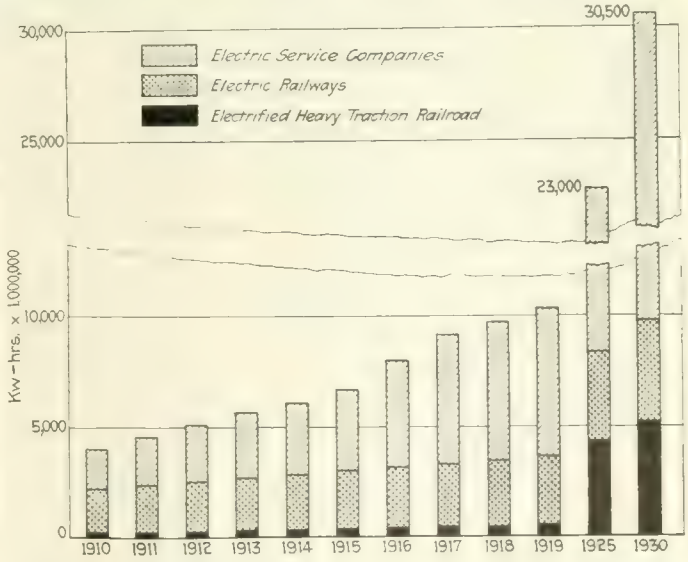
Legal Phases

E. G. Buckland, vice-president New York, New Haven & Hartford Railroad, prefaced his remarks by saying: "A charter or other legal authority must harmonize the legislative and financial requirements."

Essentially a charter must (1) grant powers and (2) limit powers. The grant of power should give the superpower corporation the right to generate and distribute throughout the Boston-Washington zone and to take by eminent







ANALYSES BASED ON STUDY OF CONDITIONS IN SUPERPOWER ZONE

Top—Energy consumption of load centers in superpower zone. The horizontal distance between graphs is proportional to the distance between projections of the load centers on a straight line between Washington and Boston. Left—Horsepower, value of products and cost of power per wage earner in the United States compared with similar values in Great Britain. Right—Past and estimated future growth of energy consumption in the Superpower Zone.

domain all necessary lands or easements. On the other hand, the corporation should be limited in the purchase or sale of energy to authorized public utilities in the zone. These utilities should have the first right to subscribe for stock in proportion to their energy output.

Mr. Buckland saw no reason why Congress should not grant the power of eminent domain to the corporation which is so fundamental. This can best be obtained in one of four ways:

1. By private charter granted by Congress.

2. Under a general corporation law to be passed by Congress authorizing the incorporation of superpower corporations to operate anywhere in the United States.

3. By an amendment to the federal water-power act extending the authority of the commission to projects involving power houses generating electrical energy by water or other motive power and providing for the incorporation under a federal charter of associations to become licensees.

4. By an amendment to the federal water-power act as above, the licensee to be a corporation organized under the law of one or more states in the Superpower Zone.

Should Congress grant a private charter, it would in all probability be for twenty years, which would be too short a period to admit of proper financing.

While a general corporation law might enlist more sympathy from Congress than a special charter, it would nevertheless be subject to the same limitations.

By a slight change of language in a few places an amendment could easily be made to the federal water-power act. An addition to the act would permit federal corporations to become licensees. There is the disadvantage, however, of the measure of control exercised by the Federal Power Commission. On the other hand, a longer franchise can be obtained this way than in any other, and even at the end of fifty years recapture by the government must be conditional upon payment of net investment plus reasonable severance damages. To Mr. Buckland the amendment of the act to include the superpower project thereunder would be the most feasible way to secure the desired result. He was of the opinion, however, that if the corporation can be organized under the laws of any of the states with the authority under the federal water-power act to operate as desired it would be the easiest and quickest way to accomplish the desired result. From the above it was concluded that the federal water-power act should be amended so as to embrace power houses generating electrical energy by water or other motive power; that a corporation should be organized in one or more of the states within the Superpower Zone wherever the law is most favorable and its power should be limited to wholesaling of electrical energy.

Financial Phases

Absolute protection to the vested rights of existing public utility companies, no price regulation, and rates lower than cost to generate by customer companies are considerations which W. S. Barstow, president of W. S. Barstow & Company, emphasized as the bases for any superpower project. The financial plan as outlined by Mr. Barstow has five aspects:

1. The superpower company as a community enterprise should be incorporated with one class of security to be outstanding, and that to be a non-par stock.

2. The Boston-Washington zone should be divided into districts showing how the distribution to the public is now taken care of by existing public service companies. All remaining territory at present unprovided for by an existing company in this zone should be served directly as occasion arises by a new distributing company which shall operate as now under state regulation and which may or may not be formed by the superpower company, but which will bear the same relation to the superpower company as will the present distributing companies.

3. All existing public service companies in the territory, as they become customers of the superpower company, should be entitled to subscribe to non-par stock in the company pro rata, based on demand, load factor or on some other predetermined definite basis. Public service companies may avail themselves of this right to subscribe or not as they may see fit, but in any event should be entitled to become customers of the superpower system, but a company which is not a customer should not become a stockholder. In case any public service company does not become a stockholder in the superpower company, the stock to which it is entitled to subscribe can be offered to the investing public. In case a public service company becomes a stockholder in the superpower company, the purchase of this stock would be authorized by state public service commissions in the same way as they now authorize the extensions to existing station capacity (as this stock represents such extensions), by permitting the issue and sale of the local public service company's securities, the proceeds from which would be used to acquire the non-par stock at its book value. The basis on which these local public service securities would be issued would, as now, be fixed by the state commission. There are, of course, many companies today that are unable on account of their complicated financial structures to raise capital to enlarge present power plants, and they therefore could not provide a corresponding amount to purchase the equivalent non-par stock of the superpower company. In this case their share in the enterprise would be waived and, as before mentioned, would pass down to the investing public. This should not constitute, however, a waiver of any future rights, as possibly at another time they might be able to take advantage of the superpower investment to improve further their own financial positions.

4. All customer companies subscribing to stock and thus becoming stockholders, as well as any outside interests owning stock, would, as now, elect a board of directors of the superpower company, which board would control the management of the enterprise.

5. A contract, which should be possible of adjustment from time to time to meet the progress of the art, should be entered into between each existing public service company, or public service company to be formed in present unoccupied districts, and the superpower company. Such a contract might in some cases be a selling contract, in some cases a buying contract, or in some cases both buying and selling might be involved, as only by such flexibility can the superpower company take advantage of every economy. The attainment of this company would no doubt necessitate a single dispatching system operated by the superpower company, which might even find it necessary, in order to obtain the results, to control and operate in conjunction with its system the power plants of its customers.

In conclusion Mr. Barstow points out that any economy effected through lower cost of producing energy would, after assurance of a proper market return on the securities of the local company, be passed down to the public. Returns on superpower company stock held by a customer company could, after deducting the proper market return on the securities issued to acquire the stock, go to a special reserve of the customer company and be distributed direct to its security holders; used as a stabilization fund or used for any other purpose not required by the state commission.

Absolute publicity as to earnings, value of stock and cost of physical property of the superpower company are advocated.

Under the above financial plan Mr. Barstow states

that the company can act as a free agent and take advantage of every economy in obtaining money, materials and labor. Any restrictions which would prevent the free flow of money to the enterprise would, it is stated, at once render it inactive and defeat the attainment of the result shown possible by the survey.

Upon the freedom of action secured through the various states in condemnation for right-of-way, etc., will depend whether or not the company shall have a federal charter. In any event, it is said, there must, in the case of the superpower company, be no price fixing involved, as the government will receive a corresponding benefit in return for any rights it can grant by securing unlimited and economical power for the future development of railroads and industries.

THE PHYSICAL ASPECTS

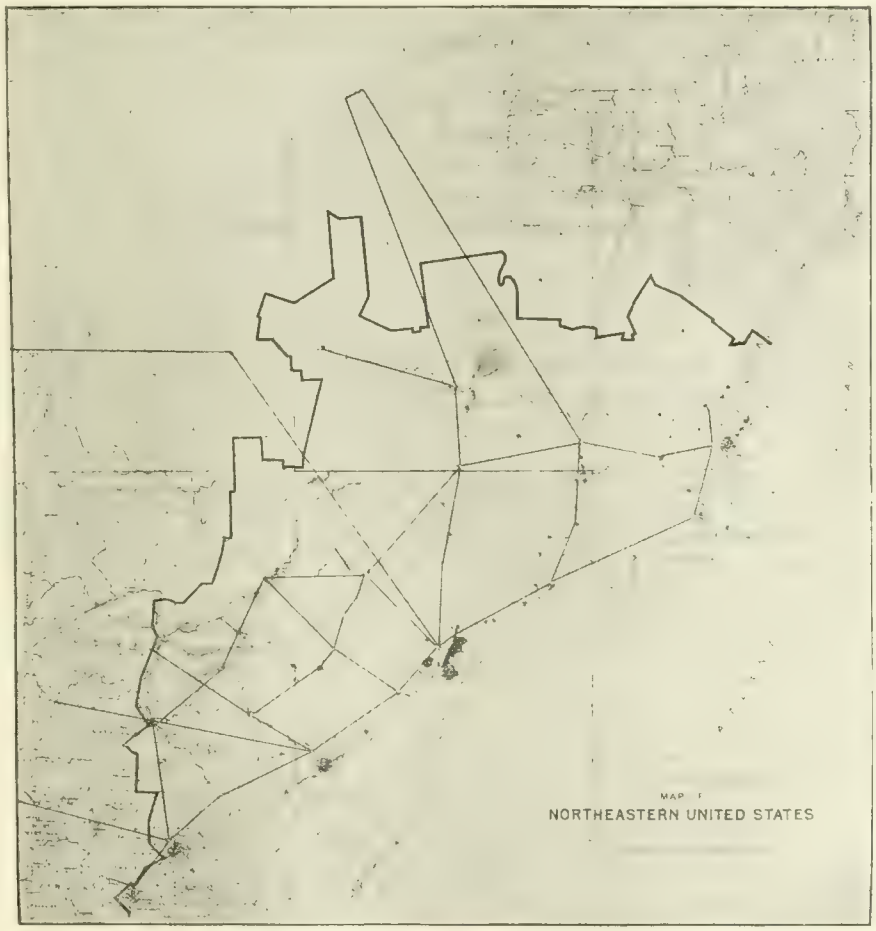
W. S. Murray in his summary of the physical aspects of the Superpower Survey pointed out that an enormous coal saving could have been effected in the Superpower Zone during 1919 if the facilities which he is advocating for that district had been in existence. The savings would have amounted to 4,300,000 tons for the utilities, 9,566,000 tons for the railroads and 11,000,000 tons for the industries, or a grand total of 24,866,000 tons. If the generation of power continues unco-ordinated, he contended, the annual coal waste will be 50,000,000 tons by 1930, which at $5.35 a ton would represent a monetary loss of $266,500,000. Through the agency of a superpower system two of the most important economies of power production can be satisfied. These would rest, first on the ability to develop hydro-electric power within the zone to maximum capacity, and, second, on the feasibility of establishing 30,000 kw. as the minimum size of generators in the Superpower Zone steam stations.

In making the survey 315 utilities were examined, representing a capacity of 4,000,260 kw., of which 11 per cent was hydraulic and 89 per cent steam. The output of these stations was 10,301,000,000 kw.-hr., hydraulic stations producing 16 per cent of this output and steam stations 84 per cent. The steam stations consumed 11,806,000 tons of coal at a cost of $63,228,000. The average coal rate was 2.73 lb. per kilowatt-hour.

Although the maximum capacity of any steam plant in the territory was 163,000 kw. and that of any hydraulic plant 83,500 kw., the average of all steam plants was found to be 10,000 kw., while the average of hydraulic plants was 2,700 kw. An investment of $598,000,000 is represented by these plants, 85 per cent of the total being for steam plants and 15 per cent for hydraulic.

An analysis of the industries in the Superpower Zone has shown a total of 76,000 plants using 9,000,000 hp. The power requirements of these industries were further divided as shown in the accompanying table.

Exclusive of Niagara Falls and St. Lawrence power, there is available within the zone for water-power development 9,000,000,000 kw.-hr. per annum. However, the utilities, railroads and industries will require 31,000,000,000 kw.-hr. annually by 1930. Allowing for economical application, probably 25 per cent of the power requirements could be supplied by hydro-electric development. To make up the balance it is proposed to use the high efficiency steam plants as a base but retain 75 per cent of the present central-station capacity for peak-load operation. To insure the realization of the full economies of the superpower system the future should see the installation of steam-generating equipment in units of not less than 30,000 kw.



PRELIMINARY MAP OF SUPERPOWER ZONE IN WHICH INTERCONNECTION OF THE MOST ECONOMICAL PLANTS IS PURPOSED

Standardization of 60 cycles as a uniform frequency is recommended, as well as the standardization of plant and railway equipment in so far as that may be possible.

POWER REQUIREMENTS OF INDUSTRIES IN SUPERPOWER ZONE

Kind of Power Used	Horsepower	Approximate Percentages
Steam	5,400,000	60
Gas	300,000	3
Electric	2,800,000	31
Water	500,000	6
Total	9,000,000	100

W. S. Murray estimated that the project would require $100,000,000 each year for the next ten years, but the annual coal saving would be $266,500,000. Of the 5,000,000 kw. capacity in central stations in the zone,

he believed that only 1,000,000 kw. would have to be written off in order to get the benefit of the more efficient superpower stations.

Several important legal difficulties which would have to be overcome were cited by H. I. Harriman in the development of his argument that the superpower company should be organized under a federal charter rather than under a charter granted by any state. He indicated several obstacles to interstate business embodied in laws of several of the New England states. These obstacles he thought could be overcome more readily under a federal charter.

Regarding agreement among utilities which would operate within the zone, C. L. Edgar asserted that ten or twenty men could be selected who should have no difficulty in getting together on a plan. From what was said at this meeting and what had been known previously concerning the difficulty utilities are having to raise money, James H. McGraw asserted that the deduction was obvious: The public utilities must be allowed to charge sufficient rates to get all the money that is necessary for them to keep up with the demands.

An interesting commentary from the viewpoint of the military was furnished by Colonel Kellar, who said that one of the great difficulties encountered during the late war was the inability to get sufficient power where it was needed. The superpower scheme should remedy this deficiency and provide a most important national insurance in time of war.

In discussing financial aspects, Guy E. Tripp questioned whether utilities could use non-par stock of the superpower company as readily as bonds for collateral in issuing their own securities. Mr. Tripp also cited the case of New Jersey, where utilities are not permitted to earn more than 8 per cent, which is only sufficient to cover interest under present conditions. He suggested that a corporation selling energy to the utilities might be permitted to earn more.

Bankers Are Readily Interested in Power Development

A. J. Sheldon said that bankers should be interested readily, but some educational work would be necessary. His own company had recently loaned $70,000,000 on Swiss hydro-electric developments, however, foreign countries are competing for American capital and recently bankers have been allowed 5 per cent commission on loans bearing 8 per cent. One reason for dearer money was that it is coming in smaller quantities, the rich man having been eliminated as an investor in these bonds on account of the income tax.

In answer to E. G. Buckland, who asked how much less than $100,000,000 per year would be required by the separate utilities to take care of increasing business without the superpower company, W. S. Murray said that more money would be required for construction by individual companies than would be necessary for the superpower system.

Mr. Edgar agreed with Mr. Murray that there was nothing in the superpower proposition that has not already been done. What has already been done over 600 miles will be applied to over 30,000 miles. The educational value of Mr. Murray's report should be great, he said.

H. I. Harriman spoke at length on legal aspects of the undertaking and expressed the belief that it would be wise for the larger companies to be the initial organizers of the superpower business of a given district. In developing his point that the federal charter is to be preferred, he pointed to the case of Massachusetts, where corporations doing business within the state must be incorporated under the laws of Massachusetts.

According to the state law of Maine no energy from water power within that state may be exported to other states. In Connecticut it is unlawful to import water-power energy. In Massachusetts corporations cannot have bonds exceeding the par value of capital stock, a provision which greatly handicaps the sale of securities. There would thus be serious difficulties in the way of a superpower corporation organized in one state and attempting to do business in other states. There would be less prejudice against a company with a federal charter, the speaker contended.

Existing Companies Should Purchase Energy From Superpower Corporation to Avoid Conflict

Mr. Harriman also dwelt upon a possible conflict between the superpower company and other companies selling wholesale energy within a given district. He held that the superpower company should not compete with the local companies for existing business. His own company, he said, sells energy to forty or fifty smaller companies and thus does a superpower business in a limited way. He suggested that the existing larger companies should continue to sell to the smaller companies, buying in turn from the superpower corporation, always under proper regulation as to rates.

This procedure was also favored by Mr. Edgar, who held that only the larger companies could afford to build substations for taking energy from the Superpower System.

E. G. Buckland asked if Congress did not have the right to give a franchise to a corporation to carry on interstate and foreign commerce in any of the states. Where such commerce was to be carried on contrary to a state law business may be greatly impeded by local interests, Mr. Harriman replied; but he felt there would be far greater difficulties if the company were chartered in another state. If the company were organized under a state charter, for instance, the state might limit dividends to 5 or 6 per cent and control the business throughout the Superpower Zone. It would be dangerous to place this power in any but federal hands, he believed.

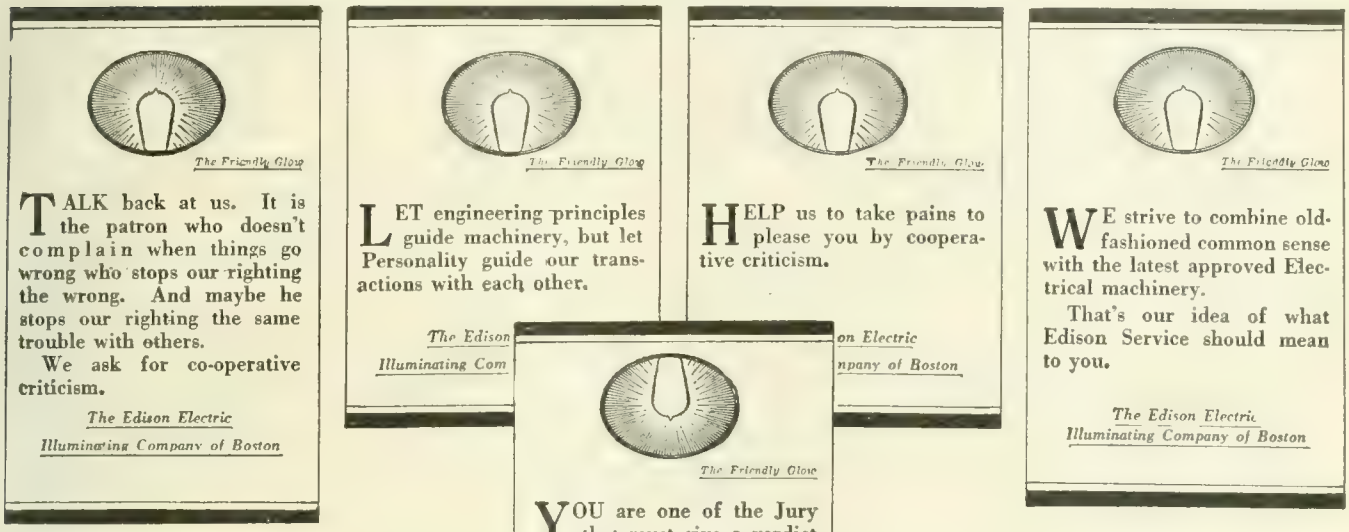
How the "Man in the Street" Is Affected

Regarding the educational value of the project, James H. McGraw said that the superpower plan should appeal to the "man in the street" because the results can be demonstrated. Professor Breckenridge pointed out that the wage earner in this country uses two and a half to three and a half times as much power as the wage earner in Europe—another strong appeal to "the man in the street."

Mr. Tripp agreed with other speakers that representatives of the principal central-station interests within the zone should get together and formulate their ideas beforehand. Dr. George Otis Smith said that the project should not be owned or operated by the government and called attention to the conservation by the project of financial as well as physical resources. He also said that unless a definite legislative and financial plan is submitted the newspapers will formulate one themselves.

Organizing Courtesy to Build Good Will

The Story of How the Boston Edison Company Put Personality Into Its Business, Built Good Will and by Education Made the First Thought of Employees that of Service to the Customers and to the Public



EXAMPLES OF THE FRIENDLY GLOW SERIES

IMPERSONALITY in corporations is believed by the management of the Edison Electric Illuminating Company of Boston to be one of the chief obstacles to an understanding of public utility service ideals and policies by employees and by the public. For many years President C. L. Edgar and his associates have been building up an enviable reputation for this largest of New England central stations in the great territory reached by its lines. Notwithstanding the excellent relations existing within the company and between it and its customers, it was felt soon after the war ended that an even closer friendship might still be realized throughout the system by uniting employees and public in a "good will and courtesy" movement.

The campaign, now more than a year old, was begun in December, 1919, following a program originated and supervised by Converse D. Marsh of New York, and carried out by the company with the co-operation of officers and employees, the advertising department and the company's publication, *Edison Life*, sharing a large part of the work. It is not possible, of course, accurately to measure the results of the campaign; but an indication of these is afforded by a recent telephonic "approach test" of officers and other employees, described further on, which disclosed virtually 100 per cent efficiency in dealing with the public. More than 2,000 employees and more than 100,000 customers, to say nothing of the outside public, are benefiting from the campaign.

All male employees of the company were invited by President Edgar to a mass meeting at the company's Service Buildings, held Dec. 8, 1919. In a letter to each he pointed out that, although he once knew all the customers himself, no single man can know thousands of customers personally, and therefore the employees must take his place in that respect. Expressing the hope that the company, no longer just a business, but a representative institution of New England, will ever remain human and not grow into a mere, huge machine, Mr. Edgar pleaded for the retention of a personality for the company, saying:

> Every day you meet our friends—customers or possible customers. As they find you, smiling or grim, so they will judge us all as a body. To them you are the company—good or bad.
>
> As we grow greater in size, it has seemed to me that we should try to grow greater in spirit—in patience, in courtesy, in true politeness. If all of us give this kind of service, in the right spirit, we have all a better chance to advance as the company itself advances and grows.

This meeting launched the campaign. It was attended by about 1,500 men employees, coming from all over eastern Massachusetts and representing nearly 100 per cent of the male forces of the company. As each man entered he received a program, a song sheet and a "courtesy button" which has become a permanent emblem of the service. Music was furnished by the Edison employees' band. Introduction cards, tobacco and a song, "Pals," written specially for the occasion by J. J. Caddigan, assistant superintendent of the advertising department, and "Chick" Story, were supplied each man. The program included addresses by President Edgar, J. W. Cowles, superintendent installations department; G. C. MacNeill, division head, northern district, maintenance of lines department; C. H. Crockett, assistant purchasing agent; C. A. O'Brien, stock dispatcher, supply department; W. L. Kenney, traffic clerk, transportation department; G. E. Seabury, superintendent station engineering department; W. D. Dyer, assistant superintendent collections department; F. D. Stiles, installa-

tions department, and L. R. Wallis, superintendent sales department. L. D. Gibbs, superintendent advertising department, presided at the main meeting, and John Campbell, superintendent special service department, led an overflow meeting. Among the topics discussed were "Meeting the Public," "You Are the Company," "Good Will from the Buyer's Viewpoint," "Appreciation of Courtesy," "Opportunities," and "The Man I Want to Know." Entertainment furnished by employees and by a vaudeville troupe interspersed the speeches. Cheerfulness as an asset in dealing with fellow employees and the public was strongly emphasized at the meeting, coupled with courtesy in mutual relations. The fact that the average customer or member of the public judges the company by the acts and bearing of the individual employee was driven home by many speakers.

A "courtesy and good will" meeting for women employees was held a week later. President Edgar spoke briefly at the opening, and leading officials were introduced, after which the men present withdrew and the meeting was conducted by the women. Informal addresses upon topics suggested by the first meeting were presented by representative women employees, and an entertainment with light refreshments was provided.

Early in 1920 the campaign was further advanced by sending to each employee calendar blotters carrying messages of good will and suggestions for personal progress, and by the use in company stores, offices, etc., of 11-in. x 17-in. window cards and bulletins conveying the courtesy note to employees and to the public. Typical window cards read:

"The business of this company is to render service and courtesy to the public."

"You help us build right here at home one of the best electric light companies in the U. S. A."

"Home people have some of their money in this company. We are not a national—just a Greater Boston business. As you help us, so we grow."

"Our ability to merit your good will is a greater asset than our bank account. We solicit criticism."

"Machines only click at you. Men and women can speak a kindly word."

The value of the "smile" in business is constantly preached and practiced in connection with the campaign. Pocket cards were also sent employees bearing a message tied in with the campaign. A typical card read: "Do not tell your troubles to customers—what did you think the last time some one tried it on you?" A booklet entitled "Playing the Game" was also sent employees, and this contained sixteen terse, suggestive rules for winning the game of business, such as:

"The smile wins."

"Life is give and take—fifty-fifty."

"Let the other fellow lose his temper—you stand pat."

"Hard workers find their work easy."

In April all employees of the company and their families were invited to a mass meeting at Mechanics Building, Boston, by President Edgar, with the object of broadening their acquaintance and further developing the campaign idea. More than 3,000 persons attended. An attractive entertainment with inspiriting addresses by L. D. Gibbs, who presided, and by H. W. Moses, superintendent of the employment bureau of the company, were features of the occasion. The practice of courtesy and the work of the employment bureau in many ramifications were discussed, and motion pictures, community singing, refreshments and dancing closed the evening. Before this joint meeting President Edgar sent each employee a letter inclosing proofs of a series of "good will and courtesy" advertisements which the company purposed to run in the Greater Boston papers. Criticisms and suggestions were invited, and the response took the form of 700 letters suggesting changes in methods of work and improvements in wording of advertisements, expressing loyalty to the company, etc. President Edgar appointed a special committee to investigate all suggestions toward betterment, and many of these have since been tested. An Edison "yell," composed by E. S. Mansfield, was adopted at the meeting, following a competition for the best cheer:

E-d-i-s-o-n!
I Will, You Will, We Will, Good Will!
Want to see—Loyalty-Courtesy!
Edison! Edison! Edison!

During April, 1919, a series of advertisements in newspapers was begun, and it has been continued to the present writing. Typical messages are reproduced herewith, all being keyed upon the words "The Friendly Glow" and seeking to enhance the friendship of employees, company and public. Besides being printed in English, these advertisements have appeared in papers published in Polish, Greek, Syrian, Italian and Hebrew. Two are run each week, and nearly half a hundred papers are utilized.

Among the outgrowths of the campaign has been the organization of departmental and bureau meetings in the fall of 1920 for the purpose of carrying forward the co-operative idea along intensive lines within the company; betterment committee work, designed to point out means of improving company practices; educational classes for employees seeking voluntarily to learn about the organization, routine and policies of the company, and conferences of the rank and file, unattended by officials, looking toward improvements in the company's service and methods. The provision of district managerships in the company's territory (see ELECTRICAL WORLD for March 19, page 661) was the outgrowth of a suggestion looking toward betterment in public relations.

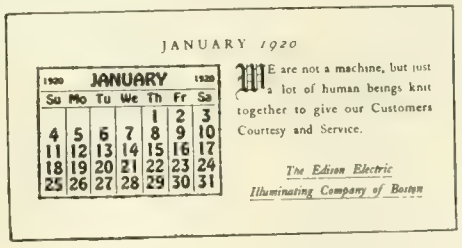
EDISON "APPROACH" ALMOST PERFECT

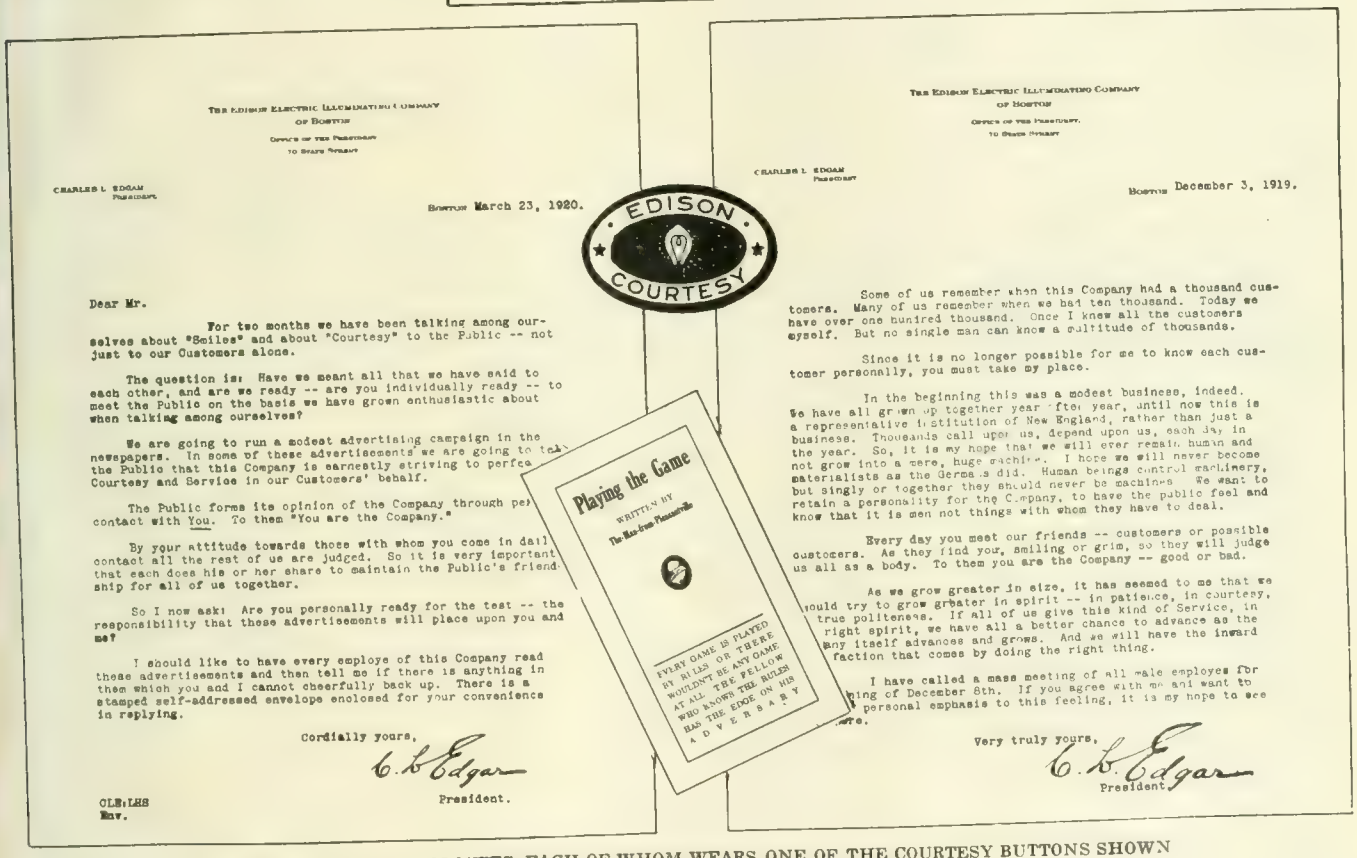
A remarkable test of the Edison employees' response to the calls of the public was recently conducted by an outsider whose hobby is emphasizing the importance of an old-fashioned politeness. The results of this inquiry, which was made over the telephone and which covered forty-two calls and thirty actual interviews with company representatives, show an almost perfect score. The inquiries were not strictly normal in any case. They noted the quickness of the company's telephone operations, the accuracy with which requests were received and transmitted, the rapidity with which department heads were called to the telephone, results of trying to provoke to irritability the Edison employee who answered the call and of attempting to confuse the hearer by an involved statement with a show of bravado that would have been absent in a personal interview, and they tried to ascertain whether questions quickly "fired" would be answered right off-hand. The excellence of the company's "manners" over the telephone was declared to be remarkable when compared with the indifference met from employees in many industrial enterprises.

All sorts of fictitious situations were brought to the attention of officials and employees from the president

down in this inquiry. "Foolish" questions were asked, imperative demands for the immediate remedying of imaginary troubles were presented, complaints were manufactured about noises in incandescent lamps keeping customers awake, the construction forces were charged with having left poles to encumber private property, pretended delay in service was condemned, and attempts were made to force employees to commit themselves on subjects which they had had no time to investigate. False assertions were made about the behavior of meters, theft of energy by neighbors (address not given) was declared to exist, unjust allegations were made against inspectors, prices of appliances were sought in rapid succession, and fabricated misinformation was utilized by the questioner to attempt to embarrass the employee. In nearly all cases the company's representative asked for the address courteously despite repeated provocation and made every effort to meet the situation with promptness and interest. The results of this unexpected test of the "courtesy factor" of the company were so uniformly good that the management feels a pardonable pride in the attitude of the employees toward the public at large and the customers of this great utility. Several hundred friendly letters and appreciative comments have been received by the company from the public since the beginning of the advertising campaign.

The ELECTRICAL WORLD is indebted to William H. Atkins, general superintendent of the Boston Edison company, under whose personal oversight the "courtesy and good-will" campaign has been conducted, for much of the information printed in this article. A further article dealing with the interesting incidents of the "approach" campaign will appear in an early issue.





MESSAGES TO THE EMPLOYEES, EACH OF WHOM WEARS ONE OF THE COURTESY BUTTONS SHOWN

Development of Electricity Supply in Norway and Sweden

THE committee appointed by the Swedish government to work out a uniform plan for the electricity supply of the country has lately reported on the requirements for electrical power in southern Sweden. The committee is of the opinion that at present southern Sweden's need of electrical energy can be met by the utilization of existing water power. The waterfalls of Lagan and Nissan can produce 400,000,000 kw.-hr. and from waterfalls in Blekinge a further 600,000,000 kw.-hr. can be obtained. The increase in demand in the last few years has, however, been so marked that it is expected that in ten years the water-power reserves of southern Sweden will be insufficient and that this section of the country will have to draw on the resources of the northern part, especially the Trollhättan hydro-electric works.

The demand for electrical energy in Norway has grown so much during the last few years that most of the larger towns have been forced to apportion their supply to consumers. This has been the case in Christiania and Bergen, and these two cities have lately been energetically at work to increase their power supply. The municipality of Bergen has acquired the Torfis waterfalls and intends to erect a power plant there without delay. The electricity works of Bergen have recently completed a 50,000-volt transformer plant at the power station of Björlo. A large company, the Bergen Municipal Power Company, has been formed through co-operation of a number of communities for the purpose of the utilization of the waterfalls in the

vicinity of Bergen. The company is equipped with a capital of 9,000,000 crowns, of which 6,000,000 crowns have been subscribed by the municipality of Bergen, which has also made a loan of 20,000,000 crowns to the company.

At the old rate of exchange a Norwegian crown was equivalent to 31 cents.

Data for Estimating Weights of Synchronous Machines

Curves Give Weights of Parts to Be Added to the Necessary Stator and Rotor for Finding Total Weights of Machines of Various Types

By THEO. SCHOU
Chief Engineer the Ideal Electric & Manufacturing Company

COMPLETE curves giving weights of active material required for synchronous machines (motors and generators) of various kva. ratings and speeds were published in the ELECTRICAL WORLD of May 7, 1921. From these data the weights of stator and rotor were estimated for engine-type machines. To obtain total weights for other types of machine, the foregoing weights may be increased by weight for other parts which are given in this issue. From such data it is possible to show how efficiently material is used in each type and also just what saving in material is effected by using higher speeds or units of larger kva. ratings, as well as to obtain weights and costs of machines for estimating purposes.

HOW WEIGHTS OF DIFFERENT TYPES ARE DETERMINED

Synchronous machines of ratings discussed in this article are built in the following types: Engine; bracket; two-bearing, belted, pedestal; two-bearing, coupled, pedestal; three-bearing, belted, pedestal; and vertical. The various types embody the engine-type stator and rotor with the addition of the parts required for these types.

Engine-Type Machines.—This type of machine is arranged for steam, gas or oil engine drive, and as it is common practice with the engine builder to furnish shaft and bearings for the alternator, this type of machine contains only the stator and rotor proper.

Built as synchronous motors, these machines are used mostly for direct-connected drive to air and ammonia compressors. For machine ratings not suited for engine drive one may still speak about the engine-type parts, which, as above stated, consist of the stator and rotor proper only. The weight of the engine-type machine, including frame and rotor spider, to go with the various parts may be estimated very closely from Fig. 2. Here pounds per kva. is plotted to kva. per pole for various back bores (outside diameter of stator punchings. See Fig. 4.)

Bracket-Type Machines.—This type of machine is built largely for high speed with small or moderate kva. capacity. The bracket-type machine contains, besides the engine-type parts, the bracket-type parts, which again consist of two end brackets (or "bonnets") containing the bearings, the shaft and two belt-tightener rails. The approximate weights of bracket-type parts, as per Fig. 3, also include main, or driving, pulley and exciter driving pulley. For the same frame size, or for machines built on the same back bore, the bracket-type parts remain approximately the same. It is understood that the shaft length and weight will vary somewhat with different core widths, and the pulleys with different values, but for estimating purposes this is not taken into consideration.

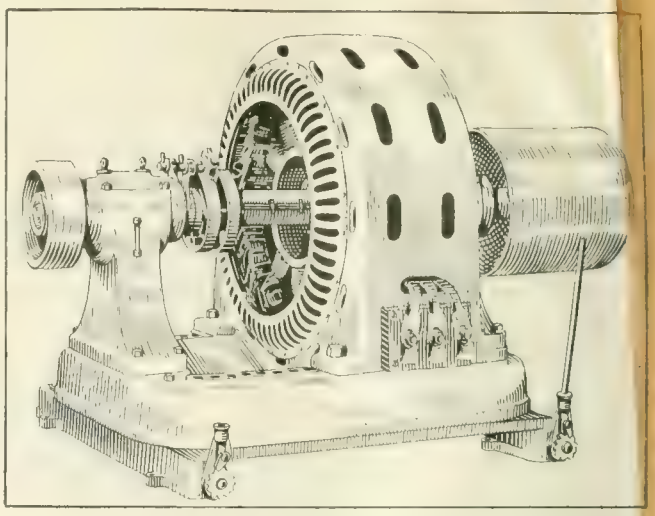
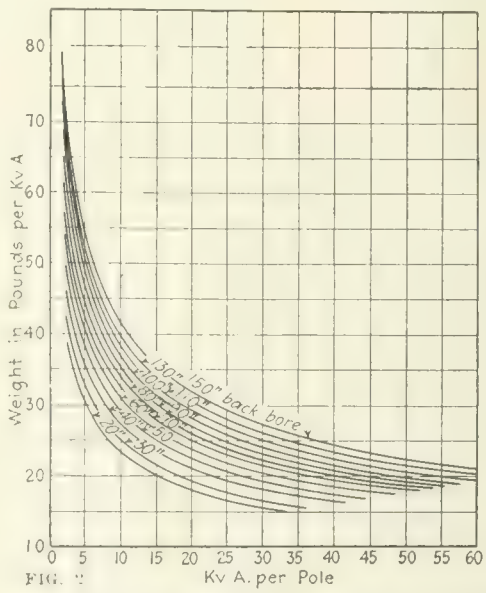


FIG. 1—TWO-BEARING PEDESTAL TYPE FOR BELT CONNECTION

Two-Bearing, Coupled, Pedestal Type.—This type of machine is built over a wide range of capacities and speeds and contains, besides the engine-type parts, the two-bearing, coupled, pedestal-type parts, which consist of base, shaft, pedestals, bearings and half coupling. The weights of the approximate two-bearing, coupled, pedestal-type parts, as per Fig. 3, do not include coupling and remain constant for the same frame size or back bore. This is, of course, again only approximately correct, as both shaft and base will vary somewhat in weight with different core widths. For



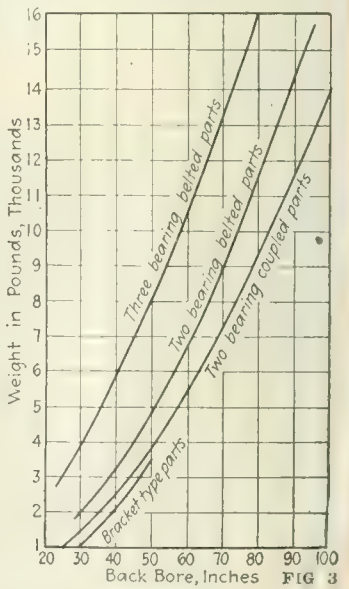


FIG. 2—NET WEIGHT OF ENGINE-TYPE MACHINES. FIG. 3—WEIGHTS OF PARTS TO BE ADDED TO STATOR AND ROTOR WEIGHTS OF ENGINE-TYPE MACHINES IN ORDER TO OBTAIN APPROXIMATE TOTAL WEIGHT OF ANY TYPE

estimating purposes, however, it will be found that values taken from Fig. 3 give a fair average.

Two-Bearing, Belted, Pedestal Type.—The two-bearing, belted, pedestal-type machine may include ratings built in the bracket type, but also machines of lower speeds and somewhat larger capacities. It will be understood that for the same kva. capacity the back bore increases as the speed decreases, and it will be found that the bracket type is limited, in addition to capacity, by the back bore. This type contains, besides the engine-type parts, the two-bearing, belted, pedestal-type parts, which consist of base, shaft, pedestals, bearings and two belt-tightener rails. No pulleys are included.

Three-Bearing, Belted, Pedestal-Type.—Where the capacity and belt pull limit the application of the two-bearing, belted, pedestal-type machine, the three-bearing, belted, pedestal-type is employed, but this type may also embrace ratings built in the two-bearing, belted, pedestal-type. The weight of the three-bearing, belted, pedestal-type parts, as per Fig. 3, includes shaft, base, three pedestals, three bearings (of which the middle one is usually larger than the two end bearings) and three belt-tightener rails. No pulleys are included.

The vertical type of synchronous machine, arranged for direct connection to vertical waterwheel or pump, may be built over a very wide range of kva. capacities and speeds. Owing to the fact that the construction of the vertical parts varies considerably with the different manufacturers, no attempt has been made in this article to approximate their weight. As to performance, it may be said that because of lower friction the efficiencies of the vertical type are slightly higher than those of the two-bearing types.

The information given in the various curves as to weight of effective and non-effective material will be found to be valuable as to reliable estimates. A few examples demonstrating their use:

Example 1.—It is desired to find the engine-type weight of a machine rated at 250 kva., 200 r.p.m. It will be found that such a machine will be built using a back bore of about 70 in. (178 cm.). The kva. per hole in this instance is 250 ÷ 36, or 6.95. This value corresponds, on a 70-in. back-bore curve, to 38½ lb. (17.46 kg.) per kva. The weight of this engine-type machine is, therefore, 38½ × 250, or 9,600 lb. (4,354 kg.). From curves, Fig. 16 (see ELECTRICAL WORLD, May 7, page 1035), the net weight of effective copper and iron is 4,000 lb. (1,814 kg.). In case of this engine-type machine the "effective" material is 41.6 per cent and the "non-effective" material 58.4 per cent of the total net weight.

To find the total weight of this same machine built as a two-bearing, coupled, pedestal-type machine, we find from Fig. 3 that approximately 7,200 lb. (3,265 kg.) has to be added to the weight of the engine-type parts, or such a machine would weigh approximately 16,800 lb. (7,620 kg.). In this case we find that the "effective" material is 23.8 per cent and the "non-effective" material is 76.2 per cent of the total net weight.

KVA. RATINGS

R.P.M.	Poles	50	100	150	200	300	400	500	600	700	800	900	1000
600	12	25 to 30			35 to 40			45 to 50			50 to 55		
514	14	30 to 40			40 to 50		50 to 60		60 to 70				
450	16	30 to 40		40 to 50		50 to 60		60 to 70		70 to 80			
400	18	40 to 50		50 to 60		60 to 70		70 to 80		80 to 90			
360	20	50 to 60		60 to 70		70 to 80		80 to 90					
300	24	70 to 80		80 to 90		90 to 100		100 to 110					
277	26	100 to 110						110 to 120		120 to 130			
100	72	130 to 140						140 to 150					

FIG. 4—DATA FOR DETERMINATION OF APPROXIMATE BACK BORES

Example 2.—It is desired to find the weight of a bracket-type machine rated at 100 kva., 600 r.p.m. The kva. per pole is 100/12, or 8.35. Such a machine will be built on a back bore of approximately 40 in. (100 cm.). From the 40-in. back-bore curve (Fig. 2) we find that 8.35 kva. per pole corresponds to 29½ lb. (13.38 kg.) per kva., or the engine-type part of this machine will weigh approximately 2,900 lb. (1,315 kg.). From Fig. 3 we find that the bracket-type parts for the 40-in. back bore weigh approximately 2,100 lb. (952 kg.). Thus, this machine, built as a bracket type, will weigh approximately 5,000 lb. (2,267 kg.).

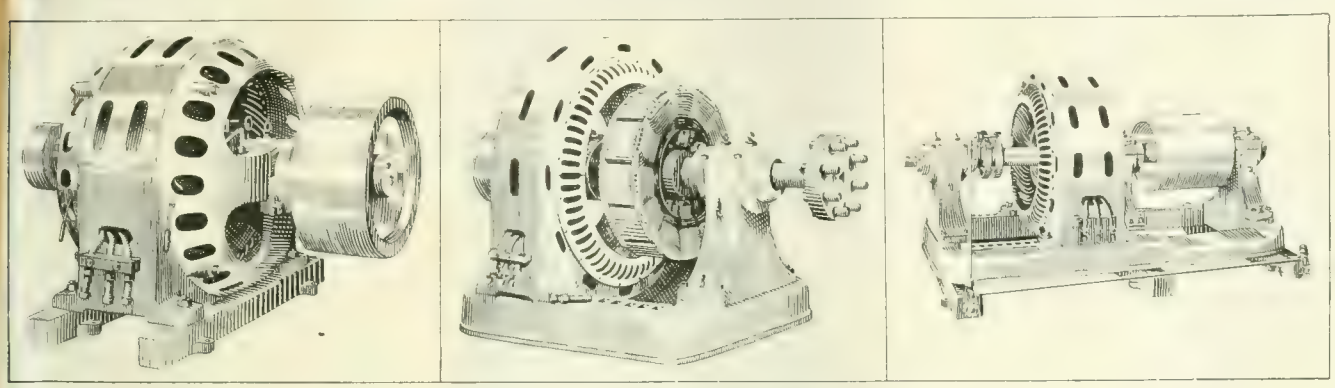


FIG. 5—ASSEMBLY OF SYNCHRONOUS MACHINES INDICATING PARTS REQUIRED FOR TOTAL WEIGHTS
Left—Bracket type. Center—Two-bearing, pedestal, coupled type. Right—Three-bearing, pedestal, belted type.

From Fig. 16 (see ELECTRICAL WORLD, May 7) we find net weight of "effective" iron and copper to be 1,360 lb. (616 kg.). For this bracket-type machine the "effective" material is 27.2 per cent and the "non-effective" material 72.8 per cent of the total net weight.

Example 3.—It is desired to find the weight of a three-bearing, belted, pedestal-type alternator having a capacity of 500 kva., 514 r.p.m. Such a machine would be built on a back bore of approximately 60 in. (150 cm.). The kva. per pole is 500 ÷ 14, or 35.7. From Fig. 2 we find that 35.7 kva. per pole corresponds to approximately 19.2 lb. (8.65 kg.) per kva. on the 60-in. back-bore curve. The engine-type part of this machine weighs, therefore, 19.2 × 500, or 9,600 lb. (4,354 kg.). From Fig. 3 we find that the three-bearing, belted, pedestal-type parts for the 60-in. back bore weigh approximately 10,500 lb. (4,762 kg.). Thus such a machine will weigh 9,600 + 10,500, or 20,100 lb. (9,117 kg.).

For this machine the "effective" material is found to be 23.5 per cent and the "non-effective" material 76.5 per cent of the total net weight.

The Rebirth of the Society for Electrical Development

William L. Goodwin in Charge with Enthusiastic Support of the Directorate—To Carry Out the Broader Aims of the Society—Some of His Plans for a Balanced Economic Service to the Industry

By EARL E. WHITEHORNE

THE reorganization of the Society for Electrical Development under the leadership of William L. Goodwin is good news for every man in the electrical industry. For it is more than a reorganization. That alone might mean nothing more perhaps than an assurance of more activity or more efficiency. What we have here is the rebirth of an idea that we have all believed in and come to feel could not be realized as we had hoped. We have the reopening of an opportunity that may lead to advantages and achievements that have never been enjoyed before in the electrical industry. Moreover, we have here an expression by a group of the selected leaders of all branches of the industry of a confidence that the time is come to go ahead. Its significance should not be lost on any one. It is something to think over and be glad about. It is something that concerns the individual—each central-station-company man and contractor, each manufacturer, jobber and dealer, each engineer and each industrial-plant electrician. I believe that I am not overstating it, for I have talked to Goodwin. I have talked to directors of the society. I am tremendously impressed with the bigness of the purpose and the broadness of the vision that have brought about this awakening of the society.



WILLIAM L. GOODWIN
Reorganizing Society for Electrical Development

A good many years ago—long before the society actually went to work in 1914—the idea began forming in the minds of some of our most forward-thinking men. There has always been a high degree of mutuality of common interest throughout the electrical industry, but a low degree of actual interorganization. Theoretically we have all been electrical men, working together. In reality we have been jobbers or manufacturers or central-station company men or engineers, each a class so intent and busy in its own affairs that there has been no one at leisure and available to do the many kinds of work for all of us that could have been done and can be done to the great benefit of the electrical industry at large.

It was to assume and exercise this function that the society was conceived and instituted. It was to provide a medium through which all classes of electrical men might express and co-ordinate their principles and purposes. It established a common meeting place and set up a machinery for use by all the industry in the working out of conflicting issues between central-station companies, contractors, dealers, jobbers and manufacturers and for the upbuilding of more harmonious and co-operative inter-relations. It aimed to study the needs of all sections and all groups. Its duty was to serve them all. But it set up shop at the beginning of a difficult time. Difficulties of organization and obstacles which developed through the years of war disturbance have interfered in many ways. Its work has been restricted in the past largely to measures of publicity and sales promotion, rendered either broadly in behalf of the industry at large or as a personal service to the individual member. The full original intent of the founders has never been really carried out. The society has never taken its place in the industry. I believe that it is going to do so now.

The men who compose the directorate of the Society for Electrical Development need no introduction to any branch of the electrical industry and no indorsement or defense.

The central stations are represented by John F. Gilchrist, vice-president Commonwealth Edison Company, Chicago; W. W. Freeman, president Union Gas & Electric Company, Cincinnati; Charles L. Edgar, president Edison Electric Illuminating Company of Boston; J. E. Montague, vice-president and general manager of the Niagara Electric Service Corporation, Niagara Falls, N. Y.

The contractors are represented by Frank B. Adam, president Frank Adam Electric Company, St. Louis; George Weiderman, George Weiderman Electric Company, Brooklyn, N. Y.; J. R. Strong, president Tucker Electric Construction Company, New York City; A. Penn Denton, president Denton Engineering & Construction Company, Kansas City, Mo.

The manufacturers are represented by A. W. Burchard, vice-president General Electric Company, New York City; L. A. Osborne, vice-president Westinghouse Electric & Manufacturing Company, New York City; W. D. Steele, vice-president Benjamin Electric Manufacturing

Company, Chicago; L. P. Sawyer, chairman sales group, National Lamp Works, Cleveland, Ohio.

The jobbers are represented by F. D. Van Winkle. Post-Clover Company, Cincinnati; E. W. Rockafellow, general superintendent and sales manager Western Electric Company, New York City; E. C. Graham, president National Electrical Supply Company, Washington; Fred Bissell, president F. Bissell Company, Toledo.

There are also four directors chosen from the industry at large. They are Henry L. Doherty, president Henry L. Doherty Company, New York City; J. Robert Crouse, National Lamp Division, Cleveland; Charles W. Price, president *Electrical Review*, New York City; James H. McGraw, president McGraw-Hill Company, Inc., New York City.

These are the men who are behind the society's new policy of expansion and broader service. These are the men who believe that the time is right to go ahead, who have voiced their confidence that the full purpose of the society can now be achieved and have placed Mr. Goodwin in charge with a free hand to go ahead and do the job. If these men, representing what they do in this great industry of ours, believe that the society can now take up its work and make its promise true, surely the rest of us can trust their judgment and give full, confident support.

Mr. Goodwin himself needs no introduction anywhere in America today to men of the electrical industry. His head first appeared above the skyline of the electrical world when, after making a noteworthy success of a large electrical business enterprise in San Francisco, he accomplished the harmonious organization of the electrical interests of the Coast in a working unity that has been a stimulus to the whole industry. Then he came East, and for the last few years he has been carrying to all parts of the nation with a degree of success that has been enormously helpful and encouraging the gospel of better business methods, broader commercial vision and more effective interorganization for electric men both nationally and locally. He is recognized as the great inspirational leader in the movement for more efficient co-ordination in the industry.

Enlisting the Whole Strength of the Industry

Mr. Goodwin has undertaken the reorganization and guidance of the society with the most enthusiastic support of the men who compose its directorate. But he has made it clear at the outset that he is not going to be content to work alone. Goodwin's conception of the function of the society is exceedingly broad and comprehensive. He believes that the great service to be rendered is an economic one. Sales promotion is but one feature. To enlist the full strength of the industry behind him, therefore, Goodwin has pledged each of his directors individually to a very active personal co-operation, and he means to set the leaders actively to work to help in the many valuable ways in which they can bring aid. He is also planning the appointment of a variety of advisory committees representing the different groups of interests within the industry, so that the different elements in the society's membership may more freely express their needs and opinions and give direction to its activities and service. In this way the society will think and work in more intimate contact, in closer harmony and in truer co-operation with the diverse active influences within the industry than has ever been possible before.

I believe from what I know of the men who have impelled this rebirth of the society and the man to whom has been given its leadership that the S. E. D. is now going ahead in a big way to crystallize and carry out the prime purpose for which such a society, representing all branches of the industry, is needed. Its great field for usefulness, Goodwin says, lies in the direction of economic research and service, and he is right. Rather than deciding itself what its precise policies shall be, it should go into the field and find out what the engineer wants done and what the jobber thinks is needed most.

Each branch of the industry has its needs right now, and its desires, and for most of them there is no machinery available with scope enough to do the job in a broad way that will affect not the central-station company alone, not the manufacturer alone, but the entire field. The industry wants more special knowledge on a hundred points, but more than that it wants this knowledge so disseminated that it will influence not one but all the classes of electrical men according to the economic relationship. Statistics locked up in a strong steel cabinet are no better than so many drawers of empty files, and it is of no use to know what the contractor may want if there is no way to bring into his trade environment the impulse to achieve it. The opportunity for service is enormous, yet I believe that the broad conception which is now to guide the society is big enough to carry the work through.

No Vagueness in the Plans

It is not all vague, however. It is not vague at all. The new, wider vision of the society's function has been well thought out, and there are many definite things which Mr. Goodwin is going to set about and do at once as the new activities can be organized. And they are things like these—I mention only a few of the outstanding plans that Goodwin has outlined to me as things to be done soon:

A school is to be established for bond salesmen, so that they can obtain the background of the electrical industry and be taught to sell electrical securities more eagerly and successfully.

A thrift league is to be started within the electrical industry, not only to encourage saving but to direct the investment of these savings in electrical securities. A responsible finance committee will be organized to give advice.

A legal department will be established to watch the activities of government and state legislation as it affects electrical men. This department will inform the industry as to the drift of legislation in all sections and advise it how to express approval or disapproval or how to adapt itself to the new laws.

An expert statistician will be set to work to develop data and statistics from government, financial, press and other sources and prepare them for actual practical use by the different branches of the industry, interpreted and analyzed for the man who needs them in his business. These statistics will not be merely filed, but sent out for the good that they will do.

The problems of installment selling will be studied and a handbook prepared for the assistance of dealers and central-station companies, backed by a service that will assist all members in the financing of installment contracts by placing them in touch with the market for such paper.

A speakers' bureau will be established on a basis that will enlist a corps of speakers who will be available

whenever an opportunity arises to present the message of the electrical industry to an audience of whatever sort. Thus our story will be more effectively told to chambers of commerce and all the other bodies throughout the country whose interest and appreciation can be made so valuable. Skeleton speeches will be prepared for the personal use of members for any kind of occasion for which an address may be needed.

Regional committees for the guidance of public opinion will be formed among the business men of cities and towns—men who are not in the electrical industry themselves but who appreciate the civic value of electricity and its influence in every industry. These men can and will bring tremendous support if they are so organized.

A correspondence school will be established to provide courses for a broad variety of subjects that will train men for different jobs in all branches of the industry.

A contact will be built up with universities and colleges that will influence the electrical education offered to the young men of this country. The industry needs more than specially educated engineers. It needs trained business men as well, and the society can help toward this.

Careful trade surveys will be made as they are needed for the service of any group in the electrical business, and trade data will be maintained available to members in times of emergency.

A representative of the society will be stationed in Washington to keep in touch with the work of the different government departments, so that the electrical industry may know in detail what is being developed there of value to it and how to utilize the information.

Good-will publicity campaigns will be conducted as needed by the different branches of the industry, and the present service of co-operation with popular magazines and trade journals will be continued and expanded.

The publication of a series of handbooks on various subjects that are not at present adequately supported by printed data is planned, as well as a sensible program of other published selling helps, produced as required.

These are but a few of the ideas around which the reorganization of the Society for Electrical Development is revolving, but they indicate the breadth of the view that is being taken and promise an economic service to the entire industry that will be of actual practical assistance in the day's work to electrical men of every class. At the same time it has been decided to reduce the dues of the society in all classes in accordance with a new scale that in some cases will mean a cut of as much as 50 per cent and to increase its membership so that it shall be truly national in distribution and comprehensive in its character. The basis of reckoning the annual amount of dues will be accurately adjusted, and the finances of the society will unquestionably be greatly strengthened.

In short, we are to have more than a reorganization. It is in truth a rebirth of the big idea, the broad basic conception of the Society for Electrical Development, which all men hailed as good when it was launched seven years ago. In the best judgment of our industry the time is now right to go on and make the dream come true. Mr. Goodwin has been given the job to do, and under his leadership we, the members, have our opportunity at hand. It is our society, and it is up to us to give Goodwin the power in support that will achieve these things he is undertaking.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Development of Bavarian Water Powers

To the Editor of the ELECTRICAL WORLD:

SIR: The Bavarian authorities are making great efforts to develop the water power of the country on a large scale. The big power stations at Walchensee and the Isar have already issued bonds to the amount of 500,000,000 marks in order to be able to meet all demands, and a new company styled the Bavarian Works, capitalized at 100,000,000 marks, is now issuing bonds to the amount of 300,000,000 marks. The chief object is to link up the large hydraulic power stations of the country by high-tension lines with the principal consuming districts. For this purpose a 100,000-volt trunk line will be constructed over a length of about 1,000 km. extending over a large part of Bavaria and the Palatinate.

The cost of construction of the Bavarian Works, including the 100,000-volt transformers, the switch station at Walchensee and the erection of twelve central transformer stations, is estimated at about 450,000,000 marks. It is expected that it will be possible to deliver at least 200,000,000 kw.-hr. per year, which by and by will be raised to 1,000,000,000 kw.-hr. The entire plant is to be ready for work in the autumn of 1923.

HENRY L. GEISSEL.

Beaurivage Thoune, Switzerland.

Load Characteristics of Wired Radio

To the Editor of the ELECTRICAL WORLD:

SIR: In the March, 1921, issue of the *Journal of the Franklin Institute* there appeared a paper under the title of "Guided Wave Telephony," by Prof. Charles A. Culver. In that paper Professor Culver outlines in a very interesting manner the recent progress in this new art and discloses the results of some of his own valuable researches.

In the portion of the paper, however, which deals with the high-frequency characteristics of the line certain statements are made which are not entirely correct and to which exception is hereby taken. Reference is made particularly to the second paragraph, page 317, where it is stated that "One of the first factors which commands one's attention is the fact that in high-frequency work a physical line acts as a lumped capacity." This may or may not be the case. As may be deduced from the theory of transmission lines, and as has been shown experimentally by the writer (*Journal of the Franklin Institute*, Vol. 191, p. 23, January, 1921) a pair of telephone lines of normal spacing or one line with ground return, as the case may be, as an electrical load, will function as an impedance, whose reactive component will have the properties of an inductance or a capacity depending upon the frequency of the impressed emf. If the length of line is such that reflections from the distant end are reduced in amplitude to such an extent that they are inappreciable in their effect when they reach the trans-

mitter, it is quite true that the condition of the terminal apparatus which yields resonance for a particular frequency is not affected by what takes place at the distant terminus. This *effective* length of line is determined by the physical line conditions and by the frequency. For very high frequencies, of the order of 500,000 cycles per second, for which there are a great number of wave developments along the lines, it may be relatively short—*i.e.*, a change in line conditions within a few wave lengths of the terminal apparatus is not felt therein. With decreasing frequency the effective line length increases until at the very low frequencies it will be of the same order as the actual physical length of line.

Under resonant operating conditions, by "tuning of the line," both at the transmitting and receiving terminal, is meant the neutralization of the inductive or capacitative reactance of the line load impedance, together with whatever reactance of either type there is included in the local circuit in series with the line, so that this entire circuit behaves as a resistance at the resonant frequency.

It would appear therefore that Professor Culver's later criticism of General Squier's original findings as to the variation in the load characteristics of the line is unfounded, and that such a variation may exist, indeed should exist.

R. D. DUNCAN,
Radio Engineer.

Washington, D. C.

Preservation of Laboratory Mirrors

To the Editor of the ELECTRICAL WORLD:

SIR: About eight years ago the writer contributed to the ELECTRICAL WORLD a little account of the practical use of lacquer in preserving laboratory mirrors silvered on the face. It was found that the highest grade of collodion lacquer used for preserving silvered ware, when diluted with five to seven volumes of the "thinner" provided for it, gave a coating which preserved the integrity of the silver surface against tarnish for a considerable time. The paper referred to may be consulted for the details of the process, to which it may be added that it has been found at the Harvard Observatory, where the process has been in use ever since the writer tried the first coating in 1913, that pure amyl-acetate works rather better than the "thinner" just now obtainable, the dilution being carried to about the same point. It was found in the early experiments that the coating held up for some months for a fairly good reflecting power even in the case of a mirror stored in a damp and dusty cellar.

A few days ago the writer found and took out of his desk a mirror which had been thus silvered very nearly eight years ago, some time in the fall of 1913, and since it looked pretty well it was thought worth while actually to measure the reflection coefficient. This turned out to be 0.70, a remarkable evidence of the practical endurance of the lacquering when kept dry. This particular mirror never had an especially high polish, probably not more than 0.85 when fresh, less probably 4 per cent for the lacquer. The lacquered surface was so tender at this time that brushing off the dust with the softest lens paper produced scratches on the lacquer. Even a camel's-hair brush had to be used with great caution, the surface being almost powdery when touched. It is evident, however, that the lacquering is remarkably durable if the mirror is kept dry and let alone, to prevent abrasion of the surface.

LOUIS BELL,
Consulting Engineer.

Boston, Mass.

Making the Partnership Between Utilities and Consumers a Harmonious One

To the Editor of the ELECTRICAL WORLD:

SIR: It is coming to be generally recognized that the consumer of electrical energy is in reality a partner of the electric light and power company. Where proper relations are maintained between the utilities and the consumers the industrial development of the community usually follows, and, on the other hand, it is hardly possible for a community—especially an industrial community—to grow and prosper unless good electric service is one of its assets. Almost every community hopes for ultimate industrial development, and the electric service company affords the means to bring this about. If the utility and the public are in step and proper mutual support is given industrial development is bound to result.

It is unfortunate, then, that this virtual partnership is so often an inharmonious one. At the present time the attitude of the public toward the utilities is in many cases anything but friendly, and the electric light and power company shares in the hostility. The reason is very largely one of dollars and cents. Hard times have come, the people are forced to practice economy again as they did in pre-war times, wages are being reduced, commodity prices are falling, and consumers ask impatiently why power and light bills are not reduced in proportion. The answer, of course, is simple, but multitudes do not know it. They do not understand that while wholesalers and retailers of commodities were able to increase their prices and maintain their profits during the period of inflation and have been as a consequence in a position to reprice their stocks, take their loss and resume their trade on the present market, the utilities, which have been struggling in the last few years against the abnormal price of fuel, labor and materials—most of them failing to make any profit in the period when manufacturers and retailers reaped such harvests—did not get relief until they had carried the burden so long that the increased rates were too late to produce immediate results.

The consumer expects his bills for electrical energy to be reduced at once to the pre-war rates, overlooking the fact that the companies have permanently increased their investment owing to the extended period of high-priced materials and in many cases are still carrying the burden of excessive fuel costs where long-term contracts have been entered into. This is the fact that should be brought home to the consumer. A campaign of publicity which will accomplish this end should be of wonderful help to public service companies. When the facts are explained every fair-minded customer will give the service companies credit for the fight they made to maintain, by efficient operation, a semblance of balance between decreased earnings and the rising production costs in their efforts to avoid the necessity of rate increases. The net results of the efficiency methods practiced in the last two or three years will ultimately benefit every consumer, for when fuel, labor and materials have once more reached normal levels the efficient methods introduced will remain in effect and will play their part in future rate reductions. This result cannot be attained at once, but if the customers can be convinced of the soundness of such reasoning, good public relations—that is, a harmonious partnership—will ensue.

E. B. NEISWANGER,
President.

American Fuel Corporation,
Dallas, Tex.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Fire Prevention in Electrical Stations

FIRES due to ordinary causes are entirely unnecessary in buildings devoted to the generation and distribution of electricity. Fires due to the breakdown of the insulation of electrical apparatus and conductors may be kept at a minimum by frequent and thorough inspection and by prompt attention to small repairs and incipient weaknesses.

In the generating plant or substation no large stock of inflammable material should be kept on hand, and there is no excuse for the accumulation of dirt and rubbish in corners and obscure places, nor for gasoline, oil, paint or other specially inflammable substances in lockers and tool closets. Dirty, oil-soaked wiping rags should not be kept, even in an approved waste can. If there are no facilities for washing them, they should be burned as soon as they are unfit for further use. Oil siphoning from transformer leads or dropping from switch cans should be caught in metal cans, and these should be emptied daily. Packing material, paper and the like should be promptly removed from the station and kept in a safe, isolated place or destroyed. Waste cans and containers of other inflammable material should be kept away from electrical apparatus, especially from rotary converters, which are likely to flash over and throw sparks.

All gasoline, with the exception of one gallon in a standard self-closing safety can, should be stored outside. No automobiles or motorcycles should be kept in any of the station buildings under any circumstances.

Slack housekeeping has been the cause of many fires, to say nothing of its detrimental effect upon the apparatus and the service in general and the morale of the operators. A neat, clean station is virtually immune from ordinary fires, and its electrical fires will be few in number and will rarely damage anything outside the apparatus in which the breakdown occurs.

Fire doors must be kept in working order at all times. They are hung on rollers on a slanting track, with a weight and a cotton rope to hold them open, the weight being just enough to keep the door from closing. If there is a fire and the rope burns off, the properly adjusted door will close itself. The best modern practice is to attach the rope to the door with a fusible link of very soft solder. This will melt if the heat becomes great, even though there is no flame present to burn the rope, and the properly adjusted door will close. Wire rope or chain should never be used to hold the weight on a standard fire door. The door should be tested at least once a week. In case a building is left without an attendant, all fire doors should be closed.

Oil should be stored in an outside detached fireproof building. This building should be isolated from inflammable material. Windows, if there are any, should be of wire glass in metal frames. Electric lights should be wired in standard conduit, and no extension cord should be used. In some stations a concrete oil room is built in the station building. A heavy steel door on hinges and with a heavy latch is provided to close the room. This door should be self-closing, and the weight should be suspended with wire rope or chain and kept free of obstructions. Smoking should not be permitted under any circumstances in the oil room nor outside close to its entrance.

Storage batteries are a fire hazard in that they give off an inflammable, explosive gas when charging. Care must be exercised not to use a blowtorch, candle or other open flame in the vicinity of the battery, especially during the charging process. Smoking should not be permitted in the section where the battery is placed.

Consumers' Power Company, H. J. BURTON.
Jackson, Mich.

Periodic Inspection of Services Pays for Itself

TO DETECT the reason for losses either from theft of energy or otherwise at consumers' services, periodic inspection of every service from the pole to the service side of the watt-hour meter is made by some companies.

For these inspections the card shown here was devised by the writer. Every such inspection has disclosed enough theft of energy and defective meter conditions to warrant easily the expense of the inspection. Moreover, the conditions revealed have justified the constant attention of at least one man to follow up the many cases that require careful scrutiny.

SERVICE INSPECTION

Folio No. _____
Address _____ Co. No. _____
Name _____ Cir. No. _____

Light
Power
Classification _____ Heat HP. Conn. _____ No. of Motors _____
Mefer Mfg. _____ Type _____ Amps. _____ Volts _____

Dial Primary
Wire _____ Phase _____ Const. _____ Mfg. No. _____ Secondary
Location of Meter _____
Distance from entrance of Bldg. to meter _____ feet
Conduit _____ Open _____ Size of wire _____ B. & S.

No. of circuits in house ____ Is Transformer secondary grounded? _____
Service wires from pole No. ____ Length _____ Size _____
Conditions of wires from entrance to meter _____

Will customer's wiring pass underwriters' inspection? _____
If not, why? _____
Remarks: _____

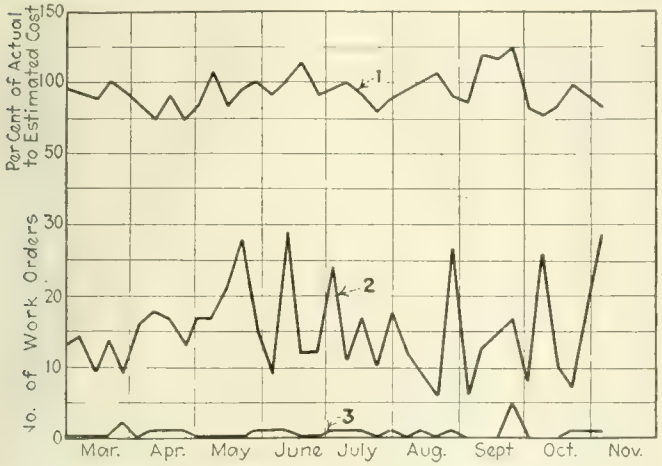
Date _____ Signed _____ Inspector

CONDITION OF SERVICE FROM POLE THROUGH METER RECORDED ON THIS CARD

Henry L. Doherty & Co., THEODORE H. RICE,
New York, N. Y. Operating Department.

Curves Which Help Management in Estimating Cost of Jobs

CURVES which show the variation between the estimated and actual cost of work have proved valuable to the distribution department of the Worcester (Mass.) Electric Light Company. Besides showing the variations above and below 100 per cent in the cost, the chart also shows the number of orders completed per week



MANAGEMENT OF DISTRIBUTION DEPARTMENT IS HELPED BY THESE CURVES, SHOWING VARIATION BETWEEN ESTIMATED AND ACTUAL COSTS

(1) Ratio of actual to estimated cost. (This does not include orders shown by (3), the cost of which fell outside of limits of 50 per cent to 200 per cent of the estimated cost.) (2) Number of work orders completed per week. (3) Number of work orders on which the cost fell outside of the limits of 50 per cent to 200 per cent of the estimated cost.

and the number of jobs for which the cost ran outside of the limits of 50 to 200 per cent of the estimates. The reasons for these variations are usually changes in job requirements. The curves are plotted from the weekly records. They are an excellent check on the accuracy of estimates and a help in making future estimates.

This company uses similar curves for many other purposes. Some of these have already been described in the ELECTRICAL WORLD during the last few weeks and others will be described in future issues.

GEORGE W. HARDY,
Superintendent.

Worcester Electric Light Company,
Worcester, Mass.

Pushing a Large Cable Through a Long Duct

WHILE pulling some cable 3 in. in diameter in the street ducts in Buffalo, N. Y., the cable grip broke several times before the job was completed. Instead of pulling the cable back to the feeding-in manhole, it was pushed the remaining distance through the duct. This was accomplished by rodding a parallel duct and running the pulling rope through this duct. Then a laced side grip was attached to the cable at the feeding-in manhole and the rope was pulled at the other end by means of a winch. This pushed the cable through the duct. In doing this the cable was braced carefully at the side grip to prevent buckling. The grip was attached 1½ ft. from the entrance of the duct, and this length was pulled. Then the grip was changed and a short length was pulled again, and so on. Several cables were pushed through the duct in this manner from 20 ft. to 175 ft. One section of 350,000-circ.mil, three-conductor, lead-jacketed cable about 3 in. in diameter and 440 ft. long, was pushed 175 ft.

To furnish the power for pulling the cable a winch using a Ford engine was employed. This winch was described in the ELECTRICAL WORLD for Jan. 31, 1920, on page 272. The Buffalo General Electric Company has pulled nearly 300,000 ft. of cable with this winch and finds its operation very satisfactory.

WILLIAM HEMPHILL,
Assistant Superintendent of Distribution.

Buffalo General Electric Company,
Buffalo, N. Y.

Compressed Air Proves Its Use in Fishing Through Long Conduit

IN AN installation of street lights in southern California where the runs between outlets was generally 300 ft. and often as much as 450 ft. it was impracticable to use the usual means of fishing the wire through the conduit. Compressed air, however, proved available, and a small air compressor driven by a gasoline engine was used to supply it. This engine was set on a hand truck and employed in connection with a storage tank similar to those commonly found in rural garages. A pneumatic fishing machine was used with a special cord consisting of extra-heavy fish line. In addition to the ease of operation, this method had the advantage that all dirt and foreign matter were blown out of the conduit.

N. B. HINSON,
Engineer of Distribution.

Southern California Edison Company,
Los Angeles, Cal.

System Neutral as Return Decreases Series Lighting Cost

A GROUNDED neutral installed for common use of the 4,000-volt primary and 115/230-volt secondary systems of the Minneapolis General Electric Company is now being used as a return for the direct-current series magnetite street-lighting system in Minneapolis. On the circuits that have been changed over the number of trouble cells has been reduced by 75 per cent, and when all the circuits in the city have been cut over to the grounded neutral system about 250 miles of No. 6 weatherproof wire formerly used as return conductors for the lighting system will be made available for additional lighting or distribution circuits or for other purposes.

Where additional lighting circuits are required the change makes two circuits available where there was one before. For example, one No. 6 duplex 7,500-volt lead-covered underground cable supplied a district 3 miles from the station. When an additional circuit was required the cost of a new cable was saved by using the grounded-neutral system for the return and employing both wires of the duplex cable as outgoing feeders.

With the individual metallic return a ground near the station often caused tree grounds at the distant end of the line, but with the system as now connected the voltage to ground is a minimum at the end of a line where trees usually give the most trouble.

S. B. HOOD,
Superintendent of Distribution.

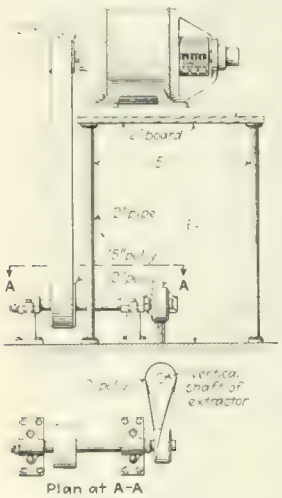
Minneapolis General Electric Company,
Minneapolis, Minn.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Dampness Causes Burned-Out Motor Coils and Belt Slippage

DAMPNESS caused much trouble in the form of belt slippage and burning out of motor coils on an extractor drive in an Eastern textile plant. By raising the motors from the floor and using a larger driving pulley at the floor the trouble was done away with. The motors were rated at 10 hp., 1,200 r.p.m. They were mounted on a concrete foundation on the floor at the base of the extractor, driving with a quarter-turn belt direct to the extractor vertical shaft, with a 7-in. pulley on the motor and a 12-in. pulley on the extractor. The trouble was overcome by erecting a 2-in. pipe framework as shown in the drawing and covering it with 2-in. plank. The motor was placed on the platform and a countershaft erected on hangers on the floor beneath. A 900-r.p.m. motor was substituted for the 1,200-r.p.m. motor, with a 12-in. pulley on the motor driving to a 15-in. pulley on the countershaft and a 12-in. pulley on the countershaft with a quarter-turn belt to the 12-in. pulley on the extractor. No trouble from slippage or burned coils was experienced after the change.



STAND FOR HOLDING MOTOR OFF DAMP FLOOR

Amsterdam, N. Y. ARTHUR R. McDONALD.

Careful Inspection of Compensator Insures Good Operation

A STARTING compensator needs to have careful attention paid to certain parts if it is to be kept operating properly. The inspector should see that the contacts and fingers are in good condition. A starter may make good contact on the starting side and yet fail to connect all the fingers on the running side, owing to one or more of them being burned short. These fingers can sometimes be bent so as to make contact for a short while, but for sure operation new ones should be put in and adjusted so that they will not get caught accidentally.

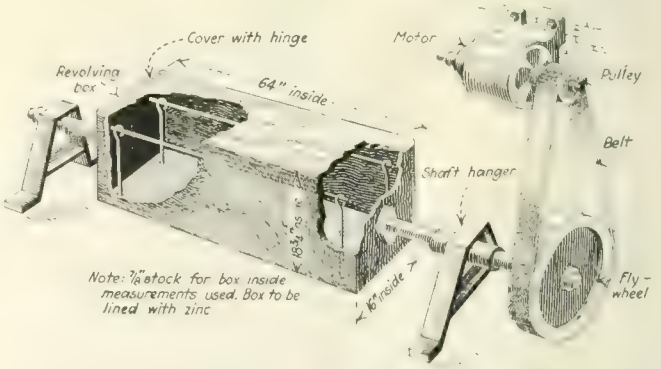
The low-voltage release and the overload relays should be tested frequently, care being taken not to shut down the motor. The adjusting nuts under the core of the relay magnet may have become loosened and have changed their position, thereby allowing the core to lift too high and get wedged tightly. The tripping lever may engage too far at running position and fail to trip when the power goes off. The remedy is to set the core nuts for the shortest trip. If the insulating oil in the starter case is low, have it brought up to the proper level so that all arcing will be fully submerged. Where a starter is exposed to the weather water is liable to get into it and run down to the bottom of the oil case, thus allowing the fingers to break contact in water instead of in oil. On 440-volt lines this water is liable to cause a bad ground and can be detected by a loud boiling sound in the oil case when the current is on. If a motor fails to start with a fair load, the taps should be changed to the next highest connections.

The overload relays should not be set for more than 50 per cent above the normal motor rating, as an excess of starting current for a few seconds can be prevented from opening the circuit by timing the plunger in the relay oil cup. The oil cups under the overload relays often loosen and even drop off. The small set screw which regulates the current limit may become loosened and change the adjustment, which will alter the degree of overload before the circuit opens automatically. H. S. RICH.

East Berlin, Conn.

Revolving Box for Prolonging Life of Edison Cells

OFTEN an old Edison cell which gives a low or a reversed voltage reading may be brought back to normal by shaking it to loosen all detached material from between the plates. For the purpose of shaking such cells a revolving box driven by a motor has been constructed in the battery-repair department of the American Railway Express Company, New York. This box is made of ⅞-in. wood stock, large enough to accommodate the largest tray used with Edison batteries. On the outside of the ends of the box are flanges holding



BOX FOR TURNING EDISON CELLS TO PROLONG THEIR LIFE

two shafts which are supported in hangers bolted to the floor. On one of the shafts is a pulley through which the box is driven by a belt from a motor.

When treating a cell half the solution is poured out, all the cells are placed in a tray which is set inside the

box, and short wooden pieces are laid across the top of the tray. On these are laid two pipes extending the length of the box on each side of the tray. The pipes are inserted in hooks made of §-in. iron and extending through four holes in the bottom of the box. The lower ends of these hooks are threaded to receive large wing-nuts which are screwed tight underneath the box, thus securing the tray firmly in place. The box is then revolved for about ten minutes at a speed of about fifty revolutions per minute.

After this the tray is removed from the box, the electrolyte is poured out and Edison renewal solution is immediately put into the cells. Such treatment will very often wash out and loosen the material which has short-circuited the plates and thus put the old battery back into good condition.

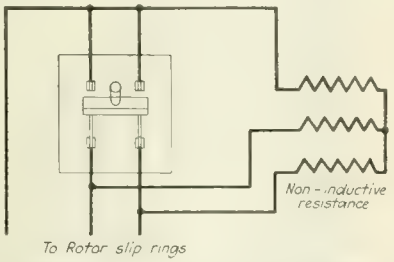
FRED A. REIBERT,
Foreman Battery Repair Department.
American Railway Express Company.
New York, N. Y.

Emergency Starting Switch for Slip-Ring Motor

IN AN emergency, when the usual starting device is not available for a polyphase slip-ring motor, a two-pole switch with an improvised resistor will be entirely satisfactory as a starting device. This would not be recommended for large-size motors, but in sizes up to about 50 hp. would prove useful. The switch and resistor are connected as shown in the figure, the resistor being connected in "star." In an instance in mind the motor was rated at 15 hp., 60 cycles, three-phase, 690 r.p.m. and 440 volts. The nameplate showed that the full-load secondary current was 49 amp. It was also found that the open-circuit voltage between slip rings (rotor stationary, full voltage applied to stator) was 147 volts. This voltage was the average taken on all three phases of the slip rings (from ring to ring) with the leads from the rings to the starter open. The rotor winding was three-phase and connected star.

To obtain an approximate value for the resistance to be inserted in the rotor circuit, the assumption was made that the motor would not be injured by a starting current of two and one-half times the normal full-load current in the rotor circuit.

Using the formula $R = E/(\sqrt{3}\ I)$ = resistance per phase, where E = rotor volts between slip rings and I = rotor amperes at assumed starting value, then $R = 147/(1.73 \times 2.5 \times 49) = 0.69$ ohm. But this includes the resistance of the rotor winding itself, which in this case was approximately 0.09 ohm. Therefore the required starting resistance per phase is 0.6 ohm. The operation of starting the motor when using the emergency starting switch as described is to have the two-pole switch open and then close the primary (or line) switch. This starts the motor with large starting torque. When the motor has reached nearly full speed, the two-pole switch is closed and the motor then operates under normal conditions.



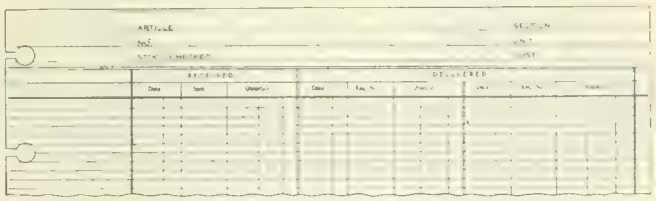
EMERGENCY STARTING ARRANGEMENT FOR A THREE-PHASE SLIP-RING MOTOR

St. Louis, Mo. F. J. B.

Number of Spare Parts to Keep in Stock in Industrial Plant

TO KNOW how large a stock of repair parts to keep on hand for electrical equipment is a problem confronting every industrial plant. Because a special study of this problem has been made through necessity by the New York & Honduras Rosario Mining Company, San Juancito, Honduras, Central America, the methods should be interesting to any plant. This company operates two hydro-electric plants of 700 kva. each—about 1,800 hp. in motors in a 400-ton silver cyaniding plant and two motors of 280 hp. each in a mine compressor plant. There is also an extensive system of electric haulage underground which is subject to rather severe service conditions. The usual time required for materials to reach the mine from the United States is six months from the date of ordering. Under these circumstances it has been found necessary to provide an unusually extensive line of parts and repair materials to take care of any possible emergency and insure continuity of operation and production.

The company maintains a general storeroom in which



SHEET FOR KEEPING TRACK OF SPARE PARTS ON HAND

materials for all departments are kept. All items are entered in ledgers provided for the purpose and are charged out to the departments as used. These ledgers are always available for inspection and afford a ready means of ascertaining at a glance the stock of any given item on hand. A sheet of the ledger is reproduced herewith. Once a year the storeroom provides each department with a list of stock on hand pertaining to that particular department. This serves the double purpose of a check-up and a reminder on items that might have slipped attention during the year. Once a month each department prepares an order based on material used during the month. This order must of necessity anticipate any extensions or improvements for six months and replenish any stock that may be depleted.

One of the principal factors determining the stock of parts to be carried for any particular machine is the importance of that machine in the scheme of production. In a cyanide mill, as in many other processes, the shutdown of a single motor will often cripple the entire plant. A thorough knowledge of the function of each drive is therefore of the first importance. One of the best means of forecasting the future requirements of a machine is an accurate record of its past performance. A record card—which was described by the writer in the ELECTRICAL WORLD of July 24, 1920—is kept for each machine and piece of apparatus. On the reverse side of this card suitable space is provided for recording the operating history. A study of this record, covering a period of years, is of material assistance in determining the repair materials it is advisable to keep on hand for the particular machine.

By far the most important electrical stock maintained is the rewinding coils of all kinds. Skilled labor being unavailable, no coils are wound in the repair shop, sets

and parts of sets, together with the necessary rewinding material, being ordered directly from the manufacturer. Experience has shown that in general the following apportionment of this material has been satisfactory: For the four generators, which represent two different manufacturers, a quarter of a set of each kind is kept. For the mill motors, which are mainly 2,200-volt slip-ring and squirrel-cage induction motors, one set of stator coils is provided for each motor, regardless of the number of motors of the same type and rating, and one set only of rotor coils for each type and rating, regardless of the number of motors of that type and rating. In most cases where there are two or more motors of the same type on important drives a spare motor is provided in addition. A complete set of coils is always on hand for the two large compressor motors. For the six 125-kva. transformers in the mill a spare transformer without the case is always in readiness and a complete set of coils is provided in addition. Twelve 15-kva. transformers are covered by a complete spare and two sets of coils. At the mine substation nine 100-kva. transformers are provided with but one set of coils as the compressor plant can very well operate on six transformers for an indefinite period of time.

In addition to the rewinding material which comes with the coils from the manufacturer, an extensive line of items such as insulating paper, sheet mica, varnished cambric, linen tape, cotton sleeving, insulating varnishes, bakelite, etc., is maintained. These materials are a necessity in making repairs of all kinds and obviate the use of materials that properly belong to the sets of coils.

For motors up to 5 hp. an extra set of bearings is provided in the stock for each motor. For motors above 5 hp. at least one set of each kind is provided, but where there are from two to five motors taking the same bearings a second set is required in stock. Provision is made for rebabbitting all sizes in use. It has been found advisable to have always on hand at least one set of slip rings of each kind in use.

With two power plants and two substations, involving four sets of lightning arresters, a complete renewal of cones and electrolyte for one set of arresters has been found satisfactory. Sufficient transformer oil is always on hand for at least three of the largest transformers.

The stock in items that require regular renewal is maintained entirely on the basis of the records of past requirements. Such items as nozzles, needles and buckets for the waterwheels, brushes, fuses, lamps, batteries, lubricating oils and greases, pinions and pulleys, etc., come under this head. While a considerable stock of such materials as wire of all kinds, insulators, trolley wire and insulators, rail bonds, sockets and wiring devices is maintained, no provision is made for very extensive improvements or extensions, and due notice is always given to the electrical department when anything of the kind is contemplated so that the required material can be ordered in time.

The mine locomotives are subject to more severe service than any of the other electrical machinery operated and consequently require more repairs and renewals. Of the six in use at the present time, two are 4-ton, two 5-ton and two 7-ton machines. Wherever possible the equipment of these locomotives has been standardized. Thus, for example, the controller and trolley-pole equipment on all six locomotives is similar. The stock on all parts subject to regular renewal such as trolley wheels, wheel shafts, bushings and harps, controller fingers and segments, brushes and holders, brake shoes and bearings, is maintained on the basis of past use. While a spare armature is provided for each locomotive, only one set of field coils, one set of wheels and axles, one complete set of resistance grids and one set of brake rods with beam jaw for each of the three sizes is found sufficient. For the four older locomotives an extra commutator and two extra sets of armature coils have proved useful. The newer locomotives, being equipped with interpole motors having ball bearings, are much less subject to breakdown.

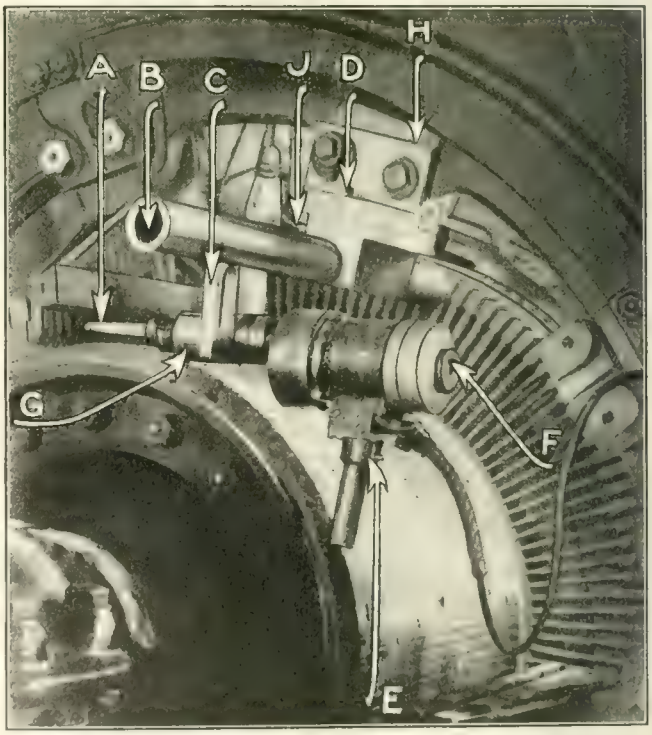
While there are, of course, a great many other items that must be kept in stock, most of those of the first importance have been cited. A thorough study of a given installation, aided wherever possible by records of past performances, will generally enable one to determine the amount of repair materials it is advisable to keep on hand.

Frederick Krug.
New York & Honduras Rosario Mining Company,
San Juancito, Honduras, Central America.

Slotting Machine for Undercutting Mica on Commutators

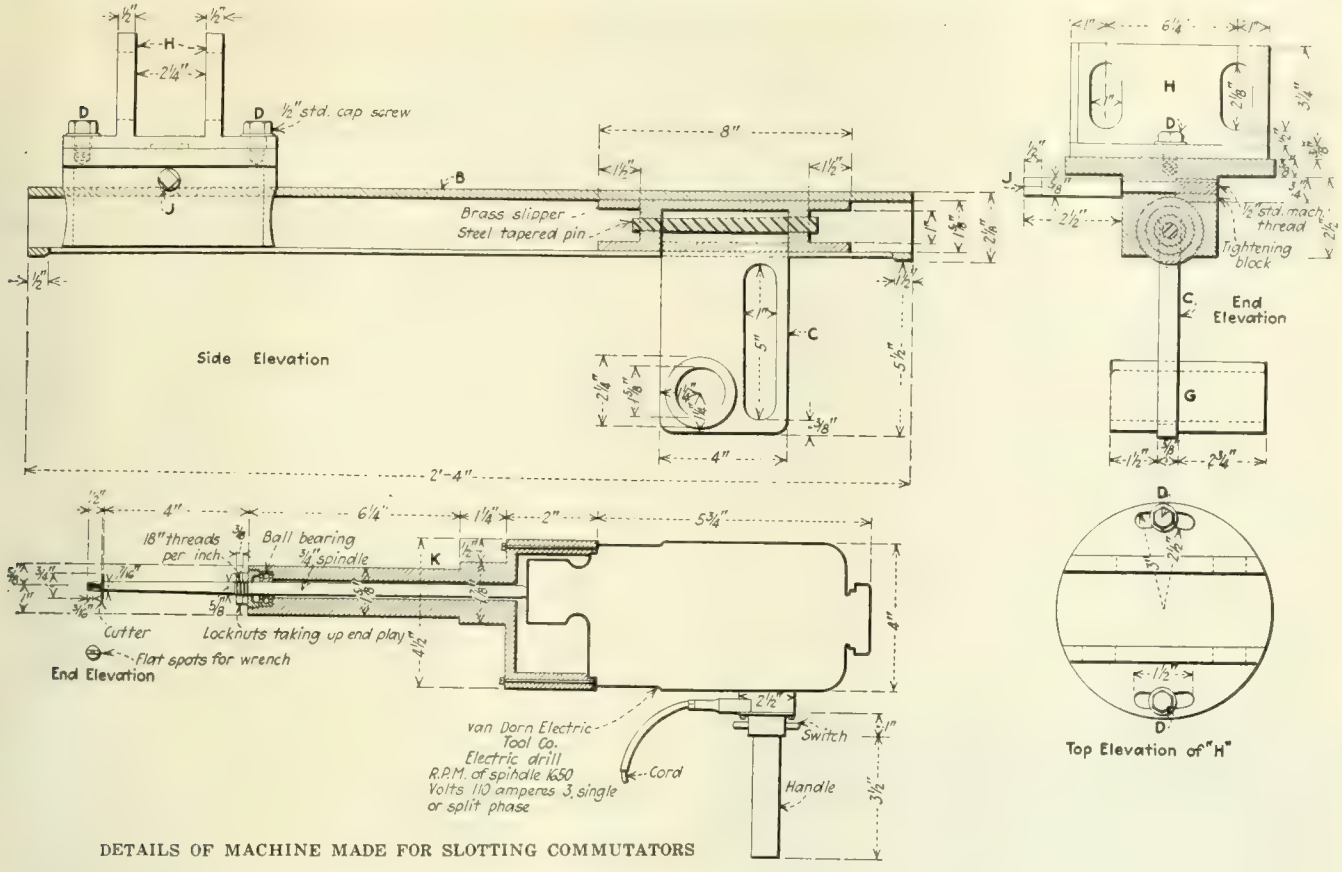
For undercutting mica on commutators the mechanical department of a large electrolytic plant in Canada has developed and built an efficient machine. This undercutter is made of an electric drill mounted so as to be movable along the length of the slot and adjustable to be parallel with the slot.

For mounting this machine it is necessary to remove one of the brush arms, in place of which are clamped the jaws *H*. On these clamp pieces is mounted a base plate which may be revolved to bring the cutter in line



TOOL MOUNTED ON BRUSH RINGS FOR SLOTTING COMMUTATOR

with the commutator slot by loosening the cap screw *D* and swinging the hollow steel tube *B* to either the right or the left. This tube is fitted in the base and can be held in any position, depending upon the length of the commutator. This is accomplished with the tightening screw *J*, which draws a tightening block up against the



DETAILS OF MACHINE MADE FOR SLOTTING COMMUTATORS

top of the outside of the steel tube, as shown in the end-view drawing. A cylindrical brass slipper is fitted in this cylinder so that it may slide, and to this is fastened by a tapered steel pin the plate *C*, which passes through a ⅝-in. slot in the tube, permitting this plate *C* to be slid up and down the length of the tube. A sleeve *G* is fitted into this plate for holding the shaft *R*. A long spindle holding the cutting tool is substituted for the chuck of the drill. In order that the cutting tool may be lifted out of the slot and also that the depth of the cut may be varied the shaft is slightly off center with the spindle which drives the cutting tool. Thus when the handle of the drill is rotated in an upward direction the cutting tool is brought down toward the commutator.

For the cutting tool a miller 0.75 in. in diameter and 0.030 in. thick with thirty-two teeth has given the best results. The cutter is driven at approximately 1,650 r.p.m. and should be about 0.0005 in. wider than the mica to remove it completely. The cutting edge should revolve in a direction toward the operator while cutting the mica. In operation the tool is drawn across the face of the commutator by means of the handle in the plate *C*.

It is advisable to have a jet of compressed air so adjusted that the particles of mica and copper will be blown away from the armature to prevent this material falling in behind the commutator and at the same time make it easy for the operator to see the slot when the cutter is throwing particles of copper and mica toward him on the face of the commutator. When a slot has been undercut the cutter can be moved to the next slot, moving the brush yoke by the lead screw or by moving the armature.

When slotting a commutator care should be taken to see that no strips or particles of mica are left flush with the commutator surface. After undercutting it is advisable to run over each slot with a V-shaped commutator file and slightly bevel the edges of the bars to make sure that the slots are free from mica and to remove bars of copper left by the slotting tool.

After the mica is undercut the commutator should be polished with a sandstone of fine grade or sandpaper attached to a block rounded to fit the commutator. The commutator stone is to be preferred, as it leaves the commutator free from scratches. This is important as the brushes to be used on an undercut commutator have no abrasive action and therefore cannot polish out scratches. Lubricants should not be used on undercut commutators, because they will hold carbon dust and other dirt in the slots and may cause short-circuits and resulting burned-out coils.

This undercutter is used on 500-kw., 125-volt direct-current machines. The advantage of undercutting commutators is that brushes which give very little friction

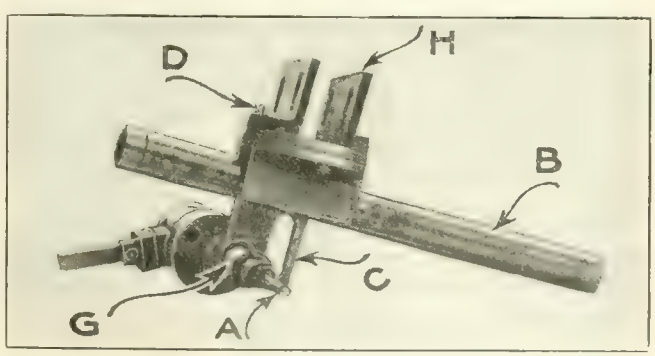


PLATE *C* MAY BE SLID ALONG TUBE *B*

and have no abrasive action on the commutator can be used.

The friction loss with an abrasive brush operated at a pressure of 2 lb. per square inch on an average machine will be about 2.5 per cent of the machine's rating.

Trail, B. C., Canada. R. H. N. LOCKYER.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

An Unexpected Letter from an Employee Seeking Stock Ownership

AN EXPERIENCE of the investment manager of one of the Standard Gas & Electric Company subsidiaries shows the wide appeal to all classes of persons made by the customer-ownership plans now being adopted by many public utilities in raising money for financing improvements. Arriving at his desk one morning, he found the following scrawled note:

> "DEAR SIR: Would you please send me some papers explaining the particulars about the investment? I work here at night—janitress. I feel like I would like to take a couple hundred dollars' worth of stock. You can leave them on your desk for Sunday night as we are not going to work tonight. Oblige. ——————"

The investment manager did not leave the literature on his desk as requested, but called personally later. He reported: "I found that the note was written by an old woman who scrubs the floors and works as janitress from 8 p.m. to 6 a.m. In cleaning up my desk she had noticed some of my correspondence and literature and had about decided to transfer her savings account to an investment in our preferred stock. This she has now done and also has arranged for me to make a sale to her son and daughter."

Tables for Estimating Customer's Maximum Demand

BY W. W. ARNETT, JR.

THE Monongahela Valley Traction Company of Fairmont, W. Va., recently put into effect a new power rate for customers having a demand of 25 kva., or over, which includes a charge for the customer's maximum demand measured in kilovolt-amperes and supersedes a rate based merely on kilowatt-hours consumed without regard to demand. In order to have a basis on which to estimate demands during the interval between the date on which the rate was made effective and the time when demand meters could be installed for all customers, provision was made in the rate for billing demands according to tables based on the customer's connected motor load.

These tables are thought to be more accurate and logical than other similar tables, as they take into consideration the three factors which enter into the combined demands of a motor installation:

1. Nature of the load on each motor—whether continuous or intermittent.

2. Diversity factor between the various motors by reason of which the combined demand is less than the sum of the individual demands.

3. Variation of power factor according to the size of induction motor.

The tables are designed to give fifteen-minute time-interval demands and to apply particularly to the coal-mine load, which predominates in the company's territory. From the first table are obtained the kilowatt demands of individual motors, from the second the diversity factor, and from the third the power factor. These are combined in the manner explained below to obtain the kilovolt-ampere demand.

TABLE I—FIFTEEN-MINUTE KW. DEMANDS OF INDIVIDUAL MOTORS

1. The kw. demand of a motor driving a continuous load is taken as 60 per cent of its rated horsepower.
2. The kw. demand of a motor driving an intermittent load is taken as 40 per cent of its rated horsepower.
3. The kw. demand of a mining locomotive is taken as four times the weight of the locomotive in tons.

Motors whose load is continuous for a period of fifteen minutes or more are placed in the first class, while motors driving such loads as coal-cutting machines, hoists and machine-shop tools are in the second class.

TABLE II—DIVERSITY FACTORS

One motor	1.00
Two motors	0.90
Three to five motors	0.85
Six to ten motors	0.80
Eleven or more motors	0.75

TABLE III—POWER FACTOR OF INDUCTION MOTORS

Average size of motors less than 5 hp.	70
Average size of motors 5 hp. to 10 hp.	75
Average size of motors 11 hp. to 25 hp.	80
Average size of motors 26 hp. to 50 hp.	85
Average size of motors over 50 hp.	90

Method of Using Tables

1. Refer to Table I to obtain the kilowatt demand for each motor connected.

2. Multiply the sum of the kilowatt demands obtained from Table I by the proper diversity factor obtained from Table II.

In the case of induction motors:

3. Divide the product so obtained by the proper power factor obtained from Table III. The quotient so obtained will be the kva. demand to be used for billing purposes.

Following is an example showing how the table would be applied to an installation of induction motors:

	Hp.		Kw.
One fan	25	× 0.60	15
One pump	10	× 0.60	6
One hoist	25	× 0.40	10
Two coal-cutting machines	30	× 0.40	24
	120		55

Average size of motors, 120 ÷ 5 ..... 24 hp.
Power-factor ..... 80 per cent
Diversity factor (five motors) ..... 85 per cent
Kva. demand (55 × 0.85) ÷ 0.80 ..... 58.5 kw.

In the case of direct-current motors operating in connection with a motor-generator set of, let us say, 100 hp. capacity the power factor would be taken as 100 per cent if the motor were of the synchronous type, or 90 per cent if the motor were of the induction type.

In applying the tables motors which never operate at the time of peak load should be omitted. For instance, in some mines the coal-cutting machines work at night only, while the peak load occurs during the day. Therefore in computing the total maximum demand of the mine the demand of the cutting machines should not be included.

Average Results Found Satisfactory

Since installing demand meters the average results obtained from the tables have been found to check very closely with the metered demands. In some individual cases, however, results obtained by the two methods are found to differ widely.

The use of tables for estimating demands is not to be recommended for customers having a demand of 25 kva. or more, except as an adjunct to the demand-meter method. Customers are continually adding to their connected load, and it is extremely difficult for the power company to keep promptly informed of all motors added. As a result a customer frequently is billed on a basis which is considerably less than his measured demand would have been.

The amount of revenue lost by lack of such information or by the expense of frequent inspection necessary to obtain it would pay for demand meters several times over. Again, customers view the demand tables with suspicion and are much better satisfied to have their demand metered than estimated.

Nebraska Power Company's Inspection Tours Improve Public Relations

AS A PUBLIC-RELATIONS movement the Nebraska Power Company, of which J. E. Davidson, chairman of the Public Relations Section of the National Electric Light Association, is vice-president and general manager, has undertaken a series of inspection tours of its generating station. To date about 2,000 club and civic organization members of Omaha and Council Bluffs, including the Lions, Rotary, Kiwanis and Concord clubs, Electrical Manufacturers and Jobbers' Association, the Advertising-Selling League and the Woman's Club, have been taken through the plant on different days in groups of as many as 250. Competent guides who had been especially trained for the work took them in groups of ten through the station, explaining every important feature of the construction and operation. The principal pieces of equipment were placarded with legends showing what they were and giving costs.

Each trip was made in logical order, starting with the coal storage and bunkers, passing on to the boiler room and through the generating room to the switchboard and outgoing lines. The trips wound up with a lunch served in the boiler room. The food was electrically cooked and music was furnished by the Nebraska Power Company orchestra.

A flashlight picture was taken of each organization, the one shown here having been taken at the luncheon given to the Advertising-Selling League.

When the guests started through the plant a pamphlet was handed to each explaining the important apparatus and equipment and containing the following note of welcome:

To Our Guests:

Because of the "din" it is not possible for me to welcome you as I would wish. The power house is "at your service," and we hope you will make yourselves at home and enjoy our little party. "YOUR ELECTRIC SERVICE COMPANY."

By J. E. DAVIDSON.

Some Facts About the Nebraska Power Company

We serve 39,000 customers.

Practically every industry in Omaha takes electricity from the Nebraska Power Company.

To generate electricity our plant burns 500 tons of coal a day—an annual consumption of 150,000 tons—a coal bill of a million dollars.

Our plant contains 71,000 hp. in turbine-driven electric generators and includes spare capacity sufficient to guarantee almost uninterrupted service.

"Big Joe," our largest turbine, has a capacity of 27,000 hp. and will take care of two-thirds of the industries of the entire city.

The Nebraska Power Company operates a fleet of thirty motor cars and trucks in maintaining service to customers.

Our service department makes 26,000 calls annually on our customers, to replace their burned out fuses or do other necessary jobs to improve their service.

Our "coal bins" will hold some 20,000 tons, and almost this much is in storage at all times, to insure service regardless of labor or transportation troubles.



ADVERTISING-SELLING LEAGUE LUNCHEON AT NEBRASKA POWER COMPANY'S PLANT

To condense the steam we use in our turbines requires the use of over 100,000,000 gal. of water a day. This is five times the daily consumption of the entire city of Omaha!

There are 33,000 poles installed in the streets and alleys, upon which are carried over 4,000 miles of wire, to carry electric energy to the homes and industries of the city.

The light and power rates of Omaha are very favorable both to residence and power users, as compared with any city in the country, even those with water-power generation.

We have over 1,000,000 regular transactions with our customers each year.

From 1917 to 1921 we have invested over $6,000,000 to meet the demands of growing Omaha.

We have tried to provide "everything electrical" that is either necessary or desirable for your comfort or convenience, and will continue to give you the best service that it is possible for us to supply.

The tours were very popular with the various organizations and gave those attending a better understanding of the meaning of a central-station generating plant. Among other things the *Ad-Sell News* of April 29, 1921, carried an enthusiastic account of the experience of the 450 members of that organization. The affair proved a valuable means of improving public relations, and the Nebraska Power Company feels well repaid for its efforts.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

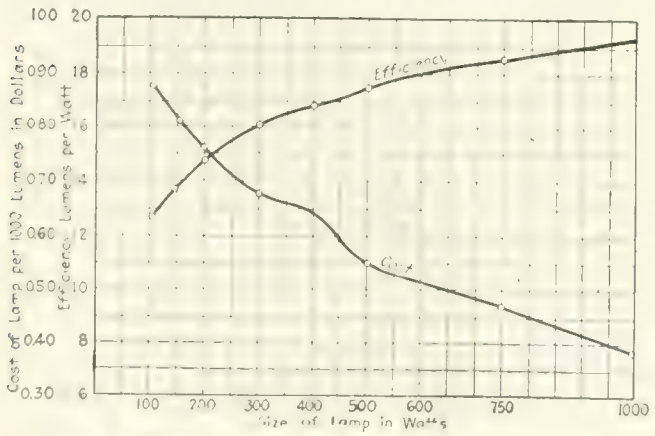
Generators, Motors and Transformers

Calculation of the Mechanical Strength of Large Stators.—H. PISTOYE.—The author determines mathematically the necessary cross-section to be given and the best points of supports of large stators used on generators and motors. As forces causing bending moments the weight of the machine and the asymmetric action of magnetic attraction are considered. The author dwells on the great attention which should be given to the proper design of the main supporting brackets and all the joints in the stator. The article is purely mathematical.—*Revue Générale de l'Electricité*, March 5, 1921.

Auto-Transformers.—R. KORNFELD.—This article deals systematically with all the different possible combinations of auto-transformer connections such as single-phase auto-transformers, three-phase auto-transformers, three-phase to six-phase auto-transformers for converters, and three-phase to two-phase auto-transformers for parallel connection of two-phase and three-phase generators. Properly adapted all the conclusions reached for auto-transformers may be used for ordinary two-winding transformers with taps on one side several of which are loaded at the same time.—*Elektrotechnik und Maschinenbau*, March 6, 1921.

Lamps and Lighting

The Lighting of Piers and Docks.—H. E. MAHAN.—The writer indicates that there is much to be desired in the lighting of piers and docks as practiced at the present time. He points out that suitable lamp units have been available and their installation in progressive industrial plants has demonstrated the material benefits



COST AND EFFICIENCY CURVES FOR GAS-FILLED LAMPS

resulting from adequate illumination. He describes several types of modern lighting units that will economically furnish the intensity and distribution of light necessary for the rapid and efficient performance of work on piers and docks, in warehouses and in large out-door storage areas. The curves reproduced here are of value in considering the cost of producing light. It should be observed that the cost of the light includes the cost of the lamp, the installation and the cost of energy.—*General Electric Review*, April, 1921.

Generation, Transmission and Distribution

Operating Experiences of the Power Supply of Berlin.—E. RÜHLE.—Since 1918 the three main power stations of Berlin have been supplied with additional energy from the large steam plant at Golpa, 130 km. south of Berlin. At present about 40,000 kw. and 800,000 kw.-hr. per day are transmitted from this plant to Berlin at a voltage of 100,000. The proper regulation of the wattless component is very difficult, but is being managed with excellent results. As a compensating device the induction regulator is given preference over any other. In the very near future the general electrification of Germany will bring transmission problems of large magnitude, for which the following rules should be well considered. (1) To achieve highest economy, only part of the required energy should be taken from the transmission line; the remainder should be generated locally. (2) Each power station receiving energy from the trunk line should compensate for its own wattless current. (3) Each power station should regulate its voltage by overexcitation of its machines. (4) No promising results may be obtained from using existing converters for the compensation of the wattless current.—*Elektrische Kraftbetriche und Bahnen*, March 10, 1921.

Power for Victorian Industries.—A series of chapters dealing (1) with the principal power developments in Victoria, giving investment cost and operating cost of three principal generating stations; (2) with the brown-coal deposits used largely in the generation of electricity in Victoria; (3) with electrical apparatus used in the generation and transmission of 132,000 volts, with descriptions of outdoor substations and protective apparatus; (4) with the application of electric power to industry and other like problems showing how they were solved in the Province of Victoria.—*Supplement to Australian Industrial and Mining Standards*, March 17, 1921.

Water Power and Irrigation Projects in Bulgaria.—The results of the investigations carried out by the government of Bulgaria into the resources of that country following the war are summarized as follows: (1) That it is possible to obtain hydro-electric energy to the extent of upward of 1,000,000 hp.; (2) that it would be possible, in addition, to irrigate by means of canals various districts representing a total of nearly 460,000 hectares; (3) that it would be possible to irrigate by means of electrically driven pumps the vast Danubian plains and those of the Deli Orman in North Bulgaria, and (4) that water could be supplied by means of electrically driven pumps to towns and villages which cannot otherwise obtain it.—*London Engineer*, March 25, 1921.

Use of Vegetable Oil as a Power Agent.—Tests were made on English and Dutch engines using both palm oil and cottonseed oil for fuel. Taking these oils as having a calorific value of 8,600 calories, the thermal efficiencies work out to be about 28, 23 and 26 per cent respectively in three cases, as against about 27 per cent with petroleum with a calorific value of 9,600 calories.—London *Electrician*, March 25, 1921.

A Practical Aspect of the Corrosion Problem.—JOHN F. THOMPSON.—This paper lays down the thesis that the use of any metal or alloy is rarely based upon the sole property of resistance to corrosion; that this, although always a necessary factor, is quite frequently not the determining one which governs practical serviceability. This is illustrated by considering various properties which are frequently the determining factors to which resistance to corrosion is secondary, such as hardness, resistance to abrasion and wear, strength at high temperature, tensile strength at low or high temperature, conductivity for heat or electricity, resilience, modulus of elasticity, absence of seasonal cracking, color, avoidance of tarnish, non-sparking property and non-amalgamating characteristics.—From paper presented before American Electrochemical Society, April 21, 1921.

A New Cement for High-Tension Insulators.—WEICKER.—The great difference in the thermal coefficient of thermal expansion between porcelain and cement undoubtedly has something to do with the phenomena of "aging" in cemented insulators. In order to avoid thermal stresses due to the cement the Hermsdorf insulator factory, instead of using pure cement, employs a mixture of cement and a powder of secret composition, which is marketed under the name of "Teleo." The thermal expansion of such cement has been investigated at the German Bureau for Testing Materials, with the following result: Porcelain, 3.5×10^{-6}; "Teleo" cement with 33 per cent cement, 4.0×10^{-6}; ordinary sand cement with 33 per cent cement, 13.0×10^{-6}. Porcelain and "Teleo" cement thus have about the same expansion coefficient, while ordinary cement has an expansion about three times as large.—*Elektrische Kraftbetriebe und Bahnen*, Vol. 18, page 273.

Electrophysics and Magnetism

Wave Propagation Over Parallel Wires; the Proximity Effect.—JOHN R. CARSON.—The mathematical study of wave propagation along a conducting system composed of two similar and equal parallel wires spaced very close together and employing very high frequency. The necessity for this study has been brought about by developments in telephonic transmission such as the carrier-wave system and the utilization of loaded cable circuits in which the wires are very close together.—*Philosophical Magazine*, April, 1921.

Photo-Electric Effect in Audion Bulbs of the Oxide-Coated-Filament Type.—THEODORE W. CASE.—A record of the discovery of photo-electric effects from certain oxide-coated filaments of some high-vacuum Western Electric audion bulbs. Calcium, barium and strontium oxide cells were made, the two last named being principally worked with. The photo-electric current is proportional to the light intensity. The current for average sunlight is 100 to 150 micro-amperes. This is sufficient to run recording ammeters and thus furnish a curve of daylight intensity.—From paper presented before American Electrochemical Society, April 21, 1921.

Recent Modifications in the Construction of Platinum Resistance Thermometers.—T. S. SLIGH.—After a brief résumé of some phases of platinum resistance thermometry a description is given of some recent modifications in the construction of resistance thermometers as regards the heads, leads, terminals and sealing of the strain-free type. Some practical notes regarding the construction of resistance thermometers and a description of the construction of a convenient and effective form of laboratory heating coil are given. —*Scientific Paper No. 407, U. S. Bureau of Standards.*

Telegraphy, Telephony and Signals

Why High Frequency for Radiation?—J. SLEPIAN.—In this discussion the author has attempted to show in a qualitative way how the introduction of Maxwell's displacement currents combined with the previously held laws of electromagnetism explain the fact that electric and magnetic fields are propagated with a finite velocity, and how it is that a rapidly varying current continually gives out energy to space. These displacement currents are required for radiation in space.—*Electric Journal*, April, 1921.

Description of a Uni-Wave Signaling System for Arc Transmitters.—W. A. EATON.—The necessity for the development of a uni-wave or single-wave signaling system is outlined and the essential equipment is discussed.—*Electric Journal*, April, 1921.

Elementary Information for Radio Amateurs.—A list of periodicals and elementary books covering radio information for amateurs. The publication also contains suggestions regarding radio-communication laws and call letters for radio stations in the United States.—*Publication Radio Laboratory, U. S. Bureau of Standards.*

Long-Distance Telephone System of the United Kingdom.—SIR WILLIAM NOBLE.—The writer says that this subject has not been comprehensively dealt with since 1905. At this time, he says, long-distance telephony divides itself along two main lines of development: (1) Communication between the principal commercial centers of the country; (2) communication with remote districts and international communication. The subject is covered in accordance with this outline.—London *Electrician*, March 25 and April 1, 1921.

Carrier Current Telephony and Telegraphy.—E. H. COLPITTS and O. B. BLACKWELL.—This paper briefly outlines the history of the development of carrier multiplex telegraphy and telephony. The fundamental principles underlying particularly the newer developments of the art are then discussed. Consideration is likewise given to the propagation characteristics of open-wire lines, including those containing intermediate lengths of cable. Commercial types of apparatus and actual installations are described and a brief statement is made as to further applications of the art.—*Journal A. I. E. E.*, April and May, 1921.

Digest of United States Patents Relating to Radio Telegraphy and Telephony.—JOHN B. BRADY.—A section of the *Proceedings* of the Institute of Radio Engineers has been set aside for the purpose of making available in convenient form for research engineers and others interested brief information on the radio patents which are granted each week by the Patent Office. Patents covered in this issue are those granted from Jan. 24, 1921, to Feb. 15, 1921.—*Proceedings Institute of Radio Engineers*, April, 1921.

Scientific and Industrial Research

(Printed in the Third Issue of Each Month)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by Prof. Vladimir Karapetoff
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

CARBON DIOXIDE RECORDER, ELECTRICAL.

An electrical CO_2 recorder has been devised which does not involve the use of any chemical reaction. Two identical platinum spirals are set in separate cells cut in a copper block and connected to form two arms of a Wheatstone bridge. The flue gas is allowed to come in contact with one spiral, and air is circulated through the cell containing the other. When a fairly large current is passed through the spirals they will heat up and lose heat to the cell walls at a rate directly proportional to the thermal conductivity of the gas in the cell. A difference in cooling rate will allow a difference in temperature between the spirals and will cause a deflection of the galvanometer in the bridge circuit. The difference in conductivity of air and CO_2 will allow the galvanometer to be calibrated directly in per cent carbon dioxide.—*Cambridge and Paul Instrument Company, London, England.*

COLOR MATCH AND SPECTRAL DISTRIBUTION.

When two different radiators, such as a tungsten and a carbon lamp, are color-matched—*i.e.*, adjusted so that the integral color is the same—there has been some question as to the extent to which they have the same distribution of energy in the visible spectrum. Experiments performed with four different radiating bodies—a black body, tungsten, tantalum, and untreated carbon—showed that if these four radiators were color-matched by determining the temperature for which the ratio of the red intensity to the blue intensity was the same then the ratio of the red to the green was not what it should be if they had the same spectral distribution when they were thus color-matched. Taking the black body as the standard the untreated carbon was found to be the same within experimental errors. The ratio of red to green for tungsten differed from that of a black body by about 0.5 per cent for a temperature of about 1,500 deg. K. to about 8 per cent for a temperature of about 2,900 deg. K. For tantalum this difference was very nearly constant for a range in temperature from 1,500 deg. K. to 2,700 deg. K. and was equal to about 6 per cent.—*E. P. Hyde and W. E. Forsythe, Nela Laboratory, Cleveland, Ohio.*

DRY-CELLS, RECORDER FOR TESTING.

Manufacturers and users of dry cells frequently have occasion to test the life of a cell or group of cells under various conditions of discharge. An instrument has been developed that will automatically control the rate of discharge at a predetermined value and at the same time give a continuous record of the variation in terminal voltage, both on open and closed circuit. It is hoped that this instrument may help to develop some new and shorter method of testing dry cells.—*Leeds & Northrup Company, Philadelphia.*

ELECTROLYTIC REPAIRING OF MACHINERY.

A series of tests has been carried out on the repairing by electrolytic deposition of worn-out or too deeply machined steel parts. The best results were obtained from a solution of ferrous ammonium sulphate with a current density of 0.23 amp. per sq.ft. (0.0213 amp. per sq.m.). If iron is deposited on a steel base and the whole annealed to above the A_3 point for pure iron the two will become strongly welded.—*W. A. Macfadyen, London, England.* [N. B.—This method will be found to be a useful adjunct and supplement to the electric welding where the latter is for some reason undesirable.—Editor.]

FLATIRONS, ELECTRIC, TESTING OF.

Plans are under way for the testing of various grades of commercial electric flatirons as to durability, efficiency, etc. The irons to be tested will be submitted by the various manufacturers, and it is planned to test first the 6-lb. size. The results of the test will be published without disclosing the manufacturers' names, but with the idea of indicating to users what figures for durability, efficiency, etc., they can employ in making specifications for their purchases and yet obtain irons of the desired quality. The following tests will be made: General records of weights, size, finish, etc.; consumption at rated voltage, also at maximum and at minimum voltages, for which the flatiron was designed; variation in power consumption on alternating current and direct current and variation with temperature. The temperature of the handle, stand, cord and other parts which have to be handled will be tested at the maximum temperature which the iron will attain; the stability of the irons in various positions will be studied, and durability and efficiency tests will be made of the whole iron and of its various parts.—*N. E. L. A., Division of Standardization and Testing, Washington, D. C.*

SPECTRUM, VISIBLE, OF ACETYLENE FLAME.

A knowledge of the distribution of energy in the visible spectrum of an acetylene flame has become important within the last few years through the use of this flame, in cylindrical form, in investigations of the visibility of radiation. The data on acetylene published by Coblentz form a curve in the visible spectrum which will not agree with that of a black body at any temperature to better than 7 or 8 per cent. As this would mean that no color match could be obtained, a short investigation was undertaken to verify the conclusion and the results gave a curve agreeing within the limits of error with that of a black body at 2,360 deg. K. In the extreme red, beyond 0.70μ, there was indication of a higher emissivity for the acetylene.—*E. P. Hyde, W. E. Forsythe, F. E. Cady, Nela Laboratory, Cleveland.* (N. B.—These preliminary studies to establish reliable standards of radiation lead to methods of measurements of extreme importance in pyrometry and in the improvement of incandescent lamps.)

STEEL FOR PERMANENT MAGNETS.

A new alloy steel possessing an extremely high coercive force and strong residual magnetism has been developed. It contains cobalt, tungsten and chromium. Measurements of the residual magnetism for specimens of slightly different composition gave values from 920 to 620 C. G. S. units, and the coercive force of the same specimens ranged from 226 gauss to 257 gauss. Artificial aging by heating in boiling water and by repeated mechanical shock reduced the residual magnetism by only 6 per cent. Its properties indicate that it is specially suited for short bar magnets.—*Kotaro Honda and Shozo Saito.*

TUNGSTEN, VAPORIZATION OF, EFFECT OF STRONG ELECTROSTATIC FIELDS UPON.

Some preliminary work has been done on the effect of electrostatic fields upon the vaporization of tungsten filaments by noting the change in resistance of a filament with constant current and exposed to an electrostatic field of varying strength which opposed thermionic emission. No effect to within 0.5 per cent was found, but some speculations seem to indicate that by a modification of conditions a positive influence of electrostatic fields on vaporization may be found.—*A. G. Worthing and W. C. Baker, Nela Laboratory, Cleveland.*

Suggestions for Research

ALTERNATORS FOR RADIO SERVICE, SPEED REGULATION OF.

Radio stations using high-frequency alternators require special devices to keep the speed constant in order to have constant-frequency output. Electrical and mechancial regulating devices are held to be unsatisfactory, and some methods of keeping the alternator under constant load have been tried. One method is to use a sending key with a relay which shunts the full alternator output into a ballast circuit when not sending. (See *Elektrotechnische Zeitschrift*, Vol. 41, p. 367, 1920.) A simpler and more effective method of speed regulation is desired.—*Editorial Suggestion.*

CIRCUIT BREAKERS, OIL IMMERSED, RATING OF.

The present method of rating the interrupting capacity of oil circuit breakers is on the basis of a duty cycle, which is intended to be representative of operating practice. However, no single-duty cycle can fully represent very many working conditions, and it is recommended that the ratings of all oil circuit breakers should be made with reference to several duty cycles, and that curves be drawn of the ratings as against the various operating conditions.—*N. E. L. A. Electrical Apparatus Committee.*

POWER PLANTS, COMBINED STEAM AND HYDRO, GOVERNING OF.

There is room for a great deal of original investigation and development in the problem of governing and regulation in combined steam and hydro-electric plants. It has been found difficult to operate such plants in parallel owing to poor frequency regulation of the hydro units. Information is desired as to the best relative regulation or inherent drop of hydro and steam governors under various conditions of water flow.—*N. E. L. A. Prime Movers Committee.*

SYNCHRONOUS MACHINES, HIGH-POTENTIAL TEST.

The present method of applying the high-potential test (A. I. E. E. Standardization Rules) fails to impose any test whatsoever on the insulation within a coil or between adjacent coils of a phase. In the case of a fully connected machine it fails also to impose any test between phase windings where the highest potential exists when the machine is operating. On the other hand, the present test imposes, barring capacity effects, the same stress on the external insulation of all coils. This is quite an unnecessary hardship upon certain parts of the winding, and in a very large machine it produces unknown stresses at certain points, due to capacity effects. Moreover, the present test may impose at some point a stress that is equivalent to exceeding the elastic limit without breakdown, and we have no means of determining the damage done. For these reasons it is suggested that the desired overvoltage be furnished, wherever possible, by the machine itself, running it at a higher excitation and at moderate overspeed, with the armature terminals (a) insulated, (b) grounded on one side. The insulation stress will then be of the same kind as in actual operation.—*W. J. Foster, Schenectady, N. Y.*

TELEPHONE LINES—MITIGATION OF INDUCTIVE INTERFERENCE.

The following arrangement due to Marius Latour has been successfully tried in France: The telephone current is amplified for transmission, and in the terminal apparatus the intensity of this current is brought down to the value corresponding to a normal audition at the same time as the intensity of the disturbing current is reduced. The amplification can be regulated at will at the start, and the disturbances decreased down to a sufficiently low value not to interfere with telephone conversations. The amplifier employed was a vacuum tube with three electrodes. [In view of the importance of the inductive interference problem in this country at the present time this method is well worth trying.—Editor.]

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Wisconsin Municipalities Support State Utility Regulation

WISCONSIN municipalities have given their full support to the regulation of public utilities in the state by the Wisconsin Railroad Commission. This attitude was manifested when the last of the series of bills introduced into the Legislature to abolish the commission was killed by a large majority. The joint committee of the Senate and Assembly which held a public hearing on the bill heard from nearly all the cities in Wisconsin either directly through their mayors, city attorneys and civic associations or through the League of Municipalities. Although utility rates have been increased in nearly all the cities of the state the bill to abolish the commission failed to gain a single supporter among the municipalities represented.

Supply Manufacturers to Meet at New London at End of June

ARRANGEMENTS are being made for the summer section meetings of the Associated Manufacturers of Electrical Supplies, to be held as usual at the Griswold, Eastern Point, New London, Conn., during the week commencing June 27.

One evening will be devoted to a banquet, with special entertainment, music, etc. The newly organized Radio Appliance Section of the association will give a demonstration of the wireless telephone, establishing direct communication with many inland cities and also with ships at sea. The golf course will be open to all and there will be music and dancing every afternoon and evening.

The section meetings will be held at convenient hours during the session, on a schedule to be arranged. The general standards committee will also hold an important meeting during the session. The board of governors will hold its regular June meeting there.

New Financing Totaling $17,000,000 Announced the Past Week

AN UNUSUALLY large volume of new financing, amounting in all to almost $17,000,000, has been announced during the past week. A closed issue of $3,500,000 of twenty-year 8 per cent secured gold bonds of the American Power & Light Company, due May 1, 1941, came out at a price to yield 8.15 per cent. The proceeds will be used to refund $2,200,000 of ten-year notes due in August and for other corporate purposes.

The San Diego Consolidated Gas & Electric Company has disposed of $2,750,000 of first and refunding mortgage 6 per cent gold bonds due March 1, 1939, which are being offered at 87, to yield 7.3 per cent.

A block of $6,000,000 of first and consolidated mortgage series A A 6 per cent gold bonds, due Nov. 1, 1950, of the Niagara Falls Power Company is being offered at 88, to yield about 7 per cent. The proceeds will be used in part in the construction of a new tunnel.

A new issue of $4,500,000 of first lien and refunding mortgage twenty-five-year 7½ per cent series A gold bonds of the Portland (Ore.) Railway, Light & Power Company was brought out a price of 96, to yield 7.85 per cent. An interesting feature of this issue is the provision that it is non-callable during the first ten years.

The Massachusetts Department of Public Utilities has approved the petition of the South Berkshire Power & Electric Company to issue 1,600 additional shares of stock at $110 a share to pay for enlargements.

Georgia Electrical Interests Band Together for Mutual Advantages

REALIZING the need of closer co-operation between the various branches of the industry in Georgia, approximately a hundred of the more prominent men in the electrical business in the state met in Macon on May 9 and 10 for the purpose of organizing a state association the membership of which is to embrace every branch of the electrical industry in Georgia. The movement primarily is the outgrowth of proposed legislation looking toward state condemnation and ownership of all utilities and a bill proposed by the Federation of Trades requiring that licenses shall be issued to electricians doing work in the state only after they have passed examinations.

In order to impress on those in attendance the urgency of the situation a well-planned program had been prepared. Preston S. Arkwright, president of the Georgia Railway & Power Company, in his opening address sounded the keynote of the meeting. Beginning with the infancy of the industry, he sketched its growth to the present time, declaring that in not one single instance can government, state or municipal ownership receive credit for the industry's phenomenal growth. Mr. Arkwright pointed out that should the bills fostered by the Municipal League of Georgia become law the powers granted municipalities under the bill could not be exercised, because the credit situation of the governmental bodies precludes the possibilities of their purchasing the properties from their present owners.

"Money," he said, "cannot be commandeered or coerced. The owners of capital must be coaxed to invest their funds in an enterprise by a feeling of confidence that the borrower will pay a fair price for the use of the money and that it will be returned at the end of the period for which it was borrowed. Threats of confiscation by the state will absolutely prevent the utilities from any further growth or expansion."

In a short but interesting discussion of the present merchandising situation P. C. Gilham, president of the Gilham-Schoen Company, stressed the necessity of more aggressive sales methods by the electrical dealer and

sounded the warning that if the present drift of the business continued, in a very short while the sale of electrical appliances would be squarely in the hands of the hardware, drug and department stores.

W. R. C. Smith of the W. R. C. Smith Publishing Company advocated a broader utilization of newspaper copy as well as direct-by-mail advertising, suggesting in reference to the former class of publicity that dealers pool their advertising funds so that they may dominate considerable space in the local papers.

The addresses of the evening session immediately followed a dinner and a motion picture of the hydro-electric developments of the Georgia Railway & Power Company. The paper by Rawson Collier, general sales manager of the Georgia Railway & Power Company, showed the connection between the state ownership leaders in Georgia and the discredited socialists of Minnesota, quoting from a program of the last meeting of the Municipal Ownership League of America to prove that the radicals were making every effort to enlist organized labor in a nation-wide campaign for government ownership of all utilities and transportation facilities. He also gave some interesting comparisons between the rates of the local utility and those of the Hydro-Electric Commission of Ontario. P. R. Bomeisler, vice-president and general manager of the Ware County Light & Power Company, spoke on the subject of "Co-operation of All the Electrical Interests," declaring that "the public generally and the public utility are one and indivisible, each necessary to the other, growing together and side by side, prosperity for one meaning success to the other and failure for either meaning dire distress to the other." W. E. Trittipo of the Ivanhoe-Regent Works of the General Electric Company made suggestions for better sales methods in the commercial and industrial lighting fields.

The opening of the Tuesday morning session was devoted to addresses by Ralph Walker, president of the Walker Electric & Plumbing Company, and Gadsen Russell, president of the Russell Electric Company, after which the meeting went into business session. The constitution and bylaws, as drawn up by a committee appointed for the purpose, were submitted and adopted. The following officers were elected for the coming year: President, L. W. Roberts, Atlanta; vice-president, G. M. Stout, Atlanta; secretary and treasurer, W. C. Drake, Atlanta; executive committee, Norton Frierson of Savannah, Joel Weir of Athens, P. R. Bomeisler of Waycross, C. S. Banghart of Augusta, Henry Morton of Columbus and Henry Lowe of Macon, Ga.

Irrigation Promoters Oppose Power Project

THE Federal Power Commission as constituted under the new administration was to have its first formal meeting yesterday, May 20. The Secretary of War has had so many demands on his time as hitherto to preclude his presiding at a regular session of the commission. The commission gave a hearing on May 16 on the application of C. E. Loose for a power development on the East Walker River in California, just over the Nevada boundary. Irrigation interests are opposing the project on the ground that the public would benefit more from the development of agriculture than from the 9,000 hp. which Mr. Loose proposes to develop for mining purposes.

Superpower Plants Practicable for Anthracite Regions, Says Murray

DENIAL is made this week by W. S. Murray, chairman of the engineering staff for the Superpower Survey, of the report published in the May 7 issue of the ELECTRICAL WORLD to the effect that mouth-of-mine plants have been found impracticable for superpower plants. This condition holds true for the bituminous fields but not for the anthracite regions, according to Mr. Murray. His statement to the ELECTRICAL WORLD reads:

"As our investigation has progressed it has been very definitely determined that the physical conditions, particularly that relating to a lack of condensing water, prevent the development of electric power in the bituminous-coal mining districts. This, however, is not the case within the anthracite region, since it appears that at Pittston and Sunbury, points on the Susquehanna River, superpower stations, each of 300,000 kw. capacity, can be constructed, to which a third can be added upon the same river about midway between Pittston and Sunbury. The development of these plants will admit of the saving of some 6,000,000 tons of coal annually by the application of their power to anthracite mining, and will provide also, owing to the better diversity factor of the load in this region, as compared with that of the load in the tidewater region, a supply of power in the territory between New York and Philadelphia at a lesser rate of cost than were it generated at these tidewater points."

Public Utility Information Bureau for Texas Advocated

ESTABLISHMENT of a public information bureau by the utilities of Texas was recommended in the address of President Hardgrave at the opening session of the seventeenth annual convention of the Southwestern Electrical and Gas Association at Galveston on Wednesday afternoon. He urged the support of the national publicity campaign by local use of the advertising material and expressed appreciation of the efforts of the manufacturers and jobbers. This appreciation was backed by a resolution of appreciation on the part of the convention. In emphasizing the non-local character of utility service Mr. Hardgrave said that only eighty-four towns with less than 1,000 population in Texas had electric service and added that anything making for uniform regulatory policies over the whole state would enable the spread of electric service to other small communities of this type which are the backbone of trade.

President Insull of the National Electric Light Association described the increased activities of that association. Local ownership of securities was urged by W. B. Tuttle of San Antonio, in reporting for the public policy committee, as a means of bringing about better understanding on the part of the public and customers of utility aims.

Light and power, technical, street railway and commercial section meetings were held Thursday and Friday, and the convention was addressed by W. G. Busby, chairman of the Missouri Public Service Commission, who discussed the subject of state utility commissions. The annual banquet was held Friday evening at the Hotel Galvez.

Indiana Utilities Pay Fourth of State Tax

MORE than one-fourth of the total assessment levied by the Indiana State Board of Tax Commissioners for 1920 was against public utility companies. Figures made public at the State House recently showed that the public utility companies were assessed by the state board for $269,372,564. The total assessments levied by the state board amounted to $969,345,253. Utility companies were assessed for almost three times as much as the total figure for all the banks of Indiana, the total bank assessments being $97,270,475.

F. M. Feiker to Assist Hoover in Plans for Government Aid to Industry

F. M. FEIKER, vice-president and chairman of the editorial board of the McGraw-Hill Company, has been appointed by Herbert Hoover as his personal assistant in the development of the Department of Commerce as an aid to industry. Mr. Hoover has divided the department into two parts, delegating to Assistant Secretary Huston the supervision of the bureaus relating to navigation and fisheries while he himself will devote his attention to the Bureaus of Foreign and Domestic Commerce, Standards and the Census. The problem is to find out from business men what kind of facts and figures industry needs from the government. Once obtained, the problem is to get these facts and figures back to business. It is in this work that Mr. Feiker is most interested. Educated in the engineering profession, his broad executive experience in business publicity makes him particularly fitted to engage in this intelligently conceived plan to make the government serve in a more tangible way American industry.



F. M. FEIKER

Mr. Feiker will be associated with Mr. Hoover while on a leave of absence from the McGraw-Hill Company, of which organization he has been a part since 1915, when he left the A. W. Shaw organization in Chicago to become editor of the ELECTRICAL WORLD. Mr. Feiker was graduated from the Worcester (Mass.) Polytechnic Institute in 1904 in electrical engineering. Except for a year or two in special research work on high-tension transmission, all of his time since graduation has been spent in technical and business journalism. A year was spent as technical journalist for the General Electric Company, and then he joined the staff of *System*. Shortly afterward he developed the idea of *Factory*, a companion magazine, and in 1912 became chairman of the editorial board of all of the Shaw publications.

Upon coming to the ELECTRICAL WORLD in 1915 he quickly sensed the commercial needs of the electrical industry, and the following year with the aid of his associates he launched *Electrical Merchandising* to supplement and extend the service of the ELECTRICAL WORLD to the industry. In January, 1920, his constructive thinking and vision was recognized in his election to the vice-presidency of the McGraw-Hill Company, now engaged in publishing ten other publications in addition to the ELECTRICAL WORLD.

Mr. Feiker has always been sympathetic with the point of view now being expressed so clearly and forcibly by Mr. Hoover. He was unusually active in the formation of the Federation of American Engineering Societies and has always taken a prominent part in the transactions of the many engineering and business societies of which he is a member.

Westinghouse Sales Amount to $151,000,000

SALES billed by the Westinghouse Electric & Manufacturing Company during the year ended March 31, 1921, amounted to $150,980,106.39. The volume of orders booked, it is stated in the annual report made public this week, reached its maximum in August of last year, and, although thereafter somewhat reduced, continued large until December, when there came a sharp drop. The monthly volume of orders since then has remained at about the level reached in December, which was between $8,000,000 and $9,000,000. Shipments continued in large volume, so that on April 1, 1921, the balance of unfilled orders was reduced to $65,621,000.

Property and plant account showed an increase over the previous year of $9,361,403.90. The recession in business, it is stated, will permit a substantial reduction in inventories and notes payable during the ensuing year.

Inventory depreciation and adjustment as of Dec. 31, 1920, at cost or current market value, whichever was lower, was taken care of by including $5,315,196 as a sales cost and appropriating $5,000,000 from surplus for a special contingent reserve to provide for further possible shrinkages and adjustments.

Following is a condensed comparative statement of operations for the past six years:

	Year Ended March 31					
	1921	1920	1919	1918	1917	1916
Gross earnings—sales billed	$150,980,106	$136,052,092	$160,379,943	$95,735,407	$89,539,442	$50,269,240
Cost of sales	138,774,084	120,972,262	144,667,402	80,225,937	72,077,752	40,839,344
Net manufacturing profit	$12,206,022	$15,079,830	$15,712,541	$15,509,470	$17,461,690	$9,429,896
Other income	3,679,464	1,721,334	1,623,262	1,325,263	1,386,547	1,106,730
Gross income from all sources	$15,885,486	$16,801,164	$17,335,803	$16,834,733	$18,848,237	$10,536,626
Interest charges, etc	3,267,950	1,594,823	2,276,795	1,429,052	768,348	869,837
Net income available for dividends and other purposes	$12,617,536	$15,206,341	$15,059,008	$15,405,681	$18,079,889	$9,666,789

Radio Appliance Section Added to A. M. E. S.

AS AN outcome of the enthusiastic convention and exhibit of radio manufacturers held in New York City the middle of March, a committee of these manufacturers applied for admission to the Associated Manufacturers of Electrical Supplies. Consequently the Radio Appliance Section of the association has been formed with D. R. Murdock of the William J. Murdock Company, Chelsea, Mass., as chairman and George J. Eltz, Jr., Manhattan Electrical Supply Company, New York City, as secretary. A committee has been appointed to recommend the different phases of radio work to cover which permanent committees will be formed.

Kentucky Utilities Hard Hit by Higher Coal Freight

VIRTUALLY every public utility company in the state will be affected by announced increases in freight rates on coal from the mines. The Louisville & Nashville Railroad has reduced rates to Lexington, which were out of line, but put a heavy increase on Louisville and way stations from both the eastern and the western Kentucky mines and on coal moving over its lines from Tennessee and Virginia. On western Kentucky fuel the increase is 15 cents a ton to $1.40, and on eastern Kentucky differentials between steam and prepared coals are removed, resulting in an increase of approximately 33 cents a ton on screenings and 22 cents on mine run.

This will hit the Louisville Gas & Electric Company rather hard on movement of coal from its western Kentucky mines at Echols, Ky., to Louisville, and it along with a number of other large consumers will probably protest against the increase, which is to become effective June 16. Jeffersonville and New Albany, Ind., as well as Cincinnati, are also affected.

Arkansas Utilities Urged to Back National Advertising

A COMBINED correspondence course of study in technical subjects and personal instruction by members of the state university faculty was outlined by Dean Gladson of the Engineering School of the State University of Arkansas in the discussion before the Arkansas Utilities Association at Hot Springs on Thursday of last week of the meter course that the university has undertaken. In addition to the work that is being done with the meter courses in co-operation with the association, Dean Gladson suggested the possibility of working out similar courses in fuel combustion and other subjects.

The local newspaper as an indispensable factor in any advertising campaign was discussed by A. G. Whidden of Pine Bluffs in a talk on "Publicity," in which he made a plea that the newspaper men always be told the facts. If treated with confidence, they can be an important factor in the winning of public confidence, provided that publicity is backed by service and quality. Attention was called to the national advertising campaigns of the National Electric Light Association, and the manufacturers and the utilities were told that these campaigns could not be successful unless they were backed by local advertising. The utility men were urged to be extremely careful of their advertising copy and to avoid the use of advertising space merely for the purpose of placating the editor. Its use was urged only for the purpose of telling a real story that the public is interested in.

The last session on Thursday afternoon was devoted to the subject of electrical merchandising. The principal paper, by C. E. Michel of St. Louis, was to the effect that the contractor-dealer needs less scolding and more encouragement.

The annual banquet was held jointly with the Southwestern Geographic Division of the National Electric Light Association on Friday evening. The following officers were elected: President, R. M. Foster, Helena Water Company, Helena; first vice-president, S. R. Brough, Arkansas Water Company, Little Rock; second vice-president, S. A. Lane, Southwestern Bell Telephone Company, Little Rock; secretary-treasurer, R. I. Brown, Little Rock Railway & Electric Company. The next convention will be held at Little Rock.

Northwest Association Convention to Be Held in June

THE fourteenth annual convention of the Northwest Electric Light and Power Association is to be held in Portland, Ore., June 15 to 18 inclusive. Formerly the conventions were held in September, but it has been decided that June is a better month. The following tentative program has been arranged:

WEDNESDAY, JUNE 15

Morning.—Address of welcome by G. L. Baker, Mayor of Portland; annual address by President Franklin T. Griffith.

Noon.—Luncheon at Portland Ad Club, F. T. Griffith chairman.

Afternoon.—"The National Electric Light Association," by M. H. Aylesworth, executive manager of the N. E. L. A.; report of the executive committee of the Accounting Section, J. S. Simpson; "Accounting," by George Nevins.

THURSDAY, JUNE 16

Morning.—Report of the executive committee of the Commercial Section, R. W. Clark; report of the advisory committee of the Northwest Electrical Service League; address by S. I. Miller, secretary-manager of the Northwest Electrical Service League.

Afternoon.—Report of executive committee of the Public Relations Section, W. H. McGrath; "Public Relations," by George L. Meyers; "The Northwest—Its Present and Future in Industry," by Robert Sibley.

Evening.—Addresses by public utility officials and investment bankers.

FRIDAY, JUNE 17

Morning.—"Some Essentials of Power Development," by L. T. Merwin; report of the executive committee of the Technical Section, George E. Quinan.

Afternoon.—Executive session; election of officers.

An extensive program of entertainment has been provided which will include an automobile, boat and inspection tour.

Publicity of Accounts Reduces Number of Rate Cases, Says Commissioner Weed

AN OPEN policy regarding accounts, coupled with adequate returns exhibiting operating facts, is a strong factor in cutting down rate disputes, declared Commissioner A. R. Weed of the Massachusetts Department of Public Utilities before the New England Division of the N. E. L. A., at a luncheon meeting in Springfield, Mass., May 17. Short addresses were

also given by S. W. Damon, president Springfield Fire & Marine Insurance Company; President Adams of the Springfield Chamber of Commerce and J. W. Lester, chief accountant of the Massachusetts commission, who conducted an informal conference upon the new accounting forms to be adopted in Massachusetts probably July 1.

Commissioner Weed emphasized the value of the returns of public utilities to the board and expressed his faith in the integrity of company accounting figures in general. He stated that he does not share the distrust sometimes expressed in regard to such figures and data. An accurate, complete and intelligent accounting is one of the best assets of a company in making for better public relations. Rate cases, with their violent and thoroughly exhausting adjustments, can often be avoided if adequate accounting publicity is practiced. The speaker disclaimed any desire on the part of the regulating commission to enter into company management. He predicted a splendid future for the electrical industry and commended the popularization of investment in sound securities devoted to the upbuilding of public utility service.

Public Relations Are Main Theme of Southwest Section Convention

PUBLIC relations and publicity problems dominated the discussions at the first annual meeting of the Southwestern Geographic Division of the National Electric Light Association at Hot Springs, Ark., on Friday and Saturday of last week. President Hardgrave called attention in his address to the necessity of continued high rates caused by the condition of deferred and current maintenance due to the war and the time lag between the rise in operating costs and rate increases. Utilities were advised to take the offensive and not wait to be placed in a defensive position by the demand from the public for lower rates induced by the decrease in other prices.

C. H. Moses of Little Rock attributed the abolishment of the Arkansas Utility Commission to public misunderstanding of the term "indeterminate" in connection with the franchise situation, state utilities having surrendered franchises given by the municipalities for indeterminate permits under the commission authority. A second factor was the impression that the commission had received authority to abrogate valuable contracts between utilities and municipalities.

President Insull of the National Electric Light Association emphasized the necessity of utilities giving good service as a preliminary to establishing proper public relations.

That action in dealing with public relations must be taken from an offensive and not a defensive position was forcibly asserted by J. H. Gill of Dallas, Tex., in discussing the needs of the industry. The first essential step in bringing understanding to the public is to destroy the conception of the utility business as a commodity business in which the capital is invested in the product sold as in other forms of business.

The essential qualities to be looked for In employees are ability to look forward, ambition, and willingness to take increasing responsibility, according to the view taken by J. F. Owens of Oklahoma City, in discussing "Internal Organization." All the public has a right to know of any employees is that they are company employees, and they should be so educated in company affairs that the information customers are entitled to regarding operations can be given by any employee.

"The most beneficent labor law ever enacted" was the characterization of the statute establishing the Kansas Court of Industrial Relations, made by Judge W. L. Huggins of that court in an enthusiastically received talk upon it. He outlined the foundation of the law in old English law and made a strong plea for the same regulation of labor that capital must face. Twenty-eight cases with a record of no appeals have so far been adjudicated by this court.

President Hardgrave pointed out that the day of the small-town central station is past, and that there is increasing necessity for the larger central stations to feed a number of communities if the service to these communities is to be successfully maintained. The necessity of non-par-value stock laws was urged, and by resolution the convention expressed its intention of undertaking the introduction of the necessary bills into the legislatures of the states included in the section. Mr. Hardgrave also said that the time was rapidly approaching when industries must be established with reference to the location of raw materials rather than at railway centers, owing to the high cost of transportation. This condition indicates the necessity of looking forward to the transmission systems that must be developed to serve potential industrial districts.



DELEGATES TO FIRST ANNUAL MEETING OF SOUTHWESTERN GEOGRAPHIC DIVISION, N.E.L.A.

Parallel meetings of the accounting, commercial, public relations and technical sections were held on Friday afternoon. These meetings revealed that the sections have been organized to fit in with the activities of the similar national sections and are now so functioning.

President Insull of the National Electric Light Association was the speaker at the banquet on Friday eve-

ning. At the Saturday section W. J. Canada, engineer of the national association, told the convention of that association's organization and plans.

The entire list of officers for last year was re-elected for the coming year. A constitution and by-laws were also formally adopted.

Nebraska Commission Powers Not Extended

THE bill before the Nebraska Legislature to give the Railroad Commission full authority over all utilities has been laid on the table indefinitely by the committee to which it was referred. At the election last fall a constitutional amendment permitting the Legislature to place all utilities under commission rule was adopted, but present indications are that it will take at least another legislative session to carry the amendment into effect.

Ontario Hydro-Electric Commission Lowers Rates

RATE reductions in three cities, twenty-one towns and thirty-two villages in the Niagara district of Ontario are, it is authoritatively announced, to be made by the Hydro-Electric Power Commission of that province. Slight increases are to be made in one city and two towns, while the remaining eighty-four municipalities in the district will continue to be served at the former rates. Prices in the city of Toronto are not changed. The commission refused to make the amount of the reductions public pending the dispatch of official notification to the municipalities affected, but it is understood that the cuts are substantial ones. The last price reduction went into effect about a year ago, and since 1912 at least one cut in rates a year has been announced.

Defective Vision Among School Children Due Largely to Poor Lighting

THERE were 141,000 cases of defective vision reported among school children last year in the State of New York. Furthermore, declared Dr. William A. Howe, head of the health department of the New York State Board of Education, in addressing the New York Section of the Illuminating Engineering Society on May 12, a large percentage of the defects of vision are errors of refraction traced very directly to poor lighting conditions. The child is especially susceptible to eye strain at the school age, and from 8 to 15 per cent of all children have their vision impaired by eye strain during the first few years of school. The illuminating engineer can play a very important part in the remedying of the situation.

F. H. Wood, also of the New York Board of Education, who is in charge of buildings, presented some of the difficulties met with in school lighting, particularly those having to do with structural features. He urged the illuminating Engineering Society to evince an active interest in the matter by submitting a statement on artificial lighting to the Board of Education conference this summer.

Although school lighting as a producer of revenue to the engineer may not be particularly attractive, the possibilities of teaching the principles of good lighting are better in the school than any other place, observed G. H. Stickney, Edison Lamp Works, in commenting on school lighting from the standpoint of the illuminating engineer. Quantity of light has been the most difficult problem of school lighting because many school boards have attempted to economize on this point. Although offices and factories are using higher and higher intensities, schools can be found with very low foot-candle values of illumination. Certainly the product of the schools, continued Mr. Stickney, is far more important than the output of an industry.

N. E. Siegel, director of night schools for the city of New York, stated that 2,000 rooms in the city schools were being used for night-school purposes, but that the illumination was poor, in most cases not exceeding 2 to 4 foot-candles.

Secretary Wallace Opposes Proposed Alaskan Development Board

SECRETARY WALLACE of the Department of Agriculture, in a public statement this week, opposed the bill to create an Alaskan Development Board to take over the activities now carried on in Alaska by the Department of Agriculture, the Department of Commerce, the Federal Power Commission and, to a large extent, the Department of the Interior. The proposed board, among other things, would have control over Alaska water powers. Secretary Wallace holds that the board would remove wholesome checks against exploitation of vast natural resources besides depriving Alaska of the benefits of federal agencies.

"The Federal Power Commission is just now getting established," said Secretary Wallace, "and it is reasonable to expect that under its administration the development of water power throughout the nation will be promoted on sound economic lines. This is a matter of great importance to Alaska. The manufacture of paper is likely to be one of the dominant industries in that territory. A large supply of timber and an abundant supply of water power are essential to this industry. The erection of pulp mills and the development of hydro-electric power in southeastern Alaska will go hand in hand. Therefore it would be most unfortunate if that territory should be deprived of the services of the Federal Power Commission and the power resources of Alaska be placed in the hands of such a board as it is now proposed to create and deprived of the help of all the governmental organizations from which otherwise it might secure technical assistance and advice."

Need for Scientific Research on Large Scale Urged

A SYMPOSIUM of evidence on the benefits to industry resulting from scientific research has been made public by the Engineering Foundation, which is working with the division of engineering of the National Research Council. Among those who have urged the need of research on a large scale are Dr. Charles L. Reese, chemical director of the E. I. du Pont de Nemours Company; A. J. Wadhams, general superintendent of the National Nickel Company; Prof. Joseph W. Richards, Lehigh University; Prof. M. I. Pupin, Columbia University; J. Vipond Davies, president United Engineering Society; H. Hobart Porter of Sanderson & Porter, and George H. Pegram of the Interborough Rapid Transit Company.

Shamokin, Pa., to Have Large Plant.—A three-million-dollar hydro-electric plant for Shamokin, Pa., is planned by the Pennsylvania Light & Power Company, which, it is announced, will utilize an existing dam between Shamokin and Seinburg.

Oshkosh Defeats Municipal Ownership.—The electors of Oshkosh, Wis., recently voted upon a proposition providing for the purchase by the municipality of the gas and electric light plants of the Oshkosh Gas Light Company. The project was defeated by a vote of three to one.

Wireless Progress in Finland.—Finland, which has hitherto had only a small 3-kw. wireless station with a range which would not carry messages much beyond Copenhagen, has just installed two new stations at Helsingfors, a 25-kw. Daniel-Poulsen system and a 35-kw. Marconi system, which will enable communication to take place with the whole of central Europe.

Popular Interest in Electrical Refrigeration. — One hundred visitors every hour examined the exhibits at the recent electric refrigeration show of the New York Edison Company, which lasted for a week. Tradesmen and merchants who wanted to know about equipment for retail shops were most numerous, with those interested in home equipment not far behind. Engineers and engineering students formed a third group, and men desirous of establishing selling agencies a fourth. Heating and ventilating exhibitions will be given by this company in June.

Mexico's Hydro-Electric Progress.—Concerning the hydro-electric plant that is being constructed near Madera, in the Mexican State of Chihuahua, at a cost of $300,000 by the Dolores Mining Company, a dispatch to the *Manufacturers' Record* says: "The plant will generate 2,000 hp., and the electrical energy employed in ore reduction will, in addition to being used to operate the machinery and mill of the company, be transmitted to outlying mining camps and industrial centers for a distance of 40 miles. It is expected that the operation of this plant will solve the fuel question, which for some time has been troublesome in this part of Mexico."

Electric "Fish Stops" Demonstrate Their Efficiency.—An electric device for preventing fish from entering irrigation canals has been perfected by a Washington State county game warden. He sets a double row of steel piles in a frame and drives this in the intake of the irrigation canal. The piles are electrically wired and the current set through them charges a curtain of water about 12 ft. long and the width of the canal. Actual trial, it is said, proves that fish will not voluntarily enter this electrified water, but turn back, and a considerable number of the "fish stops" are to be installed this year in the hope of preventing the loss of millions of fish fry in irrigating ditches.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Wireless Between Italy and United States.—According to an announcement made recently at Rome by the Marquis di Solari, work will soon be begun on a powerful wireless station near Pisa for regular communication with the United States. Operation of the plant in 1922 is hoped for, the Marquis said in an address before the Italo-American Association.

Fish Hawk Comes Out Second Best in Bout with Electricity.—From G. M. Leach, general superintendent of the Atlantic City (N. J.) Electric Company, comes the accompanying picture of the remains of a powerful but imperfectly educated fish hawk which recently attempted to take possession of



a pole near Longport, N. J., to which the company's 22,000-volt transmission line is attached. The bird's head and left wing were burned off, but it scored to the extent of interrupting service for several minutes while the cause of the short circuit was being sought.

Milwaukee Claims Largest Indirect Lighting Fixture.—An indirect lighting unit 15 ft. in diameter and containing 118 lamps has recently been hung over the center of the auditorium of the Alhambra Theater, Milwaukee. This fixture, which weighs nearly 5,500 lb., is said to be the largest of its kind in the world. One hundred of the lamps are rated at 200 watts and the remainder at 60 watts.

Seventy-five per Cent of Canadian Houses Where Energy Is Available Are Wired.—Returns from a questionnaire sent out by the *Electrical News* of Toronto indicate that in Canadian communities where electrical energy is available 74.9 per cent of residential buildings are wired. The percentage of houses using electrical appliances ranges down from 45.7 with electric flatirons and 18.2 with electric toasters to 0.7 with electric dishwashers and 0.6 with electric refrigerators. Five per cent use electric vacuum cleaners, 3.1 per cent electric ranges, 5.9 per cent electric washing machines, 5.4 per cent electric fans and 1.2 per cent sewing-machine motors.

Peru May Nationalize Her Water Power.—A bill sponsored by the Finance Minister was recently introduced into the Congress of Peru which provides for the nationalization of water power in that republic. Under the terms of this bill all water-power concessions will be granted under the provisions of the mining laws by the authorities therein appointed.

Pan-American Conference Backs Radio Development.—The second Pan-American financial conference appointed a permanent committee on communications which has adopted a resolution urging Congress to authorize the navy to accept wireless press messages to and from South America. The committee also favors the enactment of legislation for the erection of a high-powered radio station on the west coast of Africa.

Preparing for Automatic Telephoning in New York.—The new building of the New York Telephone Company on East Thirtieth and East Thirty-first Streets will, it is announced, be completed about June 1. This exchange, which will be equipped with machine-switching apparatus for automatic service, is eight stories and basement in height and has a frontage of 170 ft. on Thirtieth and 101 ft. on Thirty-first Street. The electrical installation calls for eight 80-hp. and four 43-hp. generator sets and 640 $\frac{1}{16}$-hp. duplex motors for the operation of the machine-switching apparatus. It is hoped to inaugurate automatic service at some central offices this year, though it will be several years before the whole city can be served in this way. In the greater city there are now more than 900,000 telephone stations served from 101 central offices.

Hydro-Electric Project to Serve Wellington, N. Z.—The Mangahao hydro-electric project, designed to supply power to the city of Wellington, New Zealand, is thus described by the *Electrical Times* of London: "The power-house site is two or three miles away from the railway station, at the foot of the first range. A tunnel about a mile long is to penetrate these hills to the valley of the Tokomaru and Arapiti streams. In this valley will be the first reservoir, really a lake formed by damming the stream at a narrow gorge just below a wide flat, the site of a growing settlement destined a few years hence to disappear beneath the waters. Beyond the next ridge, which is also to be tunneled, is the Mangahao gorge containing the stream that is to furnish the greater part of the water for the power station. A 90-ft. dam in the Mangahao gorge is to create a second reservoir through the tunnel. A third reservoir is to be formed about a mile and a half further up the stream. The salient feature of the scheme is the diversion of water from the two valleys, set high in the hills, to the power house on the Shannon flat, where the steel pipe lines will deliver it with a head sufficient to drive a group of Pelton wheels coupled to dynamos capable of producing 24,000 hp."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Continued Service to Consumer in Default Is Discrimination. — The Gary Heat, Light & Water Company has been ordered by the Public Service Commission of Indiana to discontinue service to a customer who has refused to pay for gas consumed by him because, owing to tampering with the meter connections by unknown persons, the amount of consumption was not registered on his meter. The commission holds that to continue service to a customer in default is to discriminate against the company's other patrons.

Commission Insists on Full Knowledge of Salaries Paid by Utilities.— Information having been given to the California Railroad Commisson that the salary of the president of the Great Western Power Company includes a percentage of the company's net income, the commission ordered the company to make a report showing the full effect of this arrangement, declaring that, while it sympathizes with officers who object to the invasion of their privacy, it "will at all times insist that information regarding salaries paid public utility administrative officers be given the commission for such use, within reason, as may be deemed necessary."

Apportionment of Bills After Rate Change.—In allowing a gas company to apportion gas bills according to the number of days between meter readings at the date upon which a new rate schedule went into effect the Public Service Commission of Pennsylvania expressed the opinion that "an apportionment on the basis of time is the only practicable method and is one that will work substantial justice, even though it may not be exactly correct for an individual case." In a similar case the Washington state commission ordered that the increased rate should be collected from all customers whose meters were read on and after a certain date.

Departments of Dual Utility Company Must Stand on Own Merits.— Holding in an application by the Elmira Water, Light & Railroad Company for increased street-railway fares that rates for the electric lighting service and the railway service of a dual utility company may properly be considered contemporaneously, the New York Public Service Commission for the Second District insisted that none the less each must stand on its respective merits, declaring: "The consumers of electric light and power should not be called upon to pay higher rates by reason of the fact that the railroad operations were not yielding an adequate revenue, nor on the other hand should the trolley passengers pay a fare more than sufficient to maintain that industry because the electric lighting consumers were not paying an adequate price for service furnished to them."

Decision for Company in Case Where Necessity of New Power House Was Questioned.—In granting increased city rates to the Binghamton Light, Heat & Power Company, the New York Public Service Commission for the Second District refused to deduct from the rate base either the value of an old generating plant still used as a distributing station, storehouse, repair shops and "cold standby" or the value of a new power house built primarily to enable the company to supply adjoining municipalities. The commission disregarded the theory that the old power house would have been adequate to the city's demands, it being established that the rates in the city would be much higher were it not for the new plant. The company was directed to make a study of the subject of service and demand charges.

Increase in Contract Rate Between Companies Authorized.—A dispute over the right of the Narragansett Electric Lighting Company to increase its rate for power furnished to the Attleboro (Mass.) Steam & Electric Company despite the existence of a twenty-year contract has been resolved by the Public Utilities Commission of Rhode Island in favor of the Narragansett company, which has also been authorized to put the new rates into effect without the statutory notice of thirty days. This decision was reached as the result of the failure of the two companies to adjust the dispute between themselves, the commission having previously deferred decision to afford them an opportunity to do so. The commission's order asserts that continued enforcement of the contract rate would result in a loss to the supplying company and thus discriminate against other consumers.

Profitable and Unprofitable Years Must Be Considered Together.—Refusing to accept the theory that surplus accumulated from operating revenues has no bearing on the question of rates, the Connecticut Public Utilities Commission said, in denying the request of a gas company for increased rates: "If a utility company during a long term of prosperous years has been able from excess earnings to set aside a substantial depreciation reserve fund and to accumulate a large surplus account, a considerable portion of which is represented not alone by book entry but by actual cash investment, it should not when an emergency arises disregard such accounts and expect its patrons to meet the emergency and bear all the immediate burdens of maintaining the company at its previous standard." A large cash surplus, the commission held, should be drawn upon in lean years before asking increases in rates.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

N. E. L. A., Iowa Section.—The annual convention of this section will be held at the Inn Hotel, Lake Okoboji, Iowa, on June 22, 23 and 24.

Western Society of Engineers.—The following officers have been elected for this society, their terms beginning on June 1: President, Charles H. MacDowell, president Armour Sterilizer Works; first vice-president, Julius L. Hecht, assistant to vice-president Public Service Company of Northern Illinois; second vice-president, F. F. Fowle; third vice-president, Benjamin B. Shapiro; treasurer, Homer E. Niesz; trustee, Edwin W. Allen.

West Virginia and Kentucky Engineers Organize.—A society to be known as the West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers was recently formed at Huntington, W. Va., for educational purposes. Officers elected are: President, J. H. Edwards, Huntington; vice-president, W. R. Harler, Eccles; secretary-treasurer, Herbert Smith, Huntington. The executive committee will be composed of J. J. Fluck, Huntington; J. S. Shepherd, Omar; C. H. Tyler, Sharples; J. B. Pennman, Deegans; R. R. Webster, Weeksbury, Ky., and Lewis Hill, Winding Gulf.

Coming Meetings of Electrical and Other Technical Societies

A. I. E. E. Section Meetings—Akron, May 25; San Francisco, May 27.

American Society of Mechanical Engineers—Chicago, May 23-26. (For program see issue of May 7, page 1069.)

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27. (For program see issue of May 14, page 1121.)

American Society of Safety Engineers—New York, May 27.

N. E. L. A. Annual Convention—Chicago, May 31-June 3. (For program see issue of May 7, page 1065.)

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Definition of "Police Power."—The following definition of "police power" was given by the Court of Civil Appeals of Texas, in Rumbo vs. Winterrowd: "Police power is that authority which resides in every sovereignty to pass all laws for the internal regulation and government of the state necessary for public welfare." (228 S. W. 258.)*

Manager and Part Owner of Small Utility May Receive Compensation for Injury Received While Doing Manual Work.—The Court of Appeals of New York has found, in Hubbs vs. Addison Electric Light & Power Company, that the manager of a small electric utility who also owned a large part of its stock can recover damages under the workmen's compensation act for injuries received while performing manual duties in the plant, he receiving a weekly salary as manager and his work including the duties during the performance of which he was injured. (130 N. E. 302.)

"High Degree of Care" and "Ordinary Care."—In sustaining a verdict for the defendant in Jackson vs. Goldin, a suit for damages because of electric shock, the Court of Appeals of Georgia found no error in the instructions given by the lower court to the jury as to the degree of care imperative on the maintainer of electrical equipment. The duty to exercise a high degree of care, the court held, does not change the rule requiring only "ordinary care," because "ordinary care" is that reasonable care and caution which an ordinary cautious and prudent person would exercise under the same or similar circumstances. (106 S. E. 12.)

Admissions of One Co-defendant Company in Damage Suit No Defense for Other.—Damages for the death of a boy from a gas explosion in a public street were sought from both the gas company and an electric light company which was alleged to have broken a gas main in laying an electric conduit over it (Nugent vs. Boston Consolidated Gas Company; same vs. Edison Electric Illuminating Company). The Supreme Judicial Court of Massachusetts has determined (1) that the admissions of the gas company or proof of negligence or unauthorized acts on its part were not a defense for the electric company; (2) that the electric company, having placed its conduit in a public way, was bound thereafter to use due care in its maintenance under whatever conditions might come into existence; (3) that the two public service companies could have been found to have been joint tort feasors; (4) that the testimony of a qualified witness that the cause of the break of the gas pipe was the weight of the electric company's conduit on top of a cross, the loose ground under the cross and the settlement of the conduit and vibration of street cars was properly admitted, being competent in the issue of negligence. Verdicts against both companies were sustained. (130 N. E. 488.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Damages Cannot Be Recovered for Neglect to Guard High-Tension Wire Where This Was Not Proximate Cause of Fatality.—In a suit (Golson vs. W. F. Covington Manufacturing Company) brought to recover damages for the death of a child who came into contact with a bare wire that some unknown person had thrown over a high-tension wire maintained by a contractor on the premises of the manufacturing company, it was held by the Supreme Court of Alabama that, although the company was under obligation to exercise reasonable care, including inspection, to guard against danger to persons not trespassers who might go upon the premises, the burden of proof to show that the dangerous condition had existed long enough for the proprietor to have notice of it was on the plaintiff. The Supreme Court sustained the verdict in the lower court for the defendant, holding that failure to guard the high-tension wire was not the proximate cause of the death. Whether the child was a trespasser, an invitee or a licensee was, however, for the jury to decide. (87 So. 439.)

Responsibility of Power Company Because of Contact Between Its Wires and Those of Light Company.—Sustaining a verdict for the plaintiff in Thombs vs. Montgomery Light & Water Power Company, where damages were awarded for the death of a customer of the Montgomery Light & Traction Company, the wires of the latter company entering deceased's home having become heavily charged through contact with the wires of the former company, the Supreme Court of Alabama, however, reduced the damages awarded from $25,000 to $15,000. The Supreme Court held that the trial court did not err in refusing the following instructions to the jury: (1) That a verdict should be found for the defendant if the danger arose from the negligence of another company; (2) that suit should have been brought against the light company; (3) that the negligence of the light company was the proximate cause of the death (this instruction was properly refused for ignoring the issue of concurrent negligence); (4) that defendant owed no duty to plaintiff's intestate to inspect its wires to correct a dangerous condition existing without its negligence. The alleged fact that the light company's wires were erected subsequently to those of the power company was not held to absolve the power company from the duty of inspection. The trial judge, however the Supreme Court held, properly ordered the jury to disregard a plea from the plaintiff's lawyer for punitive damages as a means of influencing the defendant to put its wires underground. (87 So. 205.)

Franchise Covering Night Service Only Must Be Construed According to Its Terms.—Action taken by the State Corporation Commission of Virginia has been sustained by the Supreme Court of Appeals of that state in City of Clifton Forge vs. Virginia-Western Power Company. In this case the company's franchise required it only to furnish incandescent light in the dark hours, but the company had also for ten years been furnishing day service. The latter fact, the court held, did not estop the company from applying to the commission for permission to withdraw daytime service or for a determination of adequate service and proper rates therefor. The commission's powers in the matter were sustained, it being held that under the law the city had ample opportunity to be heard as to the justness of the rates charged. (106 S. E. 400.)

Contracts Between Municipality and Utility Under Michigan Law.—In a contest between the City of Saginaw and the Consumers' Power Company over rates as affected by ordinance and contract, the Supreme Court of Michigan made these among other findings: (1) Where by ordinance a power company had the right to the use of city streets and, subject to maximum-rate and arbitration provisions, the right to fix commercial rates, no amendment of the ordinance was needed to permit it by contract to fix such rates for an agreed period; (2) where a power company included with a bid for street lighting a schedule of rates for other purposes which the city accepted in accepting the bid for street lighting the two proposals became a part of the same transaction; (3) where a contract was to continue for ten years unless the city gave written notice that it should terminate at the end of the first five years and no such notice was given, both parties were bound for the ten-year period; (4) a ten-year lighting contract which allowed an additional seven months for installation of equipment did not violate a law limiting the endurance of such contracts to ten years; (5) the company could not set up an alleged unlawful inducement made by it in entering into a contract as a reason for declaring the contract void, as this would be allowing it to set up its own wrongdoing to defeat the executory portion of its contract; (6) a contract entered into by the city in disregard of a law requiring competitive bidding could not bind the city, and the city, not being itself bound, could not compel the company to perform the contract, but where there is no mandatory provision for competitive bidding the city is bound; (7) a public service corporation cannot refuse to furnish service on the ground that the contract under which it operates lacks mutuality in not stating definitely the amount to be paid. (182 N. W. 146.)

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Charles Edwin Mitchell, president of the National City Company of New York, who has been also elected president of the National City Bank, succeeding James A. Stillman, received



C. E. MITCHELL

his early training in electrical work. After being graduated from Amherst College in 1899 he entered the employ of the Western Electric Company in Chicago. Three years later he was made credit man for the company and shortly thereafter assistant to the president. From this position he was promoted to be assistant manager and received direct supervision of the purchasing and sales departments in the West as well as of the engineering and manufacturing work. In 1906 Mr. Mitchell resigned to become assistant to the president of the Trust Company of America in New York City, which led up to the organization of the investment banking firm of C. E. Mitchell & Company. At the height of this firm's prosperity Mr. Mitchell accepted a call to the National City Company in 1916 as its vice-president and active manager. In October, 1916, he was elected president, which position he still holds in addition to the presidency of the National City Bank. The National City Company is now one of the largest investment security houses in the country and has been closely identified with the financing of many prominent electric public utilities, railroads, industrial, municipal and foreign projects.

G. Gordan Gale has been elected president of the Canadian Electric Railway. Mr. Gale is vice-president and general manager of the Hull (Quebec) Electric Company.

Tate G. Glenn has been appointed service manager of the Consumers' Light & Power Company, Ardmore, Okla.

Renier Beeuwkes, chief electrical engineer of the Chicago, Milwaukee & St. Paul Railway, who has recently received several months' leave of absence, sailed from New York City on May 11 for Panama and South American ports.

C. H. Mueller has been placed in charge of the electrical testing division of the Duquesne Light Company, Pittsburgh, as superintendent. Mr. Mueller was formerly connected with the circuit-testing division.

Benjamin F. Pearson, who has recently been appointed manager of operations of the Southern California Edison Company, will have charge of all of the operations of that company's system. This will include the generating stations, transmission lines, substations and distribution lines. Mr. Pearson formerly was superintendent of the southern division of the Southern California Edison Company, a position he had held since the consolidation of the Pacific Light & Power Company and the Southern California Edison Company in 1917. Before that he was general superintendent of the Southern California company's system. Mr. Pearson has been employed by that company continuously for more than twenty-five years, rising through the positions of



B. F. PEARSON

power-house foreman, superintendent of transmission and superintendent of generation to the post of general superintendent. A more complete biographical notice appeared in the ELECTRICAL WORLD for May 8, 1920.

H. G. Steele, formerly vice-president and manager of the Pittsburgh Transformer Company, is now the president and treasurer of the U. S. Electrical Manufacturing Company of Los Angeles. Mr. Steele was born in Harrisonburg, Va., in 1881, and attended the public schools in Pittsburgh, Pa. Immediately after graduation from school he became associated with the Pittsburgh Transformer Company at the time of its formation in 1899. Beginning with a capital of $10,000 and a total volume of business of $20,000, that company expanded so greatly in twenty years that last year its business totaled more than $2,000,000. Mr.



H. G. STEELE

Steele then sold his interests and became associated with C. E. Johnson of the U. S. Electrical Manufacturing Company of Los Angeles, the latter company being reorganized and Mr. Steele becoming its president and treasurer. This reorganization has been effected with a view toward greatly increased activity. During the war Mr. Steele served as chairman of the transformer committee of the War Industries Board.

C. W. Whiting, consulting engineer, Boston, has been appointed manager of the Wakefield (Mass.) Municipal Light Department for a period of one year. Mr. Whiting has had an extended consulting experience in municipal plant work in Massachusetts, New Hampshire and New Brunswick.

J. N. van der Ley, mechanical and electrical engineer and superintendent of the government service for water and electricity in the Dutch East Indies, is beginning a tour of this country to become familiar with the recent hydro-electric installations. In addition he will make a study of railway electrification and will visit the factories of the principal electrical manufacturers. Mr. van der Ley recently arrived on the Pacific Coast. After visiting all sections of this coast he will travel east through the northern portion of the country and visit Chicago, Niagara Falls and New York before sailing for England.

William G. Yates, formerly general manager of the Adams-Bagnall Electric Company and for more than fifteen years connected with electrical jobbing and manufacturing concerns in the Middle West, has organized the William G. Yates Company of Cleveland to manufacture a light household ironing machine which will be known as the "cottage ironer." While with the Adams-Bagnall Electric Company, prior to its absorption last year by the National Screw & Tack Company, Mr. Yates built up a fractional-horsepower motor business to a production of more than 5,000 a month in less than nine months' time, although previously he



W. G. YATES

had been engaged in sales and administrative work and had had no manufacturing experience. Associated with him in the William G. Yates Company will be several men well known in the electrical industry.

O. H. Koch, one of the members of the American Engineering Council's executive board, has just completed visits to member societies in New Orleans, Birmingham and Nashville. He reports that these societies are very much interested in the activities of the Federated American Engineering Societies.

L. W. Wallace, the executive secretary of the Federated American Engineering Societies, has returned to his office in Washington after a visit to Milwaukee, Detroit and Chicago. At Milwaukee he addressed the Society of Industrial Engineers on industrial leadership. At Detroit he spoke at the annual banquet of the local engineering societies. In Chicago he attended a meeting of the American Engineering Council's committee dealing with the licensing of engineers.

E. E. Brazier, who has been in charge of the automobile accessories sales department of the Capital Electric Company, electrical jobber in Salt Lake City, has been promoted to the position of general sales manager. Mr. Brazier has had a wide experience in the sales branch of the electrical industry.

C. A. Sticht has been appointed New York City district manager for the Valley Electric Company, St. Louis. The office of the company is in the Bush Terminal Sales Building, 130 West Forty-second Street.

Henry R. Towne, head of the Yale & Towne Manufacturing Company, Stamford, Conn., has been elected to honorary membership in the American Society of Mechanical Engineers. Mr. Towne has been a member of that society since 1882 and served as its vice-president during 1884-1886 and as its president in 1889. In 1868 he formed a partnership with Linus Yale, which resulted in the organization of the Yale & Towne Manufacturing Company. Mr. Towne directed this company as president until 1915, when he became chairman of the board.

Frederick Hayes Wilkins, European general manager of the International Western Electric Company, with headquarters in London, has been elected a vice-president of the company. Mr. Wilkins was born at Sennett, N. Y., in 1861, and educated at the University of Rochester. He entered the employ of the Western Electric Company forty years ago, eventually becoming manager of its New York branch. He went to Europe in 1910 to look over foreign trade conditions and a year later was made European general manager of the company.

J. T. Marron, president of the Electrical Construction & Machinery Company, former president of the Marron Manufacturing Company and for twenty-two years a manufacturer at Rock Island, has given up his business associations in that city and moved to Preston, Iowa, where he has purchased the Rural Power Company's plant. A high-tension line will be run from Clinton to Preston, Goose Lake, Miles, Sherlock, Bryan and Spragueville, serving these towns as well as rural districts with light and power. F. M. Burt, secretary of the Electrical Construction & Machinery Company, will be associated with Mr. Marron in the new enterprise. J. J. Murphy, also of Rock Island, will go to Preston as chief engineer of the lighting plant.

R. W. Van Pelt has been appointed sales representative for the St. Louis territory for the Maring Wire Company, Muskegon, Mich., manufacturer of enameled, cotton and silk-covered magnet wire.

Senator William B. McKinley, president of the Illinois Traction System, was elected president of the Mississippi Valley Association at its recent meeting, held in New Orleans.

H. N. Spencer, president of the Howell Motors Company, Howell, Mich., is spending a year or more in New York making a study of corporation finance in preparation for a program of expansion to be undertaken in about two



H. N. SPENCER

years. Mr. Spencer, who is also president of the Spencer-Smith Machine Company, was one of the founders of the Howell Motors Company five years ago. The company has had a very rapid growth, its orders last year being in excess of $1,000,000.

Victor T. Goggin, late New England sales manager of Fred T. Ley & Company, Inc., of Springfield, Boston and New York, has severed his connection with that concern to associate himself as contracting engineer with Dwight P. Robinson & Company, Inc., of New York City.

Obituary

Frank Clifton Owen, treasurer of the Miller-Owen Electric Company, Inc., Pittsburgh, dealer in electrical supplies, died on April 22.

Robert G. Tobey, for thirty years secretary of the Massachusetts Gas and Electric Light Commission, predecessor of the Massachusetts Department of Public Utilities in gas and electric company regulation, died at Boston on May 5. Mr. Tobey was born at Falmouth, Mass., in 1840, and prior to his connection with the commission was treasurer of the Mount Washington Glass Company of New Bedford, Mass. He was closely identified with the administration of the accounting system prescribed for the utilities of Massachusetts and for the municipal plants of the state.

Charles Hosmer Morse, for many years chairman of the board of directors of Fairbanks, Morse & Company, manufacturers of engines, motors and pumps, died at Orlando, Fla., May 5, after an illness of two months. He was eighty-eight years old. Mr. Morse entered the employ of the company, then known as E. & T. Fairbanks & Company, in 1850, and became president in 1872. He was a director of the First National Bank, the First Trust and Savings Bank and the National Safe Deposit Company, all of Chicago.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Refractory Prices Lower Under Reduced Output

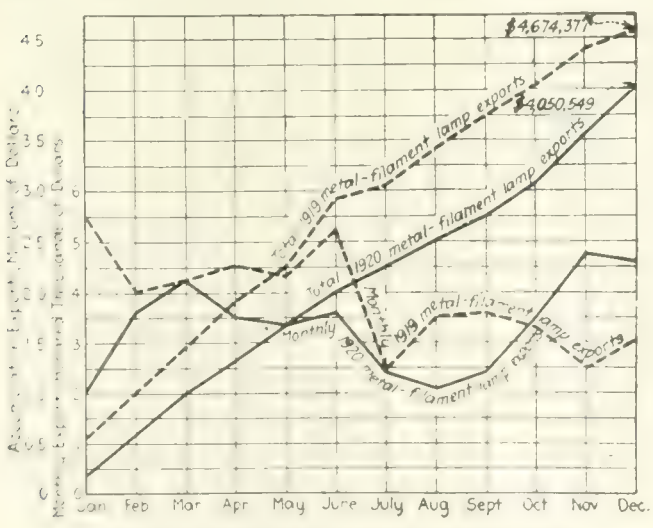
WITH the iron and steel mills operating at somewhere around a 40 per cent rate and with glass makers operating at about 25 per cent normal capacity, the demand for refractories likewise is at a low ebb. Production, consequently, is in the neighborhood of 25 per cent, some of the larger producers working at a slightly higher rate, while among the smaller producers some shutdowns have been reported. Stocks, however, are in sufficient quantity to last over three or four weeks of normal demand, but at the same time steel mills still have some materials on hand.

This supply at the refractory plants should prove of assistance on a returning steel market. An improved sentiment has been noticed in this industry, particularly in the automobile field. Although this outlet consumes only about 5 per cent of the steel output, an increase in automobile consumption at this time is an encouraging condition.

Recent price reductions in the refractory market brought Pennsylvania fireclay brick down $2 per 1,000, while in the middle of April magnesite brick was reduced $10 per net ton in standard sizes, silica brick came down $5 per ton, $5 per net ton was applied to chrome brick and from $2 to $5 to fireclay brick.

Metal-Filament Lamp Exports Lower in 1920

DURING the year 1920 exports of metal-filament lamps from the United States showed a lower value than they did in 1919 in the ratio of $4,050,549 to $4,674,377. It is significant that Brazil, Argentina, Colombia, Peru, Chile and Uruguay—all South American countries—purchased far fewer of these lamps from the United States in 1920 than in 1919. Venezuela, however, increased her amount. It is known that since the armistice Germany has been paying considerable attention to the South American market. Likewise Australia, British South Africa and British India bought fewer in this market in 1920 than in 1919, while New Zealand increased her purchases of American lamps. A tie-in with British lamp producers would not be unexpected here.



MONTHLY LAMP EXPORTS SHOW NO REGULARITY

In the table below, the figures in which were compiled by the ELECTRICAL WORLD from Bureau of Foreign and Domestic Commerce data, there are sixteen countries which in 1920 imported over $50,000 worth of American metal-filament lamps. Further more, the succeeding five countries, although they were under this amount in 1920, in the year 1919 imported very much higher amounts. The six-teen highest countries in 1920 imported $3,559,697 worth of lamps, while in the year previous they took from the States $4,275,583 worth. Consequently the remaining sixty-five countries absorbed almost 25 per cent more lamps in 1920 than in 1919 in the ratio of $490,852 to $398,794.

Canada continues as the heaviest importer here, and Cuba and Mexico also are holding up well.

1920 AND 1919 METAL-FILAMENT LAMP EXPORTS

Country	Value of 1920 Exports	Value of 1919 Exports
Canada	$974,411	$901,927
Cuba	605,747	262,210
Brazil	465,451	686,672
Mexico	315,489	352,392
Belgium	166,431	31,788
Argentina	153,266	449,169
Australia	117,052	231,555
Colombia	89,432	125,799
Italy	80,546	197,742
Panama	71,932	38,456
New Zealand	70,954	59,094
British South Africa	68,846	126,937
Peru	65,149	99,561
Venezuela	57,795	32,707
Chile	57,283	147,784
China	50,604	33,630
Uruguay	36,611	93,903
Philippine Islands	35,731	161,349
British India	35,067	72,819
Dutch East Indies	24,046	98,922
Denmark	17,854	71,167
65 miscellaneous countries	490,852	398,794
Total metal-filament lamp exports	$4,050,549	$4,674,377

Good Future Seen in Steel Transmission Tower Market

A SURVEY of the foreign and domestic market for steel transmission towers reveals fairly uniform conditions among producers. Present activity at home and abroad is very light, there being little or no demand for this class of material as yet this year. Furthermore, there does not seem to be much prospect of greater buying developing later in the year, for customers are still holding off for lower prices and difficulty in financing new transmission projects continues to retard the market.

In view of the position of this market as a barometer in the electrical industry, however, it is gratifying to note that producers are generally quite optimistic over the future. At the present time several companies report that they are receiving a large number of inquiries both in the United States and from foreign countries. Actual orders, as stated heretofore, are not being placed, but at the same time the pulse of the market is being closely felt and interest on the part of central-station companies and electric railways is considerable. From all accounts it seems that there is a large potential demand which is being held in abeyance.

The average base price on galvanized material used in fabricating steel towers is now said to be about 7 cents. There does not seem to be much chance of further price de-

creases being made, it is stated, unless steel declines further. The extent of price reductions made by different producers varies somewhat, but in a representative instance prices have receded approximately 30 per cent from the peak reached about one year ago. This figure is based upon the cost of one particular job which was figured last spring and finally held over until this year.

Deliveries can be made promptly, for though the finished product is not stocked, steel mills are keen for business and fill orders in quick time. Some producers are also carrying good stocks of material ready for fabrication.

Active Market for Electric Signs and Accessories

THE electric sign business is one branch of the electrical industry that seems to be quite active at this time. Spring months have brought in a good amount of business, and this is expected to continue until well into the summer months. The New York territory is reported to be the most active, and communities in that neighborhood have been buying well. Boston is good, and New England as a whole presents a fair market. Chicago and Detroit centers also show fair activity, although the Southern States are not so good.

The above may be applied to what may be termed the strictly electric sign business, both flasher and continuous. Within the past few years small automatically operated advertising signs in cabinet form, table signs, counter and showcase signs and window signs—some continuous, some motor-driven, some flasher-controlled—have come into the market in large numbers and varieties, and new developments in this type of sign are appearing all the time. Their market is strong and it is getting more active continually.

With all the activity the factories are not quite up to capacity as a whole. Standard equipment can be shipped in two days to a week, but it takes up to three weeks to get out special designs and sizes, except in the largest sizes for roof placement. Flashers, lamps, color caps, sockets and receptacles and other accessories can be had quickly. As with the signs, the accessories too are having a good call, flasher signs becoming more popular.

Prices show little tendency to drop. Lamps are still unchanged in price, as are flashers, porcelain, sockets and labor. Wire is lower, and with it sheets and paint. Time clocks for sign control are finding an active market, and their deliveries are running up to three months' time.

Flexible Armored Conductor Prices Are Shaded

PRICES of flexible armored conductor are being readily shaded, a survey of the situation reveals. There is keen competition for business among producers with considerable shopping around on the part of buyers, so that as large a concession as $5 per 1,000 ft. below the prevailing market price is being granted by some of the smaller manufacturers. The general Pittsburgh base price quoted at present is $55, with 5 per cent off for cash.

A fair current amount of business is being received, sufficient to maintain operation of plants, though probably twice as much as is being produced at present could be turned out if necessary. Steel strip is not being stocked by cable manufacturers in large quantities, despite the reduction in price made about the middle of last month coincident with the drop in steel prices. A large producer is now quoting $8.75 per 100 lb. on steel strip in carload lots, this price representing a drop of 75 cents about a month ago. Deliveries of this material are made in two weeks or less, as demand for it is only fair.

Good stocks of flexible armored conductor are held throughout the country so that immediate shipments can be obtained, but the general policy now is to reduce inventories. The market is expected to continue rather quiet through the greater part of this year, for although there is a good volume of building work on the horizon, it will very probably be postponed awaiting lower labor and other costs.

British Manufacturers Active in Standardization

DURING the war the great importance of standardization in the economic production of machinery and apparatus on a large scale was deeply impressed upon the members of the British Electrical and Allied Manufacturers' Association. At the annual general meeting of this association, held on April 17, it was brought out that in order to deal more effectively with this work several sections have set up permanent technical committees, usually in conjunction with the standardization committee, and these are carrying out work to form foundations on which the British Engineering Standards Association can build a final text. They comprise the accessories, dynamo and motor, switchgear, instrument, meter and transformer committees, and they have prepared drafts and specifications for dynamos and motors, carbon brushes, enameled wire, plugs and sockets, lamp holders, motor starting and controlling switches, etc.

The switchgear section has prepared a revised edition of its purchasing specifications, slate panels and slabs, and in collaboration with the insulation section has standardized a complete line of molded insulating bushings for use in switchgear and allied work. The industrial instrument section has also, in collaboration with the switchgear and meter sections, provided standard drilling centers for the ends of instruments and meter shunts. These standardizations will be embodied in future editions of the association rules. The stationary and portable storage-battery sections have standardized the relative capacities of batteries of all rates of discharge, together with final voltages. Standard curves have been plotted, and these have been accepted by government departments and large buyers. A curve for portable storage batteries has been adopted as a standard British practice by the Association of Motor Manufacturers and Traders.

The Metal Market Situation

PRESENT demand for copper is quiet, but there has been some firming of the market since a week ago. This has been caused chiefly by increased export buying which resulted from Germany's agreeing to the reparations settlement. This buying, which came largely from Germany and Japan, was brisk last week, but since then has fallen off. The clarification of the European outlook, however, is expected to improve the international credit situation, and this in turn should react on copper buying.

Domestic demand is only fair, but producers are holding to their prices firmly. Meanwhile the statistical position continues to improve, for production is being cut to the bone. The general asking price for prompt and May shipment is 13 cents delivered, with 13⅛ cents for June, though it is understood that one interest at least is shading these prices. Little business is being done in the outside market.

Sheet zinc changed to 10 cents, the market remaining quiet with no selling pressure. The tin market is dull as the chief consumers, the tinplate makers, are buying little or nothing. Lead holds its recent advances, but its position is slightly easier, owing in part to declines at London.

NEW YORK METAL MARKET PRICE

	May 10, 1921	May 17, 1921
Copper	£ s d	£ s d
London, standard spot	72 0 0	74 2 6
	Cents per Pound	Cents per Pound
Prime Lake	13 00—13.25	13.00—13 25
Electrolytic	12 75	13 00
Casting	12 12½	12 25
Wire base	14 50 15 00	14 50 15 00
Lead, trust price	5 00	5 00
Antimony	5 25	5 25
Nickel, Ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	11 00	10 00
Zinc, spot	5 40	5 35
Tin	31 87½	33 00
Aluminum, 98 to 99 per cent	28 00	28 00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 00 10 50	10 25 10 62½
Brass, heavy	5 50 - 5.75	5 25— 5 50
Brass, light	3 75— 4 00	4 00— 4.12½
Lead, heavy	4 10 4 37½	4.25— 4.50
Zinc, old scrap	2 87½ 3 00	2 50 2 75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

BUSINESS conditions in the electrical supply jobbing trade show up a little better in reports from Chicago, St. Louis and Atlanta. There is considerable unevenness in New England, New York shows no change for the good, and the West Coast is about in a similar condition. Improved collections are noted in Chicago and St. Louis, small contractors in the South seem to be paying cash, New England shows up spotty, and the West has no better report.

Farm-line materials are moving better in the Middle West with better crop movement. Residence wiring supplies and appliances have a good call in St. Louis territory. Meters are fair. The South is improving in wiring supplies sales, and municipalities and small central stations are buying better. In New England ranges, washers and storage batteries stand out well in sales. Conduit fittings and outlet boxes are reported 15 per cent lower there. California building permits for April excel those for last April. Washers are moving well. In the Northwest washers also are moving well, building is under way, and second-hand motors, wire and conduit are reported in a strong market.

A new catalog, No. 23, shows list or discount changes effecting reductions in Benjamin lines, except in panelboards and marine items.

NEW YORK

Trade in the electrical industry remains unchanged in this section. Jobbers report that the market is very quiet on all supply items, but some, however, continue to see a slight upward trend. Stocks are down low and are being kept there, for buying in every department is for maintenance only. The credit situation remains unchanged, being far from satisfactory on the whole.

With the light demand that is felt competition is naturally very keen and prices are readily shaded. This is reflected in soft quotations on armored cable and on rubber-covered wire. Manufacturers have recently announced price decreases on several electrical lines. Renewable fuses have dropped about 17 per cent, fuse wire and links 20 per cent. floor boxes 17 per cent, steel switch boxes 10 per cent and connectors from 12 to 22 per cent.

Conduit.—Not much is moving and stocks are down fairly low. Prices show no change over those quoted last week.

Flexible Armored Conductor.—The market has further softened with considerable competition among jobbers. Demand is very light and stocks are down. As low as $55 for 1,000 ft. of No. 14 double-strip is quoted by reputable houses this week.

Non-Metallic Flexible Conduit.—Little or no supply is moving. Manufacturers' prices are unchanged, with jobbers quoting from $22 to $24.25 on 1,000 ft. of ⅜-in. and from $24 to $26.25 on ½-in.

Tape.—Prices cover quite a range, from a low of about 40 cents on friction and 36 cents on rubber to a high price of 50 cents per pound on each, lots of 100 lb. Buying is slight and stocks are low.

Rubber-Covered Wire.—Conditions have not changed any. The price of No. 14 single-braid in 10,000-ft. lots varies from $6.75 to $7.50 per 1,000 ft.

Fuses. — Price reductions on renewable fuses are announced by several manufacturers, effective May 16. The cut is virtually uniform and amounts to an increase of ten points in the discount, or about 17 per cent.

Fuse Wire and Links. — A leading manufacturer has reduced prices about 20 per cent by increasing the discount allowed distributers 15 points.

Boxes.—At least one manufacturer has reduced the price of floor boxes 17 per cent, effective May 16. The change was made by increasing the discount ten points. From another source comes word of a decrease amounting to 1 cent each on steel switch boxes, effective May 6. This is equivalent to about 10 per cent.

Connectors. — Armored conductor connectors are lower. Effective May 12, one manufacturer reduced certain types $10 per 1,000 and on others which were quoted at list is now giving 20 per cent off. Another producer, effective May 16, made a flat cut of $5 per 1,000, bringing prices to the same level as those effective by the ten-dollar decrease above mentioned.

CHICAGO

A slightly improved market is noted on all sides this week, not alone in the electrical field. The slight change for the better in the number of men out of employment is felt in increased retail sales in all lines, and the gradual liquidation of crops by the farmers in the Northwest is causing an improvement in conditions there This was reflected by the placing of orders for equipment of several farmer lines and by a better tone to the market for line material.

Aside from farm-line equipment, there is little activity in power apparatus. Prices have stood firm, but the scanty volume of inquiries seems to indicate that price has little to do with the volume of sales. The only requirements for motors, either large or small, are for replacement and fill-in purposes, a few going to machinery dealers. Rural collections are better.

Locally the conditions are unchanged. The construction lockout persists, with the unions sticking firm and the contractors talking of reducing their offer for skilled labor still further. The probability is that a compromise will be effected at somewhere in the neighborhood of $1.05 per hour. If peace comes in time, it means the immediate start on upward of $30,000,000 worth of work of all classes.

Bare Copper Wire.—As was the case two weeks ago when the market on electrolytic sagged sharply, bare copper wire has failed to follow this week's fluctuations in price but has stood firm at $16.50 per 100 lb. in ordinary quantities. On large sales prices 1 cent lower are mentioned. Sales are quite numerous but are confined almost wholly to small orders.

Insulated Copper Wire.—Prices on insulated wire remain unchanged, the base on weatherproof holding firm at 16½ cents per pound. This makes the quotation on No. 6 triple-braid 17 cents per pound in 1,000 lb. lots. Rubber-covered is finding small sale owing to restricted building conditions in this city and is quoted at $7 per 1,000 ft. in 10,000-ft. lots.

Black Conduit.—The slight reduction reported three weeks ago has induced no boost in business, as with no building in progress there is no demand for pipe. Quotations are unchanged at $62 per 1,000 ft. for ½-in. in 5,000-lb. lots.

Flexible Armored Conductor.—Reduced building requirements and firm prices combine to hold sales at a low level. While present prices are said to be justified by costs, much talk is heard of the price being too high. In 5,000-ft. lots $62 per 1,000 ft. is asked for the No. 14, two-wire.

Line Hardware.—No recent change in prices has occurred, and orders are not in proportion to inquiries. Typical prices are: For hot-galvanized cross-arm braces, 1¾ in. x ¼ in. x 24 in., N. E. L. A. specification, less than 500, $168.72 per 1,000, 500 to 1,500, $149.97 per 1,000, over 1,500, $132.33 per 1,000; for hot-galvanized machine bolts, ⅝ in. x 12 in., in similar quantities, $14.35, $12.75 and $11.25 per 1,000.

Lineman's Tools.—All talk of shortage of lineman's tools has disappeared. Prices are unchanged. Price to dealers on a Klein No. 102-1, 7-in. splicing clamp is $28 per dozen; on a No. 201, 7-in. side cutting pliers, $30 per dozen. Inquiries are plentiful and orders show some improvement in the last few days.

Ground Tools.—No new price lists have been issued since Jan. 15, and prices established at that time seem high in the light of sharply reduced raw-material costs. Heavy maple peavies, 2½ in. x 4½ ft., are $43.40 per doz.; fir pike poles 2½ in. x 14 ft., are $36.10 per dozen, and maple-handled spoons, 8 ft. long, are $38.30. Reductions are freely predicted, and as a result sales are light.

BOSTON

Reports indicate uneven trade conditions this week, some days displaying good orders and others a quiet demand. A better feeling, however, dominates most branches of the industry. Bright spots on the business map are labeled "electric ranges," "washing machines" and "storage batteries." Stocks are excellent in most lines, although if the public should begin buying on a large scale long deliveries would not be unlikely in some commodities. The building and engineering contracts announced last week in New England totaled $5,230,100, which is a considerable improvement over the late winter records. The open-shop idea continues to gain headway around Boston notwithstanding long-drawn-out strikes. Collections are spotty, some of the best settlements being on a sixty-day basis. Few good accounts, however, are running as long as ninety days. Improvement in business is noted in the Vermont stone-quarrying field, and in some seaside towns north of Boston the use of electricity is rapidly accelerating from week to week. Prices showed weakness in non-metallic flexible conduit this week, and conduit fittings are off about 15 per cent.

Electric Ranges.—Demand continues good, with increasing inquiries. A leading New England factory is running five days a week and is making stock deliveries. Some retailers reporting other business quiet speak of the range outlook as unusually good. Prices are steady.

Flexible Armored Conductor.—Little of this material is changing hands. Prices are soft, No. 14 single-strip selling at Boston for $55 per 1,000 ft. in 5,000-ft. lots.

Non-Metallic Flexible Conduit.—Prices are a little weak and the demand is very moderate. The $\frac{7}{32}$-in. size sells for $21 per 1,000 ft. in 5,000-ft. lots, the $\frac{1}{8}$-in. size bringing $23.50.

Wire.—Rubber-covered No. 14 sold Monday for $7.25 per 1,000 ft. in a representative 5,000-ft. lot, but prices are not very firm in the face of actual orders. Weatherproof base is around 16 cents and bare base about 15½ cents. Wire prices are unsettled. No great demand exists.

Radiant Heaters.—Despite a poor spring for electric radiators, jobbers are ordering conservatively for the fall trade and some factory orders are being put through. Warm weather during the period of low fires hindered sales. Some summer business is in sight, however. Prices show little change.

Conduit Fittings.—A decline ranging around 15 per cent is announced in outlet boxes with two or three exceptions. Representative discounts from list are as follows: Stamped steel boxes and covers, black, 25 per cent; galvanized, 15 per cent, on less than $10 list. From $50 to $500 list the black boxes are quoted 40 per cent and galvanized 33⅓ per cent. Gang switch boxes, less than 100, are quoted 15 per cent on black and 5 per cent on galvanized. Boxes for flexible armored conductor sell for 25 cents each in lots of less than 50 and for 20 cents each in lots of 100 or over.

Motors.—Although motor sales are at a low volume, odd purchases here and there keep adding to central-station loads. Shoe and accessory plants are buying motors in a small way and many companies are noting a steady though moderate net gain in connected power loads.

Fans.—Deferred warm weather has kept the fans on the shelves so far. Little preliminary buying is reported.

Knife Switches.—A rearrangement of prices is announced on the basis of discounts from double-manufacturers' list. A leading type shows a discount of 42½ per cent off double list on less than $50 list to 57½ per cent off in $400 list and over. Revived building operations are absorbing moderate quantities of wiring material.

ATLANTA

Electrical jobbing firms report that the last ten days have witnessed considerable improvement in their business, especially in lines of building and wiring material, the movement of household appliances, however, continuing rather dull. Most of the orders that are being received are coming from the small contractors who in a great many instances are paying cash for their purchases. The larger contractors, however, have placed no heavy orders as yet, though an unusual amount of interest is being displayed through requests for quotations on large prospective purchases. Activities in the rural districts and small towns, as a whole, continue slow, though it is reported that around the large mill centers, particularly in North Carolina, the demand for electric wiring material is better than it has been for some months past. The peach crop in middle Georgia has begun to move, and prospects indicate the finest season for this fruit that has been experienced for many years. Unless some unforeseen event interferes, the marketing of this crop should put between $7,000,000 and $10,000,000 in the fruit section of this state within the next thirty days. This will, of course, relieve the financial tension and stimulate business activities throughout the middle part of the state.

No further change is to be reported from the industrial field, most of the textile mills being forced to undertake a fair percentage of curtailment, while the fertilizer plants are not up to their normal operating schedule. Jobbers report an increasing number of orders from municipalities and small central stations, the demand being largely for maintenance material and, in a few isolated instances, for new construction.

Ranges.—No activity worthy of note can be reported; stocks continue heavy and few inquiries are being received. There has been no further price reduction since that of approximately sixty days ago.

Outlet and Switch Boxes.—These are moving very nicely and stocks are being maintained in good condition. Shipments have improved materially, orders being filled by factory within ten days of their receipt.

Vacuum Cleaners.—Despite the fact that at this time of the year cleaners should be moving briskly, few sales are being reported. Stocks accumulated in anticipation of a demand have not been disposed of and large quantities are on hand throughout the territory.

Flexible Armored Conductor. — This continues to move very satisfactorily, one of the largest jobbers reporting the receipt of orders this week sufficient to wipe out current stock. Other jobbers have very fair stocks on hand and report shipments good. Price, two-wire, No. 14, single-strip, $72 per 1,000 ft.

Lock-Nuts and Bushings.—Jobbers have been unable to reduce their holdings materially on this item, in which little or no demand is discovered. No material movement is anticipated until pipe is in more demand.

Dry Batteries.—Rural telephone companies are taking the normal supply of batteries, and sales to commercial houses continue to hold up well. No price changes are noted and stocks are in good condition.

Fuses.—Cartridge fuses are very slow, but plug fuses in the 5, 10 and 15-amp. sizes are reported quite active, apparently indicating activity in the small residence and commercial line. Stocks of both types are in excellent shape.

Wire.—Another price reduction of 5 per cent in rubber-covered is reported this week. The movement of rubber-covered continues about the same as for several weeks past, the price reduction apparently not stimulating sales. Weatherproof in popular sizes continues to move fairly well. Stocks of both varieties are on hand in quantity. Price, No. 14, lots of 5,000 ft., $7.55 per 1,000 ft.

ST. LOUIS

Except for a cut in the price of copper wire, there was no development of especial importance during the past week. This reduction, coming at a time when every one was feeling that the bottom in the market for wire had been reached.

had a tendency to confuse the buyers of wire, and a decrease in sales for the week is reported. It is now generally felt, however, that the absolute bottom in price has been reached, and a tendency to stock is expected on the part of contractors. Appliances are showing a healthy increase in demand, particularly in those items which are featured during the summer months. Demand for materials entering into the construction of residences shows steady improvement, but that for industrials is still quite slow.

Many of the manufacturers have a fairly satisfactory demand, while others are working on a hand-to-mouth basis, particularly in the metal industries. Rolling mills are operating intermittently as orders accumulate and iron foundries are doing practically nothing. The demand seems to be waiting for lower cost of iron and steel, lower freight rates and lower wages. The railroad situation is not at all satisfactory, first because the high rates tend to eliminate the distant markets, and second because their financial position does not permit extensive purchasing, the lack of which has a noticeable effect upon local industries.

Collections are reported to be improving, the average basis being from forty-five to sixty days. Money is easier than it has been for some time, but conservatism still marks the loans now made. On the whole, it can be said that the business situation during the week shows improvement.

Wire.—A reduction of 1 cent per pound in the base rate on bare, weather-proof and rubber-covered marks the past week. The new base is 15 cents. No. 14 rubber-covered, in 25,000-ft. lots, can now be purchased from $6.50 to $7 per 1,000 ft., and in special cases probably as low as $6.35. The demand for bare and weatherproof continues dull, and that for rubber-covered shows some decline because of uncertainty of the market. With the present prices, which would appear to be as low as they can possibly get for some time, it is expected that a materially improved demand will soon appear. The reduction is attributed to reduction on the part of manufacturers as the local stocks are not considered at all heavy except in one or two instances.

Flatirons.—A reduction in the list price of several makes was made last week. Stocks of all irons are in satisfactory shape and the demand is reasonably good, gradual improvement being noted as the summer season approaches.

Meters.—One jobber reports a normal demand for meters and others report a reasonably good business. This is occasioned by the increased residential construction and the transmission extensions being made by the utilities.

Flexible Armored Conductor.—Lower prices prevail, No. 14 double strip being about $5 per 1,000 ft. lower and selling around $60 per 1,000 ft. in 5,000-ft. lots. Stocks are somewhat heavy, and the demand, while still low, shows slight improvement.

Flashlamps.—The demand shows improvement and the market is quite steady. The call for battery renewals has at no time since the present depression began shown any weakness and all jobbers are reporting a good renewal business.

Commercial Lighting Fixtures. — A fair business is reported and stocks are said to be on a reasonable basis. The low demand is due to the lack of industrial and construction activity.

Fans.—As the summer season approaches the jobbers and retailers are doing practically no buying, for it is appreciated that the manufacturers have large stocks which can be drawn from in the event of heavy demand. None care to have extensive stocks on hand at the end of this season, it being anticipated that prices next year must be lower. The prices of the fans this year may be a detriment to the retail trade.

SAN FRANCISCO

The seamen's strike is still unsettled and few cargoes are being shipped. The San Francisco strike of seventeen affiliated building trades unions is still continuing and all work on all large buildings is at a standstill. Sooner or later this will automatically stop electrical work, as is evidenced in the present cautious buying of wiring staples. This 7½ per cent wage decrease has extended to Oakland and other bay cities, where it has begun to affect the building.

The value of the building permits issued during April, 1921, in the four principal California cities is as follows: San Francisco, $1,913,592; Los Angeles, $6,915,216; Oakland, $1,321,246; San Diego, $1,657,055. The figures for April, 1920, were as follows: San Francisco, $2,000,672; Los Angeles, $3,076,763; Oakland, $765,797; San Diego, $294,-511. These figures reflect very fairly the present condition of the electrical wiring business in each city as compared with that for the same period last year.

Household Material.—The sale of washing machines is very quiet, that of vacuum cleaners much better, of dishwashers excellent. Sewing machines are rather quiet. Simplex ironing machines recently dropped from 15 per cent to 20 per cent in the standard sizes. A significant feature is the number of special demonstrations on all household devices now being held by the larger merchants.

Telephones.—Telephone sales are rather quiet, whether for intercommunicating, hotel or apartment house installations or for rural lines. Deliveries are better and local stocks fair in variety. Comparatively few so-called farmers' lines are being built or are even under serious consideration.

Fans.—Although the actual fan season will not be here for at least another month, advance sales point to a very big season, exceeding last year's, and this despite the fact that the spring has been unusually backward.

Farm Plants.—Sales of farm plants are running considerably behind last year. There are probably three factors responsible, the failures of growers in many rural districts to dispose profitably of last year's crops, a general expectation by the buying public of decrease in all lines, and slackening of sales efforts for these reasons.

SEATTLE—PORTLAND

Sales volumes and business in general among the electrical fraternity during the month of May to date have been about the same as during April. Jobbers attribute present conditions to lack of interest on the part of the buying public and to the number of failures of small dealers throughout the district, mainly in the surburban towns. The same conditions are expected to place other dealers out of the running within sixty days unless business picks up materially. The outlook for summer business is not promising, although a comparatively ambitious building program of public and semi-public buildings just starting is expected to augment sales volumes, particularly of schedule materials, wiring and conduit. Washing machines are strong sellers at present, although the sales of this appliance are not nearly so large as could reasonably be expected. A temporary decrease in prices of several makes of ranges amounting to approximately 25 per cent obtaining for about sixty days enabled manufacturers and jobbers to move stocks, although they were forced to accept losses. Now ranges are selling for their original price, which is expected to hold until fall. It is believed that rubber-covered wire is at the bottom but that others of these bread-and-butter articles will show further decreases, the drops coming slowly.

Portland manufacturers report that conditions have not changed except that there is a more optimistic feeling expressed than there was a few weeks ago. Jobbers report business spotty. Collections are poor and cannot be forced. Contracting in Portland still continues uncertain, and the retail stores have nothing encouraging to report.

Motors.—Jobbers, especially in Seattle, report that there are enough second-hand motors on the market to curtail new sales for a year. These came from industrial war-working plants, including shipyards which have been or are being dismantled. Second-hand motors in good condition can be purchased for half price, and industrial plants, including lumber mills contemplating electrical installations, are taking advantage of this opportunity. Considerable second-hand wire and conduit in the hands of junk dealers purchased from war-time industrials is hampering sales of new materials.

Fixtures.—Sales volumes are showing a nice increase, with continued increase in residence construction. Stocks are in good shape and prices are holding comparatively firm.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Triangle Conduit Opens Factory in Chicago

On May 5 the Triangle Conduit Company, Inc., Brooklyn, N. Y., opened its Western factory at 1965 West Pershing Road, Chicago, where there is 15,000 sq.ft. available for manufacturing space. Armored conductors, armored lamp cord and flexible steel conduit will be manufactured in this new plant, but stocks of the company's non-metallic flexible conduit, "tri-cord," etc., will be carried there in addition to stocks of the steel materials made there.

New Manufacturers' Agent Opens in Detroit

E. G. Bartling, who was formerly associated with W. D. Woolley in New York City, has established an office in the Detroit Savings Bank Building in Detroit. He will act as manufacturers' agent and up to date has taken on the representation of the Federal Porcelain Company, Carey, Ohio; Fernando C. Mesa, Irvington, N. J., in porcelain lines, and the William Wurdack Electric Manufacturing Company, St. Louis, for switch boxes.

Lalley Light Figuring on Peace-Time Costs

In commenting upon the general conditions which today hold up the economic course of business, and which are gradually clearing, William H. Lalley, president of the Lalley Light Corporation, Detroit, states that he has ignored his inventory and commitment prices, figured on present material markets, and where these have not reached the levels he feels that they should reach has speculated on such suppliers soon seeing the light of reason. And with it all, only a fair margin of profit—based on peace-time ideas and not war-time ideas—is figured.

Trust Company Finances Payments on "Universal" Washers

In order that "Universal" dealers may have the necessary capital to finance business taken on a time-payment plan, Landers, Frary & Clark, New Britain, Conn., have made an arrangement with the Commercial Investment Trust Company, 347 Madison Avenue, New York, whereby all dealers who can submit to them satisfactory credit references will be enabled to finance, without drawing on their own capital, their sales of "Universal" electric clothes washers with deferred payments running over a period of twelve months. The manufacturer states that the plan is simple in its working and is limited in amount only by the individual dealer's credit and resources.

Westinghouse's Annual Report Shows Favorable Balance

Billings of the Westinghouse Electric & Manufacturing Company for the fiscal year ended March 31, 1921, from the company's annual report just issued, amounted to $150,980,106.39. The estimate for the calendar year 1920 was $150,000,000, as shown in the April 9 issue of the ELECTRICAL WORLD. The net manufacturing profit on the year's business was $12,206,021, even after taking out $5,315,196 for depreciation and adjustment of inventories. An appropriation for a special contingent reserve of $5,000,000 has also been made from surplus to provide for further possible shrinkages and adjustments in the inventories. Total surplus on March 31, 1921, amounted to $56,053,299 after adding a net income for the year of $12,617,535.

Property and plant account shows an increase over the previous year of $9,361,403 and embraces construction completed during the year. An important extension was made to the works at Lester, Pa., where the manufacture of steam turbines, condensers and marine propulsion apparatus is now concentrated, making available additional manufacturing space at East Pittsburgh for electrical apparatus. An additional lamp factory was erected during the year at Indianapolis, Ind., and extensions were made to the plants at Milwaukee, Bloomfield, Bridgeport, Mansfield and East Springfield, Mass. Developments and investments were made in the wireless field and other high-frequency current fields.

Accounts receivable amounted to $34,551,599, while inventories embrace $80,724,389. Total capital stock is $74,812,650.

Time-Clock Maker Still Long on Shipments

The time-clock business of the electrical industry is one branch that apparently is maintaining a high level of activity. Albert & J. N. Anderson Manufacturing Company, 289 A Street, Boston, is running at high capacity, and shipments on time clocks for street lighting circuits and sign circuits are still behind. From three to five months, depending on the type of clock, is the quoted shipping time now, and this is about one month better than the time quoted a month ago. Factory capacity was doubled during the past winter.

Rauch & Lang's High Production in New England

The new factory of Rauch & Lang, Inc., makers of the Raulang electric passenger automobile at Willimansett, Mass., is rapidly approaching capacity production for the first unit of the plant. In January, 1921, a modern one-story brick factory, 320 ft. x 300 ft., began to produce cars, and since its opening it has been running on full time, with some overtime in addition.



DEMAND IS KEEPING PRODUCTION UP TO CAPACITY IN NEW PLANT

About $350,000 was invested in the plant exclusive of real estate.

Two hundred and fifty employees are now at work in the plant, and the orders on the books and coming in will keep the factory going at full speed until fall. It will probably be necessary to add to the force before long. The factory work has now been transferred from Cleveland to Willimansett, and the company expects shortly to manufacture there its own motor of the Hertner design. Bodies are not yet produced at the Willimansett plant. The proximity of this site to various New England concerns supplying important parts, the labor supply in the Connecticut Valley and the potential New England market were among the important factors leading to the establishment of the new plant in Massachusetts.

Paul A. Frank is president, and the three vice-presidents, Harry R. Doernig, Nathaniel Platt and R. W. Stanley, are respectively sales manager, export manager and general manager.

Kellogg Switchboard Financial Statement for 1920

In its annual report for the year ended Dec. 31, 1920, the Kellogg Switchboard & Supply Company, Chicago, shows total assets of $7,527,311 and a surplus and reserve of $2,236,458. Inventories amounted to $3,431,937 and accounts receivable $2,089,805. Capital stock is just under $5,000,000.

French Carbon Maker Investigating United States Market

E. Gindre, president and general manager of Le Carbone of Paris, France, is in the United States for an extended period for the purpose of investigating the prospects in the carbon and carbon-brush business incidental to the possibility of expanding his service in the United States.

Change in Name and Organization of Vim Electric

The Vim Electric Company, Inc., is the new name taken by the Vim Electric & Motor Company, 66 Cortlandt Street, New York City, following its recent reorganization. The company has expanded its scope of service beyond that of motor agents and will now handle and install motors and generators and their accessories, both new and used equipment. It is also prepared to maintain such installations and to act in a consulting and engineering capacity. A rental service for motors is another feature. Special attention will be given to sales of General Electric and Sprague equipment. The entire building of five stories and basement, containing 5,000 sq.ft., has been rented and is being renovated. Stocks will be maintained on the premises.

George Smith is president and general manager, and Samuel Kassover is vice-president.

Water-Heater Developments of Automatic Electric

The Automatic Electric Heater Company, Warren, Pa., in developing its heater line, has put into production two new 3-gal. models of its "Sepco" automatic water heaters, rated at 600 watts and 1,000 watts respectively, and has gone on with the larger sizes. Field tests have been completed in the 8, 20 and 40-gal. sizes, and these will be placed in production as rapidly as possible, probably by fall.

Electric Vehicle Development Brings Out New Light Car

What is believed to be an entirely new development in the electric vehicle field has recently been announced in the manufacture by the Automatic Transportation Company, Buffalo, N. Y., of a small-size "Exide" battery, electric passenger vehicle. It is put out for the use of executives in industrial plants and also for passenger service. The wheel base is only 61½ in. and the tread 35 in., while a 24-volt motor is used to attain a speed of 15 miles an hour over a 50-mile radius on a single battery charge.

Expansion of Output Planned by Pacific Refractory Maker

To replace a plant destroyed by fire at another site a short time ago, the Pacific Clay Products Company, American Bank Building, Los Angeles, Cal., expects to start construction on a new factory at Los Nietos for the manufacture of firebrick and refractory shapes. This plant will have an initial output of 25,000 9-in. brick per day and will be laid out for a maximum capacity of 40,000. This is somewhat greater than the capacity of the old plant, but the 25,000 quantity, it is expected, will be absorbed by the territory supplied by the old plant, which means that the consumption in that territory has increased. With the establishment of quieter conditions and equitable freight rates the company expects to ship firebrick and refractories to Mexico and other Pacific Coast countries.

E. M. Durant is president and Archibald Douglass is secretary.

Partnership of Manufacturers' Agents in New York

Cooper & Gershvin, a partnership, has been formed by W. H. Cooper, formerly in the electrical publishing business, and A. J. Gershvin, an electrical engineer formerly in business in Europe, with offices at 98 Park Place, New York City. Representation has been secured for the Detroit Electrical Branding Iron Company, Baco Electrical Company's soldering irons, Ree-Nu-It Electrical Manufacturing Company's renewable fuses, Laduby Company's lamp locks, Milwaukee Manufacturing Company's immersion heaters, C. & P. Electric Works' panels and cut-outs, Renner & Maris' portable lamps and B. & W. Specialty Manufacturing Company's heating appliance connectors. The territory served will be New York State and the Metropolitan district, which takes in New York City, New Jersey and Connecticut.

Exclusive Appliance Distributers for Sunbeam's Output

The Sunbeam Domestic Appliance Co., which recently took over the Surf Manufacturing Company of Milwaukee, is still manufacturing "Surf" washing machines in that city and will do so until removal to its new plant in Evansville, Ind., takes place some time in June. A production basis of fifty machines per day is expected shortly. The company is directing most of its efforts and distribution through the exclusive appliance distributer. Besides its connections in most of the larger cities it maintains a branch office at 431 Sutter Street, San Francisco, under H. R. Basford, and a stock of machines at that city and at Los Angeles. W. A. Carson is president, O. F. Fischedick vice-president, and E. D. Weymss secretary.

The Combustion Engineering Corporation has moved its general offices from 11 Broadway to the Combustion Engineering Building, 43-47 Broad Street, New York City.

The Bryant Electric Company, Bridgeport, Conn., has moved its Chicago office to 844 West Adams Street, where it has larger quarters.

The Sessions Engineering Company announces the removal of its offices to 832 Marquette Building, 140 South Dearborn Street, Chicago.

The Globe Electric Company, Inc., Seattle, Wash., announces the removal of its place of business from 906 Western Avenue to 313 Occidental Avenue. The company deals in wholesale electrical supplies, apparatus, etc.

The Louisville Electric Manufacturing Company, Louisville, Ky., has filed amended articles of incorporation placing its preferred capital stock at $15,000 instead of $25,000 and increasing its common stock from $50,000 to $60,000.

The Anker Engineering Company, Widener Building, Philadelphia, has made arrangements with the Wodack Electric Tool Corporation, 23-27 South Jefferson Street, Chicago, to act as its representative in the Pennsylvania district and surrounding territory.

The Crawford Manufacturing Company has removed its New York office from 277 Broadway to 13-21 Park Row.

The Philadelphia Fire Underwriters' Association, Philadelphia, announces that its electrical department is established at Room 400, Bullitt Building, 131-141 South Fourth Street.

The Star Porcelain Company, Muirhead Avenue, Trenton, N. J., manufacturer of electrical porcelain products, contemplates the erection of an addition, 30 ft. x 100 ft., two stories.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, announces that it is now represented in Pittsburgh by D. C. Paul, formerly with the Gaul, Deer & Shearer Company, Philadelphia. The Pittsburgh office is at 303 Penn Avenue, where there is also a completely equipped service station with a factory-trained service man in charge. This branch, of which Mr. Paul is manager, includes western New York, western Pennsylvania and the northern part of West Virginia.

The Arrow Electric Company, Hartford, Conn., announces that its new York sales office has been removed from 253 Broadway to the Borden Building, 350 Madison Avenue.

Alfred Box & Company, 813 North Front Street, Philadelphia, is contemplating the erection of a new machine shop, 110 ft. x 300 ft., one-story, at Tioga and Trenton Streets, to cost about $100,000. The company manufactures cranes, hoisting machinery, etc.

The De Laval Steam Turbine Company, North Clinton Street, Trenton, N. J., has awarded contract for the erection of a three-story machine shop, 160 ft. x 220 ft., to cost with equipment about $150,000.

Foreign Trade Notes

GENERATING PLANT FOR BUENOS AIRES.—Tenders will be received by the Board of Sanitary Works of the Nation, Buenos Aires, Argentina, until June 3, according to *Electrical Industries*, for the construction of a new generating station. The equipment consists of three four-cycle Diesel engines of 375 hp., adapted to run on crude petroleum from Comodoro Rivadavia, and three 250-kw., three-phase, 2,200-volt alternators. Tenders for this work were previously called for in 1919 and 1920. A copy (in Spanish) of general conditions of tender and specifications of plant, etc., may be seen at the Department of Overseas Trade, 35 Old Queen Street, S.W. 1, London, England.

STATIC CONDENSERS FOR NEW ZEALAND.—Tenders will be received by Secretary of Public Works Department, Tenders Board, Government Buildings, Wellington, New Zealand, until June 28 for furnishing and delivering at Lyttelton two 50-kva., condensers, two 100-kva., and two 200-kva. condensers in connection with the Lake Coleridge electric power supply project. Copies of specifications may be seen on application to the Department of Overseas Trade, 35 Old Queen Street, Westminster, S. W. 1, London, England.

ELECTRIC PLANT FOR SANITARY WORKS, BUENOS AIRES.—The Department of Sanitary Works, Buenos Aires, Argentina, according to *Electrical Industries*, is asking for tenders until June 13 for furnishing and erecting electric power batteries and lighting plant at Mar del Plata.

TENDERS SOON TO BE CALLED FOR ON ELECTRIC FURNACE IN AUSTRALIA.—According to *Electrical Industries*, owing to falling prices the Railways Department of Victoria, Australia, has rejected all tenders received up to Jan. 19, 1921, for furnishing an electric furnace for the Newport workshops. The department, it is understood, will ask for tenders closing in September. The present cost is estimated at £50,000.

TRANSFORMERS FOR NEW ZEALAND.—Tenders will be received by the Secretary of Public Works, Tenders Board, Government Building, Wellington, New Zealand, until June 28, according to *Electrical Industries*, for ten single-phase, oil-filled transformers for the conversion of three-phase current at 50 cycles, the voltage ratio being 50,000/11,000, in connection with the Waikato electric power scheme. Copies of specifications on application to the Department of Overseas Trade, 35 Old Queen Street (Room 59), Westminster, S. W. 1, London, England.

ELECTRIC GENERATING MACHINERY FOR SOUTH AFRICA.—The Borough Council of Kingwilliamstown, South Africa, according to the *Electrical Times*, will receive tenders until Aug. 1 for steam-driven electric generating machinery, boilers, switchgear and cable, or alternate for gas-driven plant. Specifications and further information from the borough engineer, Kingwilliamstown, applications to be accompanied by a deposit of £2 2s. Tenders should be addressed to the town clerk.

ELECTRIFICATION OF PHILIPPINE RAILROAD.—According to the *Bulletin of Government Commercial Agency in New York*, the Manila Railroad Company plans to develop the water power of the Agno River in central Luzon to supply electricity to operate the railroad. It is estimated that from 12,000 hp. to 15,000 hp. can be developed.

ELECTRIFICATION OF RAILWAYS IN SOUTH AFRICA.—Tenders will be received by the High Commissioner for the Union of South Africa, Trafalgar Square, London, England, or office of the general manager, Johannesburg, South Africa, until June 22 for equipment, switchgear and accessories, etc., in connection with the electrification of the Cape Town-Simonstown and the Durban-Pietermaritzburg railway lines. Specifications, etc., at the above offices. Further information on application to Merz & McLellan, consulting engineers, 32 Victoria Street, S. W. 1, London, England.

BROWN, BOVERI EXPANDS IN POLAND.—Brown, Boveri & Company, Baden, Switzerland, together with the Bank of the United Polish Countries of Warsaw, have just formed a company under the name of Polish Electric Works-Brown Boveri Limited, at Warsaw. The object of this new enterprise is the manufacture in Poland of line and other electric material as well as of all kinds of electric machinery, apparatus and appliances. For this purpose a large factory will be built at Trzebin in Poland and the workshops of the Electric Company Limited, formerly Sokolnicki & Wisniewski, at Lemberg, in Galicia, now belonging to Poland, will be acquired and operated by the new company.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of machinery dealers in Ceylon (No. 34,836) desires to be placed in communication with manufacturers of electric drying units with a view to developing their use in drying tea.

A business man in the Canary Islands (No. 34,856) proposes to establish an electric light and power plant for a town of about 5,000 inhabitants and requests catalogs and quotations.

A manufacturers' representative in Peru desires to secure an agency on a commission basis for the sale of electrical appliances, etc.

New Apparatus and Publications

ELECTRIC VEHICLE.— The Automatic Transportation Company, Buffalo, has developed a small electric vehicle for executive use in industrial plants and for pleasure. Electric Storage Battery's sales bulletin for April describes the car.

PORTABLE LAMP.—The Griest Manufacturing Company, New Haven, Conn., maker of the Wallace lamp, has just developed a new portable lamp for table and bedstead use.

VALVES.—The Lunkenheimer Company, Cincinnati, is distributing a small booklet describing its "Ferrenewo" valves.

CONTROL VALVE. — Bulletin R-1401, with supplementary sheet No. 2, issued by the Yarnall-Waring Company, Chestnut Hill, Philadelphia, describes its "Yarway" balanced control valve in both angle and globe patterns recently developed by the company.

INDUSTRIAL TRACTORS AND TRUCKS.—The Baker R & L Company, Cleveland, is distributing bulletin 10, describing the "Baker" series C Industrial tractors and trucks with duplex compensating suspension.

VALVES.—The A. W. Cash Company, Decatur, Ill., is distributing a small folder describing its single-seat class D valve.

REGULATORS. — The Craig Damper Regulator Company, 701 Book Building, Detroit, has issued a small folder describing the Craig damper regulator.

CONTROL APPARATUS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, is distributing leaflet 3,982, describing its type F magnetic-switch double-section control panels, together with type 22-F magnetic-switch control panels. Folder 4,455, entitled "Fans for Efficiency," describes the Ventura fans.

ELECTRIC HOISTS. — The Allis-Chalmers Manufacturing Company, Milwaukee, is distributing bulletin No. 1819, covering its different types of electric hoists.

METALS. — "Armco in Pictures and Fact" is the title of a new 247-page publication on the manufacture of "Armco" iron, recently issued by the American Rolling Mill Company, Middletown, Ohio.

SUPPLIES. — Benjamin Electric Manufacturing Company, Chicago, has just issued its 252-page Catalog No. 23, showing price reductions.

METER SERVICE.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has developed a new type of meter service switch under the Sachs patent. Circular No. 50 describes it.

ELECTRIC IRONER.—The William G. Yates Company, Cleveland, has recently placed on the market its new 46-in. "Cottage" ironer for small family needs.

TELLTALE BOARDS. — Bulletin No. 49,011, issued by the General Electric Company, describes its running-light telltale boards for vessels using electricity.

DISCHARGE TEST SET.—The Hickok Electrical Instrument Company, Cleveland, is distributing bulletin No. 21, describing the new Hickok high-rate test set for storage-battery service stations.

LIGHTING FIXTURES.—The Luminous Unit Company, division of the St. Louis Brass Manufacturing Company, St. Louis, has issued "Brascolite" bulletin No. 1, showing various hospitals that are equipped with "Brascolites," "Aglites," etc.

AMMETERS AND VOLTMETERS.—The Roller-Smith Company, 233 Broadway, New York City, is distributing bulletin No. 400, covering its type "TID" (formerly "Junior Imp" type) direct-current ammeters and voltmeters. Bulletin No. 419 describes the "FID" voltmeters and ammeters for direct current (formerly 4-in. "Imp" type).

New Incorporations

THE HALL PRODUCTS COMPANY, Ridgewood, N. J., has been incorporated with a capital stock of $10,000 by George I. Hall and Henry and Runis Amos. The company proposes to manufacture electrical appliances.

THE RUBICON COMPANY, Philadelphia, has been incorporated with a capital stock of $20,000 to manufacture electrical devices and equipment. Josef Doerr, Elkins Park, Pa., is treasurer.

THE WHALEY - CROSBY ELECTRIC CORPORATION has been incorporated under the laws of Delaware, with a capital stock of $1,000,000, to manufacture and deal in electrical supplies. The incorporators are T. L. Croteau, M. A. Bruce and S. E. Dill, Wilmington.

THE GREENFIELD ELECTRIC SUPPLY COMPANY, Brooklyn, N. Y., has been incorporated by A. L. Rush, S. Dampf and A. S. Greenfield, 995 Eastern Parkway. The company is capitalized at $25,000 and proposes to manufacture and deal in electrical supplies.

THE UNION ELECTRIC COMPANY, Union Mills, Ind., has been incorporated with a capital stock of $15,000 to operate an electric light plant. The directors are C. S. Hillabold, M. J. Hillabold and A. L. Ullrich.

THE SOUTHERN CHAIN BATTERY SYSTEM has been incorporated with a capital stock of $300,000 for the purpose of manufacturing a battery for automobile trade. I. B. Stevens, J. T. Snow and E. E. Harroun of Nashville, Tenn., are incorporators.

THE NEW SWEDEN (ME.) LIGHT & POWER COMPANY has been organized to operate a local power plant and distribution system. John N. Johnson is interested in the company.

THE CITIZENS' ELECTRIC & SERVICE COMPANY, Monticello, Ky., has been incorporated with a capital stock of $100,000 by Reuben W. Wright, Herbert J. Hodgkins and Chester C. Doty.

THE DEN-HART MANUFACTURING COMPANY, New Haven, Conn., has been incorporated by E. W. E. Denis, William R. Hartley and E. C. Smythe, 54 Tilton Street. The company is capitalized at $50,000 and proposes to manufacture electrically operated washing machines.

THE RISLER-HORNUNG CORPORATION, New York, N. Y., has been incorporated by E. A. Risler, Jr., H. J. Hornung and R. W. Maloney, 305 Broadway. The company is capitalized at $18,000 and proposes to manufacture electrical supplies.

THE ELECTRIC MANUFACTURING & SALES COMPANY, Newark, N. J., has been incorporated by E. and Abraham Beller and Herbert Parvin, 128 Market Street. The company is capitalized with a capital of $100,000 and proposes to manufacture electrical products.

ROBERT S. CONLON, INC., New York, N. Y., has been incorporated with a capital stock of $10,000 and proposes to manufacture electrical equipment. The incorporators are R. S. Conlon, W. F. Davis and E A. Vosseler, 149 Broadway.

THE ROXBURY (N. Y.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000 by J. H. Dart and others.

Record of Electrical Patents

Notes on United States Patents

(Issued April 26, 1921)

1,375,712. TELEPHONE-EXCHANGE SYSTEM; Albon E. Lundell, New York, N. Y. App. filed March 25, 1918. Manual and automatic exchange.

1,375,728. DISTRIBUTING APPARATUS; Paul M. Rainey, Glen Ridge, N. J. App. filed Aug. 28, 1917. Multiplex printing telegraph.

1,375,739. VACUUM-TUBE APPARATUS; Edward O. Scriven, New York, N. Y. App. filed June 27, 1918. Grid at potential different from that of filament.

1,375,740. SEPARATOR FOR STORAGE BATTERIES; Walter M. Studebaker and Herbert J. Epple, Erie, Pa. App. filed July 17, 1920. Woven glass.

1,375,741. PROCESS OF AND APPARATUS FOR PROGRESSIVE ELECTROSTATIC SEPARATION OF COMMINUTED MATERIAL; Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. App. filed Aug. 9, 1914.

1,375,745. ARMATURE-WINDING MACHINE; Leonard E. Wood, Valleyfield, Quebec, Canada. App. filed Sept. 30, 1918. Entirely automatic.

1,375,762. DISTRIBUTING SWITCH; George Thompson, Mount Vernon, N. Y. App. filed May 10, 1919. Automatic telephone.

1,375,763. METHOD OF FORMING STORAGE-BATTERY SEPARATORS; Theodore A. Willard, Cleveland, Ohio. App. filed Feb. 26, 1915.

1,375,765. TRANSFORMER SECONDARY CONNECTION FOR ELECTRIC METAL-WORKING APPARATUS; Herbert A. Woofter, Swampscott, Mass. App. filed July 30, 1920. Welding machine.

1,375,801. ELECTRIC COOKING STOVE; Allen R. Ross, Seattle, Wash. App. filed July 1, 1919.

1,375,819. PROCESS AND APPARATUS FOR THE ELECTROLYTIC GENERATION OF ARSIN, PHOSPHIN AND STIBIN; Henry Blumenberg, Jr., Oro Grande, Cal. App. filed June 11, 1919.

1,375,837. ELECTRICAL MEASURING INSTRUMENT; Charles E. Foster, Letchworth, England. App. filed Sept. 11, 1916. Spring-mounted jewel bearings.

1,375,863. ELECTRICAL APPLIANCE; John T. Stanton, Seattle, Wash. App. filed June 1, 1920. Electro-therapeutic blanket.

1,375,879. BRUSH AND METHOD OF MANUFACTURING THE SAME; Hugh H. Wikle, Chicago, Ill. App. filed April 13, 1918. For electrical machinery.

1,375,884. ELECTRIC IGNITION APPARATUS; Frank Aiken, Elkins Park, Pa. App. filed June 20, 1919. Internal-combustion engine.

1,375,974. INSULATOR CONNECTOR. Henry T. Pierce and Angus D. McPhee, Worcester, Mass. App. filed Feb. 11, 1918. For Hewlett type.

1,375,981. PROTECTIVE DEVICE; Benjamin H. Thompson, Schenectady, N. Y. App. filed Aug. 28, 1919. Overload relay of retarded type.

1,375,982. CONDENSER; Elihu Thomson, Lynn, Mass. App. filed Nov. 16, 1916. For use with high-potential electrical distribution systems.

1,375,991. SYSTEM OF ELECTRICAL DISTRIBUTION; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Oct. 6, 1917. High frequency.

1,375,996. METHOD OF AND APPARATUS FOR PREVENTING INJURY OF SEARCHLIGHT MIRRORS; Heinrich Beck, Schenectady, N. Y. App. filed June 12, 1920. Electrically heated at cool spot.

1,376,011. ELECTRIC APPARATUS; John J. Frank, Pittsfield, Mass. App. filed April 25, 1919. High-current winding, having taps.

1,376,015. ELECTRICAL REGENERATIVE CONTROL APPARATUS AND SYSTEM; William S. H. Hamilton, Schenectady, N. Y. App. filed March 3, 1919. Variable-pole induction-type machines.

1,376,020. BRUSH-SHIFTING DEVICE FOR ALTERNATING-CURRENT MOTORS; Willem C. Korthals-Altes, Schenectady, N. Y. App. filed Feb. 13, 1918.

1,376,022. SPARK-TROUBLE LOCATOR; Samuel P. Langmaid and Leonard A. Walton, Seattle, Wash. App. filed Sept. 1, 1920. Secured to dash of automobiles.

1,376,023. ELECTRIC HEATING DEVICE; Milton E. Long and George W. Katzung, Pittsfield, Mass. App. filed April 2, 1917. Turner for toaster.

1,376,024. AUTOMATIC PAWL THROW FOR MAGNETOS OR THE LIKE; Phillip E. Matthews, Plainfield, N. J. App. filed July 3, 1919.

1,376,034. MEANS FOR PROTECTING BATTERY ANODES; Herbert R. Palmer, Cleveland Heights, Ohio. App. filed Nov. 28, 1919. To prolong indefinitely the "shelf life."

1,376,041. BRUSH HOLDER; Henry K. Sandell, Chicago, Ill. App. filed June 12, 1916. Means for supporting.

1,376,051. SIMULTANEONS TRANSMISSION OR RECEPTION OF SPEECH AND SIGNALS; Albert H. Taylor, Grand Forks, N. D. App. filed April 10, 1919. Radio transmitting and receiving.

1,376,052. CYLINDER FOR ELECTROPLATING APPARATUS AND THE LIKE; Floyd T. Taylor and Wesley F. Hall, Matawan, N. J. App. filed May 13, 1918. Positive circulation of liquid.

1,376,066. CONDUCTOR-GRIPPING DEVICE; Reuben B. Benjamin, Chicago, Ill. App. filed May 2, 1916. Cord grip.

1,376,068. COMBINATION CAP AND SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed June 7, 1919. Cap and socket separate when cord is pulled.

1,376,072. ELECTRIC FURNACE; William K. Booth and William L. Morris, Chicago, Ill. App. filed April 9, 1920. Oscillating or rotary.

1,376,080. HIGH-FREQUENCY MACHINE; Charles W. De Moov, Cleveland, Ohio. App. filed Aug. 20, 1917. Therapeutical.

1,376,081. HIGH-FREQUENCY GENERATOR OF THE TRANSFORMER TYPE; Charles W. De Mooy, Cleveland, Ohio. App. filed Aug. 20, 1917. No vibrator.

1,376,143. STORAGE-BATTERY TERMINAL; Clarence W. Hazelett, Lakewood, Ohio. App. filed Nov. 3, 1916. Connector with brass screw embedded in lead.

1,376,144. STORAGE-BATTERY TERMINAL POST; Clarence W. Hazelett, Lakewood Ohio. App. filed Sept. 21, 1917. Completely embedded copper rod.

1,376,154. ELECTRICAL LIGHTING DEVICE FOR CIGARS AND THE LIKE; Joshua M. Morris, Rochester, N. Y. App. filed Oct. 2, 1919.

1,376,162. MAGNETO CONTACT; Virgil Rigsby, Hemphill, Tex. App. filed March 9, 1920. For Ford magneto.

1,376,171. STORAGE BATTERY; Malcom O. Smith, Indianapolis, Ind. App. filed June 9, 1919. Terminal posts readily removed.

1,376,185. ELECTRODE HOLDER; William R. Beazley, Jacksonville, Fla. App. filed July 21, 1920. For removing connector straps of battery by electric current, avoiding drilling.

1,376,207. PROCESS FOR THE PRODUCTION OF COMPOUNDS BY GAS REACTIONS AND APPARATUS THEREFOR; Charles B. Jacobs, Wilmington, Del. App. filed Sept. 27, 1919. Production of nitrogen compounds.

1,376,208. ELECTRIC COOKING RANGE; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Feb. 21, 1918.

1,376,209. ELECTRICAL HEATING UNIT; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Jan. 25, 1919. For immersion in liquids.

1,376,243. SAFETY LAMP; Nicholas Albert, Longmont, Col. App. filed Sept. 8, 1920. Lamp is extinguished when globe is broken.

1,376,257. STORAGE BATTERY; Thomas R. Cook, East Cleveland, Ohio. App. filed May 11, 1918. Cooled by continuous circulation of electrolyte.

1,276,288. ELECTRICAL SYSTEM FOR PRODUCING MUSICAL TONES; Frank E. Miller, New York, N. Y. App. filed March 18, 1915. By exciting an audion in response to electric pulsations.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WINTHROP, ME.—C. M. Bailey & Company plan to rebuild their oilcloth manufacturing plant, recently destroyed by fire, causing a loss of $150,000, including equipment. New power-plant equipment and other machinery will be required.

WATERBURY, CONN.—The Connecticut Light & Power Company has arranged for an issue of $6,500,000 in bonds, part of the proceeds to be used for additions to electric generating plants. Irvin W. Day is vice-president.

Middle Atlantic States

CENTRAL ISLIP, N. Y.—Bids will be received by the State Hospital Commission, Albany, until June 1 for building addition to power house at the Central Islip State Hospital. E. S. Elwood is secretary. L. F. Pilcher is state architect.

ELLENVILLE, N. Y. — The Ellenville Electric Company has filed notice of increase in capital stock from $30,000 to $60,000.

UTICA, N. Y.—The Madison Power Company, recently incorporated with a capital of $200,000, plans to erect an electric power plant for service in Madison and Oneida Counties. Dunmore, Farris & Dewey represent the company.

UTICA, N. Y.—The Utica Motor Car Company, Kent Avenue, plans to build an automobile service and repair building to cost about $250,000. Considerable electrical and mechanical equipment will be required.

WATERTOWN, N. Y.—The City Council is considering calling an election to submit to the voters the proposal to issue $385,000 in bonds for the completion of the city's power development.

CATASAUQUA, PA.—The Pennsylvania Power & Light Company will make new installations to replace existing pole lines, transformers and other equipment in this section.

COATESVILLE, PA.—The Town Council has approved an ordinance providing for the installation of an ornamental lighting system on Lincoln Highway. Cluster lamps on standards will be used.

FELTON, PA.—Negotiations are under way between the Town Council and the Edison Light Company, York, for the extension of the latter's lines from Red Lion to Felton. The present plans provide for the construction of a power plant on Muddy Creek.

PHILADELPHIA, PA. — Arrangements have been made by the Philadelphia Electric Company for an issue of $5,000,000 in stock, part of the proceeds to be used for extensions, etc. Joseph B. McCall is president.

SHARPSBURG, PA.—Arrangements have been made for an issue of $130,000 in bonds for municipal improvements, a considerable portion of the proceeds to be used for extensions and improvements to the local light and power system.

RIVERDALE, MD.—The construction of a municipal lighting plant to supply electricity to Berwyn and Bowie has been authorized by the voters.

PETERSBURG, W. VA.—The Community Power Company, recently organized, plans to erect a transmission line to Moorefield, a distance of about 12 miles. R. W. Baker is manager.

NEWPORT NEWS, VA.—The Newport News & Hampton Railway, Gas & Electric Company has filed notice of $1,000,000 increase in capital stock, the proceeds to be used for extensions. J. N. Shannahan is president.

PULASKI, VA.—The Virginia Anthracite Coal Corporation is considering the installa-

tion of electrical and other machinery at its properties. John G. Hayes is construction engineer.

WASHINGTON, D. C.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 18 for the installation of a turbo-generator and switchboard at Bellevue. Specification 4317.

WASHINGTON, D. C.—Bids will be received at the office of the chief of engineers, U. S. A., until May 31, Advertisement No. 69, for 2,200 ft. cable, type RL, one conductor; two reels for above; 1,500 ft. cable, type RL, on conductor; two reels for above; 1,540 ft. three-conductor cable, and one reel.

WASHINGTON, D. C.—An act appropriating $619,250 for fortifications and other works of defense for the Panama Canal Zone for year ending June, 1922, has been passed by Congress, which includes maintenance and repair of searchlights, electric light and power equipment, tools, electrical and other supplies and appliances, $30,000; purchase and installation of searchlights, $6,250; continuing construction of barracks, quarters, storehouses and other buildings necessary for accommodating the Coast Artillery troops to be stationed in the vicinity of the Panama Canal, including water, sewer and electrical systems, roads, walks, etc., $100,000.

North Central States

ASSYRIA, MICH.—The question if issuing $25,000 of electric light bonds is under consideration.

DETROIT, MICH.—The Council has authorized an appropriation of $50,000 for preparation of plans for a new municipal lighting plant. James Couzens is Mayor.

DETROIT, MICH.—The Timken-Detroit Axle Company, Clark Avenue, plans to erect a new one-story turbine power house to cost about $35,000. H. W. Alden is secretary.

MARCELLUS, MICH.—The question of issuing $15,000 in bonds for the purchase of a steam engine, generator and exciter, and a switchboard panel with equipment for same, for a new electric light plant and water-works is under consideration.

NILES, MICH.—The French Paper Company plans to build a new power plant this summer.

NORTHVILLE, MICH.—The local plant of the Detroit Edison Company was damaged by lightning recently, causing a loss of about $25,000.

FALMOUTH, KY.—Plans are being prepared for the erection of an electric power plant and pumping station at the municipal water-works. Glazier & Morlidge, 20 Miller Building, Cincinnati, Ohio, are engineers.

KENTLAND, IND.—The installation of a municipal electric light plant is under consideration. Ora E. Sellers is trustee.

ATHENS, ILL.—Bonds to the amount of $25,000 have been voted for the erection of an electric light plant between the water-works near Springfield and Athens.

CENTRALIA, ILL.—The City Council is considering the installation of an ornamental lighting system.

FREEPORT, ILL.—A movement has been started by property owners on Lincoln Boulevard to have an ornamental lighting system installed on that thoroughfare.

MANITOWOC, WIS.—The installation of an ornamental lighting system on parts of Eighth and Washington Streets to cost about $10,000 is under consideration.

MILWAUKEE, WIS.—The North East Power Company, a subsidiary of the Wisconsin Public Service Company, 425 East Water Street, has applied to the State Railroad Commission for permission to proceed with a hydro-electric power plant project on the Peshtigo River, near Ellis Junction. Two sites are to be developed by the construction of concrete dams, reservoirs and generating plants. Mead & Seastone, consulting engineers, Madison, are in charge of the project.

NEW HOLSTEIN, WIS.—Bids will be received until May 30 by H. N. Edens, chairman of the lighting commission, for the erection of a 66,000-volt transmission line to connect with the line of the Calumet Service Company at the city limits of Chilton. The cost of the work is estimated at $50,000.

OCONTO FALLS, WIS.—Arrangements are being made for an issue of $50,000 in bonds for electric light improvements and water-works extensions.

WAUKESHA, WIS.—Plans are being prepared by Erol X. Smith, architect and engineer, 305 East Fifty-fifth Street, Chicago, Ill., for a boiler house and power plant, in connection with a hospital to be built in Waukesha for Dr. I. J. Frisch.

PRESTON, IOWA.—J. T. Marron has purchased the Rural Power Company plant at Preston and plans to erect a high-tension transmission line from Clinton to serve Preston, Goose Lake, Miles, Sherlock, Bryan and Spragueville. It is also planned to furnish electricity to farmers in the vicinity of these places.

SIOUX CITY, IOWA.—The installation of more than 200 street lamps in the city this year has been recommended by J. B. Mann, head of the Public Safety Department.

BERESFORD, S. D.—Steps have been taken to make municipal improvements for which $70,000 in bonds have been authorized, and which include a new engine for the electric light plant and sinking an additional well for the waterworks system.

BROOKINGS, S. D.—Bonds to the amount of $60,000 have been voted for remodeling, enlarging and repairing the municipal light and power plant.

TECUMSEH, NEB.—Bonds to the amount of $4,000 have been voted in Elm Creek for the erection of an electric transmission line from Tecumseh municipal electric plant to Elm Creek.

LAWRENCE, KAN.—The State Commission, Topeka, is having plans prepared for the erection of a new two-story electric power plant, 75 x 118 ft., at Kansas University, Lawrence, to cost with machinery about $300,000. J. M. Shea, Kansas University, is engineer.

Southern States

GEORGETOWN, S. C.—The city has purchased the lighting plant of the Georgetown Railway & Light Company and plans to operate same in connection with the municipal waterworks. Improvements, it is understood, will be made.

LAURENS, S. C.—A proposal to issue $65,000 in bonds for extension to lighting system, street improvements and sewer extensions will be submitted to the voters.

LEESBURG, FLA.—Two proposals for extensions to the municipal lighting system will be submitted to the voters: (a) to issue $75,000 in bonds for enlarging power plant; (b) $40,000 for erection of transmission line to Iverness to secure electricity from the plant of Camp Brothers, Ocala. The project includes the erection of 24 miles of high-tension line. W. A. McKenzie is Mayor.

GEORGETOWN, TEX.—New equipment, including an electric generating unit, will be installed in the municipal water and light plant.

Pacific and Mountain States

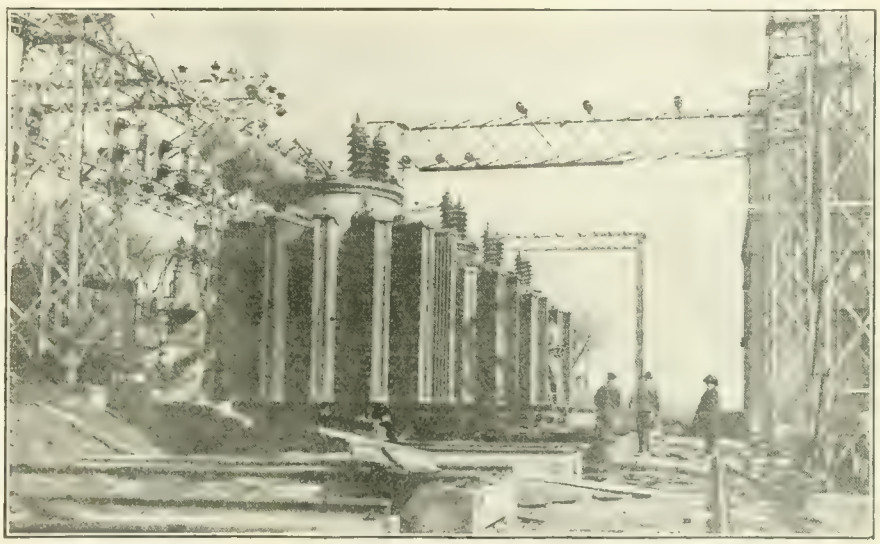
OKANOGAN, WASH. — The Okanogan Valley Power Company has announced that about twenty electrically operated pumping plant will be installed in this locality for irrigation purposes.

SEATTLE, WASH. — A resolution has been introduced in the City Council and referred to the city utilities committee providing for the installation of cluster lamps on University Way from East Fortieth Street to East Forty-seventh Street.

BALDWIN LAKE, CAL.—The Southern Sierras Power Company, Riverside, has closed a contract for the erection of a 3,000-volt transmission line from the Apple Valley line at Tussigs to the mining property at Gold Mountain, near Baldwin Lake, a distance of 25 miles.

BERKELEY, CAL.—The Board of Education has decided to ask for bids for excavation and concrete work on the new power plant at the high school. W. C. Hays is supervising architect.

PASADENA, CAL.—The Southern California Edison Company has a budget appropriation of $126,589 for new construction and system expenditures in the Pasadena district. The plans provide for a 15,000-volt transmission line from the company's main receiving station at Eagle Rock to the substation at Altadena. A similar line is to be erected from Sunland to the San Fernando station, connecting with the Kern River system, where the Kern River power plant No. 3 is nearly completed.



DROVOSBURG SUBSTATION OF DUQUESNE LIGHT COMPANY, PITTSBURGH, SHOWING FOUR OF THE 4,167-KVA., SINGLE-PHASE TRANSFORMERS BEING INSTALLED BY DWIGHT P. ROBINSON & COMPANY, ENGINEERS

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company is considering extensions and improvements to its electric power plants and system to cost about $520,000.

LOVELAND, COL.—Bonds to the amount of $45,000 have been voted to enlarge the municipal electric plant.

Canada

ST. JOHN, N. B.—The New Brunswick Electric Power Commission is considering furnishing electricity in a number of towns in Maine, including Centreville, Florenceville, Hartland, Bristol and Bath. It is proposed to purchase energy from the Maine & New Brunswick Power Company, Presque Isle, Me., and erect a transmission line probably from Bridgewater to Florenceville and on along the St. John River.

THURO, N. S.—The Common Council is considering the purchase of electrical equipment to cost $23,000.

QUEENSTON, ONT.—One of the 55,000-hp. generators at the Queenston power house of the Queenston-Chippawa development was recently damaged by fire, causing a loss of about $50,000.

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Electrical World

New York, Saturday, May 28, 1921

N. E. L. A.

Its Leadership and Inspiration Through Thirty-six Years of Splendid Achievement

LOOKING back over the forty-five years that the ELECTRICAL WORLD has served its industry and comparing the picture of the early days with the picture of today as we shall see it at the N. E. L. A. convention, a most vivid contrast appears.

A small group of large-hearted and far-seeing men were then pioneers in a new and untilled field of human opportunity and endeavor. The rest of the world was waiting, interested and expectant, to see what this new wonder—electricity—would bring to pass. Very soon, as the need for co-ordination began to be felt, came the National Electric Light Association. It brought leadership and guidance. It was a vehicle for the expression and diffusion of new experiences. It was an organization both of the men who manufactured the equipment that was needed by the generating stations and the men who operated the plants. And these two classes of electrical men virtually composed the infant industry.

Through the rapid and far-spreading evolution of all these marvelously productive years the N. E. L. A. has carried the banner. Much of the forward thinking, much of the master building has found its impulse in this organization. As the craft, the science and the service have grown so has the association, until today its size, the scope of its activities and its great power to serve reach far beyond the ken of men who led but a few short years ago. But as the industry has broadened with its growth has come a high degree of specialization, until no single organization, however great, could encompass all its parts. Manufacturers, jobbers, contractor-dealers, form each a greater interest and evince a wider activity today than the entire body of electrical men of every sort back in the early days. Each body has its own association doing its own important work.

To the N. E. L. A., however, the nation still looks for general leadership in things electrical. The great convention now assembling in Chicago, where the association was organized just thirty-six years ago, is an expression of this fact. Manufacturers, jobbers, contractors will be there. Engineers, financiers, publishers, business men of varied interests will attend. Every branch of electrical industry will contribute and participate in some degree. An N.E.L.A. convention today means more than just a meeting of central-station executives and employees.

The ELECTRICAL WORLD extends its heartiest congratulations to the National Electric Light Association. Together we enter on another year of service and co-operation that gives strong promise of increasing opportunities and achievements.

There are perplexities and problems to be faced, but in the electrical industry there is no lack of strength and leadership, courage and vision to carry faithfully through.

Chicago—the N.E.L.A. Convention City for the Ninth Time—

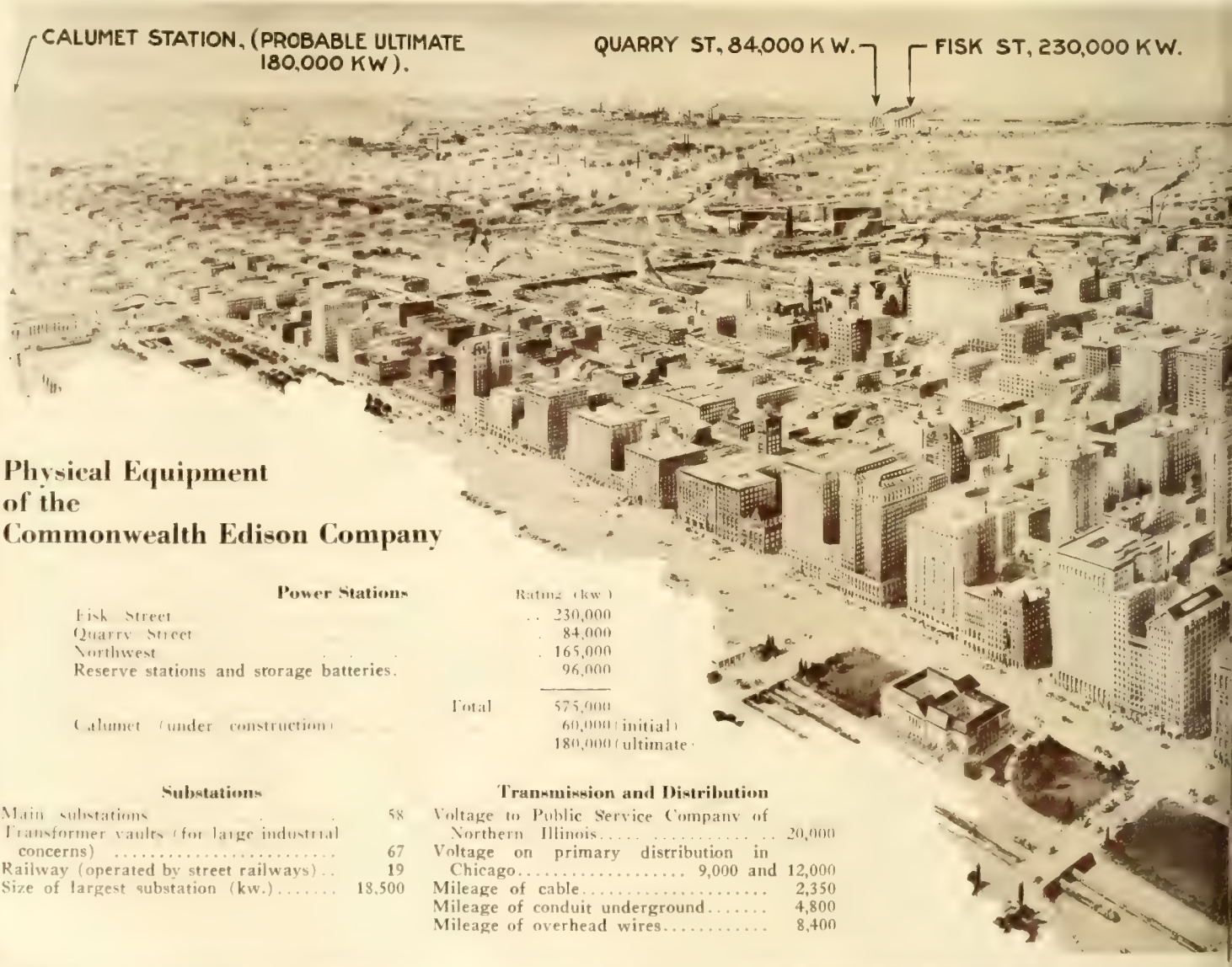
Is the Birthplace of Unified Electric Service

THE HISTORY of the Commonwealth Edison Company affords a splendid indication of the development of the electrical industry. In the brief space of thirty-three years remarkable progress has been made possible in the company by the foresight of its leader—Samuel Insull—who has always appreciated what the future holds for the industry and who at an early period in the industry's history advocated the unifying of power supply to secure the benefits of higher load factor. The wholesaling of energy to large consumers has been a policy in which the Edison company has blazed new trails. The differential rate system, which was the subject of warm discussion in early years, was largely developed in Chicago. Control of its own coal supplies has been a policy followed by the company for years and during the war was an important factor in the elimination of many troubles which other companies found embarrassing.

The company has been a leader in the work of the National Electric Light Association, it and its predecessors having contributed five presidents to the association—C. H. Wilmerding, Samuel Insull, Louis A. Ferguson, John F. Gilchrist and Edward W. Lloyd. Including the present convention, nine conventions of the association have been held in Chicago. The company is home-owned, 90 per cent of the stock being held by residents of Illinois and only slightly less than 90 per cent by residents of Chicago itself. More than 17,000 persons held stock in the Commonwealth Edison Company at the close of 1920, and when the instalment purchasers gained in the recent campaign have paid for their shares the number will be upwards of 26,000. Many of these stockholders are customers and employees, and of these many are women.

The Commonwealth Edison Company serves the district included within the corporate limits of the city of Chicago—an area of approximately 200 square miles with a population of 2,800,000.

Three principal generating stations—Fisk, Quarry and Northwest—provide the energy, while the smaller stations are held for reserve service. Fisk and Quarry Street sta-



Physical Equipment of the Commonwealth Edison Company

Power Stations	Rating (kw.)
Fisk Street	230,000
Quarry Street	84,000
Northwest	165,000
Reserve stations and storage batteries	96,000
Total	575,000
Calumet (under construction)	60,000 (initial)
	180,000 (ultimate)

Substations	
Main substations	58
Transformer vaults (for large industrial concerns)	67
Railway (operated by street railways)	19
Size of largest substation (kw.)	18,500

Transmission and Distribution	
Voltage to Public Service Company of Northern Illinois	20,000
Voltage on primary distribution in Chicago	9,000 and 12,000
Mileage of cable	2,350
Mileage of conduit underground	4,800
Mileage of overhead wires	8,400

tions lie close together about 2¾ miles southwest of the "Loop" or main business district. The Northwest station lies about 5½ miles to the northwest of the Loop. In the southern part of the city, 18 miles from Northwest station, is the new Calumet station, now under construction. In addition to the service in Chicago the plants furnish energy to the Public Service Company of Northern Illinois that reaches points almost as far north as Milwaukee, Wis., and south to Kankakee, Ill., the distance between these extremes being nearly 140 miles. These connections are through 20,000-volt lines.

The growth of the company has been remarkable. In 1889 the investment in plant and equipment alone was $797,000; on Dec. 31, 1920, it had reached the vast sum of $107,512,786. Taxes and municipal compensation have become no small expense, being $3,335,700 in 1920 compared with only $6,000 in 1889. During that year the income from sales of electricity was $105,700, whereas in 1920 the total earnings had mounted to $35,317,314.

The earnings are now increasing at the rate of 100 per cent about every four and one-half years. The original capitalization of the company in 1887 was $500,000 and its first bond issue in 1888 was $130,000. Total capital liabilities on January 1, 1921, were $102,772,600, of which $51,140,000 was capital stock and $51,631,000 bonds and notes.

While the company had only 4,100 customers in 1889, it had 485,039 on March 31, 1921. Last year the output was 1,884,000,000 kw.-hr. and the maximum load 478,820 kw. The average sales per capita were 600 kw.-hr.

There have also been great strides in an engineering way, the largest generator in 1888 being rated at 80 kw., while the largest now in operation is 35,000 kw., representing about 6 per cent of the capacity of the system. It is also interesting to note that the entire output of Harrison Street station during sixteen years, which was the largest and most economical station in the United States at the time, was less than one-third the system output in 1919.

Last year coal was being consumed at the rate of about 240 tons per hour. With this enormous demand it is not safe to take a chance on delivery of coal so the company has provided storage for at least 200,000 tons of coal.

Some conception of the magnitude of the present system is afforded by the data in the lower left-hand corner of the opposite page.

Fifty-eight main substations serve Chicago. In addition to these are sixty-seven transformer-vault substations from which large industrial consumers are served directly from the 9,000 and 12,000 volt lines, constituting the primary feeder system for the city. There are also nineteen substations owned and operated by the street railways. Approximately 2,500 miles of cable system, 4,800 miles of underground conduit and 8,400 miles of overhead wires are included in the transmission and distribution system.

The Commonwealth Edison Company's stations are the only public utility plants furnishing commercial electric service in the city, and a large portion of the industrial plants in the city depend on this service. One thousand five hundred miles of surface and elevated street railway (single track) are supplied with their entire energy requirements.

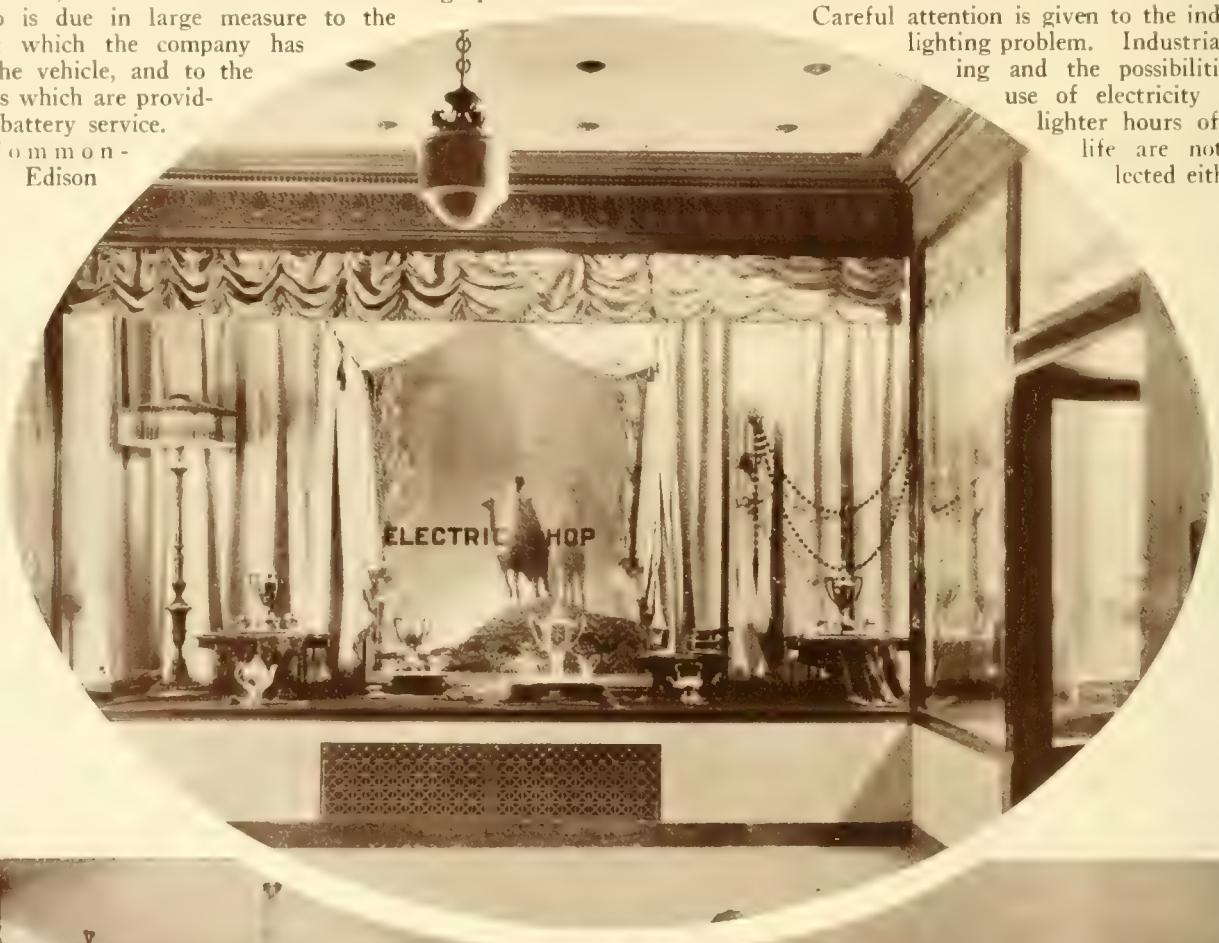






Important Factors in Building Business

THE Commonwealth Edison Company not only advocates but uses electric vehicles. The fact that more than 4,000 electric vehicles are now being operated in Chicago is due in large measure to the support which the company has given the vehicle, and to the facilities which are provided for battery service. The Commonwealth Edison Company salesrooms have been an important feature of its service for years. Here everything electrical that can minister to home comfort or better service to consumers is to be found. Careful attention is given to the industrial lighting problem. Industrial heating and the possibilities for use of electricity in the lighter hours of home life are not neglected either.



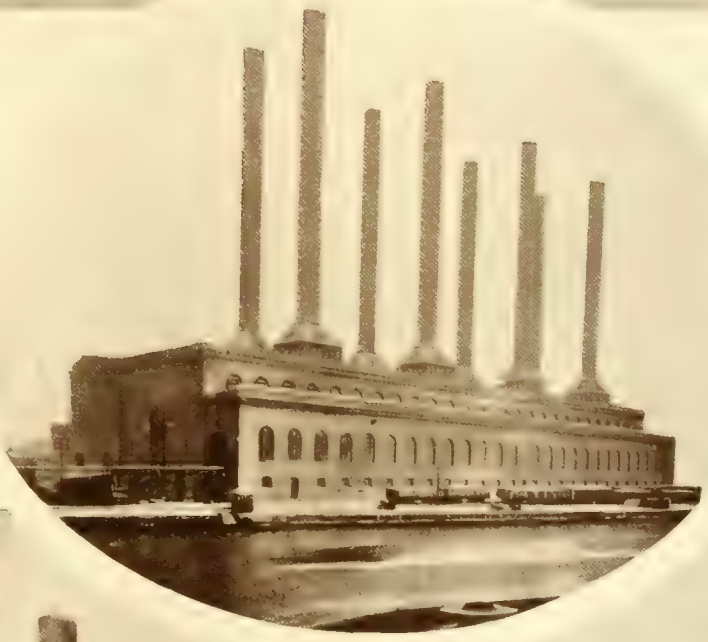


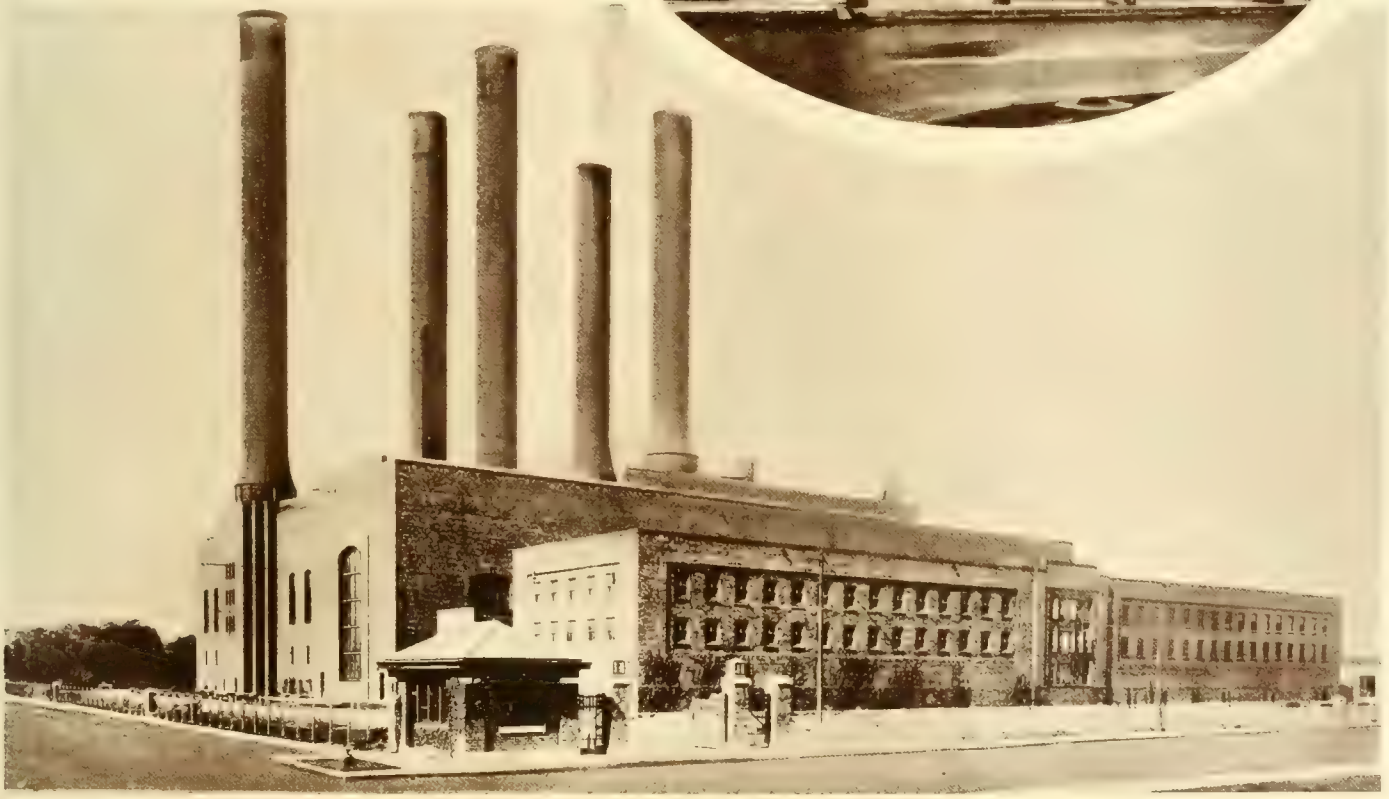


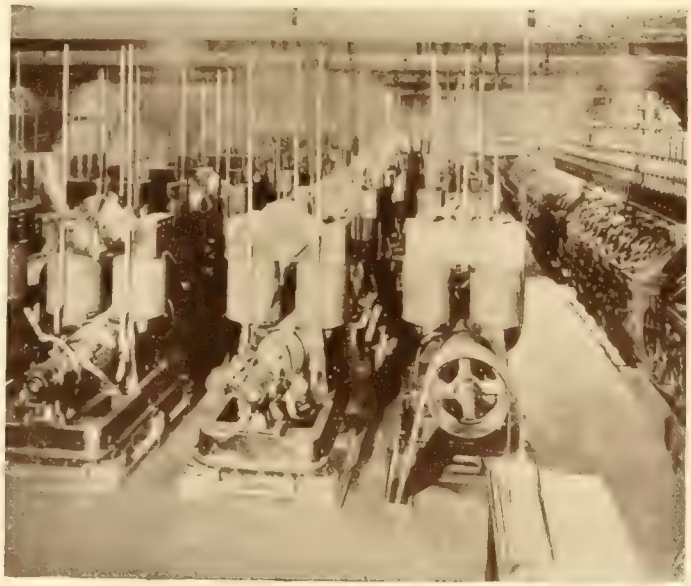


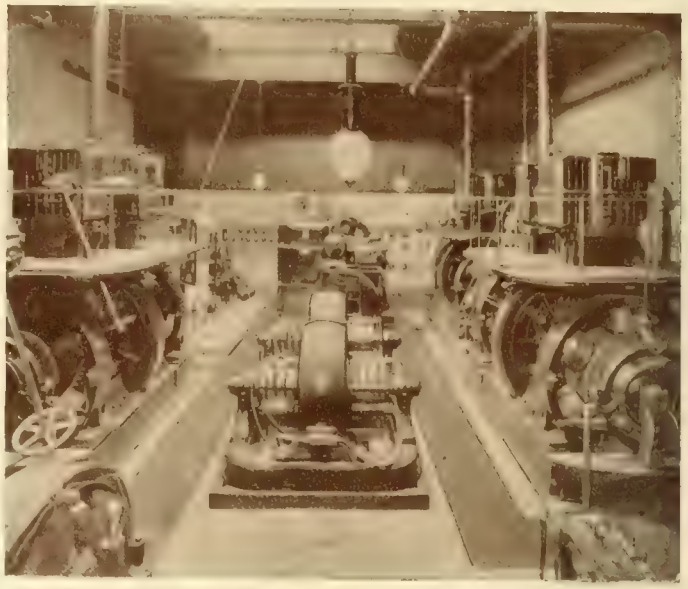
Nearly 500,000 Kilowatts in These Three Stations

THE Fisk Street, Quarry Street and Northwest stations, shown in the top, middle and bottom views, are rated at 230,000, 84,000 and 165,000 kw. respectively. They will shortly be supplemented by the new Calumet station, with an initial rating of 60,000 kw. in two units and a probable ultimate rating of 180,000 kw. Fisk Street station was the first all-turbine station placed in operation in the United States. Northwest station is the newest station in operation and the second largest in rating. Quarry Street station contains only vertical units



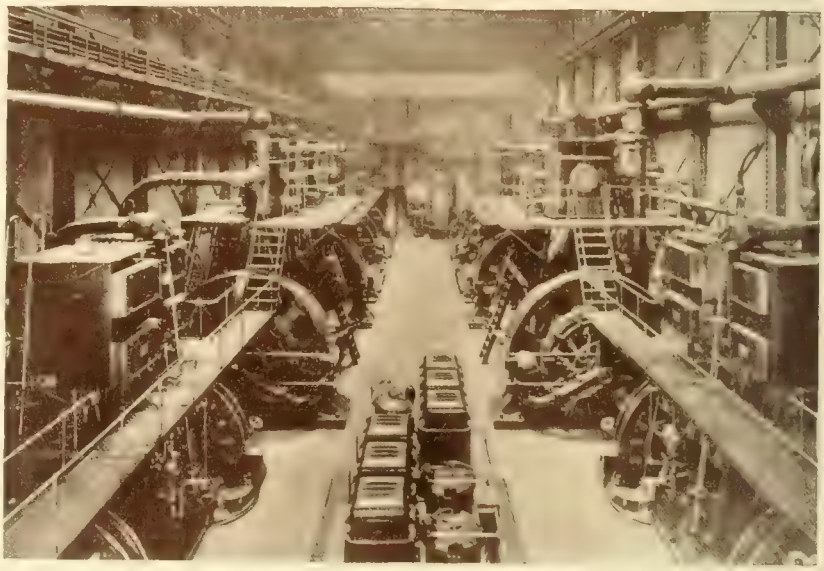


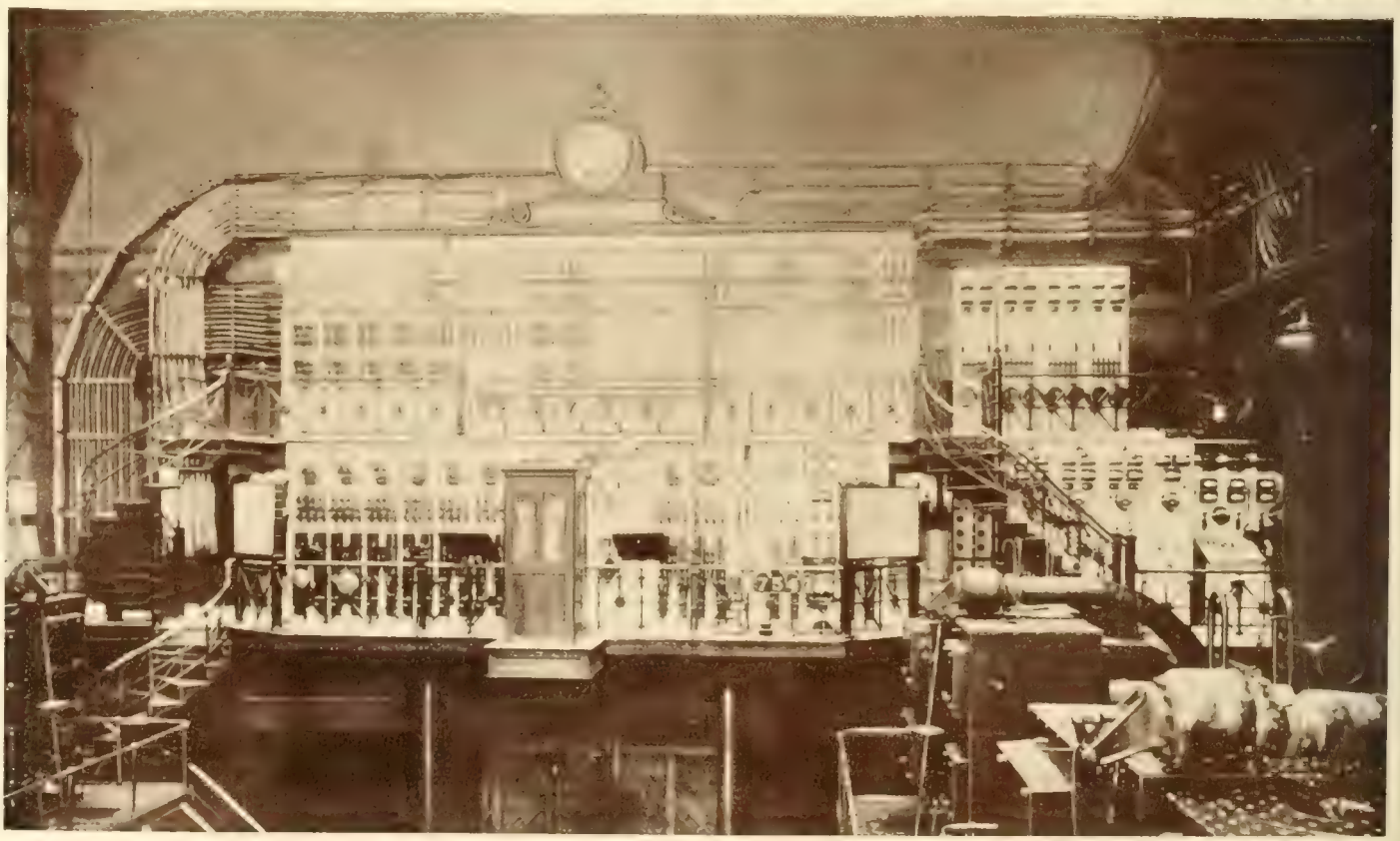


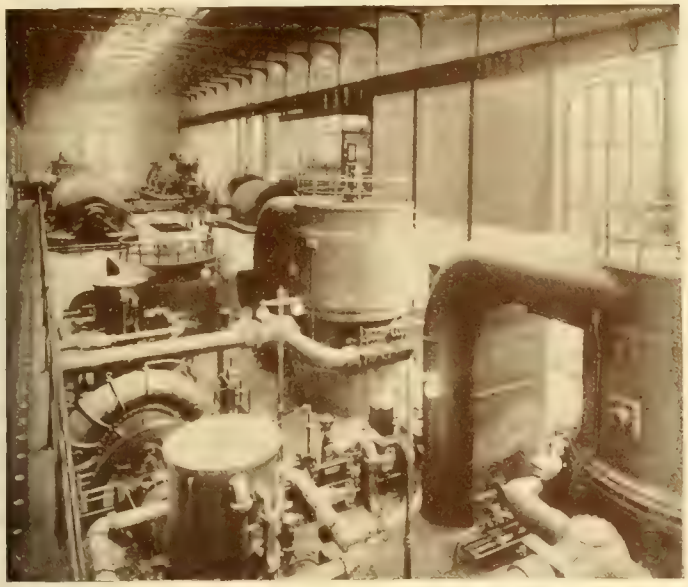


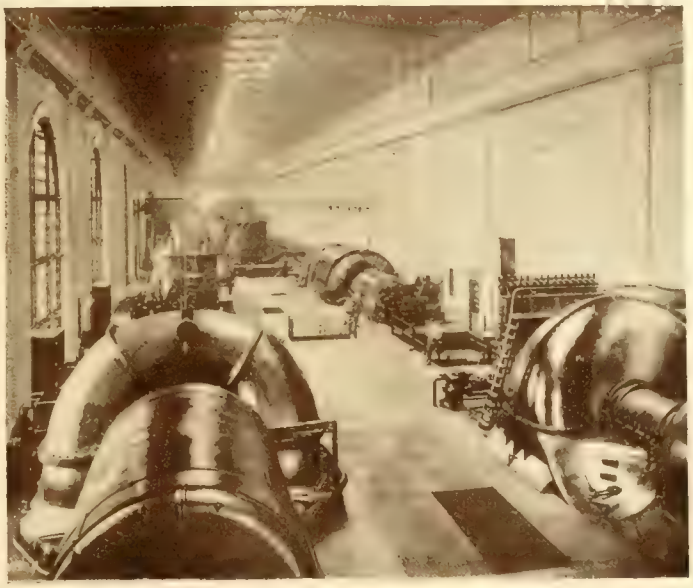
Stations that Have Served Their Day

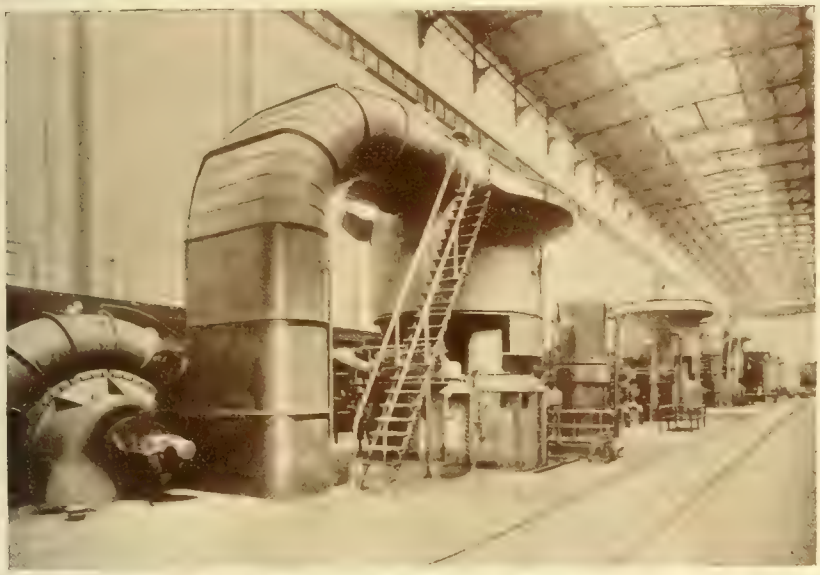
NOT one of the old stations shown has been in operation for twelve to twenty-seven years, but comparison of these and others with the present stations serves to indicate the strides made in central-station engineering. Adams Street station (1888-1894), shown in the upper left hand corner, housed the first standby storage battery, installed in 1896. Harrison Street station (1894-1902), shown in the center and lower panel, was the largest and most economical station in the United States at the time. In Twenty-seventh Street station (1897-1907) was installed the first rotary converter used for central-station service. Market Street station (1887-1904) and North Clark Street station (1893-1909), shown in the upper right hand corner, were other old generating plants.





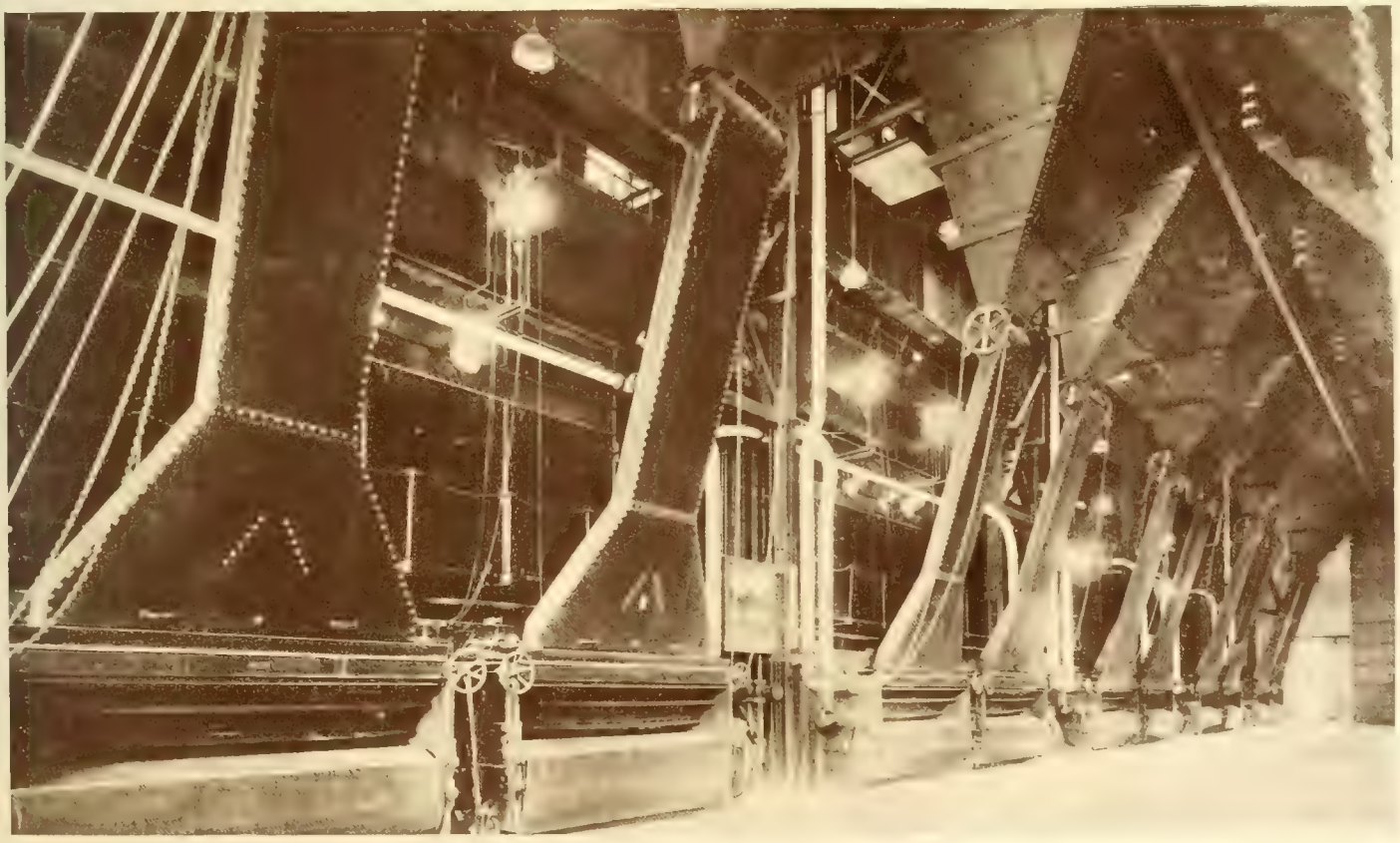






Principal Sources of Electric Supply in Chicago

NORTHWEST, Fisk Street and Quarry Street stations, shown in the three upper panels, are the chief sources of electrical energy in Chicago. Fisk Street station was initially planned (1903) for fourteen 5,000 kw. vertical units. Now it has ten vertical 12,000 kw. turbo-generators, and one each of the following rating in horizontal units: 20,000 kw., 25,000 kw., 30,000 kw. and 35,000 kw. Quarry Street station, which contains six vertical 14,000 kw. generators, was first put in operation in 1908. Northwest station was completed in 1912 and contains two vertical 20,000 kw. generators, three horizontal 30,000 kw. and one horizontal 35,000 kw. unit. The boiler room of the Northwest station, shown in the bottom panel, is typical of those in the other stations.



SAMUEL INSULL

An Appreciation

FOR more than 40 years Samuel Insull, president of the Commonwealth Edison Company, has been an outstanding figure in the electrical industry. He became associated with Thomas A. Edison in this country in March, 1881, and was a powerful influence in the evolving of the Edison industries that ultimately became the General Electric Company. He has long been a moving and guiding spirit in the activities of public utilities.

Mr. Insull is not alone identified with the largest of all metropolitan steam-electric systems. His ideas of organization, operation and development have been successfully applied and worked out in many smaller cities by public utilities known as the Insull group. He has been concerned in every phase of central-station operation. He has been a leader in thought and action, whenever there have come new problems in the industry, whether of management, policy, rates or public relations. He has been a forceful advocate of mass production and unified electric service for distribution over wide areas and to diversified uses. He has been a stimulator and a builder of plant efficiency, service ideas and operating morale, and the impulse of his thinking has been felt throughout the industry. With a record of achievement reaching back to the very birth of the central station, Mr. Insull stands today as one of our greatest leaders and inspirers of others in advancing the great science, profession and business in which we are engaged.

Details of Mr. Insull's career are outlined on page 1269

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A Bold Prophecy that Warrants Interest

WITHIN one year electron tubes will be used for rectifying alternating current for series street-lighting purposes, and in five years, perhaps, they will be replacing the synchronous converter, according to opinions expressed by Dr. Albert W. Hull before the A. I. E. E. last week. In ten years, he predicted, they will be on electric locomotives, and twenty years will see direct-current transmission lines fed through transformers and electron tubes. This is a rather bold prophecy considering the attempts which have been made to displace heavy rotating equipment by static devices, but it deserves attention and interest in view of the steady success obtained with electron tubes during the past few years. Today electron tubes perform many of the most important functions in telephone and telegraph transmission. During recent years, moreover, power engineers have found electron tubes useful where large current values are not required, for such purposes as cable testing and smoke precipitation.

Credit Due to the Average-Sized Central-Station Company

REQUIREMENTS of electric service in metropolitan districts and the proportions of development problems connected with building large transmission networks have frequently overshadowed the work done in the small and average-sized community. Nevertheless, it is the universal availability of electric service to the humble homes as well as the more luxurious and to the small isolated factories as well as the great industrial institutions that has advanced the central-station industry to the commanding position it now occupies as an essential factor in our social and business life. To the executives and the engineers in towns of average size who are successfully struggling with financial and operating problems to maintain high quality of service is due in some cases an individual credit equal to if not greater than that deserved by those in companies associated with large financial interests from which assistance can be depended upon in the extension and maintenance of physical properties. It takes a broad vision and a loyalty to ideals of service to invest money in small public utility enterprises with a regulated rate of return when there are so many opportunities to invest in enterprises which combine safety and speculative return on a more attractive and an unregulated basis. With just pride the electrical industry can boast of the high ideals of its executives. And to these men, particularly those associated with the average-sized electric utility, this issue of the ELECTRICAL WORLD is dedicated. In its columns are reflected their ideas and their problems, a testimony of progress that should be an inspiration to the industry as a whole. When it is realized that 95 per cent of the 5,700 central-station companies of this country operate stations rated under 10,000 kw., the important position of the average-sized company in the future development of electric service is revealed.

The National Electric Light Association

THE National Electric Light Association, which holds its convention next week in Chicago, is not only the dominant electrical association in the country but admittedly the most progressive and energetic public utility association of the world. Approximately 95 per cent of the total electric public utility output of the United States is generated by its members, so that all of its conventions and actions command attention. There is no phase of the electric light and power business that is not within its grasp, and yet the giant has never been known to misuse its power. The association has 174 committees at work, the personnel of which includes more than a thousand experts who meet at regular intervals to discuss what is best for the business and to exchange knowledge, experiences and ideas. Their deliberations lead to but one end—greater efficiency in the production and distribution of electricity. Freedom and frankness, which are lacking among other gatherings of executives and engineers, characterize the meetings, because, the business not being a competitive one, there are no secrets to guard and all contributions are made for the general good. The inevitable result is progress, which manifests itself in improved practices or machinery and in higher standards of service. Therefore, to the National Electric Light Association more than to any other body must credit be given for the almost universal use and application of electricity in this country. Other organizations may have suggested and proposed, others may have even anticipated the National Electric Light Association in certain directions, but unless and until the work received the stamp of approval of the National Electric Light Association it was without effect. To appreciate what this means one has but to compare the quantity of electricity produced and used in the United States with that in any other country in the world. Clearly indicated also are the benefits accruing to the nation through the genius, initiative and enterprise of private business. No city of itself can command such an array of expert talent as is made available to any one company through membership in the National Electric Light Association, and yet every city can receive the benefit of the aggregate experience, knowledge and skill of these men. Chicago is a typical example. It possesses some of the largest and most efficient steam-electric generating stations in the world, and its service is unsurpassed. So broad in extent and intensive in application is the work of the

Commonwealth Edison Company that its total kilowatt-hour output exceeds the output of a dozen or more of the smaller states combined and is not far short of the total generated in England, Scotland, Ireland and Wales. The genius and enterprise shown by Samuel Insull and reflected in the entire Commonwealth organization are typical of the spirit animating the National Electric Light Association. Regulated as to service and rates by public utility commissioners throughout the country, the increased efficiency and economy brought about as a result of research, experiments, tests and studies bring no direct financial rewards to electric light and power companies or their stockholders other than the very limited return allowed on the investment. The work of the National Electric Light Association, therefore, while it is most indispensable, essential and vital to its members, is largely a labor of love in the service of the public, which benefits through more and better service at minimum cost. Animated by this spirit, the association has grown to its present stature. The coming meeting at Chicago, in recording progress and marking out future paths, will but intensify the will to serve.

Useful Charts for Quick Solution of Short-Line Problems

TRANSMISSION engineers are frequently confronted with the problem of estimating the cost of conductor or of power loss in transmitting a given amount of power at a known power factor to a known distance at a given voltage between conductors. The problem is more complex than in any corresponding direct-current case because the power factor of the load and the distance between the line conductors enter the problem. In all such cases it is advantageous to be able to refer, for first approximations, to graphic charts or to solve short-line problems in this manner.

E. P. Peck presents this week a set of curves for each of a series of sizes of copper-line conductor by reference to which a very simple computation of the percentage voltage drop in transmission can be estimated speedily to a very fair degree of precision. These curves will be found very helpful by transmission engineers in practical work. Of course, when careful estimates have to be made for long lines the results arrived at by the aid of the curves must be supplemented by more elaborate and accurate methods.

Sunspots, Auroras and Disturbances in Communication Circuits

THE recent auroral displays witnessed in the United States were accompanied, as usual, by powerful electromotive forces and currents in telegraph and telephone lines. Fuses were melted and a few cables were damaged. It is now generally admitted that a violent storm on the sun's surface is accompanied by a relatively dark area, or sunspot, which may be many thousands of kilometers in diameter. Finely divided electrified matter is believed to be projected outward from this area at a high velocity, like an electrified jet of gas. In about thirty hours these jets reach the earth's orbit. If they are so directed as to hit the earth, the electrified substance, penetrating into the atmosphere, becomes arrested and entangled therewith at an elevation of say 100 km. above the earth's surface. Electrical disturbances in this layer set up corresponding electric and magnetic disturbances on the earth's surface. The aurora is the rarefied gaseous discharge visible in the upper atmosphere, and, as Elihu Thomson has pointed out, usually consists in our latitudes of a set of parallel streamers, nearly vertical. The terrestrial disturbances are those which are set up by electric and magnetic induction at the bottom of the atmosphere. They fluctuate in magnitude and in sign, in general conformity with the fluctuations in the streamer discharges of the upper air.

The Progress of Ornamental Lighting

FOR a few years past we have had little increase in street lighting, either ornamental or otherwise, on account of war conditions. There have been plenty of street lamps installed, but they have been the result of necessity and not a part of the orderly progress of the art. A paper on another page by Arthur J. Sweet, well known for his activity in modern street lighting, gives a conspective view of the situation as it now exists with the war conditions alleviated. Of late there has been a realization that the costs of labor and material are on the down grade, and although far from pre-war levels, have reached the point where there is encouragement toward construction. It is therefore to be expected that street lighting in the next year or two will take on a new activity, particularly in its ornamental phase. Strictly utilitarian equipment also will naturally increase, but the community nowadays tends to demand something in the line of fixtures and equipment a little better looking than would be the mere product of necessity. Just now the concrete posts are competing with cast iron for attention. Just which will possess the public favor a few years from now is, to say the least, a little uncertain. The concrete posts have worked well on the whole and their use should spread. Against them there is the present lessened cost of the iron posts and in particular the heavier appearance of the concrete structure.

One change on which the public is to be congratulated is the abandonment of the particularly inartistic and inefficient cluster type globes. They are never economical and look well only in the rare cases where they are skillfully designed and in surroundings which harmonize with their structure. The present tendency is toward single lamps with prismatic reflectors, these greatly improving the distribution of light. With this better distribution there has been a very definite movement toward greater mounting heights. The early ornamental practice was abominable in the proportion of glare to illumination, a defect due to bringing powerful lights, supposed to give a brilliant effect, down close to the eyes of the passersby. The higher post gives vastly better distribution and in city lighting gives also a better illumination of the façades of buildings and a more brilliant appearance to the street as a whole.

With these improvements have come a spacing better proportioned to the requirements of the situation and to the increase in intensity. Mr. Sweet holds with most well-informed illuminating engineers that the intensity should be pushed high for the main thoroughfares, up to a quarter or a half foot-candle in fact, with proportionate decrease in less important situations. As regards the illuminants proper, Mr. Sweet bears in mind particularly the powerful incandescent lamps and expresses himself strongly in favor of the constant-current regulator with a film cut-out socket. There is considerable difference of opinion as to whether it is better to

use this straight system or one with compensators and somewhat higher current at the lamps. Practice is split at this point, but with many installations of each kind in use it should not be difficult presently to accumulate a stock of experience which will give a definite basis for decision between the two methods.

The Electrical Industry Suffers Loss

BY THE death of Dr. Rosa and Franklin K. Lane the electrical industry has lost two stanch friends. As a physicist Dr. Rosa did very excellent and brilliant work, which was recognized internationally and which added luster to his name as well as to the annals of the Bureau of Standards. As a sociologist his work was not so productive of results, and it was always a moot question whether as a sociologist Dr. Rosa was ever so happy or so famous as he was as a physicist. He was a painstaking and conscientious worker, however, animated by the highest motives, and the electrical industry mourns his loss. Of Franklin K. Lane too much in admiration and praise cannot be said. As Secretary of the Department of the Interior he was indefatigable in awakening the American people to a realization of the tremendous value of the nation's natural resources and to the necessity of their development. He was the father of the idea of the Federal Power Commission, and his consistent stand for and vigorous advocacy of a water-power bill fair alike in its provisions to the investor and to the public was characteristic of the man. But the electrical industry was not alone in its warm affection for Mr. Lane. He endeared himself to all classes by his broad humanity and unalloyed Americanism, and his death at a comparatively early period of life is a national calamity.

Some Lessons in Middle West Utilities Development

THE system of the Middle West Utilities Company affords an interesting opportunity to study the effects of grouping properties under a single control. The properties are scattered, and while there are fair-sized cities and rich industrial districts in the territory, a large portion of the service is in small and scattered communities. Plants on the original properties were small and inefficient, and service was of the same order as the plants.

Two things stand out on a first analysis of the data presented elsewhere in this issue on the operation of this successful company. The first is that more old plants have been abandoned since the consolidation was begun in 1912 than are now operating either on a constant or an emergency basis. Closely related to this development is the reduction of the average coal used per kilowatt-hour from 8.9 lb. in 1915 to 4.98 lb. in 1920. These two physical facts are tangible evidences of improvements of which the giving of service for the full twenty-four hours of the day as a result of interconnection and the increase in operating efficiency are also forceful proofs. These things are seldom brought effectively to public attention. They are naturally followed by the less tangible improvements, such as better commercial service, increased opportunity to utilize electrical energy and other evidences of progress, that bring the small community service to a par, comparatively, with city service.

The problems involved in the handling of these properties are becoming of increasing importance, particularly in the area lying between the Allegany and Rocky Mountains, where there is a great deal of territory that until now has gone without electric service or at best limped along on night service. The education of the consuming public to the advantages of electric service is bringing the small central-station company to a crisis that has been intensified on one hand by the demands for better service and on the other by the increased labor and material costs. Many of the small stations have reached a point where the service demanded of them cannot be given at a price that the public can pay because they have not and cannot afford the plant facilities necessary. The answer lies in an increased tying up of properties to central sources of power and in such a pooling of community ability to pay as will permit service facilities that no one community can afford.

Much of our previous engineering has dealt with service where the element of cost has been a smaller factor than the question of the best methods of obtaining specific results. The engineer is now facing the problem of better service to the rural districts, the small community and the small industry. His problem is not one of pure engineering, but one of commercial engineering in the strictest sense of the word, and its dual nature will force the development of a far higher type of engineering and managerial ability than we have hitherto known.

Unusual Method for Collecting Bills in Rural Communities

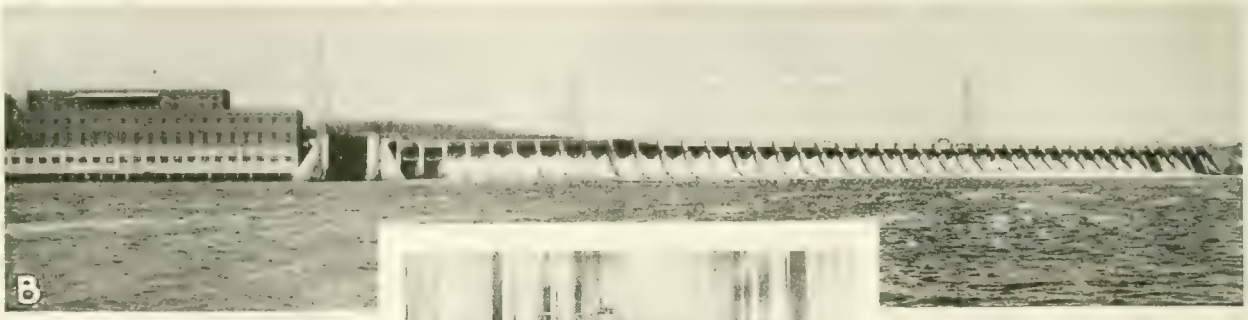
A BRIEF article by B. W. Little in the current issue gives an account of how one rural electric system met the difficult problem of efficient collections in a scattered territory. The plant in question is in South Carolina and operates its distribution system in three towns and the intervening country. The first method tried was appointing a local merchant in each town as cashier. This plan had to be abandoned on account of the difficulty met in tracing errors to their source. Local collectors were the next resort, but experience soon showed that as a rule they went after only the customers whose accounts were most easy to collect and somebody from the office had to follow them up. Next a bank or other local representative in each region was charged with the task of having all bills on file and of mailing cards to each customer giving the amount of the bill and designating the place where it should be paid. This plan, like the others, failed to prevent an exasperating number of errors.

Finally, the somewhat radical scheme was inaugurated of encouraging the payment of bills by check and sending out a combination form comprising the bill and a blank check. Experience has shown that the method leads straight to the desired end. When it was first tried occasional visits had to be made to customers who failed to comprehend the advantages of making a bank deposit at least sufficient to cover their electric bills. Eventual results have been very gratifying, and although a few customers prefer to send money, the return envelope is sufficiently stout to permit this to be done at their risk. Perhaps the plan of paying by check would not work out well in all communities, but in this steady-going and conservative Southern territory it seems to answer admirably.

Inefficient Stations Have Been Supplanted by Such as These

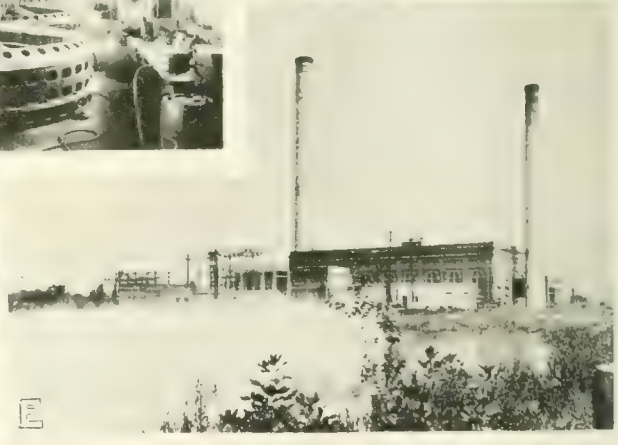
GROUPING the service to 500 communities under a single management has permitted shutting down or placing on reserve many obsolete stations. A few stations which have supplanted older ones in the territory served by the Middle West Utilities Company are shown. A is the Boelus (Neb.) station of the Central Power Company. B is the Prairie du Sac (Wis.) station of the Wisconsin River Power Company. C is the generator hall of the Williams plant of the Southern Indiana Power Company. D and E are steam-generating stations at Pocket, Va., and Muddy, Ill., respectively. F is the Southern Wisconsin Power Company's Kilbourn plant.













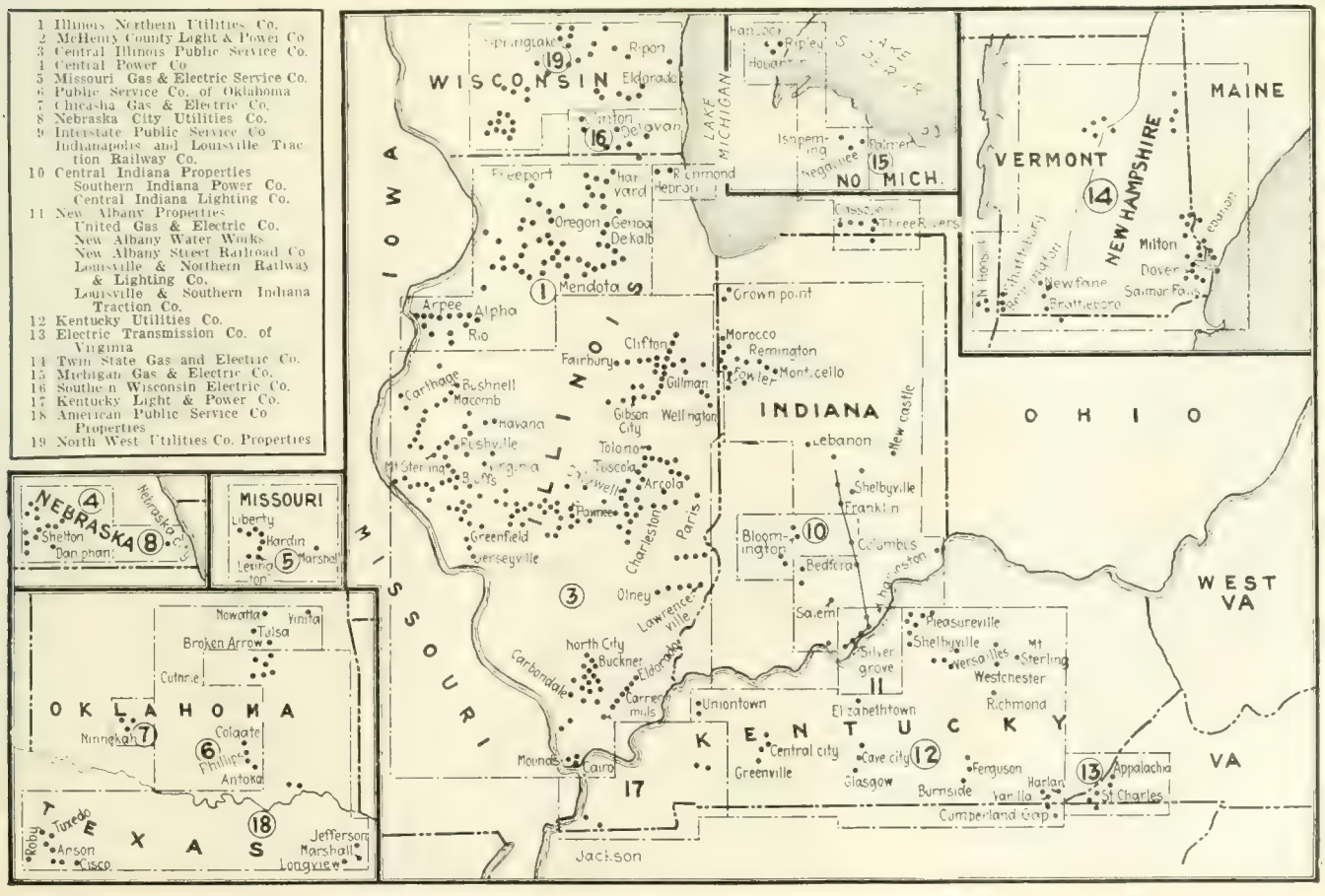
Improved Service to 500 Communities

Physical Features of Middle West Utilities Properties that Under Leadership of Martin J. Insull, President of the N. E. L. A., Have Bettered Service by Eliminating Inefficient Plants — Service Furnished in Fifteen States

THE task of operating all classes of public utilities in more than 500 communities in fifteen states involves an array of financing, operating and commercial problems that fascinate the true central-station operator. The supply of service under such conditions and the honor of contributing to the comfort of humanity in all walks of life can be justly claimed by the Middle West Utilities Company. Its power is depended on in Texas and Oklahoma for operating cotton gins and in New England for cotton spindles. In the Middle West, South and Southwest coal is mined by the aid of its power, and in the upper peninsula of Michigan the mining of iron ore is dependent on its power supply. The overflow lands along the Illinois River are reclaimed and the thirsty soil of the Platte Valley is irrigated by pumps whose source of power is the plants of the Middle West Utilities constituent properties. The building stone of Indiana and the lumber of many states use its power as they pass into industrial service. The grain of the great corn and wheat belts, the oil of the mid-continent fields and the farms of the great Wisconsin dairy country all have their claim upon the activities of this company.

In addition, every imaginable type of factory depends upon the ability of the Middle West organization to maintain its service. People are carried to and from work, aid is given in maintaining evening amusements, the merchants' display of wares is facilitated, the streets, the home and the office are lighted, food is cooked, and the thousand and one labor-saving devices that have accomplished so much in making life worth living are made possible by the activities of this extensive organization.

The spread of operations is clearly shown in the nineteen groups (below) that compose the principal subsidiary companies. An important feature of the physical characteristics of the system is the manner in which the small cities and towns form compact groups. The groups have been acquired and developed with special regard to the sources of power that could serve a given district and the industrial requirements that would utilize these power sources. The organization has been so well worked out that the electrical energy from which 60 per cent of the company's revenue is derived finds its chief market in the compact groups of small cities and towns just referred to. Where water power is available and fuel resources are distant water power is chiefly used. Where no water power is available the generating plants are built at or near the fuel supply. In Kentucky and Virginia and the Middle West steam plants are situated at the mine mouth, while in the Oklahoma and Texas groups the



TERRITORY SERVED BY THE MIDDLE WEST UTILITIES COMPANY

plants are designed to use oil or gas, either of which is produced on the spot.

Approximately 3,900 miles (16,300 km.) of transmission line of varying voltages tie in the towns of the various groups with their generating stations and substations and with each other. Table I gives the communities served, the various classes of service and the estimated population reached. The principal groups of properties and the territories which they serve are as follows:

Twelve Plants Have Supplanted Eighty-Eight Insufficient Ones in Illinois

Virtually the entire State of Illinois, with its varied industries springing from agriculture, coal mines and oil wells and the industrial plants that cluster around fuel sources, forms the scene of operations of one subsidiary—the Central Illinois Public Service Company. Two principal offices, Springfield and Mattoon, handle the entire operation of this property, which is divided into four main units with headquarters at Mattoon, Marion, Beardstown and Gilman.

Twenty-nine towns in the rich agricultural districts of northeastern Illinois are served chiefly from the station at Watseka, while standby plants are maintained at Paxton and Hoopeston. A transmission line from Fairbury to Pontiac connects the division with the Public Service Company of Northern Illinois, from which power is purchased. A transmission line from Sheldon east also ties into the transmission lines of the Interstate Public Service Company.

In the east central portion of the state are communities that include a larger number of electric, gas and heating customers than any of the others. These obtain power largely from the steam plant at Kincaid. Power is also purchased from the Terre Haute, Indianapolis & Eastern Traction Company at Paris and from the Indiana Power & Water Company at Vincennes. Standby steam plants are maintained at Mattoon, Tuscola, Charleston, Paris, Effingham, Olney and Lawrenceville.

The most productive oil fields in the state are in the vicinity of Lawrenceville and Robinson. There are approximately 8,000 producing wells, requiring an average of 3 hp. each to operate. Only a small portion are operated by electric power, but the number is rapidly increasing. The company transmission lines extend through the most productive part of the oil territory and are the logical source of power for future developments. Power is furnished to two oil refineries in Lawrenceville and one in Robinson. Railroad shops, coal mines and other industries grouped in this division draw on the lines of the company as a source of power.

The wealthy agricultural section in the west central part of the state depends chiefly on the Kincaid steam plant and the great hydro-electric plant at Keokuk, from which purchased power is available, although standby steam plants are maintained at Havana, Beardstown, Virden and Jerseyville. Sixty-three communities are served. Agriculture is the dominant industry, although there are coal mines near Auburn, Thayer and Girard. Macomb, White Hall and Colchester boast of large clay-working plants, and Havana, Bushnell, Beardstown, Pittsfield and Jerseyville have good-sized manufacturing plants. Railroad shops exist at Roodhouse and Beardstown. Grain elevators are a substantial source of power demand in this division. This division also furnishes power to central pumping stations for the drainage of about 60,000 acres flooded by the construction of the Chicago Drainage Canal.

The richest coal deposits in Illinois lie in the southern portion of the state. Many of the mines and twenty-two communities in the heart of that region obtain electric power principally from the company's steam station at Muddy. This is the largest steam station on the entire properties of the Middle West Utilities Company and is located about 3 miles (4.8 km.) south of Harrisburg. The generating plant operated at Mounds in connection with an ice plant having a capacity of 200 tons a day that furnishes nearly its entire output to the Illinois Central Railroad for icing refrigerator cars is also an important source of supply. Standby plants are maintained at Carbondale and Anna.

Sixty per cent of the coal output of the state is from mines in the vicinity of the company's lines. Of the total mining load 20 per cent is carried on the company's lines. The majority of the new mines purchase their entire power requirements, and the older mines are gradually changing over by installing motor-generator plants to furnish all their power or assist their own small direct-current plants. Power demands from oil wells, railway terminals, clay-working plants, canning factories and grain elevators help to diversify demands and prevent violent fluctuations. The most striking example of the effect of this diversity lies in the demand for drainage pumping power in the spring and summer months when the coal-mine demand is lightest, while during the remaining months the drainage power demand is light, with a heavy demand from the coal mines.

The dairy and corn belt in the northwestern section of Illinois is served by the Illinois Northern Utilities Company, sixteen counties being included in its territory. The principal steam generating plant is the one at Dixon, and there are hydro-electric plants on the Rock River, at the government dam at Sterling and at Oregon, also at Dixon and on the Pecatonica River at Freeport. Other plants are maintained at Geneseo and Belvidere, the latter a standby plant, while power is purchased at Aledo from the People's Power Company, at Belvidere and Mendota from the Public Service Company of Northern Illinois, at Fulton from the Clinton Gas & Electric Company, and at Sterling from the Dillon Mills, a local industrial establishment. Rural service is a feature of the company activities, and manufacturing activities lend diversity to the demand.

The maps best tell the story of transmission voltages for the Illinois groups, 33 kv. predominating, though 8 kv. and 16 kv. are much used on the properties in the central part of the state and 13 kv. is used quite extensively on the northern Illinois group.

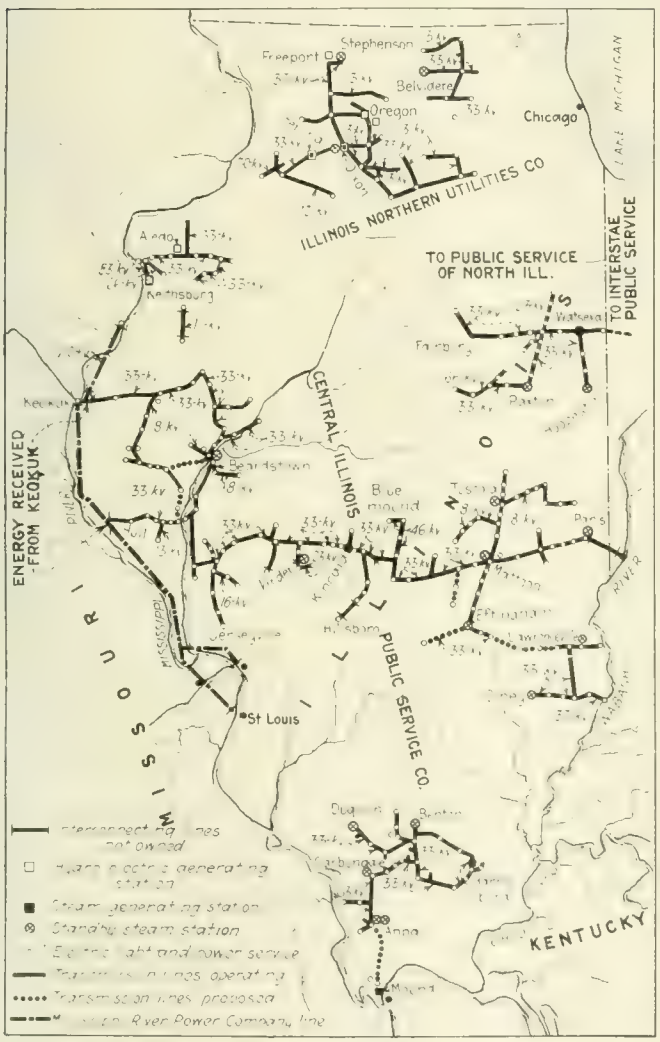
Hydro-Electric Supply Predominates on Wisconsin Properties

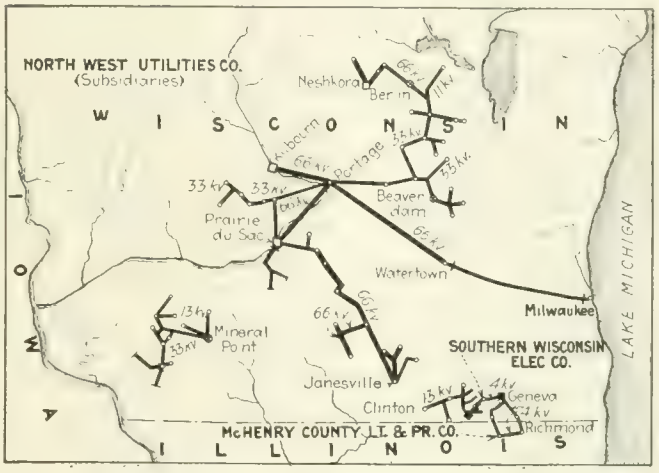
The Wisconsin properties are grouped under the Northwest Utilities Company, a holding corporation, and the Southern Wisconsin Electric Company. The latter centers around Lake Geneva, one of the noted summer resorts of the Middle West, and serves a territory in southern Wisconsin and northern Illinois rich in its farming and dairy resources.

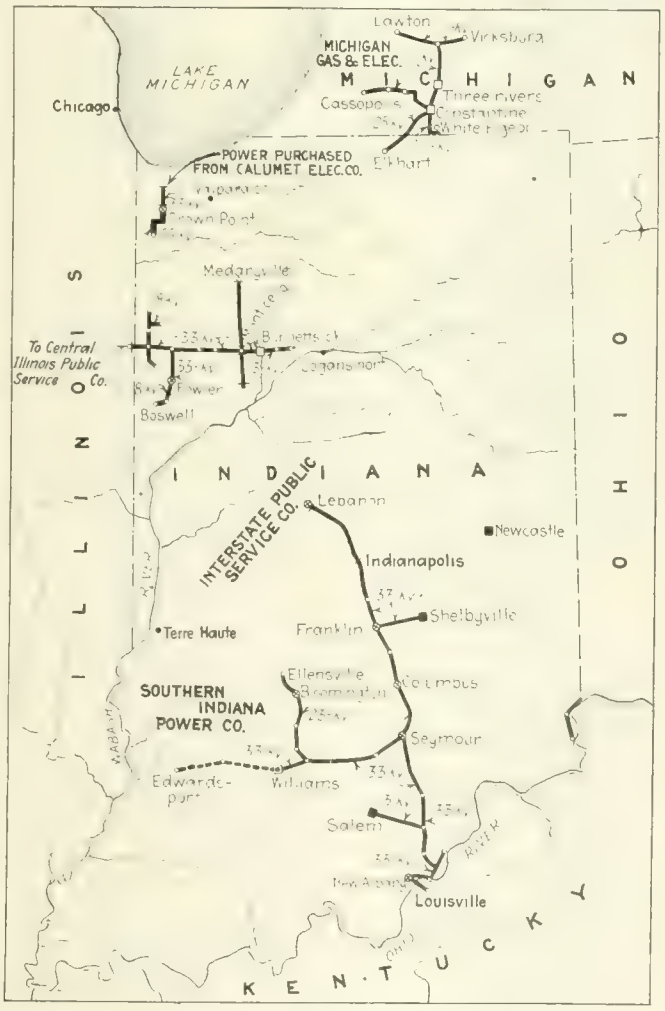
The Northwest Utilities properties are in territory known for its agricultural and dairy products and also

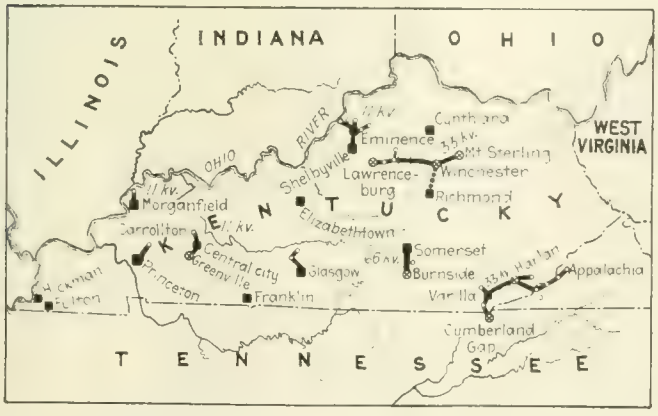
fortunate in the possession of zinc, iron ore and granite resources. Hydro-electric power supply predominates, the Wisconsin River Power Company's Prairie du Sac plant on the Wisconsin River and that of the Southern Wisconsin Power Company at Kilbourn being the main plants. The Prairie du Sac plant is the largest hydro-electric plant among the Middle West Utilities Company properties as well as the largest generating plant. Part of the generation at the Prairie du Sac plant is 25-cycle, a frequency-changer station at Portage tying the 25-cycle and 60-cycle systems together. Generating plants are maintained at Beaver Dam, Neshkora, Berlin, Kingston and Mineral Point, all except Neshkora being standby plants. Power is purchased from the Interstate Light & Power Company for the Mineral Point group, and also at Baraboo from the city. Other purchased power is on an intercompany basis to get the benefit from the two large hydro-electric stations. Wholesaling of energy to central stations in the territory is a feature of the business of the group, the utilities at Madison and Milwaukee being among the customers. The Wisconsin group also has a higher transmission voltage than any other of the groups.

The Indiana properties fall into one large and three small groups operated by the Southern Indiana Power Company and the Interstate Public Service Company.









THE MIDDLE WEST GROUP OF PROPERTIES ARE MOST HIGHLY DEVELOPED FROM AN INTERCONNECTION VIEWPOINT

What Happened When Small Properties Were Grouped Under a Single Management

The number of abandoned stations in the Middle West Utilities Company's system is nearly 50 per cent greater than the number of present operating and standby stations and more than twice as great as the number of stations in continuous operation.

Of 270 stations (including past and present) 156 which were inefficient and inadequate have disappeared and only the better class remain. This change not only has brought about improved service but it also means longer hours of service to communities that could not support twenty-four-hour service except through interconnection with other properties. The operating stations represent in general the best that the territory contains and an average level of efficiency that is well above that which can be attained without interconnection through the maintenance of numerous small plants. This tabulation does not include the stations shut down, for which see Table II.

TABLE I—OPERATING AND STANDBY STATIONS OF THE MIDDLE WEST SUBSIDIARIES, AND OPPORTUNITIES FOR PURCHASING POWER

(Figures in boldface type indicate hydro-electric rating)

Location of Station	Rating (kw.) Operating Station	Standby Station	Purchased Power
Central Illinois Public Service Company:			
Anna		480	
Charleston		230	
Beardstown		900	
Christopher			1,875
Carbondale		450	
Effingham		500	
Fairbury			1,500
Hulls			7,500
Havana		367	
Hoopeston		750	
Jerseyville		175	
Keokuk			2,500
Kincaid	6,000		
Lawrenceville		725	
Lawrenceville			1,500
Mattoon		1,581	
Mounds	675		
Mounds			225
Muddy	15,000		
Olney		435	
Paris		650	
Paris			600
Paxton		450	
Robinson		400	
Roseville			75
St. Elmo	75		
Tuscola		550	
Virden		240	
Waseka	1,750		
Illinois Northern Utilities Company:			
Aledo			500
Belvidere		440	
Belvidere			900
Dixon	6,000		
Dixon (hydro)	300		
Freeport (hydro)	400		
Freeport		1,375	
Fulton			100
Geneseo	250		
Mendota			600
Oregon	600		
Sterling (hydro)	1,500		
Sterling		300	
Sterling (hydro)	200		
Sterling			300
Northwest Utilities Subsidiaries Southern Wisconsin Power Company:			
Kilbourn (hydro)	6,000		
Wisconsin River Power Company:			
Prairie du Sac (hydro)	25,500		
Wisconsin Power, Light & Heat Co.:			
Baraboo			237
Beaver Dam		550	
Nekoosa (hydro)	225		
Berlin		1,780	
Kingston	10		
Mineral Point Public Service Company:			
Mineral Point		3,000	
Mineral Point			4,500
Northern Wisconsin Electric Company—McHenry County Light & Power Company:			
Lake Geneva and Delevan			1,000
Interstate Public Service Company:			
Aurora		100	
Aurora			600
Bloomington		475	
Campbellsburg	50		
Corydon	110		
Crown Point			450
Crown Point		240	
Columbus		1,250	
Fowler		465	
Franklin		400	
Indianapolis			3,500
Lebanon			600
Lebanon		800	
Monticello (hydro)	400		
New Castle	1,125		
New Albany		1,000	
New Albany and Jeffersonville			7,850
Seymour		550	
Shelbyville	1,225		
Southern Indiana Power Company:			
Williams (part hydro)	4,000		
	4,000		
Kentucky Utilities Company:			
Central City	150		
Cynthiana	390		
Elizabethtown	250		
Franklin	260		
Glasgow	287		
Greenville		105	
Mount Sterling		200	
Mount Sterling			450
Morganfield	300		
Richmond	275		
Shelbyville	450		
Somerset	950		
Varilla	3,000		
Versailles			225
Winchester (gas engine)		300	
Electric Transmission Company:			
Pocket	6,000		
Kentucky Light & Power Company:			
Fulton	255		
Hickman	225		
Princeton	405		
Public Service Company of Oklahoma:			
Atoka	1,000		
Broken Arrow		205	
Guthrie		712	
Guthrie			500
Nowata (gas engine)	475		
Tulsa	6,000		
Vinita	975		
Chickasha Gas & Electric Company:			
Chickasha (hydro)	975		
Chickasha	955		
American Public Service Subsidiaries:			
Abilene	875		
Abilene, new station	2,000		
Baird		190	
Cisco	550		
Fort Towson	75		
Henryetta	1,500		
Hugo	1,035		
Longview (Diesel engine)		200	
Marshall	1,405		
Okmulgee	1,700		
Stamford		600	
Tulsa	10,000		
Missouri Gas & Electric Service Company:			
Lexington		562	
Liberty		250	
Liberty			1,000
Marshall	650		
Richmond		462	
Central Power Company:			
Boelus (hydro)	2,000		
Kearney (part hydro)	750		
	900		
Grand Island	2,250		
Nebraska City Utilities Company:			
Nebraska City	850		
Twin State Gas & Electric Company:			
Brattleboro (hydro)	700		
Brattleboro			525
Bennington (hydro)	400		
Bennington			2,250
Berlin	1,850		
Dover	2,250		
Dover			2,000
Farmington (part hydro)	75	175	
Hoosick Falls (hydro)	500		
Milton Mills (hydro)	250		
St. Johnsbury			300
St. Johnsbury (hydro)	875		
St. Johnsbury (hydro)	200		
St. Johnsbury (hydro)	400		
St. Johnsbury (hydro)	100		
St. Johnsbury (hydro)	240		
St. Johnsbury (part hydro)	187		
	625		
Berwick & Salmon Falls Electric Company:			
South Berwick (hydro)	1,200		
Michigan Gas & Electric Company:			
Constantine (hydro)	1,950		
Constantine			2,000
Ishpeming	1,700		
Ishpeming			600
Three Rivers (hydro)	120		

The larger group, consisting of the Interstate Public Service properties, lying mainly between Indianapolis and Louisville, Ky., and connected with the Southern Indiana Power Company's lines by a 33-kv. transmission line between Seymour and Bedford, furnishes power to the limestone quarries, coal mines and industrial plants between Indianapolis and Louisville and is largely concerned with the operation of the successful interurban railway between Indianapolis and Louisville. Power is furnished this group from the combined hydro-electric and steam plant at Williams and the steam plants at Shelbyville, New Castle, Campellsburg and Corydon. Transmission lines on these properties are mainly 33 kv. The line between Indianapolis and Louisville has only recently been reconstructed and raised to this voltage.

Power is purchased from the Louisville Gas & Electric Company, the Merchants' Light, Heat & Power Company at Indianapolis and from the Cincinnati Traction Company at Cincinnati for the small group of properties around Aurora and Rising Sun.

Two of the smaller groups are in northwestern Indiana, one covering Lowell and Crown Point, the Gretna Green of the Chicago territory. Power is purchased from the Calumet Electric Company, and a standby steam plant is maintained at Crown Point.

The larger of the two groups is served mainly from the hydro-electric plant at Monticello and also through the connection with the Central Illinois Public Service Company; 33-kv. transmission rules in this group.

Coal Mines of Kentucky and Virginia Are Large Power Users

These properties cover a large agricultural region in central Kentucky, including ten counties of the "blue-grass" region. The properties of southeastern Kentucky and western Virginia are in a rich mining region. Seventy-five per cent of all the coal-mining operations in Bell and Harlan counties, Ky., and Lee and Wise counties, Va., are supplied with power by the Kentucky Utilities, and through the wholesaling of power to the Old Dominion Power Company the mining operations around Norton, Va., also receive power from this system. Ten operating steam-electric stations are maintained in the state and one in Virginia. That at Pocket, Va., is the largest and the Varilla station is next largest, the two being rated at 6,000 kw. and 3,000 kw. respectively. Three standby stations—one gas-engine-driven—are maintained, and power is purchased at Mount Sterling and Versailles from the Lexington Gas & Electric Company.

The tendency of the average individual will be to wonder where the advantages of grouping such properties as these may be found. In the comparative sense there are no generating stations that are large. Transmission-line practice, judged by the methods followed in some sections of the country, are not at all spectacular. The mental tendency always to dwell on the property of huge proportions and spectacular equipment leads to decidedly erroneous conclusions in a case of this kind. An indication of the facts will be furnished by a study of Tables I and II, which shows in a very striking way the effect of this property grouping on plant operation. To arrive at the true meaning of this table it must be clearly realized that these properties are not serving a single, compact, highly developed territory. Their mileage of transmission lines and number of consumers served do reach an impressive total, but the territory served covers a tremendous area of the United States. While the individual groups are compact, the property as a whole is widely scattered.

What Property Grouping Means

The physical result of the combination has been the elimination of more than twice as many plants as are now in constant operation. Since standby plants are largely non-operating plants, the practical effect has been the elimination of more than the 156 plants absolutely closed down, since at least some among the forty-two standby plants are, from an operating standpoint, in the saving of labor and fuel expense, equivalent to abandoned plants. It is safe to assume that the equivalent number of plants closed down is approximately two and one-half times the number of plants now serving the properties. When it is remembered that the nature of the territories served is such that the abandoned plants are all small, extremely inefficient and many of them of the type that gave only night service, the gain to the communities in adequate service, better rates and consequent improvement in community conditions can be well appreciated.

A more significant turn is given to the figures when they are analyzed in detail. The Illinois group, which is the most compact of the whole, has twelve operating plants against eighty-eight closed down and nineteen partially operating plants. More than seven times as many plants as are now in constant operation have been closed down completely. The Wisconsin group, with four operating and three standby plants, has closed down eleven stations, while Indiana, with six operating and nine standby stations, has closed down sixteen stations. The other groups are not nearly so compact, and the result is shown in the comparatively small number of generating stations closed down.

TABLE II—HOW INEFFICIENT MIDDLE WEST UTILITIES STATIONS HAVE BEEN SUPERSEDED

	Stations Operating	Standby Stations	Stations Closed Down	Total Stations	Sources of Purchased Power
Illinois:					
Central Illinois Public Service Co.	5	16	62	83	7
Illinois Northern Utilities Co.	7	3	26	36	4
Wisconsin	4	3	11	18	2
Indiana	6	9	16	31	5
Kentucky	14	3	14	31	1
Oklahoma-Texas	15	4	9	28	1
Nebraska-Missouri	5	3	8	16	1
New England	13	1	5	19	3
Michigan	3	0	5	8	2
Total	72	42	156	270	26

Opportunities for Purchased Power

Another factor in the closing down of stations has been the ability to purchase power both within the groups and from outside sources. In the Wisconsin group the interconnection of the systems to take power from the Prairie du Sac and Kilbourn hydro-electric plants has aided in preventing the building of numerous small plants to give service to small communities as well as in permitting the shutting down of small, inefficient stations. Illinois leads in the number of sources of purchased power, indicating her possession of a greater number of opportunities to do so advantageously. Indiana is the next state in line in this respect.

The larger part of the total territory served lies where individual communities left to provide their own

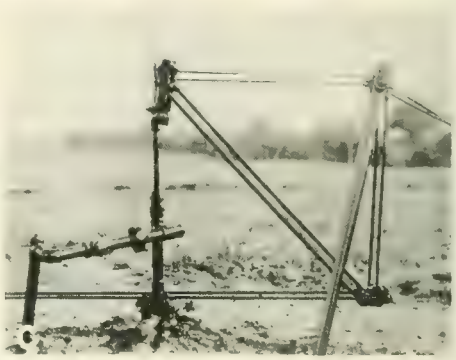
Diversified Industries Enjoy Benefits of Electric Service

EVERY imaginable type of industry depends on the Middle West Utilities Company for service. A few uses are illustrated. A is a grain mill and elevator at Guthrie, Okla. B is a 30-loaf electric bake oven. C is a pump jack and oil well near Bridgeport, Ill., near where 8,000 wells are located. D is an ice plant at Longview, Tex. E is a part of an Indiana quarry at Bedford. F. shows electric coal mining at Lexington, Mo.















service would be compelled largely to limp along with half service or none at all because of the small individual demands. The territory as a whole would not support the tremendous plants that are found in the highly developed and concentrated industrial districts of Chicago, Pittsburgh and New York districts. The achievement of the Middle West Utilities Company lies in the taking of territory that would otherwise have inadequate service and giving it adequate service by linking up the properties, utilizing the most efficient stations and providing new and efficient ones of adequate size as the needs of the service demand, shutting down inefficient plants and giving service that for the demands of the territory cannot be bettered even in the more highly developed commercial and industrial centers.

Middle West Growth Chiefly in Energy for Power Purposes

Both Connected Power Load and Energy Sales Show Remarkable Growth —Fuel Consumption Reduced by Elimination of Old, Inefficient Plants— Gross Earnings per Capita Increase Nearly Four Times Since 1912

AN INVESTMENT of $125,000,000 in property to provide utility service is a sizable sum even in these days of thinking in huge figures. This represents in round figures the investment in the operating properties comprising the Middle West Utilities Company. Of the total nearly $26,000,000 represents the investment and construction expenditures of subsidiary companies in the six years from 1915 to 1920 inclusive. What this indicates is shown in Table I, in which the classes of service, the communities served and the population dependent on service are given. In terms of population in the territory served the investment per capita reached $93 at the end of 1920. Although these figures cannot be used as an average of the investment necessary under any and all conditions, they are an interesting indication of the investment cost to give service that may have to be considered in any cases under discussion.

Much of the growth of the properties took place during the war years, when the operating and management problems were most acute. The Middle West Utilities Company was organized May 15, 1912, and therefore except in the first two years of its existence it has always had to face war problems, originally those that arose before the United States was actually engaged in the conflict, and later those incident to our active participation in the war and to the reconstruction period that is still painfully present.

TABLE I—GROWTH OF MIDDLE WEST UTILITIES COMPANY FROM APRIL 30, 1916, TO DECEMBER 30, 1920*

Subsidiary Companies	State	Number of Communities Served		Different Classes of Service												Estimated Population Served	
				Electric		Gas		Water		Ice		Heat		Railway			
		1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920	1916	1920
Central Illinois Public Service Co	Ill.	164	186	163	185	6	8	11	13	14	14	13	7	6	7	285,000	355,000
Illinois Northern Utilities Co	Ill.	60	72	58	70	9	9			1		3	1	2	2	132,200	135,900
Sterling, Dixon & Eastern Elec. Railway Co.	Ill.																
McHenry County Light & Power Co[1]	Ill		2		2												1,500
Interstate Public Service Co	Ind.	24	27	21	26	5	7	4	6	4		4	1	1	2	82,300	93,000
Indianapolis & Louisville Tractn. & Ry. Co.[2]	Ind.																
Southern Indiana Power Co	Ind.	3	3	3	3											2,500	2,500
Central Indiana Lighting Co	Ind.	2	2	2	2	1	1					1		1	1	22,000	22,000
Franklin Water, Light & Power Co[3]	Ind.	1		1		1		1								5,600	
United Gas & Electric Co	Ind.																
New Albany Waterworks	Ind.																
Louisville & Northern Railway & Lighting Co.	Ind.	8	8	7	8	2	4	2	2					3	3	46,900	46,900
Louisville & Southern Indiana Traction Co.	Ind.																
Kentucky Utilities Co	Ky.	21	34	21	34	1	1	3	6	5	8			1	1	61,400	84,000
Kentucky Light & Power Co.[4]	Ky.		5		5				1		1						13,900
Electric Transmission Co. of Virginia	Va.	5	5	5	5											6,100	6,100
Citizens' Gas Light Co.[5]	Tenn.		1				1										19,600
American Public Service Co[6]	Okla. Texas		22		21		2		1		17				1		108,600
Public Service Co. of Oklahoma	Okla.	8	10	8	9					4	6					53,200	127,500
Chickasha Gas & Electric Co	Okla.	2	3	2	3	1	1									13,400	13,900
Central Power Co[7]	Neb.		14		14		1				1						27,900
Nebraska City Utilities Co	Neb.	1	1	1	1	1	1	1	1							6,900	6,900
Missouri Gas & Electric Serv. Co.	Mo.	9	10	9	10	2	2				1					23,500	24,200
Southern Wisconsin Electric Co.	Wis.	7	10	7	10											11,300	13,500
Northwest Utilities Co[8]	Wis.		33		33		3		1				2				55,700
Michigan Gas & Electric Co.	Mich.	9	16	9	13	3	6							1	1	38,200	60,200
Twin State Gas & Elec. Co	New Eng.																
Berwick & Salmon Falls Electric Co.	New Eng.	31	38	31	38	3	3								1	107,800	117,400
Total		355	502	348	492	35	50	22	31	28	48	21	11	16	19	929,00	1,336,200

*Since Dec. 31, 1920, all the properties in Indiana except the Indianapolis & Louisville Railway and the Southern Indiana Power Company have been merged with the Interstate Public Service Company.

[1]McHenry County Light & Power Company organized in 1916.

[2]Indianapolis & Louisville Traction & Railway Company. This property was purchased in 1919.

[3]Franklin Water, Light & Power Company, now included in Interstate Public Service Company.

[4]Kentucky Light & Power Company purchased in 1917.

[5]Citizens' Gas Light Company purchased in 1916.

[6]American Public Service Company purchased in 1917.

[7]Central Power Company purchased in 1917.

[8]Northwest Utilities Company purchased in 1919.

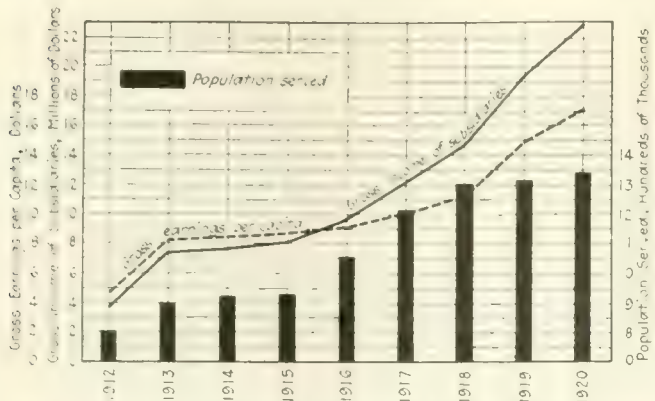


FIG. 1 —POPULATION SERVED AND GROSS EARNINGS OF MIDDLE WEST UTILITIES COMPANY SUBSIDIARIES

At the issuance of the first annual report, dated April 30, 1913, when the subsidiary properties had been under the control of the Middle West Utilities an average of nine months, 274 communities, with a population of between 800,000 and 900,000, were being served and the battle for improvement of operating conditions by the interconnection of properties and the replacement of the numerous inefficient and obsolete plants was at its height. In 1914 333 communities in ten states were served. The total increased to the 355 communities shown in Table I for 1916, and through

TABLE II—GROSS INCOME AND GROSS EARNINGS PER CAPITA OF MIDDLE WEST UTILITIES COMPANY SUBSIDIARIES

	Gross Income of Subsidiaries	Population Served	Gross Earnings per Capita
1912	$3,680,676 76	800,000	$4.60
1913	7,345,350 73	900,000	8.15
1914	7,634,745.29	917,000	8.35
1915	8,091,148 62	929,000	8.70
1916	9,620,216 13	1,055,300	9.10
1917	12,157,121.57	1,208,800	10.05
1918	14,641,035.34	1,297,150	11.25
1919	19,362,673.74	1,309,900	14 80
1920	22,729,922.75	1,336,200	17.00

the war and post-war years a steady growth has been maintained.

Something of the story written in terms of gross earnings per capita can be traced in Table II. The $4.60 per capita for 1912 represents about what may be expected from small, inefficient plants with high operating costs and little ability to render attractive service. The improvement in service and growth of facilities to give service can be traced in the increase in earnings per capita, which in 1920 were nearly four times the gross earnings per capita in 1912. These figures also tell their story of education and careful, thoughtful attention to the needs of the population served.

Table III shows that 67.2 per cent of the operating income and 60 per cent of the gross income came from the electric properties for 1920. The table is an interesting illustration of the relative positions as income producers of the various utility services given by the properties.

The income from electrical sources by years from 1916 to 1920 is shown in Table IV.

TABLE III—SOURCES OF OPERATING AND GROSS INCOME OF MIDDLE WEST UTILITIES SUBSIDIARIES FOR THE YEAR 1920

	Operating Income	Per Cent of Total
Electric	$13,622,703	67 2
Gas	1,698,676	8 2
Water	530,361	2 6
Railway	2,534,977	12 3
Heat	209,130	1 3
Ice	1,740,576	8 4
Total	$20,336,423	100 0

	Gross Income	Per Cent of Total
Electric	$13,622,703	60 0
Gas	1,698,676	7 5
Water	530,361	2 3
Railway	2,534,977	11 1
Heat	209,130	0 9
Ice	1,740,576	7 7
Merchandise	1,977,948	8 7
Miscellaneous non-operating	415,551	1 8
Total	$22,729,922	100 0

ELECTRIC POWER BUSINESS RAPIDLY INCREASING

The total number of consumers served with electrical energy, gas and water now runs to the huge total of 304,658.

The record since 1915 is given in Table V.

The growth of the electrical energy sales from 1916 to 1920 (Table VI) shows a remarkable increase. The total kilowatt-hour sales for 1920 are more than three times the sales for 1916. The most interesting figure, however, is the growth of power demands. In 1916 38 per cent of the connected load was for power purposes. This increased to nearly 50 per cent in 1920. The remarkable feature is the percentage of total sales

TABLE IV—INCOME FROM ELECTRIC ENERGY SALES BY MIDDLE WEST UTILITIES SUBSIDIARIES, 1916-1920

	1920	1919	1918	1917	1916
Commercial lighting	$6,645,906	$5,217,113	$4,006,950	$3,400,533	$2,842,877
Commercial power	3,062,948	2,358,415	1,683,111	1,195,437	1,174,866
Municipal lighting	914,350	873,757	915,361	828,617	747,813
Municipal power	195,776	163,868			
Sales to other public utilities	1,524,061	1,200,659	361,576	259,821	212,671
Wholesale light and power	1,252,130	844,918	643,284	321,442	In com'l pwr
Steam sales and miscellaneous	27,530	28,139	.....	.....	.....
Total	$13,622,703	$10,686,871	$7,670,284	$6,005,850	$4,786,477

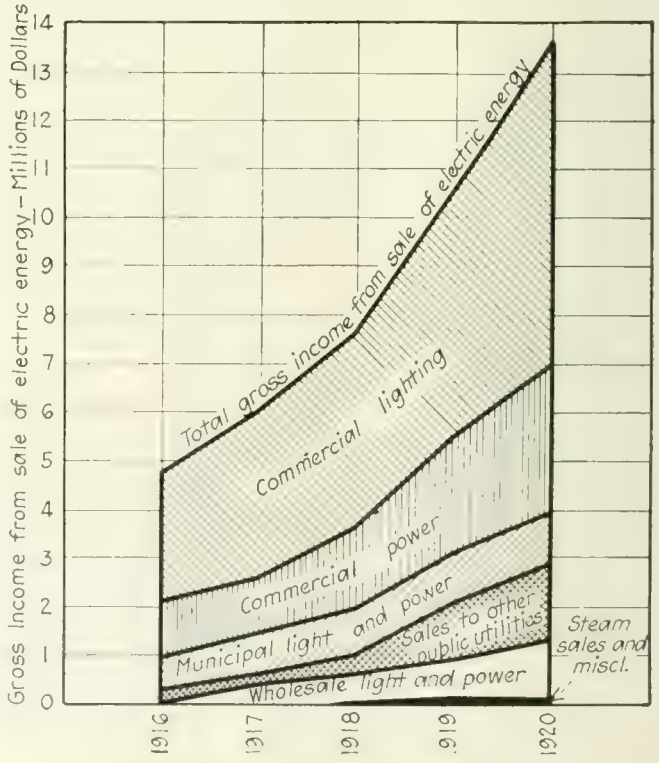


FIG. 2—GROSS INCOME FROM SALE OF ELECTRIC ENERGY BY MIDDLE WEST UTILITIES SUBSIDIARIES

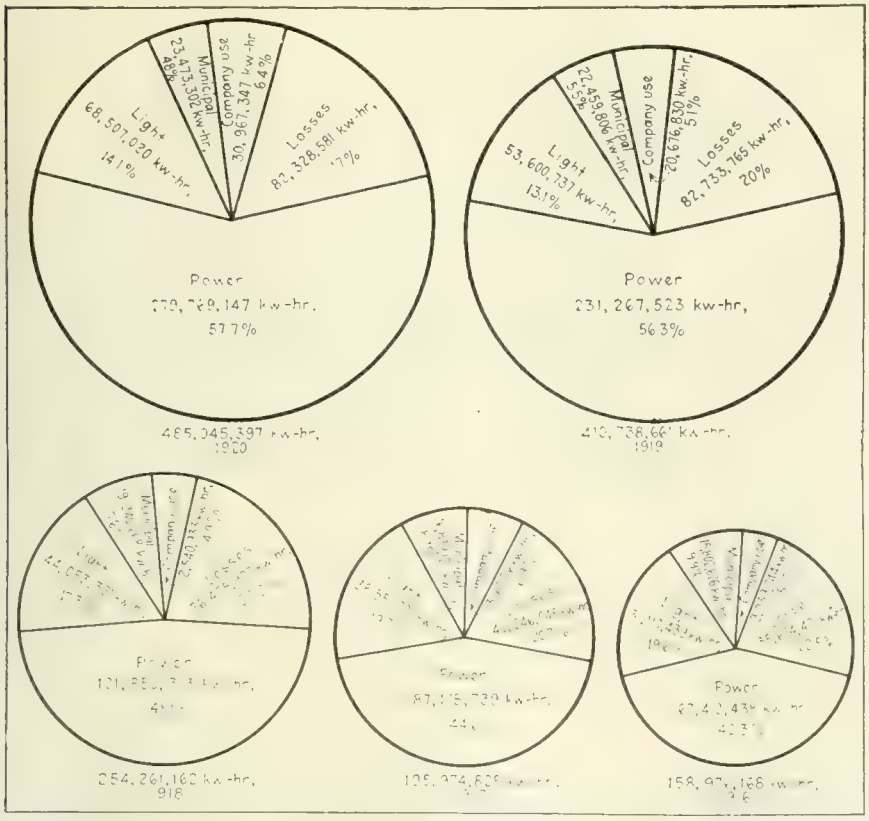


FIG. 3—DISPOSAL OF ENERGY DISTRIBUTED BY MIDDLE WEST UTILITIES SUBSIDIARIES

that are credited to power demands. Whereas it was only 48 per cent of the total in 1916, it had risen to more than 75 per cent of the total in 1920. This is significant of the growth of business in the territory and also of the fact that not only has the organization eliminated inefficient central stations but that it has been instrumental in displacing inefficient industrial plants and in preventing the building of new ones.

TABLE V—ELECTRIC, GAS AND WATER CONSUMERS SERVED BY MIDDLE WEST UTILITIES COMPANIES

Year	Number of Customers Served			
	Electric	Gas	Water	Total
1915	105,571	37,168	14,500	157,239
1916	124,158	39,079	16,097	179,334
1917	143,842	44,782	17,548	206,172
1918	166,051	47,352	20,681	234,084
1919	199,857	52,184	22,300	274,341
1920	226,094	54,500	24,064	304,658

The figures also indicate the direction in which the greatest service to the territory is being performed. Another significant fact is that the margin between energy produced and purchased and the sales, after eliminating company use, has been reduced from 24 per cent in 1916 to a little more than 18 per cent in 1920, pointing toward a material betterment in the adjustment of physical property to operating conditions even during the war years, when the tendency was naturally in the other direction. It is interesting to note that in 1920 190,724,961 kw.-hr., or 39.2 per cent of the total output, both generated and purchased, came from water power.

SECURITIES DISTRIBUTED AMONG SMALL INVESTORS

This movement has only been under way for about a year, having been inaugurated in the spring of 1920. Its remarkable growth is shown by the increase in the number of stockholders from 6,063 and 6,902 on Dec. 31, 1918, and December, 1919, respectively to 10,491 on Dec. 31, 1920, these stockholders holding securities of Middle West Utilities and subsidiary companies. The two earlier years showed an average holding per stockholder of 57 and 51.5 shares respectively. At the end of 1920 this figure was 36.8, showing that the securities have been spread among a class of much smaller investors. These figures do not include approximately 4,100 holders of Middle West prior-lien stock, part of this stock being fully and the rest partly paid up.

Four thousand subscribers to preferred and prior-lien stocks of the subsidiary companies who are likewise partly paid up also are not included in the list of figures.

It is interesting to note that in 1915 there were no electric ranges on the properties, whereas 4,271 were being served at the end of 1920. This is an indication of the possibilities of growth that electric cooking holds forth.

Transmission-line mileage has increased two and one-half times since 1915. There were 1,643 miles (2,643 km.) in that year and 3,964 miles (6,376 km.) at the end of 1920. The daily capacity of ice plants at the end of 1920 was 1,590 tons and the storage capacity 22,795 tons. These plants utilize surplus and off-peak power.

Coal burned is no small item. No less than 557,681 tons was utilized in 1917. This increased to 648,334 tons in 1920. The interesting fact regarding fuel is the reduction of average coal consumption for all plants from 8.9 lb. (4 kg.) per kilowatt-hour in January, 1915, to 4.98 lb. (2.2 kg.) in December, 1920. This reduction was made despite the fact that many of the smaller plants that are low in efficiency must be kept running until conditions will permit of further interconnection and the elimination of those plants which are not altogether up to the standard in the matter of fuel economy.

TABLE VI—TOTAL CONNECTED LOAD, POWER LOAD AND ENERGY PRODUCED, PURCHASED AND SOLD BY THE MIDDLE WEST UTILITIES COMPANIES FROM 1916 TO 1920

Year	Total Energy (Kw.-Hr.)			Disposal of Energy (Kw.-Hr.)						Connected Load	
				Sold to Consumers				Company Use	Losses	Total Kw.	Power Only (Kw.)
	Generated	Purchased	Total	Light	Power	Municipal	Total				
1916	121,166,582	37,809,586	158,976,168	31,117,439	67,412,438	15,802,626	114,332,503	9,039,244	35,604,421	179,871	68,670
1917	145,755,264	50,219,564	195,974,828	38,551,707	87,175,739	16,839,121	142,566,567	13,162,216	40,246,045	219,026	85,103
1918	198,052,900	56,208,262	254,261,162	44,053,321	121,850,313	19,340,668	185,244,302	12,540,933	56,475,927	253,548	104,661
1919	330,027,813	80,710,848	410,738,661	53,600,737	231,267,523	22,459,806	307,328,066	20,676,830	82,733,765	339,066	163,603
1920	373,973,089	111,072,308	485,045,397	68,507,020	279,769,147	23,473,302	371,749,469	30,967,347	82,328,581	385,353	189,448

Interconnection Has Enabled Increased Economy and Reliability of Service

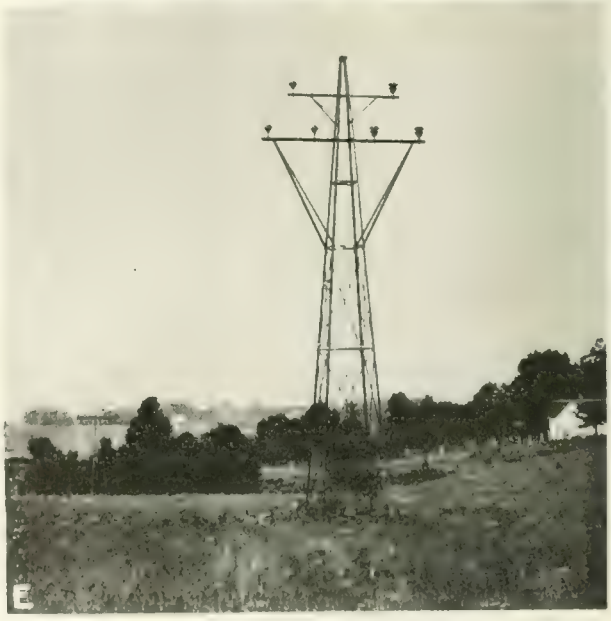
BY TYING together the generating stations in adjacent communities it has been possible to reduce the reserve equipment necessary and also permitted generation of energy in the most economical plants. The lines have permitted giving twenty-four-hour service to rural communities that could not have enjoyed such service otherwise. A is a substation on a large ranch served by the Central Power Company of Nebraska. B and E are tie lines in Illinois between Harrison and Benton, and between Williams and Bedford respectively. C is a transmission line of the American Public Service Company across the Arkansas River near Tulsa, Okla. D is a tie line between Liberty and Missouri City.











Relations Between Management and Public

Middle West Utilities Company Maintains The Policy of Making Local Men Real Managers—Commercial Organization Designed to Aid Consumers in Efficient Use of Energy—Rate Schedules Tend Toward Maximum-Demand Basis

THE success of the management of an organization like the Middle West Utilities Company depends on the adjustment of policies to the needs of the communities served. Policies that might be adequate to a property serving a community of equivalent size gathered into a single compact unit would be totally inadequate here because in the main they would be based on the ability of a single community to demand and pay for service that an equal population widely scattered would be totally unable to use.

There are more than five hundred communities in the groups comprising the Middle West Utilities properties. The majority are covered by the Illinois properties, and, close as the grouping in this state is, comparatively, the properties are nevertheless scattered over a wide area. The remainder are distributed over fourteen other states. In the group are cities that support industrial projects of large proportions. Their needs demand the best of specialized skill in the operation of the central station supplying their power requirements. At the other extreme is the community which, left to itself, could command only the barest elements of service, and that for only a few hours of the day. To supply such a community with a service that meets its needs as fully as does the service to the large community involves management problems of no mean proportions, if the allowable cost of service is not to be exceeded.

With such a scattered group of properties there is always the danger of leaning one way or the other in considering the needs of the group as a whole. Consideration and adoption of policies must necessarily be nicely balanced between the two extremes to avoid neglect of either one. The success of these properties and their rapid growth are a testimonial to the ability of the management in successfully avoiding the pitfalls that would mean disaster.

Elsewhere in this issue attention is called to the fact that on these properties old, inefficient plants totaling in effect fully two and one-half times the present number of operating plants have been abandoned. With the increase in the physical efficiency of the properties due to the linking up of the original separate units and the possibility of improving the power supply by increasing the size and efficiency of generating units and utilizing the diversity of demand that must exist in a group of communities there must come a corresponding improvement in the management policies over those that the separate small units could hope to enjoy. Increased service such as that involved in aiding customers in the best and most efficient use of their power supply means an increase in expense that can only be borne up to a certain limit by a single community. Grouping of such communities means the combining of the prices for service that can be afforded until it is possible to provide

Nature of Rate Structures

TABLE I—TYPICAL LIGHT AND POWER RATES

RETAIL

Per Kw.-hr.

12.5 cents for first 30 hours' use, maximum demand
7.5 cents for next 30 hours' use, maximum demand
5.5 cents for over 60 hours' use, maximum demand

When 7.5 per cent and 5.5 per cent portions after prompt payment discount are over $40 there is a discount of 1 per cent to 50 per cent for bills up to $1,000.

Discount—1 cent per kw.-hr. to tenth of month. Minimum 50 cents per hp. per month, or $8 per year per hp.

WHOLESALE

Primary:

Per Kw.

$4.12 for first 50 kw. of maximum demand
3.45 for over 50 kw. of maximum demand

Secondary:

Per Kw.-hr.	Kw.-hr.
8.63 cents for first	1,000
5.24 cents for next	4,000
1.87 cents for next	25,000
1.5 cents for next	70,000
1.35 cents for over	100,000

Discount—10 per cent of secondary to tenth of month. Minimum—$12 per hp. per year for alternating current motors, not less than $22.50 per kw. of demand

TABLE II—GENERAL COAL-MINING RATE

MONTHLY MAXIMUM-DEMAND BASIS

Primary:

Per kw.

$2.40 for first 200 kw. of maximum demand
1.95 for over 200 kw. of maximum demand

Secondary:

Per kw.-hr.	kw.-hr.
5.3 cents for first	1,000
3.4 cents for next	2,000
2.5 cents for next	2,000
1.7 cents for over	5,000

Discount—10 per cent of secondary charges—ten days. Minimum—$12 per hp. per year. Not to be less than $22.50 per kw. per year of highest monthly maximum demand.

ANNUAL MAXIMUM-DEMAND BASIS

Primary:

Per kw. per year

$28.50 for first 200 kw. of maximum demand, payable at rate of $2.40 per month.
23.35 over 200 kw. of maximum demand, payable at rate of $1.95 per month.

Secondary:

Per Kw.-hr.	Kw.-hr. per Month
6 cents for first	1,000
4.0 cents for next	2,000
3.0 cents for next	2,000
1.7 cents for next	20,000
1.5 cents for next	500,000
1.2 cents for next	1,000,000
1.12 cents for over	1,525,000

Discount—10 per cent of secondary charges—ten days. Minimum—$12 per horsepower per year. Not to be less than $22.50 per kw. per year of highest monthly maximum demand.

Maximum demand to be based on three highest five-minute periods in a month, which once established is to stand for a year. Power factor must be 90 per cent.

TABLE III—COMMERCIAL LIGHTING

Per Kw.-hr.

15 cents for first 30 hours' use of maximum demand
9 cents for next 30 hours' use of maximum demand
6 cents for over 60 hours' use of maximum demand

Discount—1 cent to tenth of month. Minimum—$1 per month.

Sign, Window and Outline—1.8 cents per month per watt connected. Discount—¼ cent per watt to tenth of month.

TABLE IV—DOMESTIC RATES

Residence Lighting:

Per Kw.-hr.

15.5 cents for first 30 hours' use of maximum demand
9.0 cents for over 30 hours' use of maximum demand

Discount—1 cent per kw.-hr. to tenth of month. Minimum—$1 per month. Employees have 50 per cent discount.

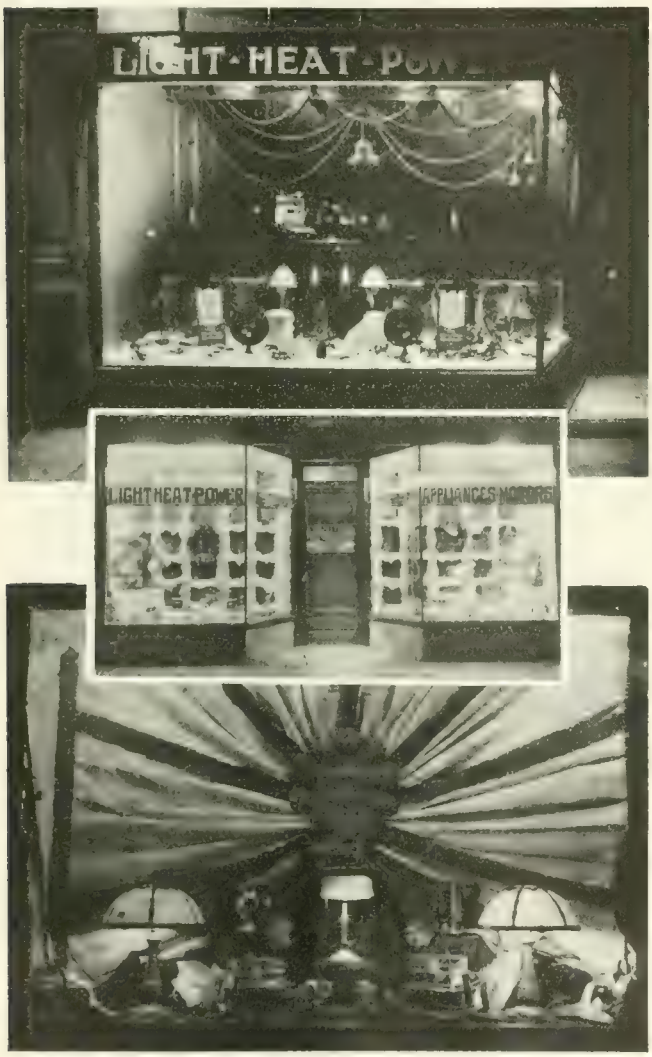
Heating and Cooking:

Per Kw.-hr.	Kw.-hr.
11.7 cents for first	10
3.7 cents for all over	10

Discount—½ cent per kw.-hr. to tenth of month. Minimum—$24 per year for up to 6,000 watts; $4 per year per each additional 1,000 watts.

for a large group the expert service that until recent years has been possible only in larger and more compact properties.

Commercial policies are of first importance because they deal most directly with the public and determine the success or failure of management. The first important policy of the Middle West Utilities Company lies in the fact that management is local. The community need not look beyond the officials within its own range of view for the handling of the problems that arise. As a result these men become a part of the community life and not mere figureheads through whom the public must deal with some far-off intangible organization thought



TYPICAL WINDOW DISPLAYS WHICH HAVE ATTRACTED BUSINESS

of as a "soulless corporation." This policy lays the foundation for the successful handling of problems because the men in contact with the public have the power to deal finally and effectively on a personal basis with those who know and respect them. These men have the entire resources of the organization at their command for advice and assistance in determining policies that fit specific conditions.

Backed by this policy is a commercial organization so worked out that each group has available the needed expert advisers. These commercial departments may consist of one individual or several as the local needs determine. The aim is to advise customers how their power supply may be used most advantageously. Customers are assisted in selecting the apparatus best suited to their needs. The housewife is instructed in the best methods of using household devices.

One activity of this department consists in co-operation extended to the various domestic-science departments in the public schools. They are advised as to the apparatus best suited to their needs. One important result is the increased use of the electric range and appliances in the communities where this co-operation is extended. The children in the schools, brought to a knowledge of the advantages of the household use of electric appliances, in turn educate the parents.

An item of prime importance in the commercial policy is provision in every office, no matter how small, for an attractive merchandise display. These offices are the most important point of contact with the public. It was found in the smaller properties taken over that oftentimes no attempt had been made to make business offices attractive. In many cases the offices in such properties were in the generating plant and consisted mainly of a desk set down amid unattractive surroundings. A consistent policy of establishing attractive offices has been followed.

Special attention has been given the display windows because they are the first point of contact with the customer who has occasion to visit the office. A favorable impression created by an attractively dressed window and backed by a well-arranged and well-managed office is a vital element in public relations. Such a window and office create the impression of a well-managed and trustworthy concern. The local newspapers are the backbone of the advertising policy. Supplementing this advertising is the window and office display already mentioned. Inclosures with bills are used, and circular letters and similar forms of advertising are employed.

Special campaigns on seasonable appliances are a part of the business policy, though no attempt is made to carry on the same campaign over extended territories. Each community or group is considered on its own merits, and the devices applicable to the local conditions are featured.

A consistent comparison between closely related properties of the results from these commercial activities is carried out, each division or property knowing what has been accomplished elsewhere each month.

Another road to the confidence of the public lies in the possibilities of rural service in the agricultural territory that forms so large a part of the area covered by these properties. The commission rulings in the various states where they are established are followed. Of these the so-called Wisconsin rules (see ELECTRICAL WORLD, Dec. 18, 1920, page 1205) are an important example. Officials of the Wisconsin properties of the Middle West Utilities Company took an important part in the formulation of the rules. Officials of the Illinois groups also took a part in the formation of the Illinois rules established for that state by the commission in December, 1920. The two sets of rules represent the most important practice so far developed in the rural-service situation outside of the combined irrigation and rural service practice of the Western States.

One important practice in rural service followed largely by the Middle West Utilities is to provide the farmer with all apparatus that he can profitably use when service is first established. The farm power equipment, household appliances and wiring, as well as the line and transformer equipment, are included so far as possible in the original proposition, so that proper equip-

ment, safe wiring and a generally successful installation will be provided. The effort in furnishing rural service is not to connect all the business that is offered, but to develop that which is profitable to the consumer and the company on a basis that will make it successful from the start.

No general policy as to loads that will utilize the off-season or off-peak capacity of the plants is possible. Each property must be studied on its own merits. In some cases the electric range may be utilized in this connection. Electric appliances in the home are particularly pushed by all the commercial departments as a means for improving the load curve. One important item has been the drainage pumping along the Illinois River in southwestern Illinois, where the construction of the Drainage Canal overflowed valuable bottom lands. This load has been an offset to the coal-mining load in southern Illinois because its greatest demand occurs during the slack mining season. Municipal water-supply pumping that can be done during off-peak hours is a type of load that has been particularly developed.

The most important load for this purpose has, however, been the ice plant. The majority of the properties are in territory where natural ice is either limited in supply or not available at all. Forty-eight ice plants have been built up to supply ice in communities in which light and power are supplied. These plants are operated in connection with generating plants, it having been found that the addition of a few laborers to the regular operating forces will permit the operation of both plants at a low labor cost. Ice manufacture can be carried on when power is not needed for other purposes. Because of the high overhead cost a very small ice plant cannot operate as an independent concern supplying ice to the commercial trade. The Middle West Utilities Company is, however, operating plants with a capacity as low as ten tons daily. The largest plant of this kind, operated in connection with the Mounds (Ill.) generating plant, has a capacity of 200 tons per day, and nearly the entire product goes to supply the cars of the Illinois Central Railroad.

A uniform rate structure to cover such a wide spread of properties is impossible. There are, however, certain fundamentals that are being worked out as the rate schedules are remodeled from time to time. These are well illustrated by the rate schedules in Tables I, II, III and IV. The kilowatt-hour rates in these schedules must not be construed as standard for the entire system. The significant fact is the common maximum-demand basis of all but the sign lighting and heating and cooking schedules. The tendency shown by the rate schedules is toward this basis as the fundamentally correct one. Numerous other forms of schedules that are too many to quote are utilized on the various properties.

Electrical System Additions Call for $226,000,000 in 1921

"Electrical World" Survey Shows that Over 1,250,000 Kw. Will Be Added to Generating Plants by Central-Station Companies During 1921

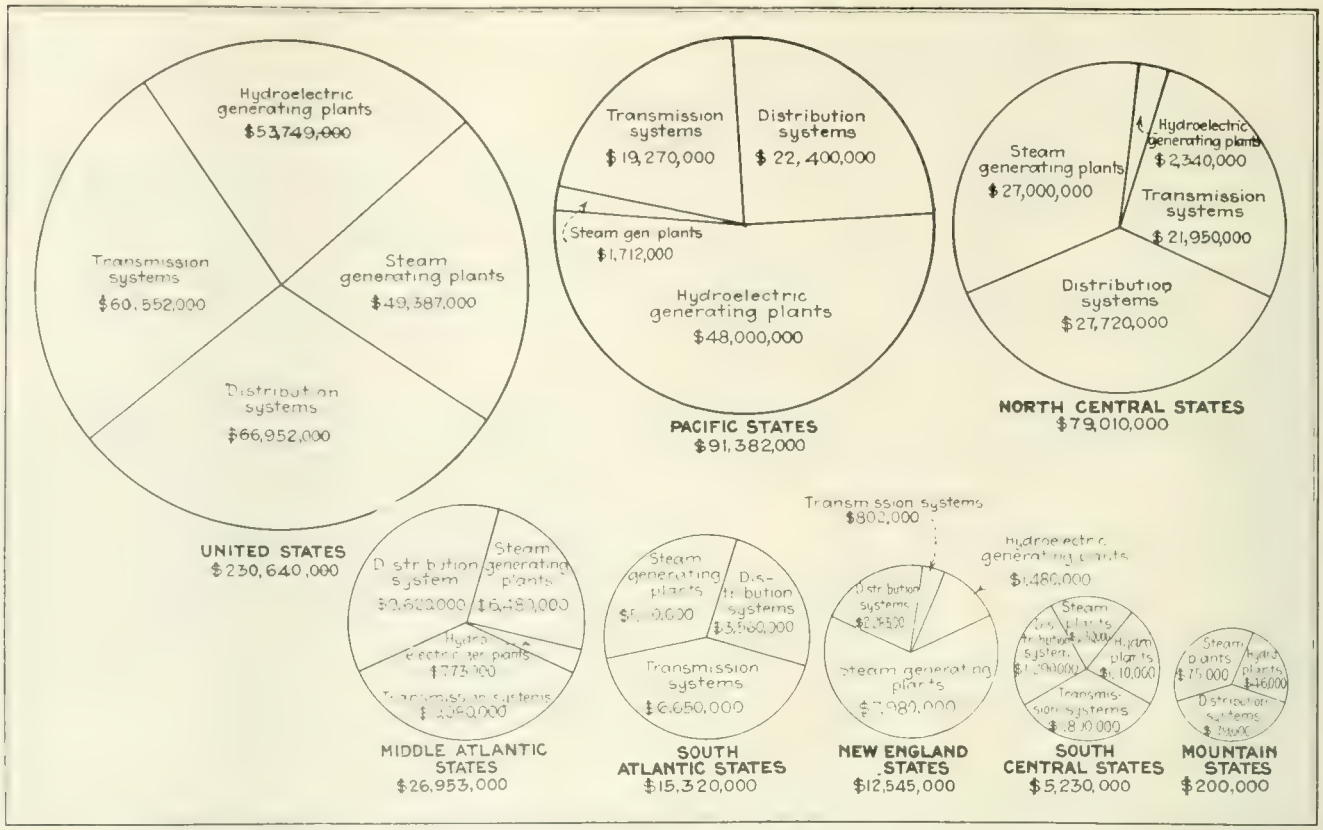
ALTHOUGH construction and equipment costs have materially decreased during the last six months, additions to central generating and distribution systems are going forward as fast as they are financially feasible. It is estimated that at the present time the central electric light and power plants of the United States are deficient about 2,800,000 kw. in installed rating. Owing to the industrial depression and the resulting decrease in industrial energy requirements, the central generating plants of the country are having a brief respite from the constantly accelerating growth which has characterized the industry during the past decade.

Results of a survey of the new-construction plans of the industry just completed by the ELECTRICAL WORLD are given in the table. Based on the returns received from 128 companies, the ELECTRICAL WORLD has made an estimate of the total probable additions to steam and hydro plant equipment, as well as the total value of the probable extensions to the transmission and distribution systems of the country during 1921 by sections of the country.

The total value of the new additions to the central generating, transmission and distribution systems during the present year is estimated at $225,770,000, which figure is about 26 per cent of the gross revenue of all the light and power companies from the sale of energy during 1920. The estimated new generating installation totals 1,251,700 kw., of which about 72 per cent is for steam plants and 28 per cent is for hydro plants. It is not probable that the central generating systems of the country as a whole will be required to carry a load equal to the maximum of 1920 much before next November. If next winter's load does not exceed that of the fall of 1920, and it probably will not, the central generating plants of the country in spite of the new additions now planned will still be deficient about 1,500,000 kw. in installed rating.

TABLE I—SUMMARY OF REPORTS FROM 128 COMPANIES (OVER 2,500 KW. GENERATOR RATING) GIVING ADDITIONS TO GENERATING AND DISTRIBUTING SYSTEMS PURPOSED DURING 1921

Country and Sections	Companies Reporting: Number	Companies Reporting: Total Generator Rating Jan. 1, 1921 (Kw.)	Steam-Electric Generating Plants: Total Generator Rating, Jan. 1, 1921 (Kw.)	Steam-Electric Generating Plants: Proposed Additions During 1921 (Kw.)	Steam-Electric Generating Plants: Value of Proposed Additions	Hydro-Electric Generating Plants: Total Rating Jan. 1, 1921 (Kw.)	Hydro-Electric Generating Plants: Proposed Additions During 1921 (Kw.)	Hydro-Electric Generating Plants: Value of Proposed Additions	Total Value of Proposed Additions to Steam and Hydro Generating Plants During 1921	Value of Proposed Additions to Transmission Systems During 1921	Value of Proposed Additions to Distribution Systems During 1921	Total Value of All Proposed Additions During 1921
New England States	18	376,131	258,529	65,000	$2,200,000	117,602	6,375	$500,000	$2,700,000	$250,000	$709,000	$3,659,000
Middle Atlantic States	30	1,542,257	1,163,324	47,000	3,042,450	378,933	45,400	512,500	3,554,950	4,866,500	4,645,732	13,067,182
South Atlantic States	16	371,900	315,950	50,000	2,410,000	55,950	.....	.....	2,410,000	1,715,000	917,000	5,042,000
North Central States	37	515,979	467,529	99,000	6,642,500	48,450	4,175	162,500	6,805,000	2,285,000	2,919,000	12,009,000
South Central States	10	213,300	143,350	4,000	260,000	69,950	13,600	503,000	763,000	410,000	258,000	1,431,000
Mountain States	7	282,660	13,150	1,000	75,000	269,510	2,050	43,000	118,000	.....	35,000	153,000
Pacific States	10	716,556	281,030	37,500	2,712,250	435,525	126,200	23,330,000	26,042,250	6,872,000	10,245,000	43,159,250
United States	128	4,018,783	2,642,862	303,500	$17,342,200	1,375,921	197,800	$25,051,000	$42,393,200	$16,398,500	$19,728,732	$78,520,182



DISTRIBUTION OF ESTIMATED NEW INVESTMENTS BY THE ELECTRIC LIGHT AND POWER INDUSTRY DURING 1921

The greatest expansion during 1921 will take place in the Pacific States and will reach a total value of more than $86,000,000, of which amount 55 per cent will be for hydro-electric plant construction and generating equipment appertaining to it. The North Central States follow with an estimated new investment of almost $80,000,000, of which amount 35 per cent is for steam-electric generating plants. The total value of the additions to transmission and distribution systems is estimated at $121,634,000, an average of $21,300 for each operating company in the United States.

In the Sept. 11, 1920, issue of the ELECTRICAL WORLD was published a tabulation giving the proposed additions of 121 light and power companies during 1920 as totaling $141,867,847. This figure is almost double that reported by the 128 companies making returns for 1921. A study of the returns for both years indicates that with but few exceptions the same companies reported in 1921 as in 1920. If these figures can be taken as a barometer of central-station expansion during these two consecutive years, the conclusion is reached that the total new investments in central-station generating, transmission and distribution equipment during 1921 will total only about one-half those undertaken during 1920. It is undoubtedly true, however, that, due to high cost of material and the financial stringency, a large proportion of the additions contemplated during 1920 were not undertaken. If the 1920 figures are corrected accordingly, it is probable that the proposed additions for 1921 will be about the same as the actual additions made during 1920.

It must be borne in mind that these estimates are for additions to generating and distributing systems which were operating prior to Jan. 1, 1920, and do not include the systems of new operating companies organized during 1920 or 1921.

TABLE II—VALUE OF ADDITIONS TO ALL CENTRAL GENERATING AND DISTRIBUTING SYSTEMS DURING 1921 AS ESTIMATED BY "ELECTRICAL WORLD"

Country and Sections	Steam-Electric Generating Plants			Hydro-Electric Generating Plants						
	Total Rating of All Steam Central Generating Stations, Jan. 1, 1921, Kw.	Estimated Additions During 1921, Kw.	Value of Additions	Total Rating of All Hydro Central Generating Stations, Jan. 1, 1921, Kw.	Estimated Additions During 1921, Kw.	Value of Proposed Additions	Total Value of Estimated Additions to Steam and Hydro Central Generating Plants During 1921	Value of Estimated Additions to Transmission Systems During 1921	Value of Estimated Additions to Distribution Systems During 1921	Total Value of All Estimated Additions by Central Generating Companies During 1921
New England States	862,000	236,000	$7,980,000	345,820	18,700	$1,480,000	$9,460,000	$802,000	$2,283,000	$12,545,000
Middle Atlantic States	2,358,500	102,000	6,480,000	725,500	23,300	773,000	7,253,000	10,080,000	9,620,000	26,953,000
South Atlantic States	818,228	106,000	5,110,000	593,000	. . . . .	. . . . .	5,110,000	6,650,000	3,560,000	15,320,000
North Central States	3,457,367	404,000	27,000,000	799,000	60,000	2,340,000	29,340,000	21,950,000	27,720,000	79,010,000
South Central States	770,198	15,000	1,030,000	185,000	30,000	1,110,000	2,140,000	1,800,000	1,290,000	5,230,000
Mountain States	156,276	1,000	75,000	439,000	2,200	46,000	121,000	. .	79,000	200,000
Pacific States	469,182	37,500	2,712,000	1,029,000	216,000	48,000,000	50,712,000	14,400,000	21,400,000	86,512,000
Totals for United States	8,891,751	901,500	$50,387,000	4,116,320	350,200	$53,749,000	$104,136,000	$55,682,000	$65,952,000	$225,770,000

Utility Management and Policies

INCREASING EMPHASIS is being placed by utility executives on the broader problem of management, such as public relations, finance, organization, and the like, because of the new set of conditions that came in the wake of the war.

Utility Growth to Come Through Public Information

General Recognition of the Economic Relation of Light and Power Companies to Community Welfare Essential to Progress

BY NORMAN READ
Vice-President and General Manager Colorado Power Company, Denver, Col.

ONLY with the support of the public can the utilities grow, earnings be maintained and money commanded at reasonable rates. The public will naturally be back of any enterprise which it honestly feels is essential to its comfort and to its prosperity. It is fair to assume, then, that for electric light and power companies to promote a better public understanding of the economic relation of the company to the community welfare has become essential. In direct ratio with the accomplishment of this object will come public good will.

The early history of Colorado is typical of that of other states. In Colorado the primary sources of the state's wealth came from the gold and silver mines scattered through the Rocky Mountains. Later the development of coal and other mines strengthened the position of the mining industry. Even though the agricultural developments, stimulated in more recent years, have been the source of great wealth, and though there are greater prospects in sight, yet the fact remains in the minds of many of the people of the state that mining is the principal source of wealth and that nothing should be allowed to detract from its development.

Here we have a case where one industry has had consideration over another in spite of the fact that the preferred industry is largely dependent upon the other. Little account seems to be taken of the facts that the introduction of electric power into mining operations has resulted in lower costs of production and that were it not for electricity the mining industry of Colorado would undoubtedly be forced to work to much closer limits. Transportation to most of the mining camps is, at the best, expensive. Had it been necessary to haul coal for the generation of power to operate the mining properties, the added cost might have proved an insurmountable obstacle, especially in the last two or three years. Yet, when the continued existence and expansion of the electric utilities demand more equitable rates for the service rendered, an unenlightened public cries out that the life of the mining industry is threatened.

The public generally is slow to grasp the fundamental nature of the electric light and power service. The case of the mining industry in Colorado and its interrelation with the electrical industry is but one example, yet a typical one. Were the public apprised of the need for protecting and encouraging the electrical industry to the same extent that it lends its sympathies to mining both would make more rapid progress. It would not then be always necessary to expend large sums to present and defend the electric utility's position when questions of rate adjustments are pending. Instead, the public would be inclined to take the part of the electric light and power company and be anxious to be assured that the utility was kept in the most sound and prosperous condition. This is a utopian condition, but one that may be reached if properly approached. It is the manner and the frame of mind in which these ends are reached.

The nation-wide program of good-will advertising that is now being carried out in the popular magazines is one step toward this end. But purely impersonal advertising, even though it be well conceived and has widespread circulation, will not complete the task. To the casual reader glacing over one of these advertisements the thought will come that the intention is right but that it does not come home to him in the closest way. His mind turns to his local utility. He is bound to compare the ideals, so clearly set forth in the advertisement, with the attitude of the electric utility which renders him service. If he has met with good service—if his dealings with his utility have been pleasant and he can feel that his utility has done everything within its power to further the growth of the community, then he will be inclined to heed the case for utilities.

EMPLOYEES THE KEYSTONE

The matter therefore comes back, in the final analysis, to the attitude of the employees of the utilities. They are in a position to influence rightly or wrongly the thought of a large part of the community to which service is given. Increasing attention must be bestowed upon the need for encouraging the employees—both those who officially come in contact with the public and all those others who meet the public through their circle of friends—to pass on correctly the ideals of service held by the utility.

The use of publicity in the presentation of facts in order to build up good will for a utility has a time element of the greatest importance. Publicity during times when the public is not engrossed in the progress of a controversy over rates or service or franchise matters is likely to bear better fruit. The good that will come from publicity at times of controversy is questionable. Then the public is on the defensive. It will be seeking to find flaws in the arguments presented. It will think that the company must be badly in need of protection. Besides, there is the possibility that publicity at such times will only continue the controversy, whereas if less were said, in many cases a settlement would be reached sooner and with less friction.

This is a problem for every utility to work on. It is not alone for the larger companies or the smaller. Each one must do its share. The question is the same in nearly every locality. Build up a broader and a sounder

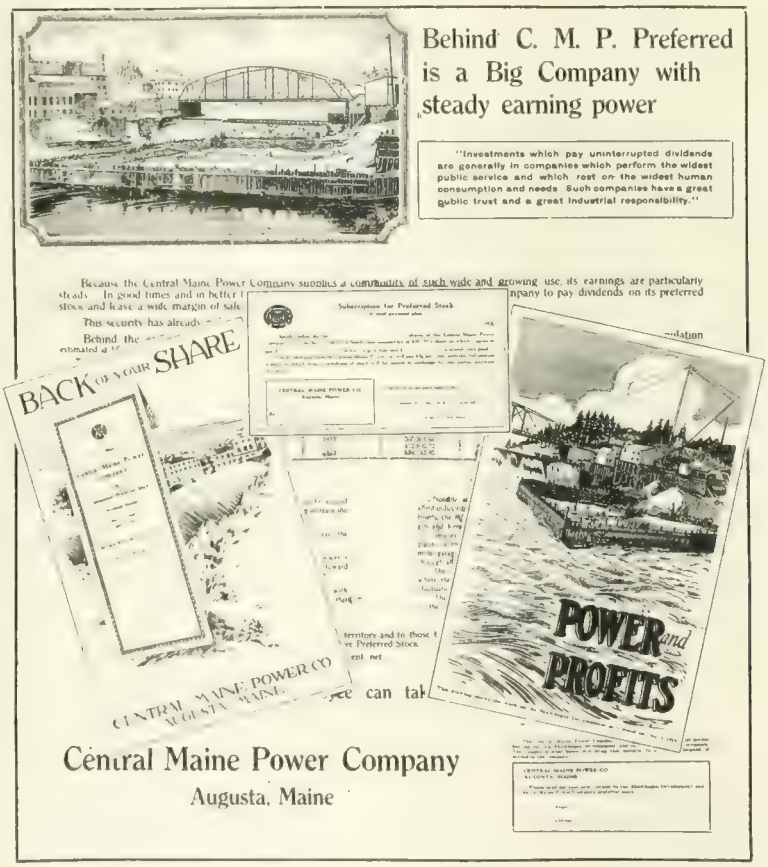
relation with the public in times of smooth sailing. Do this by constructive work through the medium of the employees, supported by a logical presentation of the facts by means of widespread publicity.

Intensive Sale of Public Utility Securities

Systematic Covering of Territory Enables Company to Do Major Part of Its Financing Through Sale of Preferred Stock—Advertising and Methods Employed

By Percy H. Whiting
Manager Securities Department Central Maine Power Company

TO SELL each year $1,500,000 of 7 per cent preferred stock of the Central Maine Power Company, which supplies about 36,000 customers in a widely scattered territory, has presented very serious problems. In view of the facts that this stock is sold at $107.50 per share to net 6½ per cent and that the company does the major part of its financing in this manner an explanation of our methods of intensive selling may be of help to other companies contemplating a customer-ownership plan of financing. Before we start advertising, soliciting or anything else we send a man ahead to get up lists of prospective purchasers. In a town that we serve we run off a list of our customers and have our local representative cross off the hopeless ones. We call on the rest. In a town not on our lines we arrange to have some town official or political expert prepare a list and then have it checked by the tax assessor or tax collector. Frequently we have the list double-checked. We want plenty of "prospects," but we want possibilities only and have found that money spent on getting a good list is money well invested. It is cheaper to hire tax assessors than salesmen. Our instructions to the man who goes after this list is to get the name of everybody who has $100 or more in the bank or who can save $10 a month, and we plan to call on from 10 to 25 per cent of the inhabitants of any town. It takes time, but it is the only way to cover the ground thoroughly.



TYPICAL CUSTOMER-OWNERSHIP PUBLICITY USED BY CENTRAL MAINE POWER COMPANY

The securities department manager, faced with the task of making his field produce every single share that it possibly can, first studies the circulation of the daily and weekly papers in the field he plans to work. Selling must follow advertising. When he starts advertising in any given paper he will plan to cover every town, as well as the intervening countryside, that is dominated by that paper's circulation. Thus he makes his advertising pay the highest possible returns.

When we have our names ready we start our newspaper advertising. Ordinarily we open the campaign with a double-center spread in the daily papers that cover the field. Then we drop to full pages, to halves, to quarters, and then wind up with a long series of advertisements three columns in width and 10 in. deep. While the campaign is on we advertise in nearly every issue of every paper in the field.

The advertisements are adapted as far as is practicable to local conditions. We try to show how the investment in our preferred stock will directly benefit that locality. Another fixed rule in writing our advertisements is to discuss only one point—be it tax exemption, safety or certainty of return. Whatever it may be it is the sole subject of that day's advertisements. I mention this because I have seen so many "bird-shot" security advertisements. We run illustrated advertisements frequently, display them well and insist that they must not be run on the financial page.

Just before we are ready to open our campaign we send a form letter to every prospective customer in the town and try to fit this appeal to the community. The letter always ends by saying that our representative will call. With the letter goes a circular giving the usual facts about the security and the company, but differing from the conventional circular in that the first page contains an illustration designed to picture the possibilities of water power. The whole circular, unlike the usual security circular, is set in type that is easy to read. With these preliminaries out of the way we send all or part of our campaign force into the town. We use about one salesman to every 200 "prospect" cards. The campaign, if at all important, usually starts with an all-day sales meeting, presided over by the sales manager, field manager or his assistant. The special situation in that town is discussed, answers to objections are threshed over and suggestions are made for fitting the sales talks to local conditions.

Then the campaign begins. Not only are all the "prospects" in the town carefully followed up, but also every road leading from that town out into the coun-

try. The rural work is done almost on a house-to-house basis. Each salesman reports on each call by filling out a card. These reports are filed and they give us a wonderful "prospect" list. In the past two and a half years our salesmen have called on probably 50,000 people and have reported on most of them.

The wise securities manager will have even the smallest towns worked. Our motto is "Every town with people in it is our town." The most productive of all are prosperous small towns which have no bank. One of our salesmen once spent two days in a town that numbered two families and sold his week's quota there. It is by no means enough, however, to work the small towns alone—the salesman must go out into the rural districts and work them, road by road. He will, if his experience is like ours, meet his best success there.

Naturally even the best sort of "campaign" is a sketchy affair. It lands only such customers as are ripe and ready, leaving many of the best for a later period. When enough towns have been worked to make a total population of from 25,000 to 35,000 we have a new "territory" ready. This territory is declared closed and put in charge of a resident salesman. Usually it is awarded to the leading man on the campaign force. He settles down there and begins to work his towns on a continuous, year-round basis. A man so situated in a territory can usually produce considerably more business than when he was campaigning.

Size of Territories

The population of our territories averages 26,000 people. On this basis, when we complete our canvass of Maine, which we hope to do within six months, we shall have the entire state handled by twenty-eight "territory" salesmen. Our present tendency is to cut down, rather than to enlarge, territories. In normal times it seems likely that one salesman could make his best showing working in a territory of perhaps 20,000 people. We are experimenting now on some territories that contain, on an average, 11,000 people. The average bond salesman in a town of 11,000 people would probably not have more than from five to ten "prospects"—and not over a day's work every month.

Recently, while on the way to start soliciting in a new town, I was talking with a bond salesman. "How many people do you bond salesmen call on in this town?" I asked him. "Three," he replied. We worked that same town three weeks with three salesmen and found it productive.

To central-station companies which are finding that they have to sell more securities we recommend heartily that they discontinue the practice of "spotting around" and get down to "covering." Until that is done the central-station company cannot hope to come anywhere near the possibilities of the field. The bond men say that such a course is suicidal, that it will soon reach the saturation point. Our experience, based on fairly intensive selling spread over nearly three years, is that the saturation point will be reached about the same time that the savings banks put up their shutters and quit—and that's a long way off. The amount of stock we have sold since our intensive campaign began, in the summer of 1918, is close to $3,000,000, par value.

From the customer-ownership advertising comes a surprising amount of help in enlisting support in public-relation matters. The very nature of the effort to sell preferred stock is an appeal to recognize what the company is doing to build up its community. The idea of sharing the ownership and the earnings of the power company with the people is steadily hammered home.

When the Legislature of Maine took up the question of state ownership of water powers our company took stock of the situation and found that through two and a half years of customer-ownership advertising it had presented its case to the people of Maine. It had told its "public relations" story, not through "propaganda" advertisements, but in connection with an appeal that the people of Maine unite with it in building up the state. In any political crisis this advertising will be worth all it has cost as good-will advertising—yet it paid for itself as it went along in helping to sell preferred stock.

Electrical Merchandising by the Central-Station Company

Merchandising Department Should Earn Fair Profit—Central Station Company Best Medium for Introducing New Devices—Results Attained

TO WHAT extent the central-station company should engage in merchandising and the best methods to adopt to make this business return a fair profit have for long been topics which offer a fertile field for differences of opinion. That the sale of electrical merchandise can be made to return a fair profit to the electric light and power company when conducted properly has been demonstrated by a number of companies. However, there is a belief on the part of some in the electrical industry, including certain central-station executives, that the electric light and power company is in business only to sell electrical energy and that the sale of electrical devices is out of its field. Others have gone so far in the opposite direction as to maintain that the electric utility not only should sell all kinds of energy-consuming devices but should sell them at cost in order to increase the kilowatt-hour sales. The latter policy has brought a storm of protest from dealers, many of whom think that central-station men are trying to drive them out of business.

Companies which operate in scattered territories serving small towns and rural communities are frequently the only means through which their customers can procure electrical devices. Through small local offices and occasional visits of salesmen the central-station company is able to sell appliances where dealers would find it difficult to maintain a shop or send canvassers. Without this service by the electric light and power company such customers would for the most part go without electrical devices.

Central-Station Company Must "Pioneer" New Devices

In the earlier days, when the first appliances were brought out and were passing through a strenuous period of development, it was natural that the central-station company proved the only medium through which these devices could be introduced. Now these companies feel that, having borne this expense of introduction and development, it is not logical to expect them to step out of the business as soon as a market has been created.

Taking it for granted that a central-station company conducts a merchandising department, there is the problem of making it pay a profit. That it must be conducted on business principles is obvious. Prominently located salesrooms and offices, well stocked with goods

properly displayed, backed up with a force of salesmen who will make frequent calls on all consumers, produce results. Advertising is essential, but it has to be done intelligently and it is money wasted unless it carries a selling appeal as strong as does the advertising of other merchants in the same town.

In the past some companies have been confused as to just what charges to make against the merchandising department. The N. E. L. A. classification of accounts provides a system of accounting for this department which if followed will show exactly the results obtained. In general it should be remembered that that branch of the commercial department engaged in selling energy to power and industrial consumers should be charged with its proper proportion of overhead expense and that the merchandising department should be charged likewise in order to determine whether the latter is paying its way.

Profits from Merchandising

The volume of business that can be done by a central-station company will naturally depend proportionately upon the aggressiveness of its sales policy. The possibilities of merchandising can best be judged from the results obtained by companies which have successfully conducted such a department. In a recent paper D. W. Snyder, general manager of the Bloomington & Normal (Ill.) Railway & Light Company, stated that in a territory including a town of 28,000 people and about a dozen small communities daily sales amounted to $500 per day—approximately $150,000 for the year. Net revenue was $36,244.50, from which should be deducted $9,153.85 for advertising and development expense, leaving a net profit of $27,090.65. The average merchandise stock carried was $28,000. These figures are significant, as it will be noted that this stock was turned over five and a quarter times during the year and that the net profit was very nearly as great as the average investment in stock. Compare this with the revenue from kilowatt-hour sales where the capital is turned over once in five years. The rate of turnover on merchandising in this case was twenty-six and a quarter times as fast as that on kilowatt-hour sales.

A holding company which operates about twelve properties throughout the country had up to 1917 conducted its commercial department with a view to increasing consumption of energy. It then changed its policy, started selling appliances at list prices and planned to make the department self-supporting. A comparison of the company's gross revenue, expense and net earnings from merchandising during the past five years follows:

	1920	1919	1918	1917	1916
Gross revenue	$760,117	$597,653	$471,660	$85,744	$429,265
Expenses	598,860	491,389	424,648	84,495	457,294
Net earnings	$161,257	$106,264	$47,012	*$1,249	$28,029
Promotion expense:					
Total promotion expense charged to gas, electric and steam operations	$83,288	$74,443	$61,169	$83,695	$11,214
Excess or deficiency of merchandise and jobbing earnings over company's total promotion expense	$77,969	$31,821	*$14,157	*$82,446	*$146,243

* Deficit.

The items under "promotion expenses" were charged to operations and were not a direct charge against the merchandising business. From these figures it will be seen that this company has been able to pay all of its promotion expenses from the sale of merchandise and that for the years 1919 and 1920 a net profit was made over and above all these charges.

The Colorado Springs Light, Heat & Power Company, which serves a population of about 35,000, reports these figures for 1920:

Gross income from merchandising	$68,925 87
Expenses	62,807 53
Net profit	$6,117 84

This company had a stock turnover of four and a half times during the year, the stock investment never exceeding $15,000. This investment, however, was considered by the company to be unusually large, since, because of its inability to obtain material as needed, it was necessary to increase the usual stock nearly 100 per cent. Under normal conditions the stock investment was about $8,000.

As to the growth of merchandise sales, a Western company in 1913 had a gross merchandising revenue of not quite $100,000. In 1920, seven years later, this company's gross revenue from this source was a little over $900,000. Still another company asserted that the profits from its merchandise sales were sufficient to pay one-half the dividends on its outstanding preferred stock. In one company the average gross sales per month to residential customers equaled the amount accruing from kilowatt-hour sales to these customers.

Rate of Capital Turnover

When considering the possibilities of a merchandising department, one outstanding feature is the small investment required per dollar of gross income as compared with the investment in plant and equipment necessary for the sale of kilowatt-hours. Furthermore, the investment in a merchandise stock can be increased or decreased pretty much at the will of the manager, but to decrease the capital invested in a utility property is next to impossible. The earnings from the sale of electrical merchandise are not subject to commission regulation, and the central-station company is at liberty to expand or retrench on its activities as varying conditions may dictate.

One question which will probably always be kept open for discussion is the relation between the electric light and power company and the contractor-dealers. What differences have existed are for the most part the result of misunderstanding. As a matter of fact, where the central-station company has conducted its merchandising business along aggressive lines, following the principles of any other merchant, it has been demonstrated that the business of the contractor-dealer has been benefited and actually increased. On the other hand, in some instances where the central-station company has retired from this field the use of electric appliances has shown a decided falling off. Experience proves that there is plenty of room in the field for both the central station and responsible dealers and that the result of honest competition will bring increased business to both.

The central-station company is directly interested in securing the largest and widest distribution of electrical devices to its customers, and it cannot well afford to abandon this field. With this end in mind, the electric light and power company's merchandising policy may be summed up as follows:

To operate this department upon a profitable basis, observing business ethics; to sell only standard appli-

ances which will require the least amount of service and repair work, but to do such work promptly when necessary; not to do house wiring where there are responsible and reliable contractors to handle this class of work; to co-operate with local contractor-dealers; to conduct the merchandising department with a view to increasing the use of electrical energy and developing the use of new devices and appliances, thereby rendering to its customers the best service possible.

Organizing for Efficient Operation

How a Company Serving a Territory of 300 Square Miles and Containing 3,100 Electric Consumers Is Equipped to Give Good Service Economically

By Walter P. Schwabe

Vice-President and General Manager Northern Connecticut Light & Power Company, Thompsonville, Conn.

THE organization of small electric service companies covering a considerable territory and serving a moderate-sized population demands careful planning in order to insure efficient operation. To achieve success constructive planning of plant improvements and business development is essential. Mistakes that cost money affect the future of a small company much more than they affect a large one where the financial loss might even be hardly noticed. Therefore an excellent opportunity exists for thorough systematization of all phases of company work, for clear definition of responsibilities and for the establishment of vigorous and positive policies.

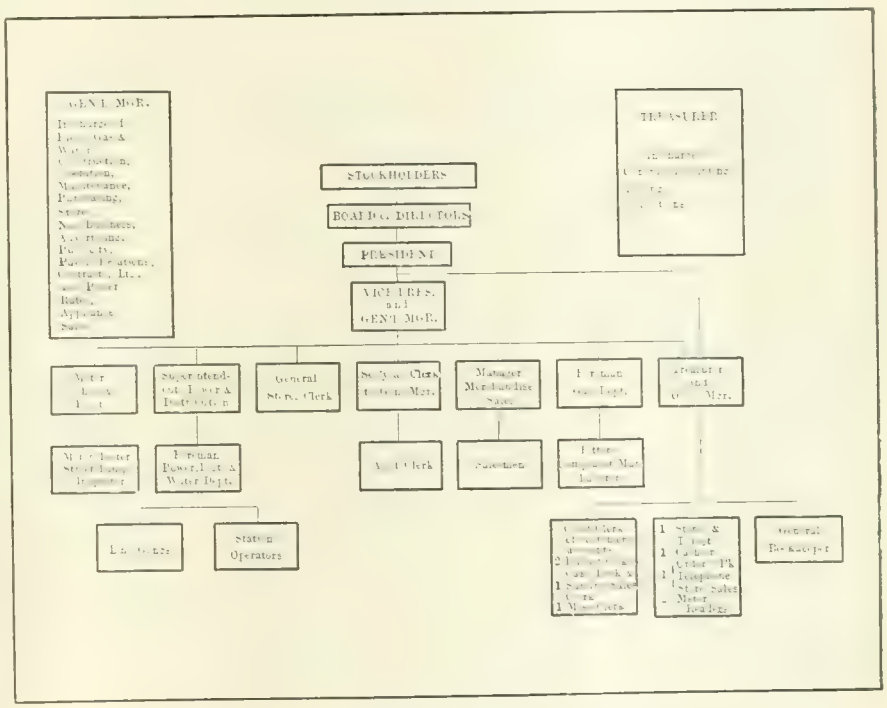
Since large companies can make many refinements in organization and methods of handling work that smaller companies cannot afford, the writer will refer to a moderate-size utility serving a population of 28,000 people scattered over 300 square miles to illustrate what small companies may profitably do. The company to which the writer refers furnishes three services—water, gas and electricity—supplying 2,400 water consumers, 2,700 gas consumers and 3,100 consumers of electricity respectively. Good public relations are maintained principally by the personal contact of employees in public affairs, the general manager being a director in two building and loan associations and president of one, a director in the Connecticut Chamber of Commerce from the local Board of Trade and concerned in many other activities.

The accounting department is in charge of the treasurer, with one bookkeeper, cashier, chief clerk and five assistants. The accounting, meter reading, billing and commercial work of the water companies are also handled by this force, and for this a fixed charge is made to these companies. Meters are read continually for twenty days by two men, bills being mailed daily. Electric, gas and water meters are read at the same time. An Elliott-Fisher billing machine is used and addressograph work is done by meter readers when not in the field. Four collection agencies are maintained, at which points customers' complaints are also received. These agencies deposit receipts daily in a local bank to the credit of the company, mailing duplicate deposit slips with coupons from bills and any complaints received to the cashier at Thompsonville. All complaint notices are turned over to the order clerk, who takes all telephone calls from the entire territory. Virtually all customers can call the company's office without toll charges.

Line construction and maintenance is handled by one gang, consisting of a foreman, three linemen and a ground man with a White truck. A Stewart truck with two men is used in making service connections and small repairs, all under the direction of the superintendent of power and distribution.

The company does no wiring or repairs to wiring. Eight or ten small contractors in the territory do this work, and the company co-operates with them fully, especially in financing time-payment jobs.

Meter maintenance and setting, appliance repairs and utilization complaints are handled by the meter chief and two assistants. Street-lamp inspection and replacements are cared for by one inspector and an automobile.



ORGANIZATION OF PERSONNEL IN A MEDIUM-SIZE COMPANY

The company operates about 1,100 street lamps, illuminating 60 miles (96 km.) of highway. This department also keeps history card records of all poles, meters, transformers and street lamps and maintains up-to-date distribution system maps. Line extensions applied for are investigated by the superintendent of distribution, who estimates the cost and sketches the required detail on a special form. When the cost of an extension exceeds the outlay warranted by the estimated revenue, the applicants pay 14 per cent fixed charge on the excess line cost in addition to the regular charges for service.

A showroom is maintained at the Thompsonville office, in charge of the merchandising manager. Sales are made principally through an outside salesman, with an automobile, working on a commission. Merchandising is aggressively promoted, and the merchandising manager's salary depends on the net profits from this department, which is charged with fixed overhead expenses, such as rent, merchandising and advertising expense,

sales commissions, interest on inventory, storeroom expense and clerk hire. Last year merchandise sales totaled $26,000. Four cooking lectures have been given during the past month to promote the use of the electric range, and the annual house-wiring campaign is on during the month of May. Three months' free service and one year to pay for wiring are offered as inducements.

Advertising material for the promotion of better public relations prepared by the National Electric Light Association and the American Gas Association is largely used in the local press. Twelve periodicals of public utility interest are taken by the company. Nineteen of the twenty-one employees in the company's electrical department are members of the N. E. L. A., the company paying the dues.

Until a few years ago improvements and extensions were financed by sale of bonds and preferred stock through Boston and Hartford bankers, but during the past year money was temporarily obtained through a bank loan. The company is now considering financing by a sale of some form of security to its customers and employees.

Transforming Public Opinion

Two Difficulties that Often Block the Way to Better Relations with Customers—A Western Company's "Department of Greater Service"

By S. M. Kennedy

Vice-President in Charge of Business Development and Public Relations Southern California Edison Company, Los Angeles

PERHAPS there is at the present time no subject which is more constantly in the minds of public utility executives and managers of commercial enterprises than the topic of relations with the public. Certainly no subject is more discussed when representatives of such organizations gather together in committees or assemble at conventions. Those who have followed the course of events for some years past can recall that for a long time there was seemingly a careless disregard on the part of many utility managers of the opinion of the public concerning their business and operations. Today all has changed, and a keen anxiety regarding public opinion is observed in many directions where it has not been noticeable heretofore.

Notwithstanding all that has been said and written during the past few years on the subject of the relations between public utility companies and their consumers, there undoubtedly lurks in the minds of a considerable portion of the public a rooted dislike of them. To many an otherwise clear-headed man the ways of big corporations are a dark and impenetrable mystery. He is inclined to look with suspicion on all they do. The millions tossed about so freely in annual reports frequently seem to him ill-gotten gains that he would like to see distributed among the so-called common people.

Two Difficulties in the Way

There are two difficulties yet remaining before the pathway to better public opinion can be cleared of the obstructions that block or impede progress. The first is that the majority of those composing the public are liable to consider utility companies collectively rather than individually. Consequently those corporations that do not progress not only stand in their own light but they help keep the light of truth from spreading. They also blind the public vision to the good intentions of other companies whose methods may be more conciliatory and progressive. The second difficulty is caused by such utility companies as announce they are going to do thus and so, with the idea of conveying to the minds of their patrons that radical changes are to be inaugurated and strenuous efforts made to please, and who do not live up to their promises. Then there are other companies with really good intentions whose officers think they have adopted progressive methods but whose employees are either ignoring instructions or have not been told what to do. Their patrons and the public in general are not getting what was promised and the people cannot be blamed if in their disappointment they say things uncomplimentary to the corporations that have not kept faith with them.

It is generally conceded that the day has long since passed when the management of any industrial or utility organization can ignore public opinion. It is asserted, however, that there are corporations whose managing officers may have the right ideas regarding intercourse with the public but who do not make it their business to see that these ideas are promulgated among their assistants and the employees down the line. They do not "follow through," and consequently excellent thoughts and good intentions are dissipated and lost because they fail to reach the points of contact where they would produce desired results. There never was a time before when people at large gave to public utility companies such close attention. These corporations occupy greater prominence than ever before, not only because of the increasing demands for the service supplied, but also because many utility companies are looking to their consumers for copartners in the industry in which they are the ultimate patrons. It is an axiom that money flows only to where there is confidence, and confidence is acquired by many only after the closest scrutiny. The unreasoning and unreasonable consumer is fast disappearing in territories where the standard of public relations has been raised, and in his place there has arisen the thinking individual who is willing to meet the progressive company's outstretched hand more than half way, and whose friendship and good will become tangible assets.

Employees' Attitude of Vital Importance

After all, it will usually be found that down the line most utility companies have the kind of employees who can carry out instructions given and follow examples set. It is for the management to decide what shall be the instructions and whose example shall be followed. Employees are as much a part of the organization as the president. The elevator operator meets more people than the general manager. Does he do it in the right way? The troubleman has more personal contact with the public than the chief engineer. Does he make a good impression? The collector greets more consumers than the treasurer. Does he perform the difficult task of taking people's money and leaving them pleased? The knack of saying and doing the right thing at the right time is a wonderful asset in public relations, and its absence has been the cause of many a company's loss and many a man's failure. Strangely enough, it not infrequently happens that some men who have failed have given considerable thought to the subject of meeting and dealing with the people in a pleasing way. They missed the mark because they did not get the real philosophy of it. They have tried to please

the people, but have overlooked the individual. Successful business is business plus personality. The more a business is crowded with personality the faster it will grow and prosper. Orders issued from leather-lined swivel chairs regarding public relations will not do the work; instructions given across mahogany tables regarding treatment of consumers will fall short; resolutions of boards of directors containing stock phrases regarding courtesy and consideration to the public will be entirely ineffective if the crux of the subject is overlooked. Employees are individuals and consumers are individuals, and as individuals the one class representing the company meets the other class representing the public and it is in the contact that good will is made or ill will engendered.

The management of a company may announce a policy regarding its attitude on public relations, and it will be assumed that this policy will be made known to all employees, and by various means eventually to all consumers and the public in general. But one announcement to either employees or the public will not accomplish the desired result. Those who have given the matter of publicity and spreading information a study, such as publishers, writers and big advertisers, know that the people do not learn the facts on any subject or catch the ideas it may be desired to convey by one announcement. They know it requires constant iteration and reiteration and continuous hammering to drive home to the people the idea it may be desired to implant.

The methods adopted to improve public relations require to be both instructive and constructive. Employees should not only be told what to do but also how to do it. The public should be informed not only concerning the company's aims and ideals but how it proposes to put them into effect. Above all, the question of improving public relations and acquiring public good will is essentially progressive. There can be no measure of success in starting from the top and working downward. It is better far to start at the bottom—make the foundation firm and then build upward. Further, it is as necessary to give proper publicity to a company's desires and plans for improved public relations as it is to advertise in order to sell merchandise. The people can't be expected to know unless they are told.

Utility of Picture Displays

The nerves from the eyes to the brain are many times larger than those from the ear to the brain. Therefore, when possible, the use of pictures is recommended. A central-station company, for instance, should display pictures of power plants, waterfalls, interiors of offices, uses of electricity, etc., and use a few words as connecting links for the pictures. As an illustration of the value of this medium for publicity one has only to look at how the film industry has developed during the past ten years.

A Western company that has given to public relations a close study for many years has made another step forward by inaugurating a "department of greater service." The officers of most public utility companies assume that the service supplied is satisfactory if no complaints are made. This may appear, under ordinary conditions, a fair assumption. But the company referred to is not satisfied with what may be termed a negative answer as to conditions of service—it wants from its consumers a positive statement. The new department consists of a staff of approximately twenty-five men, carefully selected for the special work to which they are assigned. These men have been patiently schooled as to the company's history, organization, departments, operations, developments, aims, ideas and practices, and have been distributed over the company's system, one man to each geographical district. Each man reports through the local district manager to the head of the department of greater service in the general offices. The work of the men in the department of greater service in each district will be fourfold, as follows:

To inquire from each consumer whether or not the service supplied by the company is satisfactory in every respect. This refers not only to the physical service, but also to the consumer's relations with meter readers, collectors, troublemen, clerks, telephone operators and other employees of the company with whom he may come in contact.

To give consumers, where the information is needed or desired, details regarding rate schedules and methods of charging for service, the welfare work assumed by the company in behalf of its employees and the present and prospective development work which is being carried on for the benefit of the communities served, the idea being to create an interest in the company's affairs and to convey the thought that the work the company is doing is for the benefit of the territory supplied and that the more rapidly the company's business grows and develops, the more rapidly will the state progress in its onward march.

To ascertain the mental attitude of each consumer interviewed, the idea being to find out if the consumer is (a) in accord with the company's operations and prospective development work, (b) indifferent to what the company is doing, or (c) in any way antagonistic to the company.

Assuming that the conditions are satisfactory, the representative of the department of greater service will explain to the consumer the company's plan for customer ownership and its desire that all consumers, if it be possible, shall become personally interested in the company's operations, even if only to a minimum amount.

The company which has put into effect this new idea of sending trained men into the field to "look for trouble" is more than satisfied with the results being obtained. Where any troubles are reported they are immediately remedied. Where information is asked it is freely given. The officers of the company are learning more about the business than they knew before. Employees are becoming more alert to see that the service is what the management desires—high-grade in every respect. Finally, consumers are greatly pleased with the attention and courtesy displayed by the company, and public good will is being developed and strengthened to a remarkable degree.

In military affairs a commanding officer plans to capture and hold a position. Public good will should be captured and held in the same manner. It is no hit-or-miss affair. The great lesson to be learned by company executives and managers is that this much-desired good will cannot be obtained by treating with consumers as classes or communities, but rather by giving recognition to the individuality of each whose friendship is sought. For the public is made up of individuals, and it is the man in the street and the woman in the home who mold public opinion.

Station Economies and Production Costs

NEVER HAS THE TIME been more opportune for emphasis upon systematic maintenance of utility properties and careful checking of station operating economy than at present. Actual operating results reflecting present conditions should be set up for progressive engineers to aim at.

Operating Costs of Small, Medium and Superpower Plants

Costs and Performance of Steam Generating Plants in Superpower Region—Effect of Size of Plant, Size of Units and Plant Factor

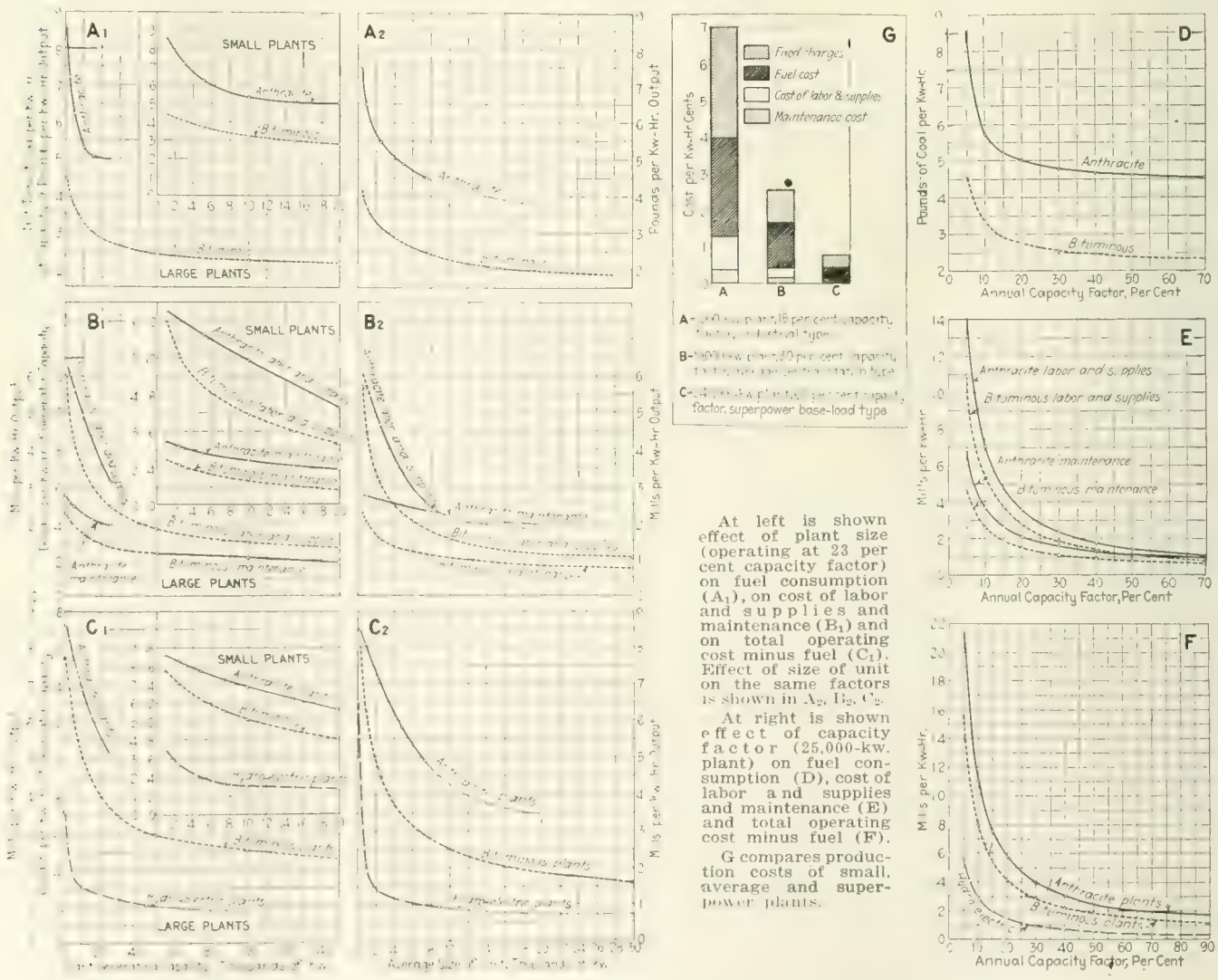
BY HENRY FLOOD, JR.*

A COMPARISON of operating costs of small, medium-sized and large superpower steam generating plants has been made possible by the Superpower Survey conducted by the United States Geological Survey. In this survey records of 219 plants in the Superpower Zone were analyzed in order to ascertain their performance and operating cost with relation to size of plants and with relation to the capacity factor† at which the plants operated. The summaries of the analyses which are given in the accompanying table bring out strikingly the effects of these two conditions on the cost of generating power.

The Superpower Zone, which extends along the Atlantic seacoast from Washington to Portsmouth, N. H., and inland on an average about 150 miles, contains some 400 steam-electric plants in the electric utility

*Mr. Flood is engineer-secretary of the Superpower Survey being conducted by the United States Geological Survey, of which George Otis Smith is director. W. S. Murray is chairman of the Superpower Survey.

†"Capacity factor" as used throughout this discussion is equivalent to the term "plant factor" as defined in the A. I. E. E. Standardization Rules. It is the ratio of the average load to the aggregate rating of the plant.—EDITOR.



COAL CONSUMPTION AND OPERATING COSTS FOR PLANTS OF DIFFERENT SIZE

At left is shown effect of plant size (operating at 23 per cent capacity factor) on fuel consumption (A_1), on cost of labor and supplies and maintenance (B_1) and on total operating cost minus fuel (C_1). Effect of size of unit on the same factors is shown in A_2, B_2, C_2.

At right is shown effect of capacity factor (25,000-kw. plant) on fuel consumption (D), cost of labor and supplies and maintenance (E) and total operating cost minus fuel (F).

G compares production costs of small, average and superpower plants.

OPERATING STATISTICS AND COSTS FOR STEAM-ELECTRIC PLANTS IN SUPERPOWER REGION—YEAR 1919

	BITUMINOUS COAL									ANTHRACITE COAL							
	Under 1,000 Kw.	1,000 to 2,500 Kw.	2,500 to 5,000 Kw.	5,000 to 10,000 Kw.	10,000 to 25,000 Kw.	25,000 to 50,000 Kw.	50,000 to 100,000 Kw.	Over 100,000 Kw.	All Plants	Three Best Plants	Ten Best Plants	Under 1,000 Kw.	1,000 to 2,500 Kw.	2,500 to 5,000 Kw.	5,000 to 10,000 Kw.	10,000 to 25,000 Kw.	25,000 to 50,000 Kw.	All Plants
Number of plants	33	36	32	29	31	14	13	8	196	3	10	3	6	5	4	2	3	23
Average yearly output (th usands of kw-hr.)	1,016	2,827	6,680	12,110	30,610	62,600	172,500	335,037	38,020	248,635	193,050	697	2,036	7,280	15,551	43,925	125,275	25,050
Average peak load, kw	545	1,308	2,790	5,600	12,210	21,880	50,600	102,750	12,680	72,200	62,499	322	901	2,068	5,715	14,000	27,783	6,570
Total generator reserve, per cent	30 8	32 0	36 1	42 0	34 2	53 8	37 7	60 5	46 5	35 0	48 6	73 5	53 5	59 6	9 8	22 2	6 15	15 5
Total effective reserve, per cent	19 8	13 2	19 0	25 0	18 8	27 1	9 7	27 5	20 6	9 4	12 5	73 5	40 5	47 5	9 0	15 0	—1 2	5 9
Average generator capacity, kw	705	1,720	3,790	7,950	16,400	34,100	69,300	164,500	18,400	97,500	92,760	560	1,380	3,300	6,270	17,100	29,500	7,590
Average effective capacity, kw	650	1,510	3,320	7,000	14,500	28,000	55,500	131,000	15,300	79,000	80,255	560	1,270	3,070	5,200	16,100	27,430	6,950
Ratio of total to effective capacity	1 09	1 14	1 15	1 14	1 13	1 21	1 25	1 26	1 18	1 23	1 15	1 0	1 09	1 08	1 08	1 21	1 06	1 09
Average size of unit, kw.	273	540	905	1,580	3,000	6,420	12,600	15,800	4,140	28,200	15,400	240	460	970	1,255	3,420	7,375	2,080
Load factor, per cent	21 3	24 7	27 3	24.7	28 6	32 6	38 4	37 2	34 4	39 3	35 2	24 7	25.8	40.2	31 0	35 8	51 5	43 5
Capacity factor:																		
(a) On total generator capacity, per cent	16 4	18 6	20 2	18 2	21 3	21 0	28 2	23 5	23 3	29 0	23 8	14 2	16 8	25 0	28 3	29 4	48 5	37 6
(b) On effective capacity, per cent	17 7	21 4	23 0	19 7	24 2	25 4	35 5	29 4	28 4	36 0	27 4	14 2	18 3	27 2	34 0	31 0	52 0	41 0
Net tons fuel per kw.-yr. of generator capacity	4 34	3 45	3 18	2 90	2 85	2 30	2 72	2 20	2 55	2 23	1 94	8 85	8 7	8 7	6 4	6 4	9 22	8 05
Maintenance cost per kw.-yr. of generator capacity	$7 82	$3 95	$3 72	$3 65	$2 90	$2 07	$2 45	$1 80	$2 42	$1 07	$1 64	$4 95	$4 71	$3 25	$5 46	$5 29	$4 89	$4 87
Labor and supplies per kw.-yr. of generator capacity	$13 38	$11 90	$9 00	$7 10	$6 10	$3 57	$3 76	$2 54	$5 18	$2 10	$2 13	$15 00	$10 80	$10 20	$10 80	$8 26	$5 18	$7 44
Fuel cost per kw.-yr. of generator capacity*	$23 50	$18 60	$17 20	$15 65	$15 40	$12 40	$14 70	$11 90	$13 80	$12 05	$10 50	$23 75	$15 28	$23 35	$17 15	$17 15	$24 85	$21 57
Fuel cost to total operating cost, per cent	52 5	54 0	57 5	59 5	63 0	67 0	73 0	64 5	79	74		54 3	49.6	63 5	51 3	55 9	71 2	63 7

* Bituminous coal, $5 40 per net ton in bunkers. Anthracite coal, $3 per gross ton in bunkers.

industry. While it is recognized that the cost of producing power varies over wide limits with local conditions, such as the cost of coal, the availability and temperature of condensing water and other factors, it is nevertheless true that where so many data are available it is possible to determine the average performance and the average operating cost of power when the data are properly analyzed. These 400 steam-electric plants generated very nearly 9,000,000,000 kw.-hr. in 1919. Of these plants, 219, totaling some 3,820,000 kw. of installed capacity, were found to have very excellent records both as to performance and as to operating cost. These plants had a total output of approximately 8,000,000,000 kw.-hr., or very nearly 90 per cent of the total amount of energy generated in the superpower region by steam-electric plants. For the purpose of showing the variation of performance and cost with the size of plants, Charts A_1, A_2, B_1, B_2, C_1 and C_2 have been prepared. Chart A_2, showing the variation of fuel consumption at the constant capacity factor of 23 per cent, brings out that fuel consumption decreases rapidly as the plant becomes larger for plants of less than 50,000 kw., while it decreases at a comparatively slower rate for plants of more than 50,000-kw. capacity.

In chart A_2 is shown the same variation in fuel performance with the size of the generating unit. Here is brought out the decreased cost of generation for the larger units. These curves were developed for the reason that many of our large stations today are equipped with a large number of small units as compared with the present tendency toward a small number of large units.

Charts B_1 and B_2 show the variation of maintenance cost and of labor and supplies with the size of the plant at a constant capacity factor, while Charts C_1 and C_2 show the total of all operating cost, except fuel, with its relation to size of plant. On this particular curve sheet there has also been shown the total operating cost of hydro-electric plants. These costs were developed from a study of fifty-eight selected hydro-electric plants within the region, and it strikingly brings out the lower cost for the operation of hydro-electric plants regardless of size.

To show the variation of the cost of power with changing capacity factors Charts D, E and F are presented. In order to keep these charts simple, only one size of plant is shown—*i.e.*, 25,000 kw.—and the coal consumption of these plants is plotted for various annual capacity factors on Chart D, while the costs of maintenance and of labor and supplies are plotted on Chart E, and the total of all production costs excepting that for fuel is indicated on Chart F.

All of these costs are given for both bituminous and anthracite coal. The bitumious coal in all cases shows substantially lower costs.

As the result of this investigation a very interesting comparison has been made on Chart G. This shows the cost of operating small isolated plants, average central-station plants and superpower plants. In the Superpower Zone the average size of isolated plants in the manufacturing industry will be considerably less than 1,000 kw., and they will operate at a capacity factor of approximately 15 per cent. The average size of central station in the zone is 10,000 kw., operating at an annual capacity factor of approximately 30 per cent. The superpower plant is rated at about 100,000 kw. and will operate at about 60 per cent capacity factor. For the purpose of carrying the base of the load the superpower system should have very large stations which will operate at high capacity factors in order to produce the bulk of the energy at a very low production cost.

It is interesting to note that the total cost of energy for the average industrial type of plant is about 7 cents per kilowatt-hour, compared with about 0.8 cent per kilowatt-hour for the superpower base-load type. It is also interesting to note that the total production cost of power in the base-load type of station is actually less than the operating charges alone for the average central-station type.

The conclusion to be drawn from a study of these tables and charts is that the time is now at hand to stop building small-sized power plants at local centers, which are limited to small-capacity installations and to operation at very low capacity factors. Instead the larger, highly economical stations should be interconnected to serve intermediate territory.

Instruments Indispensable for Boiler Room Economy

Economical Operation Is Virtually Impossible Without Measurements of Coal, Water, Etc.—Instruments that Are Essential and Desirable

By Roy Page
General Superintendent Nebraska Power Company, Omaha

THE economical use of fuel is the most important factor in the efficient operation of a steam plant, no matter what kind of fuel is used nor what the size of the plant. Fuel, except in very small plants, is the major item in the cost of steam generation, and yet until the recent large increases in the cost of coal and oil it was the item of expense to which the least attention was paid. Most plant operators were content to purchase their fuel and turn it over to the boiler-room force with little or no instruction other than an order to maintain steam pressure. As a result fuel waste has been and still is large in most of the plants. To maintain any degree of efficiency in plant operation it will be necessary to purchase virtually all of the apparatus described in this article. But unless the boiler-room force is first convinced of the necessity and usefulness of the instruments and instructed in their proper care and use no increase in efficiency should be expected. These instruments are but tools, and without good workmen to handle them good tools are of very little use.

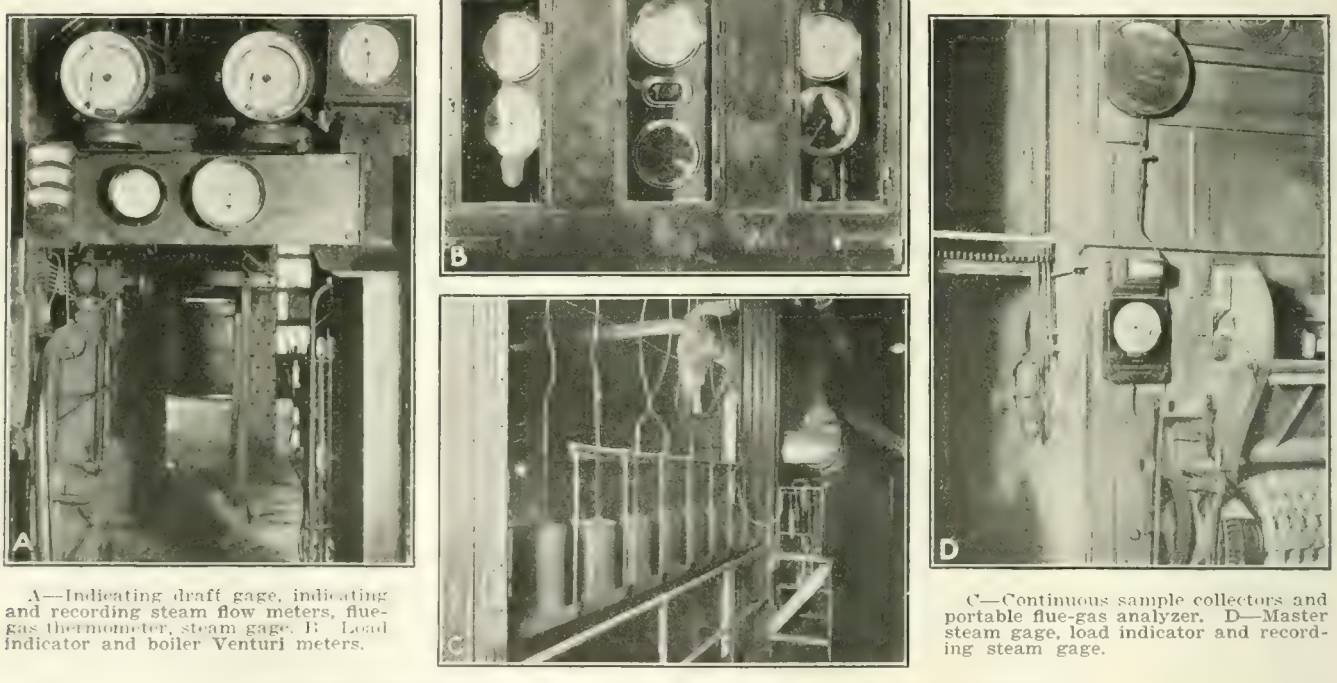
There are three things required to insure economy in the production of steam—first, an adequate supply of fuel of a uniform grade and of a kind fitted to the needs of the plant; second, an operating force capable of applying proper methods of burning the fuel, and, third, sufficient instruments of the proper sort to measure the results obtained and to guide the operating force in handling the equipment. Of course, the size of the plant will in some degree affect the refinements to which it is possible to go in the measurement of results, but unless there is *some* method of measurement only a guess can be made of the efficiency, and to guess that it is poor will not be far wrong in most cases.

It is important that care be exercised in the purchase of fuel, especially, as has already been said, with reference to uniformity and adaptability to the equipment in which it must be burned. In every case the price of the fuel should be carefully balanced against the efficiency which may be obtained with the type of equipment available.

Weight of Fuel.—In plants using fuel oil the process of arriving at the weight of fuel burned is comparatively simple. In most such plants it is obtained by gaging a calibrated tank.

In coal-burning plants obtaining the weight of fuel is not such an easy matter. Especially is this true in smaller plants, which cannot afford an installation of high-priced weighing equipment. Some method, however, should always be provided to obtain as accurately as possible, at least once a month, the weight of coal supplied to the boilers. Volumetric measurements (with so-called "coal meters") have been found satisfactory in hand-fired plants using fine coal. The careful use of railroad weights, in conjunction with accurate measurement of amounts in storage and bunkers, is also effective as well as inexpensive, and this method may be employed in plants of any size. Automatic coal scales for stoker-fired plants are good unless the fuel is of a type which will rapidly corrode the scales and throw them out of adjustment. Other methods are available, and one should be chosen which will give the most accurate results consistent with the size of the plant.

Heating Value of Fuel.—While the heat content of the fuel is not essential in arriving at the cost of the steam generated, before efficiency of the boiler plant can be figured it will be necessary to ascertain the average heat content of the fuel burned. This is not only an interesting figure, but it is absolutely essential if it be desired to discover where losses are taking place and to improve the efficiency of operation.



A—Indicating draft gage, indicating and recording steam flow meters, flue-gas thermometer, steam gage. B—Load indicator and boiler Venturi meters. C—Continuous sample collectors and portable flue-gas analyzer. D—Master steam gage, load indicator and recording steam gage.

INSTRUMENTS WHICH ARE NECESSARY AS A GUIDE TO EFFICIENT OPERATION

Some method should be installed, as nearly automatic as is practicable, to obtain a sample of fuel which will reflect the average heat content of the fuel burned. Great care must be used in the collection and preparation of this sample; it is the method of sampling and not the laboratory analysis which introduces the greatest inaccuracies. Full instructions on how to take and prepare a coal sample for laboratory test have been issued by the Bureau of Mines. The sample obtained should be sent to a reliable laboratory where the proximate analysis and the heat-content can be accurately determined.

In the plant with which the writer is connected it has been found most satisfactory to prepare a sample of each day's run and then to combine these samples at the end of the month to produce the average for the whole period.

Good Methods of Measuring Boiler-Feed Water.—The amount of feed water evaporated should be carefully ascertained. There are many devices on the market for measuring the weight of the water supplied to the boilers. Among them are the "V" notch meter, the volumetric (or dumping-type) meter and the Venturi or other type of differential pressure meter. All these methods are good, and the one most suited to the plant in question should be chosen. Whatever meter is installed should be regularly inspected, so that it may be depended on to give accurate results.

Indicating or, more preferably, recording thermometers should be provided to give a record of the average temperature of the feed water as supplied to the boiler. Some method should also be provided to keep a check on the number of blow-offs made, as the amount of such blow-offs must be deducted from the results indicated by the feed-water meter in order to arrive at the actual evaporation.

Automatic feed-water regulators may be provided, but, if applied, those in charge of boiler operation should have instructions to watch the water as carefully as though no regulators were used. They should be considered more in the light of devices to regulate the supply of water to the boiler than as something to relieve the attendant of the duty of watching this detail of operation.

Each boiler, of course, should be provided with an accurate indicating steam gage. If there are a number of boilers, there should also be a large dial gage on the main steam header. A recording steam gage on the header is also a very desirable instrument.

If the size of the plant will warrant it (and there are few plants which will not, if efficiency is to be maintained), each boiler should be equipped with an indicating and recording steam-flow meter. This instrument is very valuable in indicating the steaming rate of the boiler and recording whether or not instructions in the operation of the boiler have been carried out.

There should also be provided in the main steam header an indicating or recording thermometer to give a record of the average temperature of the steam supplied to the prime movers.

Combustion Instruments.—Each boiler should be equipped with a draft gage, which should be arranged to measure the draft over the fire and the draft at the boiler side of the damper. The gages should be mounted so as to be readily visible to the fireman in the performance of his duties. If forced draft is used, a pressure gage to indicate the blast pressure under the fire will also be necessary.

A flue-gas thermometer (pyrometer), either indicating or recording, should be mounted in the uptake to the breeching, so that a careful record may be kept of the temperature of the gases leaving the boiler.

To obtain samples of the flue gases for CO_2 determination it is desirable to have some type of continuous sampler, which may be adjusted to take samples over periods of from fifteen minutes to eight hours. Portable Orsat apparatus should be used in conjunction with such a sampler and for taking snap samples when necessary.

Refuse Samples.—A very considerable part of the fuel lost in boiler operation is due to the combustible which is contained in the refuse. This is especially true when it is necessary to operate the boilers at high ratings. It is advisable to take frequent samples of the refuse and have them tested for the percentage of combustible. This loss may be very large even though the gas analysis and other conditions may indicate a high state of combustion efficiency.

Operating Results of a 1,500-Kva. Automatic Hydro Station

Reliability, Low Operating Costs and Absence of Labor Difficulties Potent Reasons for Automatic Operation —Experience of Iowa Railway & Light Company

BY T. A. E. BELT

Lighting Engineering Department, General Electric Company

THE rapid growth of the electrical industry may be credited to the fact that central stations as a whole have given efficient service and have generated cheap energy, but since the efficiency of labor in the last few years has greatly decreased, this efficient service has been challenged, particularly in localities served by the small or medium-sized station where high-grade operators cannot be maintained. If water power is the

DATA CONCERNING AUTOMATIC GENERATING PLANTS

Company	Location	No. of Units	Kva., Each	Type of Generator	Voltage	Frequency	Master Starting Element	Year Installed
Iowa Railway & Light Co.	Cedar Rapids, Iowa	3	500	Synchronous	2,300	60	Float or remote hand switch	1917
Ontario Power Co.	Ontario, Cal.	1	500	Synchronous	11,500	50	Remote hand switch	1919
Blue River Power Co.	Seward, Neb.	1	240	Synchronous	2,400	60	Combination float and load switch	1921
Iowa Electric Co.	Manchester, Iowa	1	125	Synchronous	2,300	60	Float switch	1921
		1	75				Load switch	On order
Holyoke Water Power Co.	Holyoke, Mass.	1	625	Synchronous	6,600	60	Energize line	1921
Burkhardt Milling Co.	Hudson, Wis.	1	375	Synchronous	2,300	60	Remote hand switch	On order
International Paper Co.	Corinth, N. Y.	1	625	Synchronous	600	40	Remote hand switch	On order
J. & J. Rogers Co.	Ausable Forks, N. Y.	1	500	Synchronous	2,300	60	Remote hand switch	1921
Cazenovia Electric Co.	Cazenovia, N. Y.	1	225	Synchronous	2,300	60	Remote hand switch	On order
Cheboygan Elec. Power & Light Co.	Cheboygan, Mich.	1	240	Synchronous	2,300	60	Float switch, Energize line	On order
Hayden Milling Co.	Tecumseh, Mich.	1	312	Synchronous	2,300	60	Energize line	On order
Keene Gas Electric Co.	Keene, N. H.	1	150	Synchronous	2,300	60	Energize line	On order
Washington Water Power Co.	Spokane, Wash.	1	12,750	Synchronous	4,200	60	Remote hand switch	On order

source of energy in these districts, the reliability of the large stations able to maintain high-grade operators may be assured by equipping the small stations with automatic control, for so equipped the plant is operated by the skillful engineer who has designed and built its control equipment.

After three and one-half years of operation of the 1,500-kva. automatic hydraulic plant at Cedar Rapids, Iowa, the Iowa Railway & Light Company, which owns the station, has made a statement showing that its automatic plant is more reliable than its hand-controlled stations and that the future policy will be not only to equip present plants with automatic control but to make all hydraulic developments automatic. The statement, which emphasizes the fact that "relays never sleep," follows:

"We have found from experience that the operation of the automatic station is more satisfactory and more reliable than the hand-controlled station, owing to the reason that the relays never sleep. We would not consider installing another hand-operated station and are changing over our hand-operated stations to automatic stations as fast as money will permit."

Of almost equal importance with efficient service is the cost of energy. A small or medium-sized plant burdened by a large operating expense is not an attractive proposition as the rates for power existing today are in most cases based on conditions which prevailed before the war. The Iowa Railway & Light Company says: "Our reason for selecting automatic control equipment was that we recognized that labor would increase in price and decrease in efficiency. The plant, from a financial standpoint, would not have been practically interesting if burdened with an additional labor charge of not less than $3,600 per year and probably, at the present prices, at least $4,800 per year.

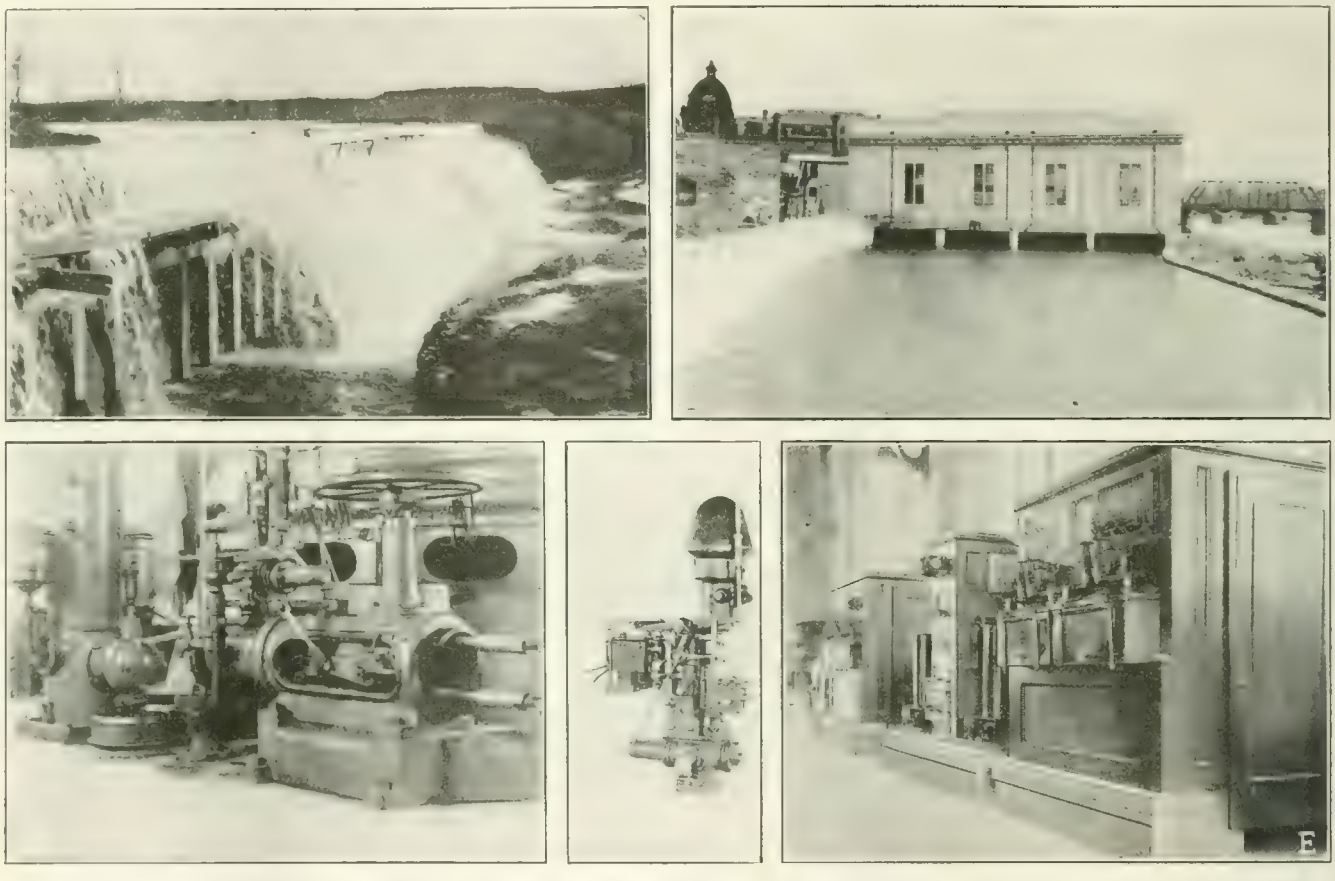
"The inspection given the station is the cleaning of the trash racks each day by one of the boiler-room oilers who stops there and cleans off the racks on his way to work. The time required for the work is about thirty minutes. An electrical and mechanical inspection is given the plant once each week, requiring approximately two hours.

"The maintenance and operating charge of the station has averaged about $178 per year. The energy generated is approximately $7,500,000 kw.-hr. per year."

In addition to the inefficiency and the high cost of labor, one operating company has a third reason for installing automatic generating stations. It is on account of inability to keep operators on the job. The plants are situated in the country, in some cases several miles from a town, and operators will not stay at a station for any length of time. These plants when automatically equipped will come into service at peak load, differentiating on water level; that is, the stations where the water level is the highest will be the first to come into service on load demand, the other plants waiting until the load further increases.

The Iowa Railway & Light Company, in referring to its automatic station, states:

"The cost of delivered energy is based on the interest charges of the plant plus the maintenance and operat-



RELIABLE AND ECONOMICAL SERVICE IS FURNISHED TO SMALL COMMUNITIES BY AUTOMATIC HYDRO-ELECTRIC STATIONS

A—Dam and storage reservoir for an automatic station of the Blue River Power Company recently installed at Shestak, Neb.
B—Automatic station of the Iowa Railway & Light Company at Cedar Rapids, Iowa, which requires negligible maintenance.
C—Governor mechanism in the Blue River station.
D—Automatic starting mechanism for automatic hydro-electric plants.
E—General view of main control board at Cedar Rapids plant.

ing cost. The total fixed charges against the plant are about 12 per cent, based on the price of money when the plant was constructed."

The cost of the 1,500-kva. plant was approximately $280,000; therefore the yearly fixed charges against the plant are $33,600. The additional yearly operating and maintenance charges of $178 make a total yearly charge against the plant of $33,778, which, based on an output of 7,500,000 kw.-hr., gives a cost for delivered power of 0.45 cent per kilowatt-hour.

The table shows that the advantages and practicability of automatic hydro-electric stations are now being recognized by other companies.

Maintenance Handled in Central Shop on Southern System

Station Operators Not Allowed to Make Repairs—Central Shop Handles All Maintenance Work—Sufficient Force Maintained to Meet Any Emergency

BY GEORGE A. ILER
Superintendent of Operation, Tests and Repairs, Georgia Railway & Power Company, Atlanta

SEVERAL years ago the Georgia Railway & Power Company centralized its repair force, establishing its headquarters in the same location with the electrical laboratory. The repair shop is kept open continuously, including nights and holidays, and is in direct touch with every station on the system. In order to co-ordinate the repair men's work with the load dispatcher's requirements, virtually all shop telephone traffic is routed through the load dispatcher's office. In this way the repair shop is able to determine whether certain equipment will be available for repair and whether it can be spared or not at off-peak times.

The central shop handles all repair work from the smallest job to the largest, which includes the building of stations, repairs of transformers up to and including those rated at 3,333 kva. and 110,000 volts, the repairing of all burned-out rotaries and generators and the testing of this equipment when repairs are completed.

MANUFACTURING CARRIED ON AS SIDE LINE

As a part of its work the repair shop carries on enough manufacturing work in the central shop to make available always a sufficient working force to handle any emergencies that may arise. At such a time the manufacturing work is temporarily discontinued and all of the men are used to make rapid repairs by placing two or three shifts on the work. In this way a repair job can be carried on continuously until it is finished, when the men go back to the manufacturing work. Work which is carried on in this way is the manufacture of angle blades, disconnecting switches, live-line tools, reclaiming old oil, cabinet work, repairing of office furniture, etc.

Reclamation work is another important feature of the central repair shop and is carried on by the same force of men. This work consists of the continuous process of gathering new and old materials that are left lying about the numerous stations by the construction or other crews and bringing the collection into the repair shop, where it is renovated or reconditioned before it is placed back in stock. Such work is also handled on what is really a commercial basis; that is, all departments within the company sell their old material to the reclamation department for the price of junk or, in some cases, the price of badly used second-hand material, and after the repairs have been made the material or equipment is placed in stock and sold at the prevailing market price.

There are numerous substations and power plants in the vicinity of the city of Atlanta within a radius of 7 miles, this territory being known as the "seven-mile zone." If at any time trouble should occur at any of these stations, the load dispatcher is immediately notified by the station operator, and the dispatcher in turn transmits the information to the proper subdivision of the test and repair department. Quite often, owing to the nature of the trouble, the men from the testing department are required to get on the job first in order to locate the trouble before the repair crew starts in to work.

It has also been the policy of the company to store all spare parts for electrical equipment at a central point, keeping a proper record of this material or equipment so that it will be available at a moment's notice. Before this system was placed in operation an occasion arose where a spare set of collector rings for a 2,000-kw. railway rotary was needed. These collector rings had been purchased and very carefully laid away to take care of any future emergency, but had been on hand so long that there was only one man connected with the company who knew where they were. Unfortunately this man could not be found, and therefore a general search for the rings had to be instituted. This kept several men busy for an entire day and night opening boxes until the rings were finally located. An incident of this sort could not happen with the present system of carrying spare parts at a central point where it is possible to have them properly boxed or crated and numbered and a card-index record kept showing where they may be found.

In this maintenance system the station operators are not allowed to make repairs of any description, it being the belief that the operator's entire time is required in watching the station instruments, controlling the machines, looking for hot bearings, taking semi-hourly log-sheet readings, answering the telephone, and in general keeping his mind on the operating conditions. It was felt that if he were required to do minor repairs he would have a legitimate excuse to slight some of the above-mentioned duties. It was also found that if operators at the different stations were allowed to perform their own minor repairs, each one would have his own way of doing the work and would have an individual idea of what constituted the proper electrical repair. There would also be a variety of ideas as to what a neat workmanlike job looked like. Furthermore, if the operators were required to make such repairs, it would mean that each station would have to be equipped with a complete outfit of tools, blowtorches, repair parts, etc., which would entail considerable expense. Even so the equipment would not be as complete as might be provided at a central repair shop, and therefore the operators or local utility men could not be expected to do as good work.

By having all the repair men centrally located it is possible to have groups of men who are trained to do certain kinds of work as specialists, and further it is possible to have the work done with uniform standards.

Another feature which has been found valuable is that of holding a service truck ready for an emergency when the dispatcher has been informed that a storm is moving toward one of the large power centers.

Interconnection Problems and Economies

INTERCHANGE OF ENERGY between plants and even between systems has been proved to be profitable and practical. Progressive companies are not overlooking the economies which may be effected by tying in with their neighbors. The problems are chiefly in providing switching and protective facilities and mutually agreeable interchange arrangements.

Charts for Quick Solution of Line-Drop Problems

By Means of Two Sets of Curves Voltage-Drop Calculations Can Be Graphically Made with Sufficient Accuracy for Practical Purposes

BY E. P. PECK
General Superintendent Electrical Department, Utica Gas & Electric Company

ENGINEERS are continually being called upon to make calculations on transmission lines of different voltages, lengths and sizes of wire, to carry different loads at all distances with different wire spacing, when there is not sufficient time available to make the mathematical calculations for exact solutions. Frequently they must give almost immediate answers to such questions as "What voltage will be required and what size wire will be necessary to carry x kw. y miles?" or, "Is it better to add load at this particular voltage, or will it be better to use another voltage, as there is a possibility of load increasing to perhaps 300 per cent of that carried at the present?"

To make it possible to answer such questions promptly a large amount of time has been spent in the attempt to reduce all transmission-line calculations to data which could be put on one sheet and made very simple to use. While this result has not yet been accomplished, it has been found possible to cover the eight most common sizes of wire with two charts, which will give very closely the voltage drop obtained with these eight sizes of wire with any load at any distance, with power factors from 50 to 100 per cent and line voltages of any value. Two such charts are reproduced in the insert which appears elsewhere in this issue. These charts cover all commercial voltages from 110 to 110,000, and constants may be computed for any other voltage without the use of a pencil. A number of checks have been made on the values computed from these charts, and it has been found that with virtually all loads, distances up to 100 miles (160 km.) and voltages up to 110,000, the charts give less than 2 per cent error, and in very few cases, within the limit of 150 miles (240 km.), is the error as great as 3 per cent. This accuracy is very much higher than is required for any preliminary calculation, and in fact is as good as is desired on perhaps 95 per cent of the transmission and distribution lines. The sizes of wire covered are Nos. 4, 1, 2, 1/0, 2/0, 3/0, 4/0 and 250,000 circ.mils.

In the Jan. 16, 1915, issue of the ELECTRICAL WORLD H. B. Dwight gave a chart for calculating the regulation of transmission lines. This chart has been of material assistance in the past, and curves given here were made up largely from calculations based on H. B. Dwight's chart.

To use the chart it is necessary to assume some size wire, some load, some power factor, some distance and some spacing of conductors. Let us take a load of 3,000 kw. at 75 per cent power factor, at a distance of 15 miles (24 km.). We will assume a voltage of 22,000 and a wire size of No. 2/0. We wish to find the percentage of voltage drop.

On the No. 2/0 curve we find the vertical line for 75 per cent power factor, which is followed up to the intersection of the diagonal line giving wire spacing, which we will take as 3 ft. (0.9 m.). From this intersection we follow to the left and find that d is 9.15. To get the voltage drop we multiply d, or 9.15, by 3,000 kw. and by 15 miles (24 km.) and divide by a factor K, which is found in the table to be 20. V, or the voltage drop at the receiver end from no load to full load, is then 2,059 approximately. The percentage of drop referred to the no-load voltage is 9.35. This calculation is made on a slide rule in a few seconds, and it compares with a very long calculation if transmission-line formulas are used.

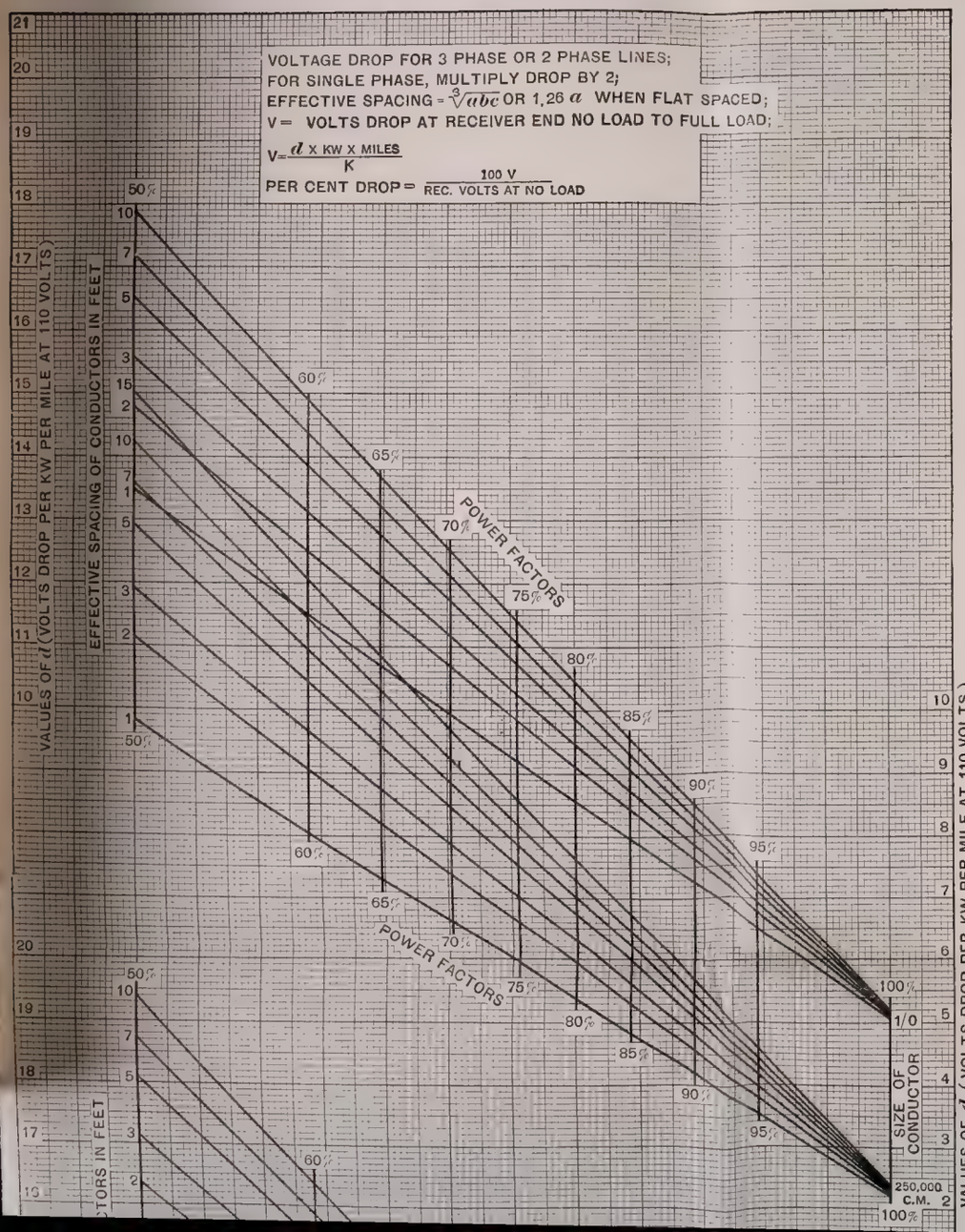
For lines of a length greater than 50 miles (80 km.) the voltage at the receiver end is appreciably higher with no load than the voltage at the generator end. The correction at 50 miles is approximately 0.5 per cent and may be neglected. The correction at 100 miles (160 km.) becomes approximately 2.1 per cent, and at 150 miles (240 km.) approximately 4.85 per cent. The distance-correction curve given at the corner of the chart is merely the percentage voltage rise along a transmission line when there is no load on the line, for a line of average characteristics as to size of conductor, spacing of conductors, etc. It is thus approximately correct for any voltage or any spacing of conductors. This correction need not be made if only the regulation or change in voltage at the end of the line is desired. The correction is applied when it is desired to get the drop in voltage from the generator to the receiver with load applied. Thus after having obtained the percentage drop in voltage at the receiver end from no load to full load from the main chart the distance-correction curve is applied by subtracting the per cent correction. The voltage at the receiver under load may be found to be lower or higher than the voltage at the generator.

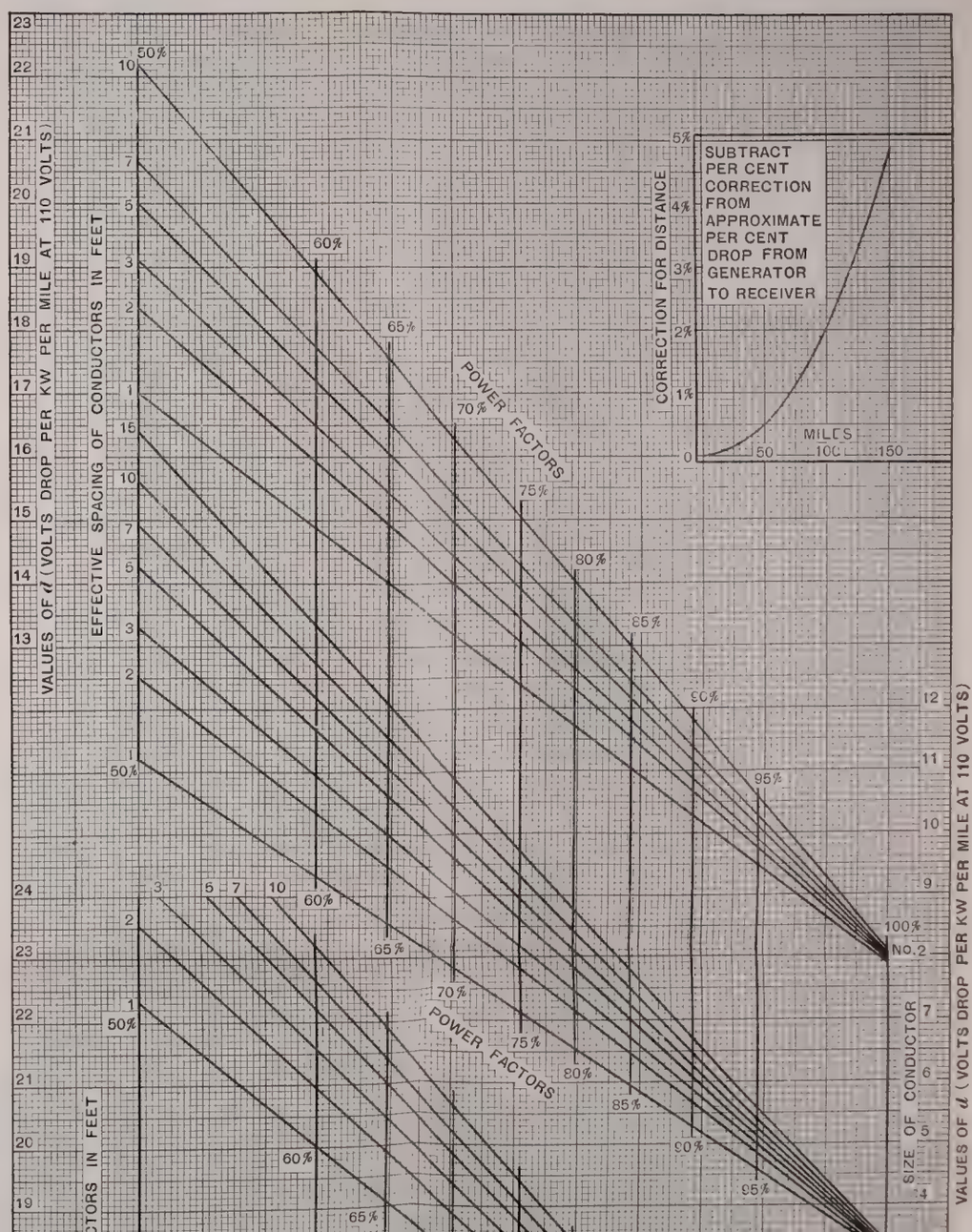
The conductor spacings are taken at sufficient intervals to allow interpolation for any conductor spacing. The spacings given are effective spacings, which correspond with the line spacing if wires are arranged in the triangular position. With flat spacing the distance between adjacent wires is multiplied by 1.26 to get effective spacing, or if the conductors are irregularly spaced it is necessary to take the cube root of the product of the conductor spacings. All of this information is given in formulas on curve sheets.

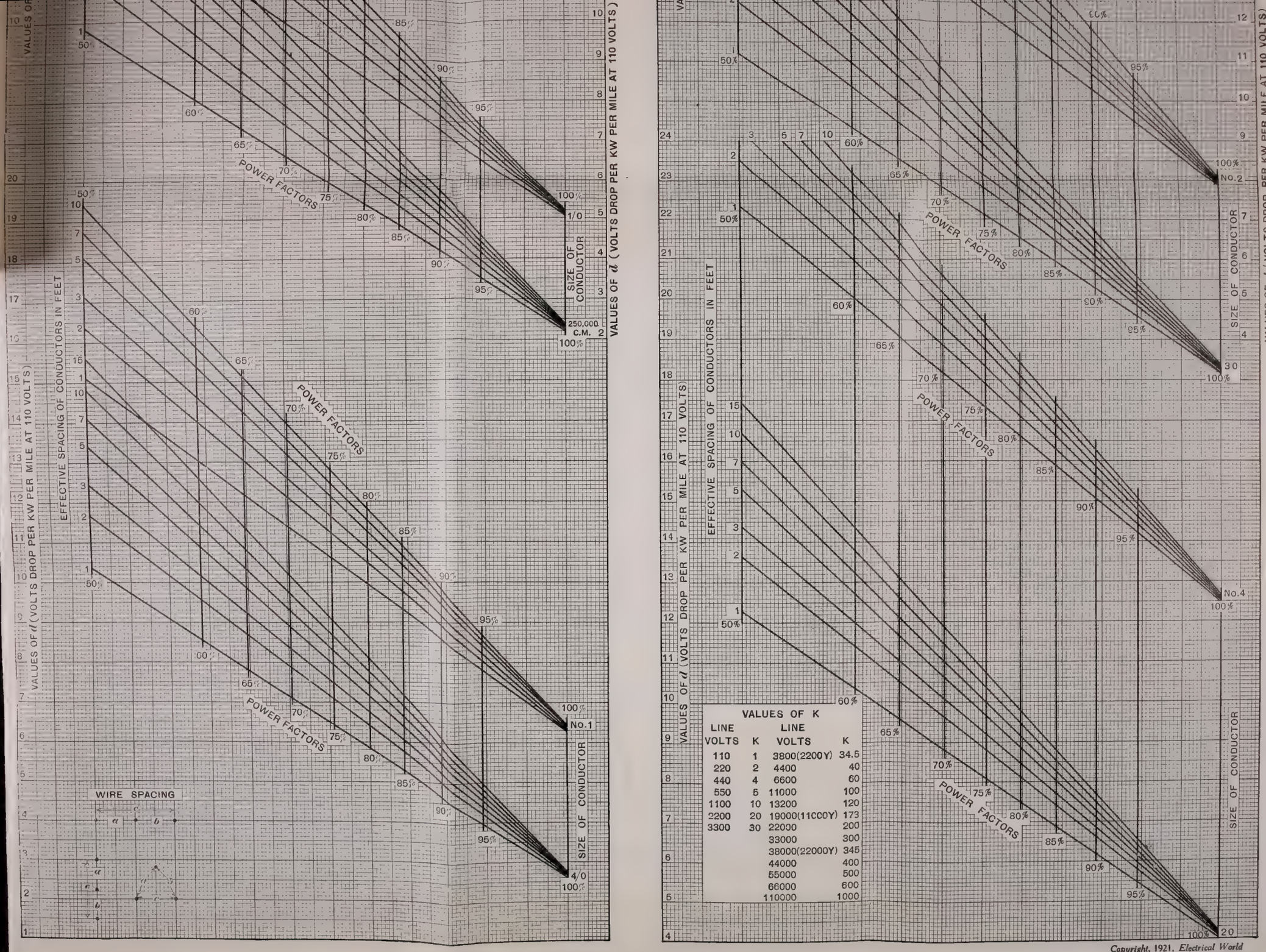
Charts for Quick Solution of About 95 Per Cent of Line Drop Problems

Supplement to Article on Page 1238, Electrical World, May 28, 1921

By E. P. Peck, general superintendent electrical department, Utica Gas & Electric Company, Utica, N. Y.







VALUES OF K			
LINE VOLTS	K	LINE VOLTS	K
110	1	3800(2200Y)	34.5
220	2	4400	40
440	4	6600	60
550	5	11000	100
1100	10	13200	120
2200	20	19000(11000Y)	173
3300	30	22000	200
		33000	300
		38000(22000Y)	345
		44000	400
		55000	500
		66000	600
		110000	1000

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Conditions that Must Be Watched When Interconnecting Small Plants

When Small Generating Plants Are Tied in with Larger Systems the Rupturing Capacity of Switches Becomes a Very Important Consideration

BY HARRY J. BURTON
Consumers' Power Company, Jackson, Mich.

WHEN plants of relatively old design are tied by means of transmission lines to systems or plants of larger capacity it should be kept in mind that the simple operation of opening and closing a switch under load may produce results entirely different from those that could occur before the interconnection was made. Sometimes the short-circuit current may be increased above the interrupting capacity of the existing circuit breakers as well as above the mechanical strength of busbars, current transformers and other apparatus. Consideration of these facts is peculiarly important because death has marked several recent disasters that have occurred in or around power stations when large volumes of electrical energy have broken loose.

SYSTEMS SHOULD BE STUDIED BEFORE INTERCONNECTING

Before additions or interconnections to an existing system are considered a study should be made to determine the possible short-circuit current with a view to providing proper spacing of conductors, adequate interrupting capacity, suitable current-limiting apparatus and relay protection. Methods have been devised for calculating system short circuits so that it is possible to predict them with great accuracy. Furthermore, oil circuit breakers have been designed with large interrupting capacity. By selective action of oil circuit breakers, supplemented by current-limiting reactors or segregation of portions of the system and the proper use of relays, it should be possible in most cases to protect the system and cut off the short circuit without serious damage.

While many appear inclined to the belief that the simplification of circuits and control is the only requirement in assuring satisfactory operation of heavily loaded circuits, the control of such large concentrations of power presents very difficult problems. The electromagnetic stresses and abnormal temperatures set up are enormous. The cutting out of relays to prevent switches from tripping when a short circuit occurs is, in the author's opinion, like the proverbial blocking of the safety valve. Some of the larger companies are growing so fast that they have outgrown their circuit-breaker capacity and are segregating portions of their system, at least until adequate circuit-breaker capacity is installed. Other companies are installing circuit breakers with a rupturing capacity of 1,000,000 kva. or more and in addition are using current-limiting reactors and segregation methods.

True economies are obtained and the utmost gain is realized only when every known or possible element of hazard that may tend to destroy life or property is considered. If it is not possible to make a system reasonalby safe because of its size, the economic limit has been reached. If oil circuit breakers or other protective apparatus cannot be designed at a reasonable cost to protect life and property adequately, they are the weak links in the chain and limit the economic size of a system. Precautionary measures, whether included in the scope of initial design or in the application of safety plans, are of equal importance and operate in the same direction as regards protecting the capital investment.

From what has been said it should not be inferred that large electrical systems are unsafe and costly to operate. The contention is that careful consideration should be given to the various factors. Some of the questions which must be answered in dealing with this problem are the following: Is the danger line approached because of uncertain factors? Are all the parts that go to make up a modern electrical system keeping pace with the development? Are engineers on the right track in their attempts to interrupt suddenly currents of several million kilovolt-ampere capacity? What is the economic limit to the size of a system?

Economic Benefits Derived from Energy Interchange

Massachusetts Central Stations Have Interchanged 800,000,000 Kw.-Hr. in Past Eight Years at a Net Price Below Half a Million Dollars

THE rise of interconnection among neighboring central stations is one of the most significant developments of the past decade in the public utility field. The advantages of energy interchange are now widely appreciated, and even the non-technical public has some conception of the underlying reasons why interconnection may be worth while. Rarely does the central station seeking the right to "tie in" with another system meet serious opposition before the legislative, municipal or commission authorities concerned, provided that pains have been taken to set forth clearly in the press and otherwise the gains expected from plant interlinking. Massachusetts central stations afford an interesting illustration of interconnection development from year to year. Many companies operate in a comparatively small area intensively developed and containing cities and towns embracing highly diversified manufactures and business enterprises. Residential use of electricity is rapidly increasing all over the state. Electric railway development of large importance affords bulk loads. Energy produced by hydro-electric plants is fed into systems supplied by steam-driven stations, and vice versa. The neighboring systems are near enough in many cases to permit interconnection at moderate and even nominal cost of line construction. The network of interconnected lines built up within the past few years covers practically all of central and eastern New England, and in a sense operations in Massachusetts form a cross-section of the larger district's activities. The growth of interconnection was indicated in the ELECTRICAL WORLD of May 8, 1920, the principal high-tension lines and connected plants being mapped in that issue.



GROWTH OF ENERGY INTERCHANGE BETWEEN MASSACHUSETTS CENTRAL STATIONS

The central stations of Massachusetts interchanged 191,038,868 kw.-hr. in the year ended June 30, 1920, making the total interchange for the past eight years 807,053,479 kw.-hr. The rate of increase in interconnected delivery of energy was 6 per cent, compared with 13.4 per cent the previous year. Sixteen interconnections were utilized for mutual interchange, and the participating companies delivered in one direction 119,102,072 kw.-hr. and received from the other direction 71,936,796 kw.-hr. Many companies also sold to or purchased energy from others, but the above total covers interchange operations and not straight supply operations. The average price paid per kilowatt-hour of energy purchased was 1.08 cents and per kilowatt-hour sold 1.12 cents. The total energy, 191,038,868 kw.-hr., changed hands at an average price of 1.09 cents; but since the companies paid $1,287,545 and received $804,584 for the energy interchanged, the net outlay was but $482,961, or 0.25 cents per kilowatt-hour.

The accompanying table, compiled from returns of the several companies to the Department of Public Utilities, exhibits a wide diversity of transactions in energy interchange. The amounts of energy and the prices paid vary greatly, from nominal interchanges to mutual supplies running into millions of kilowatt-hours for the year. It none the less is true that the ability of each company concerned to furnish electricity at times when it is to another company's advantage to buy justifies variations in price for energy received as against energy delivered. As a rule hydro-electric companies purchasing from steam plants were obliged to pay from 2 mills to 9 mills more per kilowatt-hour than the steam-operated central stations paid for water power. This was no doubt due to the market value of surplus or secondary hydro-electric power available at different periods and also to the high cost of fuel. The opportunities interconnection affords for taking advantage of load-factor conditions are being utilized in virtually all these cases.

The low cost of water-power delivered under favorable conditions is very striking. Thus the Boston Edison company received 7,125,257 kw.-hr. from the New England Power Company at a total cost of only $33,101, or 0.46 cent per unit; the Worcester Electric Light Company received 5,335,520 kw-hr. from the New England at 0.54 cent per unit, and the United company, Springfield, received 11,832,800 kw.-hr. from Turners Falls at 0.754 cent. At present steam-generating costs such arrangements are very much worth while, for in this way any surplus of water power helps to reduce the cost of supplying energy on the steam systems, and the co-ordination of generating equipment and loads on both types of systems enables more reliable service to be rendered and at a lower cost than would be feasible with independent operation. In passing, the almost perfect balance between the Fitchburg and New England companies may be noted, both as to interchange and prices. The existence of an unbalanced-energy account, however, by no means indicates an inefficient interconnection. The price of efficiency, none the less, is engineering skill, operating intelligence and economic insight.

That interchange is aiding plant operation from the economic standpoint is indicated in the fact that in 1916 eleven representative Massachusetts systems, with a total station rating of about 198,000 kw., handled 384,000,000 kw.-hr. at the bus, whereas in 1920 these companies, with about 330,000 kw. rating, handled 756,000,000 kw.-hr. at the bus. That is, in 1916 these plants handled 1,940 kw.-hr. per kilowatt of station rating and in 1920 they handled 2,290 kw.-hr. per kilowatt of station rating, a gain of 18 per cent in equipment utilization.

INTERCHANGE OF ENERGY IN MASSACHUSETTS CENTRAL STATIONS FOR THE FISCAL YEAR 1920

Interchange		Purchased from (B)			Sold to (B)		
Company A	Company B	Kw.-Hr.	Price	Cents per Kw.-Hr.	Kw.-Hr.	Price	Cents per Kw.-Hr.
Amesbury	Newburyport	3,920,000	$53,422	1.364	36,710	$231	0.63
Central Mass.	N. E. Power	11,962,018	167,203	1.39	1,065,881	10,275	0.9
	N. E. Power	7,125,257	33,101	0.46	11,560,822	155,820	1.35
Boston Edison	E. Mass. El	646,700	9,080	1.40	3,430,000	50,726	1.48
Greenfield	Turners Falls	2,986,000	34,803	1.655	1,464,000	7,320	0.5
	Adams	10,273	327	3.06	1,337,700	20,218	1.51
	Athol	4,675	51	1.10	5,144,777	58,482	1.14
N. E. Power	Fitchburg	2,362,400	34,727	1.47	2,304,309	34,435	1.49
	Marlboro	2,500	176	7.07	4,475,817	60,094	1.34
	Turners Falls	37,195,740	260,120	0.70	440,500	4,277	0.97
	Worcester E. L.	12,135,395	130,511	1.08	5,335,520	28,587	0.54
Malden	E. Mass. El	18,953,500	318,238	1.679	5,660	134	2.37
Salem	E. Mass. El	48,000	2,429	5.06	23,490,000	284,406	1.21
Turners Falls	Springfield	17,733,200	161,890	0.91	11,832,800	89,197	0.754
Adams	No. Adams	157,864	4,792	3.04	10,200	255	2.50
Revere	E. Mass. El	3,858,100	76,675	1.99	2,100	127	6.06
Totals and averages		119,102,072	$1,287,545	1.08	71,936,796	$804,584	1.12

It is conservatively estimated that the interchange of energy among the Massachusetts stations listed in the table saved from 75,000 tons to 100,000 tons of coal during the fiscal year 1920, and there is good reason to believe that interchanging energy is saving these companies over a million dollars a year in operating costs and fixed charges.

Finland's Wealth of Water Power

AN IMPORTANT factor in the industrial development of Finland is the exploitation of its wealth of water power. The potential output of power from hydro-electric sources, chiefly from waterfalls, is estimated at 3,000,000 hp., to which the River Ulea and the rivers south of it contribute 1,200,000 hp. A considerable part of this water power is owned by the state. Among the important water-power resources entirely or partly in possession of the state are the following: Vucksen Falls, 300,000 hp.; Imatra Falls, 211,000 hp.; River Ulea, 542,000 hp.; Pyhäkoski Falls, 100,000 hp.

The output from existent hydro-electric power plants is only 170,000 hp., but the Finnish government seems determined to promote the exploitation of water power energetically. Finnish manufacturers, however, cannot supply the necessary machinery and electrical equipment, and for these foreign countries must be looked to.

Distribution Service in Rural Districts

SOME COMPANIES may not have considered this service a profitable business because of the long lines required to serve widely separated loads. However, several companies in the middle and far West have built up large and profitable loads by proper consideration of financing and service expenses.

Serving Dense Irrigation Load in California

Rapid Growth of Load Called for Revision of the Distribution System to Improve Service—Calculating Voltage Drops.

BY EDWARD N. D'OYLY
Superintendent of Electric Distribution Western States Gas & Electric Company, Stockton, Cal.

ONE of the richest and most intensively cultivated districts in San Joaquin County, California, is that surrounding Lodi, about 15 miles (24 km.) north of Stockton. The crop value from this district in 1920 was $20,000,000, which was made possible only by intensive irrigation done by electric pumping. There is an abundant supply of water to be had at a depth of from 20 ft. to 50 ft. (6 m. to 15 m.) below ground level, and almost every farmer has his individual pumping plant. Electrical energy in this district is supplied by the Western States Gas & Electric Company, which gives service to 2,214 consumers, of whom 2,000 are power consumers. A 4,600-volt distribution system is employed to feed the district, the transformer stations ranging in capacity from 1 kva. to 150 kva. Within a 6-mile (9.6-km.) radius of one substation are 1,991 transformers having a total capacity of 11,382 kva. It is believed that the number per square mile is greater than in any other rural district of equal area.

Heretofore one substation rated at 3,000 kva. at the center of the load supplied the whole district. The transmission voltage of 60,000 was stepped down in two 1,500-kva. banks of transformers to 4,600 volts, and four feeders, each equipped with a 10 per cent boost-or-buck induction regulator, carried the load. The remarkable increase in demand last summer so overloaded these feeders that immediate steps had to be taken to improve the service. A detailed study of the system was made with a view to determining the most desirable way of handling the situation.

At the outset a maximum voltage regulation of 10 per cent at the terminals of any motor was decided upon, since the frequency is maintained constant at 60 cycles and all motors are guaranteed to operate satisfactorily at normal frequency and with applied voltage 10 per cent above or below normal. Measurement of current, voltage and power factor were made at the substation and at various points along the feeders. From these data empirical relations, such as the ratio of maximum feeder current to kva. of distribution transformers, were established as a basis for calculation. Four schemes for the improvement in service were then worked up.

The first proposition involved increasing the size of the present feeders, maintaining the voltage at 4,600. This proved impracticable as it would have been necessary to string 500,000-circ.mil. cable for the 1925 load.

The second scheme contemplated connecting the low-tension side of the substation transformers in star to give a feeder voltage of 8,000. The State Railroad Commission, however, has issued an order restraining power companies from operating double-starred transformer banks on transmission lines involved in parallels with telephone or other communication circuits. To comply with the ruling it would have been necessary to purchase new transformers with tertiary windings or with primary wound for 60 kv., since all of the transformers are wound for 34,650 volts primary and are star-connected to the 60-kv. lines. Furthermore, with 8,000 volts on the feeders, it would be necessary to interrupt service when installing new transformers or extensions, whereas in this system the 4,600-volt feeders are handled when alive.

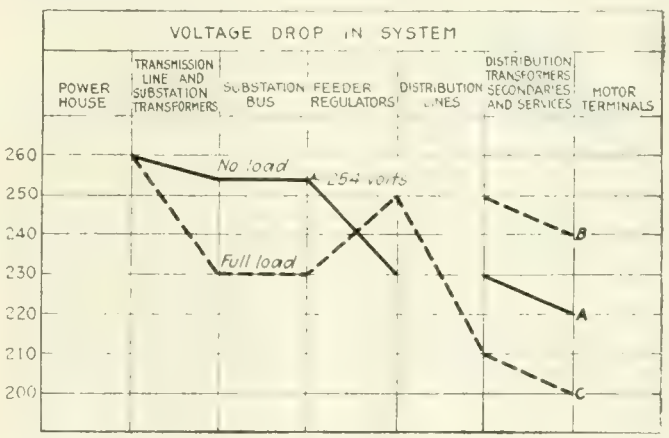


FIG. 1—VOLTAGES ON TRANSMISSION AND DISTRIBUTION SYSTEM SERVING THE LODI DISTRICT

All voltages are expressed in 220-volt terms. *A* is the voltage on all motors when the system is lightly loaded; *B* is the voltage on motors near the substations, and *C* is that on motors at the ends of feeders when the system is fully loaded.

Proposition No. 3 involved a system of 11-kv. feeders running to eight centers of distribution, where the voltage would be stepped down to 4,600 to feed the present system. Since all station transformers purchased during the last few years are designed for secondary voltages of 11,000, 4,600 or 2,300, this proposition proved more desirable than either of the first two, but was abandoned in favor of the fourth scheme, which was finally adopted.

This plan was that of building additional 60-kv. substations and extending the transmission line, where necessary, to feed them. Preliminary computations indicated that induction-feeder regulators would be necessary, and the chart shown in Fig. 1 was drawn up

to show the maximum over-all voltage regulation allowable from power house to motor terminals. At no load on the system taps are chosen on the primary of the substation transformers to give a bus voltage of 5,080. The feeder regulators lower this voltage to 4,600, which is maintained throughout the feeder. A drop of 10 volts is allowed in distribution transformers, secondaries and service, giving 220 volts at motor terminals. At full load on the system the bus voltage will drop to 4,600, and feeder regulators will raise this to 5,000 volts at the substation. The maximum permissible drop in



FIG. 2—ONE OF THREE SUBSTATIONS FOR SUPPLY OF THE GRAPE-GROWING INDUSTRY NEAR LODI, CAL.

any feeder is limited to 800 volts, giving 4,200 volts on transformers at the end of the feeder. Allowing 10 volts drop in distribution transformers, secondaries and services, motors will operate at 200 volts. Consequently those motors near the substations will operate at voltages between normal and 10 per cent above normal, while those at the ends of the feeders will operate between normal and 10 per cent below normal voltage.

It was found possible to handle the 1921 load with two additional substations, although still another two will probably be necessary within the next two years. Locations for these were chosen at such distances from the original station that no copper heavier than No. 2 B. & S. would be required on the 4,600-volt feeders.

The 60/4.6-kv. transformers are placed outdoors, and space is provided for lightning arresters to be installed later. Duplex lead-covered cables are run in underground conduits from the low-tension bushings of the transformers to the inside of the building to six disconnecting switches mounted side by side. The delta connection is made just above these disconnecting switches. This made it possible to dispense with any structure built around the transformers to carry the heavy secondary leads, and in case of transformer trouble it is necessary only to open two "disconnects" and remove one primary fuse in order completely to disconnect the defective transformer. Provision is made in each building for handling four feeders of 75-amp. capacity. Each feeder is equipped with a 10 per cent boost-or-buck regulator and protected by an oil circuit breaker with overload release. Graphic wattmeters and voltmeters are installed to give continuous records of output and operation. The transformer capacities in the three stations comprise three 1,000-kva., three 500-kva. and three 333-kva. units, making 4,500 kva.

ANALYSIS OF VOLTAGE CONDITIONS ON A TYPICAL FEEDER

Section (Refer to Fig.)	Length, (Miles)	Size Feeder, B. & S.	Rating of Distribution Transformers, Kva.	Maximum Line Current, Amp.	Drop in Section, Volts	Volts at End of Section	Volts at Motor Terminal
a	0.25	2	790.5	49.4	26	4,774	229
b	0.5	4	775.5	48.5	71	4,703	225
c	0.5	4	730.5	45.7	67	4,636	222
d	0.5	4	491	30.7	45	4,591	220
e	0.5	4	460	28.8	42	4,549	217
f	0.5	4	155	9.7	14	4,535	217
g	0.27	4	116.5	7.3	5	4,530	217
h	0.7	6	49	5.0	15	4,515	216

Measurements of line current at different points on the various feeders gave the average ratio between maximum feeder current and kva. of distribution transformers connected beyond the point of measurement as one to sixteen. In other words, if a feeder carries 1,000 kva. of transformers, the maximum current demand will be 62.5 amp. The average diversity factor on the feeders is 50 per cent. Owing to the large number of transformers and the diversity of load, the power factor does exceed 75 per cent.

According to records taken at station No. 3 on April 22, 1921, the load factor is 74.5 per cent, which is an average for the district during the irrigation season. In figuring line regulation resistance of copper is taken at 149 deg. F. (66 deg. C.) and the equivalent spacing of conductors at 3.1 ft. (0.94 m.). Line drop at a power factor of 75 per cent can be expressed with close approximation as:

$$D = \sqrt{3}(R \cos \theta + X \sin \theta)$$ per mile per ampere.

This neglects the drop due to the out-of-phase component of impedance, which is small. The product of line current multiplied by D gives the drop per mile. Each feeder was divided into half-mile sections and the drop calculated on the assumption that the total current at the beginning of any section was carried throughout.

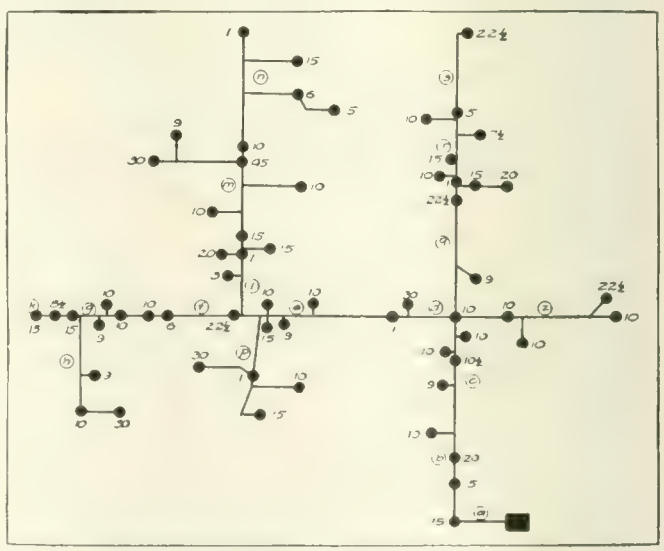


FIG. 3—TYPICAL FEEDER CIRCUIT SHOWING LOCATION AND SIZE OF TRANSFORMER BANKS

The drop at the end of any feeder must not exceed 800 volts, and wire sizes were chosen accordingly.

In order to maintain the standard of service desired, it was found necessary to increase the 60-kv. transmission-line capacity. Consequently it was decided to replace the original No. 1/0 aluminum conductor with

No. 2/0 stranded copper. In December the work of reinforcing the old poles and rebuilding the corners was started. By March 23 half of the new copper was strung, but the work had to be abandoned on that date on account of the irrigation load, which was increasing so rapidly that it could not be handled over the other line. However, since the reconstructed system is designed to carry the 1925 load no difficulty should be experienced in maintaining the desired voltage on all services during the 1921 season.

Rural Lines Owned by Farmers

Farmers Build, Own and Maintain Lines According to Minnesota Company's Specifications—Rates Include an Energy Charge and a Fixed Charge

BY C. S. KENNEDY
General Manager Otter Tail Power Company, Fergus Falls, Minn.

A LARGE demand for lines to serve farmers has developed in the territory covered by the Otter Tail Power Company, Fergus Falls, Minn. The lines are growing more popular every day, and it has become somewhat of a problem for the utility to know just how to care for the increase in this class of business. The system which this company has adopted has proved quite successful. Because of the favorable rates which can be given to the farmers they use energy for small motors and cooking ranges in addition to lighting.

The farm lines, operating at 12,000 volts or 6,600 volts, tap the company's 40,000-volt lines through transformers. The farmers build the farm lines and afterward retain possession of them. They own and maintain the lines and all equipment up to the point where the 40,000-volt line is tapped. The 40,000-volt transmission lines, about 400 miles (640 km.) in length, connect the plants of the Otter Tail Power Company to fifty-seven towns and villages in the States of Minnesota, North Dakota and South Dakota and traverse some of the richest farming communities in the three states. The plan now being followed is for a number of farmers to form a stock company and raise money enough to have a line built by a contractor which will serve all of the stockholders. The Otter Tail Power Company supplies the specifications under which the line is to be built so that all rural lines shall be uniform in construction. The rural line in most cases is built along the highway. Owing to the fact that the farmers have had to finance and build their own telephone lines, it has not been difficult to make them understand that the utility cannot make the investment and give rates for energy which would compare favorably with town rates.

Specifications for Building Rural Lines

Farm lines are either three-phase, four-wire, 12,000-volt Y, or single-phase 6,600-volt. The lines in general are constructed of three conductors and one overhead static wire. At each pole the conductors are supported on one 8-ft. (2.4-m.), three-pin cross-arm of $3\frac{3}{4}$-in. x $4\frac{3}{4}$-in. (9.5-cm. x 12-cm.) treated Washington fir. The static wire is attached directly to the pole just below the roof. Northern White Cedar poles, measuring 7 in. x 30 ft. (17.8 cm. x 9 m.), are used, being butt-treated and set 200 ft. (60 m.) apart. Pins are of steel with paraffined wood tops, and insulators are of porcelain, rated at 17,000 volts. Each conductor consists of either $\frac{1}{4}$-in. (6.3-mm.) double-galvanized steel wire strand or No. 6 seven-strand bare copper wire. The overhead static wire is a $\frac{1}{4}$-in. double-galvanized steel wire strand and is fastened to the pole by means of a 6-in. (15.2-cm.) galvanized three-bolt clamp, the middle bolt of which is replaced by a $\frac{1}{2}$-in. (1.27-cm.) machine bolt passing through the pole. This static wire is grounded at every pole by means of a No. 8 galvanized-iron wire stapled to the pole its entire length, and the wire is carried zigzag at least four times across the butt end of the pole and stapled in place before the pole is erected. For substation equipment at the supply end of the 12,000-volt line there is used a triple-pole, 15,000-volt automatic oil-break switch. Three disconnecting switches are placed so as to isolate the substation equipment when the disconnecting switches are open. Lightning arresters and choke coils are connected on each phase to protect the substation equipment. Although the contour of the country influences the cost, the average is between $1,000 and $1,300 per mile.

Transformers are rated at 6,600/110/220-volts and protected by choke coils, lightning arresters, "disconnects" and fuses, mounted on the first pole away from the main line. The case of each transformer and the neutral of the 110/220-volt secondary are grounded.

Return postal cards are sent out each month on which each consumer may indicate the position of the meter dial hands and forward the card to the office so that the bill can be made out. This method of reading has been found very satisfactory, and it is only in rare instances that a card is lost or not returned. The bills are mailed direct to the farmer who pays by check or to his bank.

In case of trouble to services the farmer telephones to the nearest office or contractor, and all expense for time and material is billed to him.

Favorable Rates for Farm Service

Rates for service include the following provisions:

(a) A fixed charge to cover transformer losses as per the following schedule, which indicates the loss charge per month with a transformer rating not exceeding the amount given in each case: 5 kva., $2.22; 7.5 kva., $3.33; 10 kva., $4.44; 15 kva., $5.55; 25 kva., $8.88.

(b) Six cents per kilowatt-hour as registered by the meter, less 10 per cent for payments by the tenth of the month following that for which billed.

In case energy is taken through the same meter for general purposes and electric cooking ranges, the fixed charge remains the same, the first 100 hours' use per month of the connected lights will be charged at 6 cents per kilowatt-hour and all energy used in excess of the above charge at 3 cents per kilowatt-hour, or at the discretion of the power company a separate meter may be installed and all energy used for cooking charged at 3 cents per kilowatt-hour.

These rates are based upon electricity generated by water power. In case of a water shortage a reasonable increase may be added for energy generated by steam. In case two or more consumers are served from the same transformer, the installed transformer capacity for each consumer shall be estimated and the fixed charge as given under (a) above shall be so apportioned when the bill is rendered.

The problem of inductive interference with telephone lines paralleling the farmer lines on the same highway is one that has to be met in nearly every instance. In many cases it is necessary to provide complete metallic circuits before they will give satisfaction.

Considerations Necessary in Circuit Layout and Street Lighting

IT IS generally recognized that the development of distribution engineering has not kept pace with station equipment. More expert analysis of load conditions and construction of lines is needed. Street lighting, too, appears to be on the verge of general rehabilitation and improvement.

Distribution Systems Need More Expert Attention

Mechanical Strength of Ordinary Wood Cross-Arms Is Inadequate for Heavily Loaded Systems Requiring Minimum Copper

By S. B. Hood
Superintendent Distribution, Northern States Power Company

IN SPITE of the fact that "a chain is no stronger than its weakest link," the distribution system in the average electric utility property receives less real study than any other part. Generating and transforming equipment has undergone most radical improvement during recent years and its installation receives very intensive study and forethought. However, when it comes to the distribution system, representing a very considerable proportion of the total system investment, its design and construction are far too often left in the hands of men who, though they may be well qualified to do the actual work, are very seldom of the type who can give proper consideration to the importance of the engineering and economic features.

Many electric light and power systems are following the lead of the telephone companies, which have been able to adopt a standardized construction specification that insures maximum service with minimum upkeep cost. In so far as it is applicable this is an excellent plan as every detail has had far more extensive study than any purely local power system could afford to give. There are, however, many very definite limitations as to the extent to which signal-line construction practice can be safely or economically applied to power-line distribution standards.

The advisability of proper preservative butt treatment as a means of lengthing the life of wood poles is beyond dispute. A properly treated pole will give at least double the life of one untreated. As the cost of treatment is comparatively small compared with the cost of the pole and the labor of setting, it follows that the depreciation item of the annual fixed charge is nearly halved.

When the life of the pole is doubled the life of everything attached to it likewise should be increased in order to maintain the economic balance. To this end all hardware must be hot-galvanized or otherwise protected against erosion. Properly protected, there is no reason why this hardware should not outlast several poles and therefore become almost a permanent asset.

Wood has proved the best material to use for cross-arms owing to its insulating qualities. However, the so-called "standard" arm and its method of installation, except on very light lines, is from the mechanical standpoint little short of an engineering farce. Given a timber with 3½-in. x 4½-in. (8.9-cm. x 11.4-cm.) cross-section and barely enough strength as a cantilever beam to support a reasonable number of conductors, the first step is to bore it full of pinholes, cutting down its area by over 40 per cent. In these holes are put wooden pins that persistently break at the very time they should not. Not infrequently one broken pin starts trouble that costs as much to put right as the cost of all the pins on the system. As a last step in this folly attempts are made to keep the arm in a horizontal position on the pole by means of a pair of flat braces, and these are expected to add to the bearing power of the arm. If a bridge designer used flat members under compression, his first bridge would land at the river bottom, and he probably in an even less desirable place. This mechanical basic principle has been violated from the day the first lines were built. Some of us have had the doubtful pleasure of seeing our cross-arms all gracefully drooping down like garden flowers after the first frost. After the sleet has melted or dropped off we serenely go out with our crews and replace them in the same way and wait to see what the next storm brings us.

Bracing Cross-Arms for Heavy Loads

On arms no longer than four-pin and carrying not more than the equivalent of four No. 1/0 conductors the old-style flat brace is probably strong enough to give ample safety factor. On trunk leads using six-pin arms and heavy feeder wires flat braces should be absolutely discarded in favor of angle or channel-section braces. With this type of brace the fulcrum of the lever is transferred from the through-bolt to a point over the brace end, the brace acting as a strut under compression. With this type of brace the safe load that can be carried is approximately four times that of the older method of bracing, and the cost of construction is increased but a few cents per pole. By using these properly designed braces there is no necessity of using arms of larger cross-section than standard, even with heavy feeders.

In the matter of pins utilities should get away from the idea of using a type of pin that passes through the arm, even though it be of the metal shank type. By having a pin that clamps around the arm we bind the wood fibers together and absolutely prevent splitting under undue conductor stress. A further advantage is that of being able to vary the pin spacing to suit the type of construction. In this way it becomes possible to use a standard cross-section and length of arm for all voltage classifications. One company that is using this

principle stocks only three arm lengths, all of same cross-section, and uses them for all voltages from 2,300 to 110,000. The pins used on this particular system are of two sizes and of the clamp type, the smaller with 1-in. (2.5-cm.) tops being used for voltages up to 6,600 and a higher $1\frac{3}{8}$-in. (3.5-cm.) top for higher voltages up to 33,000. Above this suspension insulators are used with the strings supported from arm clamps.

For voltages below 750, taking in all secondary distribution, the cross-arm can well be abandoned entirely in favor of secondary rack construction. These racks, with their heavy porcelain spools, not only furnish a cheap, strong means of support of these heavy and more numerous conductors, but make a line of far neater appearance. This question of neatness is one that too often is neglected, and to such neglect can be directly traced many cases of insistent demand for underground construction.

Example of Good Pole-Top Design

To show a comparison of what can be accomplished in building a neat-looking lead designed along correct mechanical principles the two pole-top drawings should be carefully studied. Fig. 1 shows the common practice of "how not to do it." Actual photographs have not been given of this type as one can go out almost anywhere and see such poles on a quantity production basis. Fig. 2 shows the same number of conductors and the same apparatus as in the former. Here it will be noted that arms are scientifically braced, pins are of proper design, and the transformer is placed in a position where it is easy to get at and where it places only about one-half the strain on the pole that it does on the top arm in the other construction.

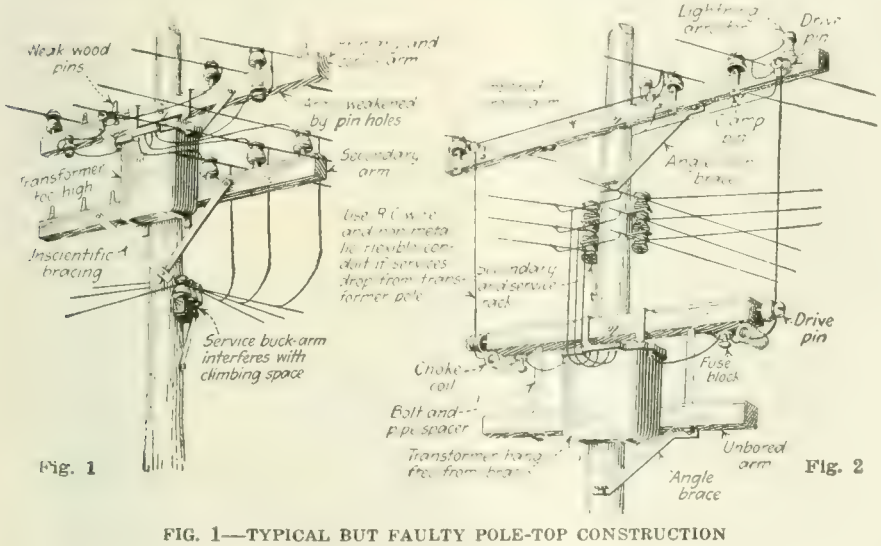


FIG. 1—TYPICAL BUT FAULTY POLE-TOP CONSTRUCTION
FIG. 2—STRONGER AND NEATER THAN IN FIG. 1

Having given these mechanical problems their due consideration, equal attention should be given that of the economical balance from the electrical standpoint. The size of transformers used, their spacing and the secondary conductor size for any given load must be such that the annual fixed charges are at a minimum. The larger the transformer the lower the cost per kva. and the corresponding core loss. As an offset to this larger conductors must be used to distribute with a limiting voltage drop. There is under any condition of load and material cost some one point where the economic balance is maintained. Just where this is must be determined by accurate load survey and careful plotting. If the line foreman is capable of doing this, hold on to him—he is one in a thousand. The other 999 can waste enough money, with all the good intentions in the world, to pay for several trained distribution engineers.

In secondary distribution the interconnection of secondaries and banking of transformers offers a simple and reliable means of reducing the investment as well as adding to the reliability of service. This method of secondary operation must, however, be attempted only after most careful study and forethought. To indiscriminate banking and interconnection most of the failures in secondary network operation can directly be traced. With careful forethought and the addition of inexpensive fusible sectionalizing devices, the secondary network becomes as reliable as the old direct-current systems on which interruptions are almost unknown.

Two-wire secondary bus lines should never be used except for small scattered loads fed by individual transformer units. A good rule to apply here is to change to three-wire whenever the load is such that two No. 6 wires will not carry it without excessive drop in lamp voltage. Do not overlook the fact that the three-wire system will carry four times the load for the same loss as the two-wire system, and that it requires only one extra wire of relatively small cross-section.

In selecting wire sizes it is uneconomical and foolish to attempt to stock every size on the table. All practicable demands can be supplied by using numbers 8, 6, 4, 2, 1/0 and 4/0. The intermediate sizes are so little different that it is splitting hairs to attempt to figure drops so closely that they must be used.

In laying out the secondary network good practice does not require the neutral to be so large as the outer wires. For mechanical reasons no wire smaller than No. 6 should be used except for service drops. For larger-size secondary outers the next smaller stock size as given above will be ample for the neutral.

If the neutral of a secondary system is not properly grounded, it may be the indirect cause of serious consequences. For real protection ground to water pipes. Driven pipe grounds are a delusion and a snare. One water-pipe ground is worth a score of driven ones. Where physically possible extend neutrals so that they can be interconnected to form a grid network over the entire distribution system. This is not a difficult matter in the average city or town where normally the various secondary bus lines come close together. If the method of wiring used in any town is that of having the service enter through conduit, which should be insisted upon in order to minimize the chances of theft of energy, this conduit must be grounded to comply with the code. If multiple grounds are applied to the neutral, it should be noted that the code now permits making grounds at each individual service provided the local inspector is broad enough to see outside the four corners of the rule book. The last code edition also permits grounding to water pipes without the necessity of running to the street side of the water meter or stop cock. Under this ruling the cost of grounding is but a few cents.

Effective Street Lighting as Exemplified by the Milwaukee Installation







Top—Ornamental lighting with 30-ft. mounting height. Two 6,000-lumen lamps per post. Posts 180 ft. apart. Intensity of illumination sixteen times full-moon light. Note detail with which street surface and objects can be seen even at a distance.

Left—Day appearance of 30-ft. ornamental post. Note the open and spacious appearance of the street.

Right—Day appearance of 22½-ft. posts.

Center—White concrete post with prismatic glass globe supported at a height of approximately 14 ft. above the street.

Bottom—Ornamental lighting with 22½-ft. mounting height. One 6,000-lumen lamp per post. Posts 180 ft. apart. Intensity of illumination nine times full-moon light. Note the excellent detail (automobiles, etc.) even at a distance of 400 ft.





Important features of the Milwaukee street lighting installation are the generous mounting height, which minimizes glare, and the use of holophane prismatic-glass inclosing globes. These result in a high intensity of illumination at the street level, and at the same time do not interfere with the normal functioning of the eye. Where serious glare exists even a high intensity of illumination is of no avail since the contraction of the pupils of the eye results in poor vision.

The Trend of Practice in Ornamental Street Lighting

The Choice Between Concrete and Metal Posts and Prismatic and Opal Globes Is Discussed—Period of Extensive Street Lighting Activity Is at Hand

BY ARTHUR J. SWEET
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DURING the war high prices of labor and material and the necessity of devoting all available capital to war needs led to the very general postponement of needed improvement in street-lighting service. In the summer and fall of 1920, however, there was a marked revival of interest in better street lighting, and many municipalities made tentative plans for providing improved service in 1921. General business conditions during the first quarter of 1921, on the other hand, had a psychological reaction on street-lighting projects; and there has been a tendency to await further development in business conditions before proceeding with actual installation. More recently the writer has noted, at least in the Middle West, a growing realization that material costs have reached substantially as low levels as can be expected for some time, and that labor costs, if not yet at anticipated levels, have at least dropped materially from their recent high levels. This realization, coupled with a real need for improved street-lighting service, bids fair to offset to a considerable degree such timidity as exists with respect to making increased public expenditures at this time. A rather considerable activity in the street-lighting field may therefore fairly be expected for 1921 and a still greater activity for 1922. This will be more especially true of ornamental street lighting, since great improvement in non-ornamental street lighting was made just previous to America's participation in the war. Non-ornamental installations are therefore not in such great need of rehabilitation and improvement as are the ornamental.

Facing, as we doubtless do, a period of more than usual activity in the ornamental-street-lighting field, it is especially appropriate that the electrical industry should carefully consider the trend of development in order that the public may be wisely advised and the social need be the more intelligently served.

At the present time it is worth while to give particular consideration to the suitability of concrete posts for this service and the question of using the more efficient prismatic glass for inclosing globes. There are still great differences of practice concerning mounting heights, spacing of units and illumination intensities. Several types of control equipment in common use require further analysis, and more complete knowledge of losses in the armor of steel-taped cables should be available when this type of construction is considered.

During the first decade of ornamental street lighting metal posts—cast iron, iron pipe with cast-iron fittings or fabricated sheet steel—were almost exclusively employed. About six years ago an organized effort was first made to develop the concrete post and place it in this field. During these six years the use of concrete ornamental standards has steadily grown, especially in Middle West territory. Experience with the concrete post has generally been highly satisfactory, though there have been a very limited number of cases, two or three at most, of unsatisfactory service. These are directly traceable to improper methods of manufacture or to rail shipment of the posts before the concrete was sufficiently seasoned. While the metal post is still obtaining the lion's share of new business, there are indications that the concrete post is going to constitute a greater portion of the business than it does now.

The once popular "cluster" type of post head has been found to involve such extravagant operation costs that it is no longer installed except in small towns out of touch with the best standards of practice. The trend of practice is strongly toward the use of a single lamp per post, though in the case of high mounting heights, as at Milwaukee and San Francisco, two or three lamps per post have been used to a limited extent. The opal globe continues a favorite, though the prismatic globe is coming into increasing use. The prismatic globe is characterized by approximately 50 per cent higher efficiency than the opal globe and by a considerably better distribution of light on the street, while popular taste generally prefers the appearance of the opal globe. Where some educational effort has been provided, teaching the public to make judgment on the basis of general lighting effect rather than on the appearance of an individual unit, the prismatic globe has fully met the test of giving complete and permanent public satisfaction.

A new type of prismatic globe, shown mounted on the post in the center view of the accompanying photographs, is being installed at St. Louis, about 3,000 of these new globes being employed.

TENDENCY TOWARD GREATER MOUNTING HEIGHTS

There is a definite but very slow movement toward the employment of greater mounting heights. In early ornamental installations the lamps were supported at a height of seldom more than 10 ft. (3 m.) above the street surface. From 1912 to 1914 it was common practice to make this height in the neighborhood of 12 ft. (3.7 m.). Typical present practice is to employ mounting heights of from 12 ft. to 14 ft. (3.7 m. to 4.3 m.), though in several of the larger cities materially greater heights, 25 ft. to 35 ft. (7.6 m. to 10.7 m.), have been extensively employed. The situation may be summarized as one in which engineering and service considerations constantly tend to bring about greater mounting heights, while commercial considerations—cost of changing patterns and difficulty of making metal posts in the greater mounting heights—and the tendency toward copying past practice exert a powerful retarding influence.

It is still a moot question whether the most satisfactory ornamental effect is produced by a considerable mounting height (say 25 ft.) or by a lesser mounting height (say 12 ft.). The building fronts and the street itself are unquestionably more attractively lighted in the case of the greater mounting height, and there is a very much less glare. It should also be noted that the use of greater mounting heights permits the correspondingly wider spacing of posts with equally satisfactory lighting results; and where there is an absence of all poles except the ornamentalal light posts, the open, spacious effect produced by this wider spacing of posts is most pleasing. On the other hand, the ornamental or spectacular effect of the lighting unit itself is much less marked in the cast of greater mounting heights.

Spacing.—While there are wide variations in the matter of spacing as between different installations, an average value for opal-globe installations is approximately seven times the mounting height, at which spacing the uniformity (ratio of maximum illumination to minimum) is approximately ten to one. Prismatic globe

ornamental installations have generally been planned with more careful regard to the matter of uniformity, a spacing of eight times the mounting height and a uniformity of four to one being typical of such practice.

Illumination Intensities for Cities of Different Size

Illumination intensities vary widely as between different installations, though limits of from five times full-moon light to twenty-five times full-moon light would include most practice in main-business-street lighting. It is the writer's opinion that an intensity of twenty times full-moon light (approximately 0.5 foot-candles) is approximately correct for the main business district in cities exceeding 100,000 population, ten to twelve times full-moon light for cities of 20,000 to 100,000, and four to eight times full-moon light for cities of less than 20,000.

Arrangement of Light Units.—While a staggered arrangement of light units will produce lighting results equally good at materially lower costs, the more pleasing appearance of placing the units in pairs opposite each other has led to the more general adoption of this arrangement. On main business streets the improved appearance doubtless justifies the increased cost, but it is doubtful if this holds true for any but the chief traffic and promenade streets.

There is still a considerable tendency toward locating ornamental posts at street corners. More and more, however, it is being realized that the ornamental unit at the corner itself generally constitutes an undesirable obstruction to traffic, and that equally satisfactory lighting and esthetic effects can be obtained by keeping all units back of the property lines of the intersecting street.

Underground Circuit Construction.—Eight years ago the proposition of laying steel-taped cable in city streets without duct protection was regarded as a radical one. Experience during the intervening period has emphatically demonstrated that the steel tape, if properly protected from deterioration by electrolysis or chemical action, affords ample mechanical protection to the cable. In the light of this experience there is an increasing tendency toward the use of steel-taped cable. Leading engineers in the street-lighting field are, however, beginning to look askance on the use of steel-taped cable from quite another standpoint—that of induction losses in the steel tape layer. Experience indicates that these induction losses are in some cases serious enough to represent a cost greater than the fixed charges on the increase in installation cost involved in a well-laid fiber-duct installation. Present practice is tending toward an increased use of steel-taped cable. It is the opinion of the writer that a fuller knowledge of the induction loss may reverse this tendency.

Three types of current control are at present in general use, as follows:

(a) Moving-coil, constant-current regulator with film cut-out at socket.

(b) Moving-coil, constant-current regulator with two-coil transformer or with compensator at base of post.

(c) Multiple-tap, constant-potential transformer with reactance transformer at base of post.

While the trend of practice is not sufficiently marked to permit of drawing conclusions based thereon, it is the belief of the writer that practice will more and more tend toward the use of the moving-coil, constant-current regulator with film cut-out socket. This system is characterized by excellent regulation, low installation costs and, most important of all, unequaled reliability and simplicity. Its chief disadvantage is that high voltage is carried to the lamp terminals, but the possible danger therein involved can be essentially removed by proper design of post and post head. Where a few lamps of higher amperage are burned on a circuit chiefly operating 6.6-amp. lamps, the above system can still be advantageously employed, using compensators with the higher current lamps. Where, however, the circuit chiefly operates lamps of higher amperage, the use of multiple-tap, constant-potential transformer with reactance transformer at each lamp has much to commend it.

Tracing the Unaccounted For Losses in Distribution Systems

In Twenty Small Systems in Kentucky Elimination of Stray Losses Produced a Saving of Energy Worth $20,000 in One Year

By G. T. Bogard

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THE unaccounted-for kilowatt-hours, or losses, on small and medium-size distribution systems in many cases are likely to receive less attention than is accorded to them on the larger systems. Often the energy delivered to the system is not metered, and sometimes the energy sold is not metered, as in the case of municipal street lighting, sign and display lighting, and power and light for other departments of the utility company. The small system as a rule has a higher generating cost, and the loss in money, therefore, will be proportionately higher than in large systems and certainly should not be neglected.

One company, operating a number of small and medium-size plants supplying service to a number of towns having populations varying from 300 to 10,000, recently found it necessary to effect substantial savings on account of high fuel and labor costs. In addition to the necessity of making income meet expense, it was found that station equipment was in many cases becoming overloaded, with poor prospect of securing any additional equipment to take care of the increasing demands. After making a preliminary investigation of the situation it was decided that the most economical way to solve the problem would be to utilize some of the energy lost in the delivery system.

Substantial Savings Effected by Hunting Down Losses

Twenty systems were selected, and the figures given in the table were made up for 1919, as a basis for effecting the saving for 1920. The net results of the undertaking may be summed up as follows: In 1920 55,872,098 kw.-hr. was distributed with a loss of 8,386,323 kw.-hr., or 15 per cent. In 1919 44,989,276 kw.-hr. was distributed with a loss of 8,093,996 kw.-hr., or 18 per cent. Comparing 1920 with 1919, the difference in percentage loss of 15 and 18 gives a 3 per cent reduction on the total energy distributed, which is 1,676,163 kw.-hr. Assuming the cost to be $0.0125 per kilowatt-hour, the same as 1919, makes the saving due to reduction in losses $20,952.

Referring to the table, it will be seen that there is a large variation in production cost and in percentage loss. In general where the greatest losses occur the cost of

energy is highest. Systems No. 2 and No. 6 show a high loss and a production cost more than five times that of No. 11 and No. 20. The effected saving in kilowatt-hours on either of the first would be worth more in money than five times the number of kilowatt-hours on the others.

In making comparisons conditions had to be taken into consideration, for in some instances all energy was measured at transformed voltages and in small quantities and in other cases large amounts were measured at

LOSSES IN TWENTY DISTRIBUTION SYSTEMS IN KENTUCKY IN 1919

Town No.	Station Production Cost (Total)	Cost Per Kw-hr. (Cents)	Energy Distributed (Kw.-hr.)	Energy Accounted For (Kw.-hr.)	Loss (Kw.-hr.)	Loss	Per Cent Loss
1	$16,617.40	2.4	703,941	538,110	165,831	$3,979.00	23
2	17,292.69	4.0	424,796	290,971	133,925	5,357.00	31
3	14,771.83	3.0	465,440	371,881	93,559	2,806.00	20
4	13,368.25	1.3	1,011,501	862,949	148,552	1,931.00	14.5
5	28,856.08	2.8	1,001,945	819,420	182,525	5,710.70	18
6	16,723.46	4.6	354,705	273,119	81,586	3,571.00	23
7	27,165.13	1.7	1,586,016	1,328,267	257,749	3,381.00	16
8	14,645.15	1.2	1,278,872	1,070,431	208,441	2,501.00	16
9	10,938.17	1.4	789,250	674,556	114,694	1,605.00	14.5
10	17,846.12	3.5	501,317	380,335	120,982	4,234.00	24
11	35,555.98	.8	4,818,893	3,826,726	992,167	7,937.00	20
12	14,854.41	1.5	971,181	768,193	2,029,888	4,044.00	21
13	69,518.71	1.17	5,940,619	4,767,534	1,176,085	13,760.00	20
14	14,531.31	2.8	513,000	411,864	101,136	2,831.00	20
15	12,685.78	3.9	327,186	250,576	76,610	2,987.00	23
16	8,437.76	3.5	241,922	186,072	55,850	1,954.00	23
17	20,284.58	3.3	609,430	515,492	93,938	3,100.00	15.5
18	10,930.66	3.3	300,347	248,040	52,307	1,726.00	17.5
19	20,152.07	2.6	761,915	660,854	101,061	3,627.00	13.4
20	147,583.31	.65	22,387,000	18,652,990	3,734,010	24,271.00	16.8
Total	$532,759.01		44,989,276	36,895,280	8,093,996	$101,492.00	18

generated voltage. As an example system No. 17 measured and sold more than 50 per cent of the total at generated voltage on switchboard, and the losses in this case accordingly should be 31 per cent instead of 15 per cent. Additional figures were prepared showing the losses and overload in detail on each circuit in each system. By the aid of these figures more effective work could be done.

The total loss of $101,492, representing an average of 18 per cent, indicated need of immediate action. These figures and others were given each district manager with a request that a survey be made for determining the saving that could be made with reasonable expense.

Chief Sources of Losses

All of these plants were built, owned and operated independently until purchased by the present syndicate from four to eight years ago. Consequently no standard method of construction could be expected. In making the survey in many cases the lines were found to be overloaded, secondaries in particular, and transformers improperly located as to load center and capacity. In some cases the cost of relocating transformers was covered by the value of transformers removed and used elsewhere. A number of old dry-type 1,100-volt transformers were being used, two in series, on 2,200-volt circuits. These had a very high core loss. One side of the secondary of all transformers has been permanently grounded, and in some cases a high resistance ground has been found on opposite side of secondary circuit. Where the ground was on the consumer's premises, and unless the current coil of meter was connected in a non-grounded side of circuit, the loss would not be registered by the meter. Many meters were found to be slow, a few fast, and a considerable number improperly connected.

After making a survey of the situation and analyzing the results, work was started to bring about a reduction in losses. In order to keep the men posted as to the result obtained, monthly reports were made up showing the losses on all circuits, and the position of each was shown in the order of percentage loss. In a very short time the losses were on a decline, and at the end of the year 1920 the reports showed that a marked saving was made.

One distribution system, supplying a town of 5,000 population, received special attention with a view of determining how near the actual losses could be brought to the calculated losses. By calculated losses it is meant that core losses of transformers were measured, the size and length of copper wire in loaded circuits were measured and losses calculated, and also losses in meters and copper losses in transformers were estimated. After the distribution system was put in good condition and all meters calibrated the actual loss over a four-month period checked within 5 per cent of the calculated loss.

Minimizing Capital Investment in Line Construction

By Simplifying Overhead Construction Profitable Load Was Developed in Sparsely Settled Cape Cod District—Joint Poles with Telephone Company

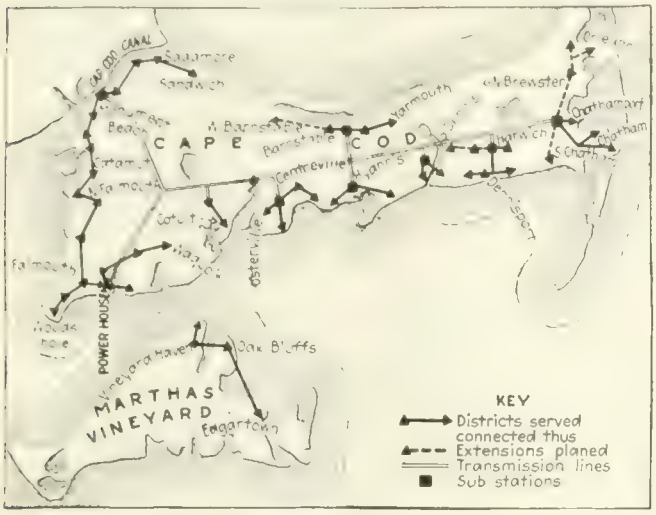
By Eugene Carpenter
Treasurer Cape & Vineyard Electric Company, Falmouth, Mass.

IN PROVIDING facilities to give electric service profitably and economically in the sparsely settled Cape Cod district of Massachusetts some methods have been employed which may be of service elsewhere. The development on the cape began at Falmouth and has steadily extended until today about 65 miles (105 km.) of transmission line are in operation and more than 5,000 customers are served. From the first it was recognized that owing to the large area which must be covered and the low density of population in that area methods which were generally in use would not be suitable if the project were to succeed. At first 6,600-volt lines were used, the typical circuit consisting of three No. 6 bare copper conductors with 7,000-volt insulators mounted on wooden poles. The cost was in some cases only $900 per mile. The territory was favorably located with regard to tidewater, pole deliveries as a rule being made from Long Island from points not easily accessible to railroads but convenient for transportation by small sailing vessels.

At the outset it was seen that pole distances would have to be stretched to the safe limit, or else the investment costs would make it impossible to develop a large part of the territory. Considerable data were available from the experience of local telephone and telegraph interests extending over a score of years, and it was well known which direction of the wind gave the most destructive results. Thus, a northeast or a southwest wind was always very destructive to a line crossed by the air currents at approximately a right angle, whereas a line of inferior construction was seldom injured by a wind blowing parallel to the line direction. This led to the use of spans of varying length, owing to the relation of the local section of line to wind prevalence and force.

At first the telephone organization in the territory preferred to make no joint distribution pole-line contracts with the central-station organization, which was weak and struggling; but by persistent application to

this problem a contract was finally agreed upon which has been mutually beneficial. Line construction plans were carefully made and revised again and again before being put into operation. The idea back of the whole enterprise was that investment costs must be reduced to their lowest terms in order to insure even a moderate success. The lines were calculated with great care, and data which had been worked out by the Roeblings in



SPARSELY SETTLED CAPE COD DISTRICT SUCCESSFULLY SERVED BY THE CAPE & VINEYARD ELECTRIC COMPANY

suspension-bridge construction were available and were used in determining the distances apart for poles. Semi-hard-drawn copper was used in quantity, as this had the same conductivity as commercial wire and a tensile strength of about 50,000 lb. per square inch (3,500 kg. per sq.cm.). On lines of small carrying capacity iron wire was used, generally galvanized No. 6, E. B. B. Combined with the use of the tungsten lamp it is surprising how small an investment is required to secure a fairly good amount of lighting business.

Spans were initiated at about 200 ft. (60 m.), then these were extended to 250 ft. and even to 375 ft. (75 m. to 115 m.). In operation lines of this type have given no trouble, and in some cases 500-ft. (150-m.) spans have been employed. These last, however, have been used only with No. 4 galvanized-steel wire or larger. Considerable care must be taken in the use of such long spans, and today spans would not be built, as a rule, in excess of 250 ft.

It is evident that with these long spans greater separation must be made between the wires than is usually done, and the engineering rules which have been thought so necessary in regard to inductance and capacity, and which in lines of large current capacity are important, have been found relatively unimportant in operating these short lines.

Today the load requirements call for the use of a four-wire Y-connected transmission, with a voltage of about 22,000 between phase wires and a neutral carried at the pole top about 24 in. (60 cm.) above the other three conductors. The neutral is grounded, and the potential between any conductor and ground is about 13,200 volts. Using three No. 6 copper and a $\frac{3}{8}$-in. (9.5-mm.) Siemens-Martin steel neutral ground wire, the present high-voltage line cost, including a right-of-way, is about $1,480 per mile. Only slight additions have been made to these lines since the period of increased material cost began, with the exception of that required during the war. Probably these cost figures could not be duplicated at present, but fortunately the company has its transmission system virtually complete except for minor extensions.

The rights-of-way permit of ample tree trimming. The largest step-down transformer is rated at 200 kw. and the smallest at 5 kw. Aluminum-cell lightning arresters have been installed at points near which a troubleman is located, so that charging can be handled satisfactorily, and at more remote points oxide-film arresters are used with good satisfaction. No large motor load is available in this territory, although at Sandwich a refrigerating plant is in service with a total installation of 112 hp.; 35 hp. is installed in a brickyard at Barnstable, and at Chathamport there is a 45-kw. synchronous motor-generator for charging batteries in the high-powered receiving station of the Radio Corporation of America. An engine-driven steam plant is located at Falmouth, but at present energy is purchased from a system interconnected with the large steam station of the New Bedford Gas & Edison Light Company. It is planned later to install mixed-pressure turbines in the Falmouth station. The minimum load of the Cape Cod system is now 36 per cent of the maximum.

The small energy requirements of the tungsten lamp have been a vital factor in the development of the system, coupled with rates specially designed to overcome as far as possible the handicap of being obliged to serve the peak business of the year in the four summer months. For every dollar of sales in the smallest months the company takes in $19.20 in the largest month.

Of vital importance has been the planning of transformer locations and cutting out those not in use, to keep line losses at a minimum. This company feels that the abandonment of the 600-watt size and the proposed doing away with the 1-kw. size by manufacturers is a great hardship to companies serving territories like the Cape Cod district. A 750-watt, 2,300-volt primary transformer is needed, and it is hoped that companies situated like this one will protest vehemently to the end that such a unit may be obtainable.



SIMPLE SUBSTATION AND LINE CONSTRUCTION FOR SERVING SCATTERED LOAD

Meter Reading and Collections

IN THE smaller communities where the number of customers is not large it takes an uncommon amount of tact to keep the customer happy when paying his bill and still not have an expensive accounting system.

Direct Billing by Meter Readers Cuts Cost

Reduction in Time Between Reading of Meters and Payment of Bills Effects a Saving of 4½ Cents per Month per Consumer

BY J. R. KAISERMAN
Manager Livingston Branch Montana Power Company

NEARLY three years' experience by the Livingston branch of the Montana Power Company with direct billing of consumers by meter readers has demonstrated that the method employed has many advantages and shows a considerable saving over the one formerly used.

Under the old method of billing the meters were read by the meter reader and the readings entered and figured in the consumers' ledger. From this the bills were prepared, put in envelopes, stamped and mailed. Unless a window envelope was used it was further necessary to address the envelope. Several days after the meters had been read the bills were delivered by the postman, who covered virtually the same ground as had the meter reader. As the entire procedure was wasteful an effort was made to eliminate all unnecessary duplication.

The first thing was to eliminate the meter readers' record book. It was found that the addressing-machine plate could easily supply the necessary information such as the company's serial number for the meter to be read. This number is either on an aluminum tag attached to the meter, under one of the binding nuts on the face, or is placed on the meter by a rubber stamp which imprints the number on the dial plate. Following this number a letter, or combination of letters, is the key denoting the meter location, and following this is a numeral signifying the classification of the consumer. This latter classification number denotes the kind of service which the meter records. The meter readers' routes are laid out to make the walks as short as possible, so that no unnecessary overlapping is done, and the consumers' accounts are arranged to coincide with the route taken by the meter readers.

In the plan now in use the bills for a certain route are run through the addressing machine in the same order as found in the ledgers, and necessary information is written on the bill, such as the previous reading and date, the meter constant and readiness-to-serve charge (if any), the balances due, and, in the event of power users, the fixed charge and the corresponding rate.

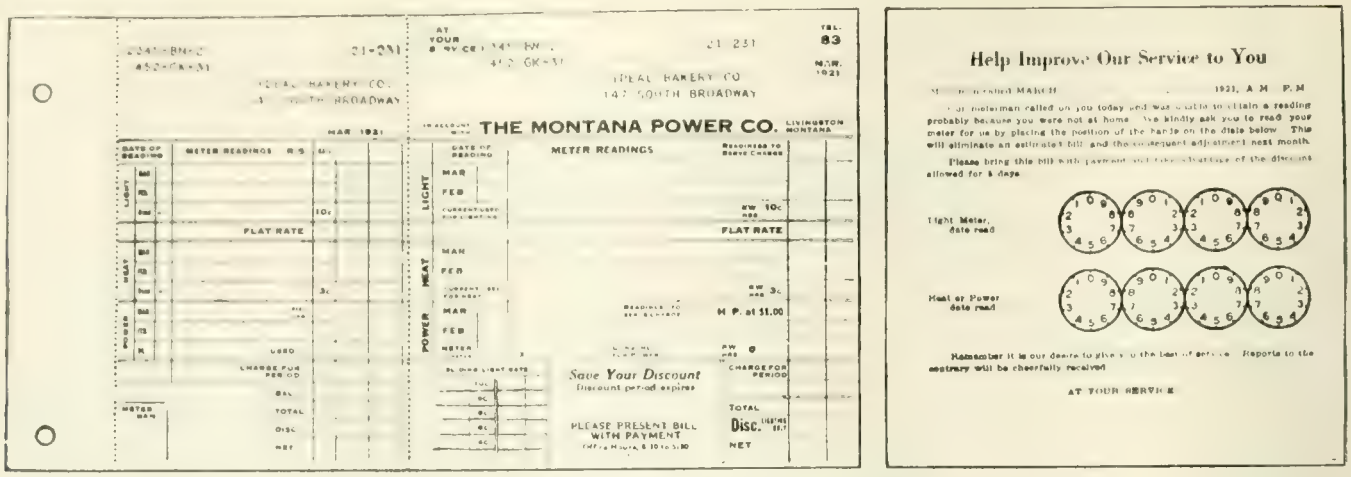
The meter reader (better called the outside office man) is now ready to start on his route to read meters, compute the bill and leave it with the consumers. The bill is thus rendered several days sooner than by the old method. No attempt is made by this man to collect the amount of the bill as we wish to have our consumers come to the office, where appliances are on display.

The stubs, bearing copies of the bills left with the consumers, are then returned to the office and placed in a file near the cashier's window. When the consumer produces his bill to make payment the route and serial number are noted by the cashier and the corresponding stub is quickly located. Before closing the day's business the cash receipts are listed by the route and serial number to check against the cash, and the following day these stubs have their new data posted on the consumers' ledgers. In one operation the new reading, the date of reading, the kilowatt-hour consumption, the amount of the bill and the amount paid, as well as the discount allowed, are all posted. We find that approximately 90 per cent of the bills are paid within the five-day discount period allowed. The bills unpaid within that period are posted from the stubs left in the cashier's file.

KEY TO COMMERCIAL CLASSIFICATION
Complete classification of consumers simplifies form of billing

No.	Lighting	No.	Heating	No.	Power
1	Residences	5	Electric ranges	30	Commercial power, flat rate
2	Stores	6	Other heating	31	Bakeries
3	Hotels and rooming houses			32	Brick plants
4	Offices			33	Breweries and malt works
7	Industrial establishments			34	Butcher and packing plants
8	Miscellaneous			35	Cement works and rock crushers
9	Restaurants			36	Creameries and refrigerators
10	Amusement parks			37	Grain elevators
11	Bowling and pool rooms			38	Freight and passenger elevators
12	Churches			39	Foundries and blacksmiths
13	Depots			40	Garages
14	Hospitals			41	Laundries and cleaning establishments
15	Laundries			42	Marble works
16	Livery stables and garages			43	Mines
17	Lodge halls and clubs			44	Mine mills
18	Saloons			45	Flour mills
19	Schools			46	Print shops
20	Signs (metered)			47	Pumping (irrigation)
21	Theaters			48	Railroad shops
22				49	Schools
23				50	Smelters
24	Commercial arc lighting			51	Theaters
25	Commercial, including flat rate and signs			52	Woodworking
26	Municipal arcs, alternating current			53	Industrial establishments
27	Municipal arcs, direct current			54	
28	Municipal street lighting			55	Miscellaneous
29	Municipal building lighting			56	Municipal power

The advantages shown after more than two years' operation of this method are these: The meter-record books are eliminated; the time necessary for transcribing the readings to the ledgers is saved; there are no bills to prepare from the ledgers and no placing of bills in envelopes, stamping and mailing; bills are in the hands of the consumers three to five days earlier than before, and accounts are collected much sooner. An advantage noted by the cashier is that it is no longer necessary to run through the ledgers to see what



LEFT—FORM OF BILL USED BY METER READERS. RIGHT—REVERSE SIDE OF BILL

The number "2345" stenciled in the upper left corner of this bill is the meter number, the letters "B X" indicate the meter location as being in a cabinet on the second floor; the figure "2" indicates service to a store; the figures "21-231" are the route and serial number. The reverse side of bill is to be filled out by consumers when access to meters is impossible.

accounts are unpaid. As long as any stubs remain in the file he knows that they represent unpaid accounts, and delinquents are easily followed up.

Another advantage is that where the meterman has no record of previous readings for several months back to indicate the usual monthly consumption of energy, he becomes more efficient in reading meters as he does not have anything to serve as a guide and has no opportunity to "guess" the reading. We now find it extremely seldom that an error is made in readings as the meter readers have been trained to become more accurate and self-reliant.

No effort is made to read meters as "follow-ups" in the residences except where there are special reasons for doing so. Many consumers to whose premises the meter readers have not been able to gain access when on their routes bring in their own readings, feeling that we have mutual confidence and that they have thus forestalled the rendering of an estimated bill. Our appreciation of their interest is always extended to them for this service.

The system outlined is applied to all consumers except in the case of a small number of very large customers, for whom a special form of bill is used. As nearly as the saving in expense over the former method can be computed, the amount is placed at approximately 4½ cents per consumer per month. No complaints on the part of the consumers have been made, and certainly the plan has minimized the work of the office force.

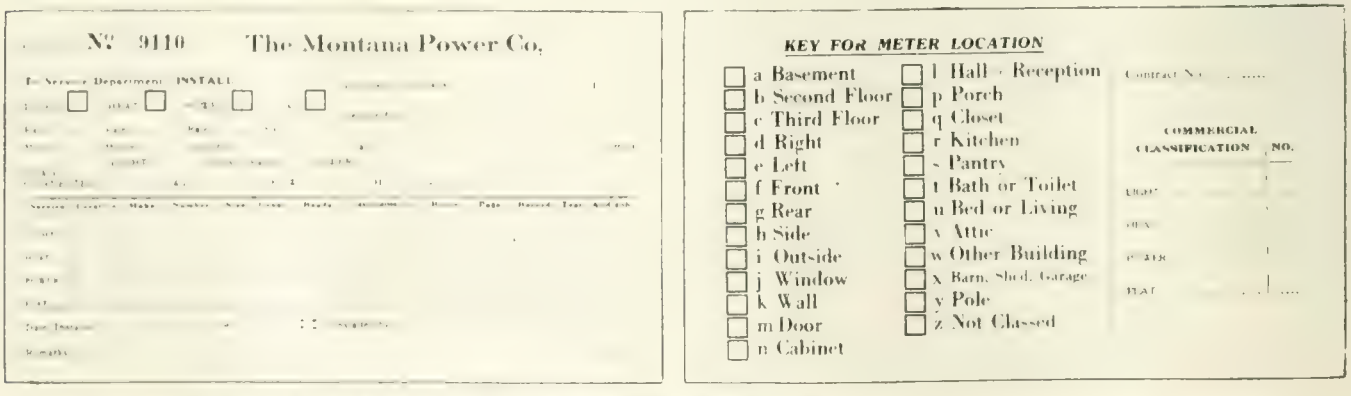
Meter Readers Can Create or Destroy Good Will

Bonus System Is Frequently the Cause of Trouble—A Method that Reduced Adjustment and Special Tests Expense and Established Good Will

BY R. S. SEESE

General Manager Smith County Electric Company, Carthage, Tenn.

THE profitable and continued operation of most public utility companies is largely if not altogether dependent upon securing and holding the confidence of the taxpayers. Since most of the taxpayers are also customers the contact which the company has with its consumers is of utmost importance. In possibly 90 per cent of the cases the contact is established and maintained through the meter readers; still, companies which have recognized the importance of friendly relations between themselves and the public have overlooked this all-important fact. This is not said to discount the value of selling company securities to customers, maintaining complaint-adjustment departments, distributing educational propaganda or providing convenient and attractive offices where consumers may pay their bills. However, many remittances are made by mail, many consumers never see the company officials, some seldom read company literature, and many do not care to purchase securities. Nevertheless, such con-



FRONT AND REVERSE SIDES OF INSTALLATION ORDER FORM WHICH FURNISHES A COMPLETE RECORD OF ACCOUNT

sumers must be established as friends, and the prevention of one error in meter reading or billing would be worth fifty corrections in bringing about this relation. Quite naturally the average consumer is prone to form his opinion of the entire company by the actions of its representatives who call at his home, namely, the meter readers. Therefore why is it not a good investment to raise the standard of this class of labor?

Friction with consumers can be traced largely to the practices of guessing at the meter reading, unauthorized entrance to premises, deliberate underreading to pacify the consumer at the time, a disposition to argue or resent, and lastly, ignorance of the company's policies and methods, together with inability or lack of inclination to explain any apparent discrepancy or extraordinary features of the consumer's bill. The consumer is ordinarily referred to the complaint department for answers to his questions, and the name itself suggests argument and ill will. Such irritation could be avoided in two minutes, usually, if the meter reader were equipped with moderate mental ability and proper instruction. Besides, he would be able to establish a feeling of confidence and good will on the part of the consumer.

CAUSES OF TROUBLE

Responsibility for troubles with consumers can be attributed largely to the bonus system with its penalties for errors and omissions in meter reading. In one recent case an Eastern company was fined $500 by the courts because its "bonus" reader frightened a woman by unauthorized entrance to avoid missing a meter reading. In another case an Illinois meter reader was seriously injured in a fight because he entered a bathroom to read the meter without observing proper formalities. In these cases the meters were read by boys who earned anywhere from $2 to $3, depending on the number of meters read per day. This amount would scarcely attract men capable of properly representing a large utility company or of maintaining a courteous bearing to its consumers.

Trouble such as that alluded to is avoided by one Middle West company, which has 40,000 consumers, by paying meter readers enough to attract intelligent young men who will take an interest in their work and be uniformly courteous. Instead of placing a bonus on the number of meters read per day the territory is divided into districts, the time required to cover the territory is estimated, and the meter reader is expected to stick to the time allowed within reasonable limits. The readers are thoroughly instructed in how to meet and talk with consumers and are provided with blank forms on which any complaints which cannot be adjusted by the reader are written, signed by the consumer and forwarded to the adjustment bureau.

After two years' experience with this system, which increased the meter-reading expense about 40 per cent, the personnel of the adjustment bureau was decreased one-half, requests for special meter tests were virtually eliminated, and the general attitude of the public and the press was so modified that an application for increased rates in 1919 was granted by the State commission with almost no protest. The net increase to the company in cost of operation on account of this system amounts to only one-fourth of the normal advertising expense, and the value in friendship of the public is incalculable.

A smaller company in a Southern state provides triplicate forms for its readers, arranged according to route, on which the previous meter reading and any arrears are printed. The meter reader makes out the current bill on the ground and collects the total. This eliminates considerable office detail and makes collections simpler, but of course requires a higher grade of labor, and it is applicable only to smaller towns and to widely scattered communities and rural service.

On the average meter reading will probably cost 0.75 cent per meter read, although the expense may vary from 0.5 cent to 2 cents, depending on the density of service and the character of the district.

Mail Collection of Consumers' Bills in Scattered Territory

How a Company Educated Its Customers to Pay Their Bills by Check—Minimum of Trouble and Expense —Method Used for Three Years Without Loss

BY B. W. LITTLE
Manager Liberty Light & Power Company, Liberty, S. C.

WHERE the customers of a light and power company are in small towns and scattered rural communities collection of bills can be made at a minimum expense and trouble by utilizing the mail. Several plans were tried out by the Liberty (S. C.) Light & Power Company, which has distribution systems in three near-by towns and intervening rural territory. A local merchant was appointed in each town to act as cashier for the company, but this method was discarded because there were too many cashiers, and when an error occurred it was next to impossible to trace it. Local collectors were also tried, but they got only the convenient customers' checks or payments and left a good portion of the bills uncollected, so that some one from the main office had to go out and follow them up.

The first remedy applied was to arrange for a bank or a local representative to have all bills on file and then mail out cards to each customer giving the amount of his bill and informing him of the local representative's name. Forms for this purpose were printed on private mailing cards. This scheme worked better, but did not eliminate errors. In several instances it was found that unauthorized parties had received the money or checks, and they were often misplaced. This brought considerable trouble and resulted in the loss of several payments because there was no way to trace the misplacements.

METHOD ADOPTED

Another method of collecting local bills by mail—the one now used—then received a thorough trial in one town, and after some changes it was adopted for the entire territory served by the company.

This method involves the use of a combination form, containing the regular consumer's bill on one side and on the reverse side a blank check for the customer's use as illustrated. A distinctive color of stationary is used for each company, town or station in order to avoid confusion. The account number appears on the bill, the check and the return envelope. The check on the reverse of the bill is filled out for the amount of the bill and dated, and the return envelope inclosed is stamped.

A post office box is rented at each town so that only the minimum postage is required in case there is a one-cent drop letter rate. In case of delivery by carriers

two-cent postage must be used. On regular visits the mail is taken to the main office from the local boxes, and all clerical work is done there. By thus renting a post office box at each local station at a cost averaging $2 per year and mailing the bills in a bundle in the local offices we eliminate all unnecessary handling. The only additional expense as compared with the usual methods of mailing bills is the cost of the manila return envelope and the postage.

The mailing scheme was submitted to the banks and had their approval, the only change suggested being that the forms should correspond with the standard-size bank check. The general form of the bill was designed with this in view. The next step was to send out a form letter a few days previous to mailing the first bills advising customers that no collector would call and describing the method that would be employed. This letter was made as brief and plain as possible, and the bills followed while the matter was fresh in their memory. The plan was received with favor by the business men, who were not bothered by collectors or by having to go to some designated place to settle their bills.

Of course, in a few instances where the idea was not understood we had to make personal visits to make it clear so that all customers would become accustomed to mailing their remittances. Many persons not acquainted with the advantages of paying bills by check were made to see the protection it afforded and were induced to make small deposits for this specific purpose.

When a check is not received at the time it is due, a duplicate bill is sent calling attention to the oversight. This second bill does not carry with it a stamped envelope, but does carry an envelope to which the customer must add postage.

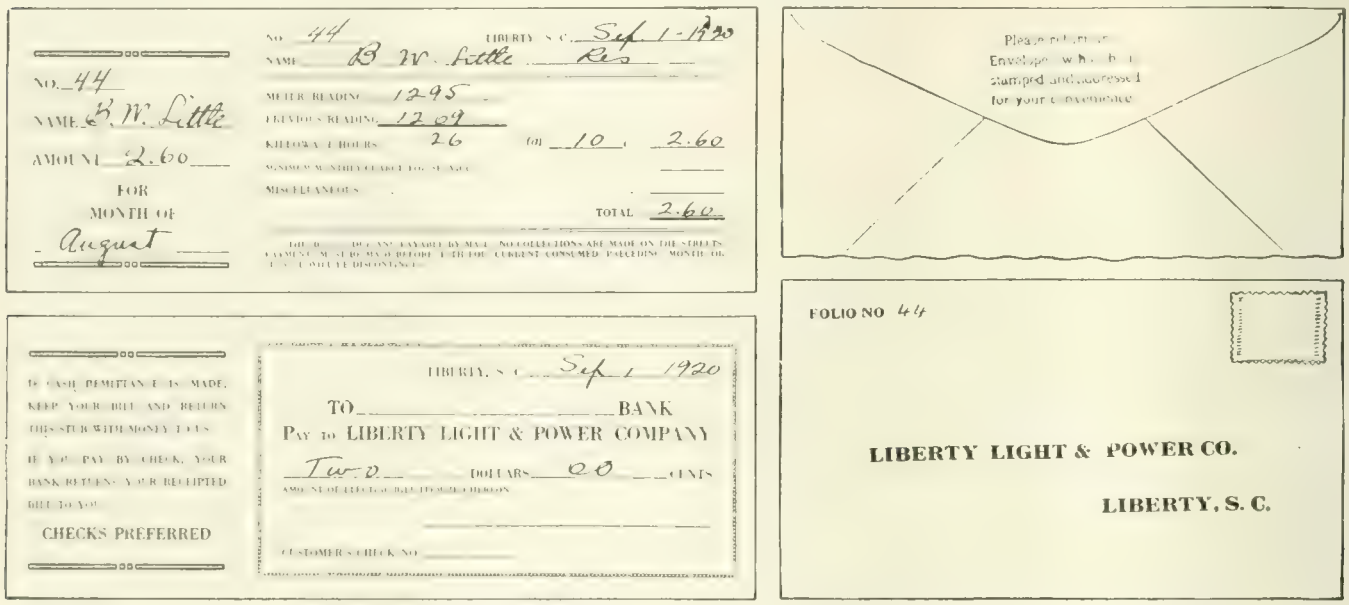
The method has the indorsement of all the banks since it encourages the making of small deposits to care for the bills and educates patrons to the advantage of paying bills by bank checks. Of course, there is a percentage of customers who will not use the check system. However, the heavy brown envelope is a stout holder for currency and small change for those who are willing to take the risk. The customer is identified by the number on the envelope even if no other means of identification is inclosed.

During the three years this system has been in use there has not been a single instance in which a cash remittance was not received just as it was mailed, and it is hard to believe that any other method of collecting scattered accounts can show such a record.

Indianapolis Banker Tells of Value of Customer Ownership

"A STRIKING phase of public utility development of the last few years," said George C. Forrey of the Fletcher American National Bank, Indianapolis, recently, "lies in bringing the public and the utilities closer together through what is known as the customer-ownership movement. A large number of progressive companies have invited their customers to become profit-sharing partners in the business, offering as a rule their preferred stocks for cash investment or on a partial-payment basis. The response of the public has been surprising. Customer-ownership is proving to be of the greatest value in improving the public relations status of the service organizations. It means popular ownership with retention of the virtues of private operation and responsibility. No more satisfactory result than this can obtain under any other condition that would give proper service.

"The public attitude toward utilities is very different from that of 1914. The public has come to realize the inseparable importance to the individual and communal welfare of electric light and power and electric railway transportation. Moderate increases in service rates have been contrasted with doubled and tripled prices for other necessities. Disappointing results from government railroad operation have been compared with continued efficiency by the privately owned utilities. The result has been a much fairer public sentiment and a strengthening of the hands of state and municipal bodies in granting equitable rates to the companies."



LEFT—COMBINATION CONSUMER'S BILL WITH BLANK CHECK ON REVERSE SIDE. RIGHT—RETURN ENVELOPE

The bill is made out on this form, the account number appearing on both the bill and the stub. On the reverse side the blank check is filled out for the amount of the bill.

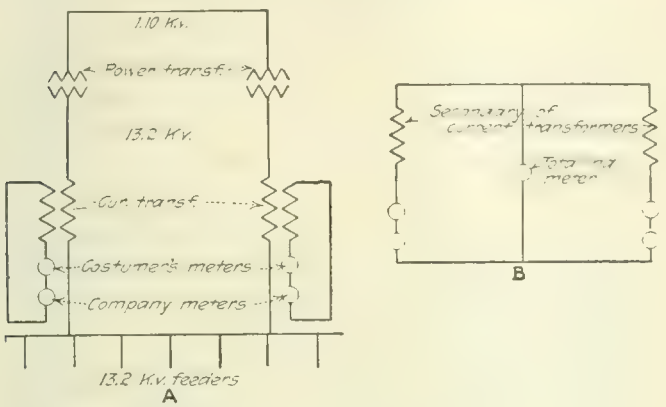
This envelope also carries the customer's account number and is inclosed stamped with the bill for customer's use in making remittance.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

One Meter Measures Total Power on Two Buses

A TOTALIZING watt-hour meter which is thought to be as simple as possible and which at the same time gives commercially accurate results with a minimum of expense has been placed in service by the Alabama Power Company. Almost every one is familiar with the problem of measuring the total station output where several polyphase generators feed into a system of buses which in turn supply various feeders. The problem has sometimes been solved by the use of a totalizing meter with several elements operating on one



ONE METER (AT B) USED TO MEASURE TOTAL KILOWATT-HOURS ON TWO 13,000-VOLT BUSES

shaft, each set of elements being energized by the current and voltage from one particular generator. But this is expensive, not only in first cost but in maintenance.

On this system a large customer is fed through two banks of 110,000/13,200-volt transformers into two buses which are normally tied together and only operated separately for a few moments at a time during periods of interruptions. There were formerly two meters on the 13,200-volt side, one for each bank of transformers. As the customer concerned was a large one, a duplicate set of meters was operated from the same current and potential transformers to check the recording of the first set.

A simpler scheme of measurement was sought. The 110,000-volt lines are tied together at a station 13 miles distant from the customers' substation, hence the load is not equally divided between the two banks. However, as the low-tension voltage of the two banks is bound to be the same and the 13,200-volt currents combine in the buses to produce the power actually delivered to the customer, it was decided that the currents in the secondaries of the 13,200-volt current transformers should also combine correctly if they had an opportunity. Accordingly the experiment was tried of connecting the secondaries of the two sets of current transformers in multiple and allowing the combined current to operate a fifth polyphase meter, which thus became a totalizing meter. The original connection of the current transformers in single-line diagram is as shown by *A* in the diagram. At *B* are shown the connections for the totalizing meter, omitting all but the secondary connections of the current transformers. It will be seen that the individual meters, as before, continued to measure the power from the individual banks, and that the totalizing meter received the sum of the two currents.

The operation of these five meters was watched very carefully, and at the end of a thirty-day period the difference between the kilowatt-hours shown by the totalizing meter and the average sum of the others was 0.26 per cent. This was so satisfactory that the four individual meters were removed and a second totalizing meter installed as a check meter for the first. The arrangement has been operating for a period of sixty days in its final form and giving perfect satisfaction.

Alabama Power Company, Birmingham, Ala.

S. A. FLETCHER, Superintendent of Service.

Resistance of Earth Between Stations

IN THE calculation of the short-circuit current in an extensive transmission network the resistance of the ground connections and of the earth between widely separated stations plays a rather important part. Inasmuch as such calculations always involve the use of many variables, some of which are indeterminable, it is best to have accurate information on as many of these variables as possible. For this reason the San Joaquin Light & Power Corporation in June, 1920, made a series of tests of the resistance of the ground connections and of the earth between several of its stations.

The measurements were made with a Wheatstone bridge. The circuit in each case consisted of one wire of the transmission line, the station grounds at the two ends and the earth between as the return conductor. The stations are situated in a level valley which has ground water at a depth of from 12 ft. to 15 ft. below the surface under the entire section involved.

At station No. 1 the ground connection was made by means of ten 20-ft. lengths of 1-in. galvanized-iron pipe driven into the earth at various points surounding the station. All of these pipes were connected to a heavy copper wire. At station No. 2 the ground connection consisted of six 20-ft. lengths of 1-in. galvanized-iron pipe driven into the ground and interconnected as at station No. 1. At station No. 3 the earth connection consisted of four 20-ft. lengths of 1-in. galvanized-iron pipe driven into the ground and connected as in station No. 1.

Between station No. 1 and station No. 2 the resistance was found to be 2.32 ohms. The distance between the stations was 9.5 miles. The earth resistance between stations No. 1 and No. 3 was found to be 3.17 ohms. The distance between these stations is 29.5 miles. These figures are for the resistance of the entire

circuit with the resistance of the one conductor of the transmission lines deducted. Therefore they show the combined resistance of the ground connections at the two stations plus the resistance of the earth between the stations.

Another test was made between stations No. 1 and No. 2 in which a well at station No. 1 was used as a ground instead of the ten ground pipes. This well is 104 ft. deep and is cased with No. 16 galvanized-iron casing, 8 in. in diameter. This test gave a resistance of 1.62 ohms as against 2.32 ohms in the other test.

Two months later the new Kerckhoff hydro-electric station of the San Joaquin Light & Power Corporation was placed in service, and an opportunity was available to make a similar test in this case before the line was energized. The ground at Kerckhoff station is made to the penstocks, which are very large and should have plenty of ground contact area. However, they rest on solid granite and the best path for ground currents is probably through the water they carry, thence to the river and down the river to the valley. The transmission line parallels one of the company's 66,000-volt lines for a short distance, and for that reason the Wheatstone bridge could not be employed for accurate measurement. Direct current at 250 volts was used in making the test, and the resistance between the Kerckhoff station and station No. 2, a distance of 28 miles, was found to be about 11 ohms. This value is the resistance of the earth between the stations plus the contact resistance at the two stations. These results were obtained, of course, at a time when the station grounds were carrying no other than the test current and would therefore be useful only in determining instantaneous short-circuit currents. No doubt they would be higher if heavy current were permitted to flow for any considerable time and thus dry out the earth around the ground pipe.

L. J. Moore,
Electrical Engineer.
San Joaquin Light & Power Corporation,
Fresno, Cal.

Some Pointers on Keeping a Generating Station in Good Condition

SINCE uniformity of fuel-bed thickness is such an important factor in maintaining high boiler efficiency, great care must be exercised in keeping the hopper coal gates in good condition. When the gates are three or four bricks short enough coal will be wasted to pay another fireman. The coal will pass into the furnace in ridges and not have time to burn before it goes over into the ashpit. Another thing that needs very close watching is the formation of clinkers. For instance, a clinker 6 in. thick on a side wall shoves the coal away from the wall, letting cold air pass along the wall and cool it. Such a clinker also reduces the effective grate surface and forces coal to run over into the ashpit only partly burned. Another bad place for a clinker to form is on one end of the bridge wall. This will deflect the fire to one side so that the gases will not be distributed equally through the boilers. Slag on the tubes on one side of the boiler has the same effect as a bridge-wall clinker, driving the gases to one side. If draft gages are watched closely, the differential pressure will indicate when boiler tubes are becoming "slagged up." If a boiler is slagged up, take it off the line and clean it. Usually this should be done at night.

Next in importance in the boiler room comes the feed-water heater. See that it is kept clean, that the pans are in their proper place and that the relief valve is working properly. Inspect the valve of the live-steam trap for leakage. A by-pass is to be put on all the traps of this company so that by opening an open-end valve in the trap it may be ascertained at a moment's notice whether the trap is leaking or not.

In the engine room the vacuum should be checked frequently. If it has gradually been decreasing on peak loads but has been good on half load, the trouble probably is a dirty condenser or intake screen. The circulating pump may be worn or some obstruction may be lodged in the runner of the pump. If, however, the vacuum is poor at all times with light or heavy load, look for leaks. The most probable place to find an air leak is in expansion joints, stuffing boxes or valves, vacuum-pump valves or hot-well gland seal.

John W. May,
Traveling Engineer.
Iowa Railway & Light Co.,
Marshalltown, Iowa.

Substantial Alley Construction for Heavy Leads

AVOIDANCE of the usual unsightly alley construction, where all the lines are on one side of the poles, has been effected by the Albuquerque (N. M.) Gas & Electric Company. As shown in the photograph, rather light poles have been set on both sides of the alleys in the business district and long cross-arms placed between them. The number of arms depends upon the



SERVICES MAY BE EASILY TAKEN OFF TO EITHER SIDE OF THIS ALLEY CONSTRUCTION

number of circuits. The usual width of the alleys is about 18 ft. Transformers are hung on one or the other of the poles in the usual manner and are connected to the lines by wires run along the arms in conduit. The cost of this construction is considerably less than that of underground construction, which would not be warranted in a city the size of Albuquerque.

Field Editor Electrical World.
San Francisco, Cal.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Utilizing "Dead" Coils in Motor for Emergency Repair

ALTHOUGH an undesirable disturbance may result from cutting out coils in a motor circuit, the presence of such "dead" coils proved to be a salvation recently in putting a machine back quickly into service after a breakdown. The motor had been originally a two-phase machine and later it was connected for three phases. The usual practice when making such a change without replacing the windings is to cut out a number of the coils so that the winding will be more nearly suitable for the operating voltage. The reason for this is evident since a two-phase winding for a given power, speed and voltage contains one and one-quarter more conductors than a similar three-phase winding.

In the case mentioned two coils were destroyed when a short circuit occurred. Taking into consideration all the difficulties of procuring the wire of proper size, making a form, etc., replacement appeared at first to be no simple proposition. However, as there were twelve idle coils already in the windings it was a quick job to remove two of these "dead" coils from their slots and substitute others for those which had been destroyed.

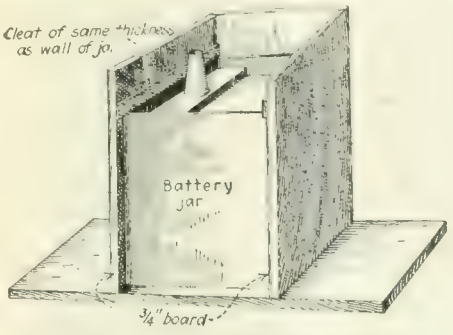
New York City. WILLIAM THOMSON.

How to Open a Storage-Battery Cell

BEFORE opening a cell of a storage battery for inspection or repair both hydrometer and voltage readings should be taken. If a battery has been in a location where dirt might fall on top of the cells, they should be washed with water applied with a hose or a sponge or poured from a bucket. All the vent caps must be in place while washing. Then the ends of the cell connectors are removed from the posts of the cell with a screw-type connector puller, or, if no puller is available, the center of each connector above the post may be drilled with a $\frac{5}{8}$-in. drill to a sufficient depth to allow the connector to be pulled off with pliers. Some find that it is quicker to apply a flame to the top of the connector and melt it just enough to allow it to be pulled off. The removed connectors may be used again. After the connectors are removed from the posts they are bent back so as to be out of the way of the cell when it is lifted from the battery. If the cell sticks it may be loosened by inserting a saw or other thin metal piece between the cell and the tray. It may be necessary to loosen a side piece of the tray. Any free pieces of lead or other material should be carefully brushed off to prevent them from falling into the cell when the cover is removed.

To remove the cover it may be heated by a blow torch or gas flame, by steam or by hot water. Before a flame is brought near a cell precaution must be taken to prevent an explosion of gas and possible injury from acid or pieces of the cover. With the type of cover used with the "Ironclad" battery the electrolyte should be drawn out until it is below the top of the plates. With cells of any type the gas should be blown out with either a low-pressure air hose or a syringe. It is the practice in some shops to add an ounce or two of water to the cell being worked on and to the nearby cells. This is said to lessen danger of an explosion. It is advisable to place a board or asbestos sheet over the tops of the cells near the one being worked on. Sometimes a wet cloth or burlap is employed for this purpose.

If a flame is used, it is run around the compound on the top of the cell until it is soft. When steam is used, a small rubber tube is inserted into the vent and low-pressure steam is allowed to flow for several minutes until the compound is melted. In some cases hot water is allowed to flow through a hose over the tops of the cells for this purpose. Care should be taken that all the vent caps are in place before running on the water. After the compound is melted it is removed with a warm putty knife.



BOX HOLDS DOWN BATTERY JAR WHILE PLATES ARE PULLED OUT

When the compound is removed the putty knife is inserted under the edge of the cover and it is pried loose from the sides of the jar. All bits of compound must be scraped from the inside walls of the jar because these may cause the jar to be broken when the plates are pulled up against them. In the case of cells used in tractors, locomotives, etc., the cover is usually taken off the plates before they are removed. The plates of a smaller cell may be removed from the jar together with the cover. If sealing nuts are used, they are loosened with a special wrench and the nuts and the cover are lifted off. To lift out the plates the jar is gripped between the feet, the two posts are held with large gas pliers and the element is pulled out. If the cover has been removed, small hooks may be used in place of the gas pliers for lifting the plates. These hooks are shaped to take hold underneath the pillar straps beneath the posts. In case the element sticks, the jar may be slid into a box having cleats which fit over the edges of the jar as shown in the accompanying drawing. The man doing the pulling stands upon the boards on either side of the box and the cleats hold the jar down while the plates are being pulled. Sometimes it may be necessary to place the cell in very hot water to within an inch of the top of the jar, which softens the rubber and permits the element to be pulled out.

If it is desired to install new wooden separators the element is placed on edge and the old separators are removed. The new separators are inserted from the bottom, care being taken to push them all the way up

and to see that they are projecting fully on each side of the plates and that none are omitted. If the plates must be taken apart, the separators are first removed and then, holding both posts, the plates are worked apart gradually.

When reassembling the cell the element should be gripped near the bottom in order to keep the plates from flaring out. After it is in the jar the edge of the cover and the inside of the jar are wiped with waste moistened in ammonia to neutralize the acid and the cell is sealed by applying hot compound with a hot putty knife. If the cover has been removed, the posts are wiped with waste moistened with ammonia, rinsed in water and dried thoroughly with clean waste, after which the new cover is put in position. With "Ironclad" cells care must be taken to have the soft-rubber gaskets on the posts under the cover. The sealing nuts are lubricated with a little graphite mixed to a paste with water. The nuts are put on and tightened with a wrench. Grease or vaseline should never be used for lubricating the nuts.

Before replacing the cells in their tray it is well to wash the inside and the upper edge of the tray with ammonia or soda solution. To prevent acid soaking into the top edge of a tray it is painted with melted paraffin around the top and about 3 in. down the sides before replacing the cells. If a jar does not slide easily into place in its tray, it may be lubricated with a little grease.

James H. Henderson,
Battery Repair Foreman.
American Railway Express Company,
New York, N. Y.

Wire Sizes for Lines Feeding Induction Motors

THERE is some question in the writer's mind as to whether or not an underwriters' inspector in this district would approve work done in accordance with the table given in the article on "Combined Conduit and Wiring Tables" appearing on page 885 of the Electrical World for April 16. It is our observation that wire sizes for branches consisting of rubber-covered wire run in rigid iron conduit to feed one squirrel-cage induction motor are usually obtained by assuming a starting current equivalent to two and one-half times the full-load current of the motor and then providing current-carrying capacity for this in accordance with the Underwriters' Table C in the 1920 edition of the code.

If there is more than one motor to be supplied, the general interpretation of the rule is to provide for a total current equal to the starting current of the largest motor plus the full-load currents of the other motors. Using one 30-hp., three-phase, 220-volt squirrel-cage motor, for example, we would assume a starting current of two and one-half times 81 amp., or 202½ amp., and could use a No. 1 0 wire having a Table C carrying capacity of 200 amp. and run in 2-in. conduit. It is probable that No. 2/0 wire run in 2-in. conduit would be used, as the writer has found that for distances such as are to be expected in a large shop or yard the voltage drop is excessive when using wire just large enough to pass the Underwriters' requirements.

Regarding fuse sizes, it is the general practice to fuse branch cut-outs to the capacity of the wire, in this case 200 amp. Without question the 100-amp. fuses indicated in the article would never carry the surge of starting current, but possibly they were meant for use as running fuses shunted during the starting period, and in this case they are correct.

The practice discussed above would, of course, be modified in the case of wound-rotor induction motors having starting resistance which limits the current when starting.

Frank G. Perley.
Allentown, Pa.

Motor Bearings and Oil Must Be Watched Closely

THE oiling system of a motor requires most careful attention because a hot bearing may cause a shut-down. For this reason an inspector should first look at the oil rings and gages and place his hand for a moment on both bearings. If the bearings are hot, that is, so that the hand cannot be held on them, trouble is indicated. Either there is no oil in the bearing, even though the gage is full, or the rings are hindered from turning, owing probably to thickly gummed oil or dirt sediment. If one or both bearings are hot, shut down the motor as soon as notice can be given the operator to remove the load and immediately use plenty of oil, pouring it in through the cap of the bearing and not through the gage. Examine the rings with a light, or feel them with the little finger to make sure that they are free to turn. The motor may then be run; but if there is time to spare, instead of putting oil in at once, remove the gage and bottom plug and allow the old oil to drain off, afterward washing out with gasoline.

Motors in dusty places should have all bearings cleaned out and new oil put in at least once in six months, and oftener if needed. Motors in warm places should have oil with considerable body to it. "Mobile A" is a good oil for warm places, but for motors subject to considerable heat, such as crane service over a furnace, an engine oil which is not very thick will be found good.

For elevator motors in penthouses on the roof and fans and blowers situated outside the main building and subject to very low temperatures a thin oil that will not freeze and clog the rings should be used, such as "Keystone No. 6." No grease or thick oil should ever be used in motor bearings. If a gage or plug leaks, the oil is likely to be exhausted before it is noticed; therefore one should look carefully for leaks, especially from broken or loose glass tubes. No motor should be run with its bearing caps open, as dust will certainly collect, especially at the pulley end, where the belt or chain acts like a conveyor.

Oil for relays and starting compensators must not be used as a lubricant, as it is far too thin. Thick oil should not be thinned with kerosene, as kerosene cuts and does not help to lubricate. If a bearing has run so hot as to smoke, it is very likely somewhat worn, and a careful test with a steel gage should be made.

Look for a somewhat rare fault, that of the sleeve turning upside down, thus preventing the rings from running in their slots, the result, of course, being extreme heat. This trouble is generally caused by the set screw working out of place. If a motor has recently been taken apart, there is a chance that the rings have been bent and the bearings may run hot as a consequence.

H. S. Rich.
East Berlin, Conn.

Switchboard Made of Standard Parts Is Compact and Safe

OWING to limited space it was impossible to install a regular slate switchboard with knife switches or oil switches in a substation of the Union Switch & Signal Company, Swissvale, Pa. However, a neat, compact and safe board was built of safety switches supported on pipes, as illustrated in the photograph. This is a three-phase, 60-cycle, 440-volt distributing switchboard. The switchboard frame was set 3 ft. from the wall to allow a passageway. The framework was made of 1¼-in. iron pipe, using standard malleable-iron switchboard frame fittings fastened to the pipe by ⅜-in. U-bolts. The frame work is 10 ft. long x 8 ft. high and has one 1¼-in. pipe at each end and one in the center of the frame to which the cross pipes supporting the switches are mounted with pipe cross clamps, there being one cross-pipe at top and bottom of each switch.

The switches are spaced 8 in. apart horizontally to allow opening the door for replacing fuses and inspecting. They are spaced 6 in. apart vertically to allow for condulets coming out at the top of the switches. The switch boxes are fastened to four standard mounting brackets, which are attached to the frame with ⅜-in. U-bolts.

The four switches at the top are each 400-amp., 600-volt fused-bottom switches. The four lower switches are 200-amp., 600-volt fused-bottom switches. The connections from top of switch to busbars are made with rubber-covered cable. The 400-amp. switches are connected with 500,000-circ.mil cable cable run through

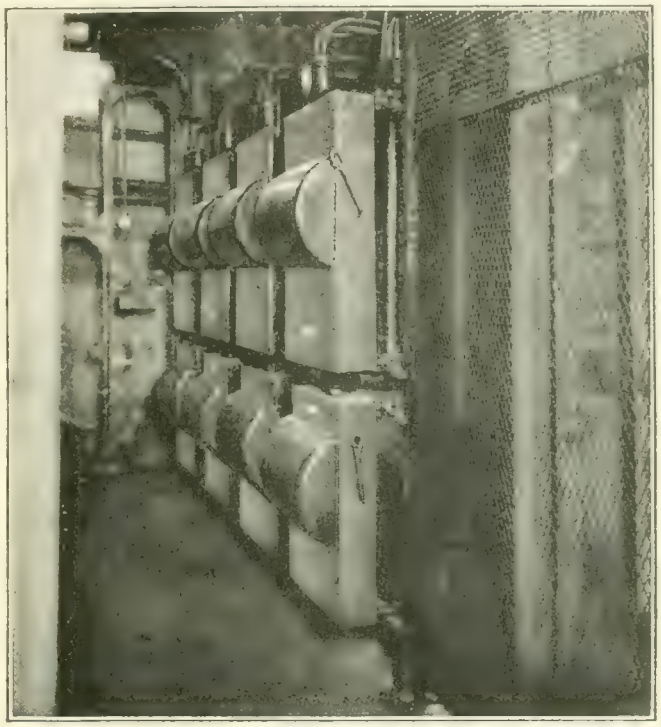
LIST OF MATERIAL USED IN CONSTRUCTING THREE-PHASE, 60-CYCLE, 440-VOLT SAFETY SWITCHBOARD

Four No. 56,365 400-amp., 600-volt "square D" switches.
Four No. 56,364 200-amp., 600-volt "square D" switches with end plates.
Thirty-two No. 112,878 pipe-mounting brackets, complete with ⅜-in. mounting bolts, Westinghouse Electric & Manufacturing Company.
Fifteen No. 216,509-A pipecross clamps, 1¼-in. pipe, W. E. & M. Co.
Three No. 225,654 pipe flanges, 1¼-in. pipe, W. E. & M. Co.
75 ft. 1¼-in. black iron pipe.
Twelve No. 238,467 bus supports with 1¼ in. pipe-frame mounting, W. E. & M. Co.
Twenty-four No. 196,397 busbar clamp terminals, W. E. & M. Co.
Nine pieces ¼ in. 3x10 in. hard-drawn copper busbar.
45 ft. No. 500,000-circ. mil. R. C. D. B. copper cable, N.E.C., 600-volt.
100 ft. No. 4/0 R. C. D. B. copper cable, N.E.C., 600-volt.
Six No. 330,333 busbar clamps, Electrical Engineer Equipment Company.
Five No. L.B.-66 condulets, complete with No. 600 covers.
Four No. L.R.-66 condulets, complete with No. 600 covers.
Four No. L.B.-77 condulets, complete with No. 700 covers.
Four No. L.R.-77 condulets, complete with No. 700 covers.
Four No. A-8 condulets with No. C.F.-83 covers.
Four No. A-6 condulets with No. C-F-63 covers.
Four 3-in. conduit lock-nuts.
Four 2½-in. conduit lock-nuts.
Eight 2-in. conduit lock-nuts.
Four 3-in. conduit bushings.
Four 2½-in. conduit bushings.
Eight 2-in. conduit bushings.
2 ft. 3-in. conduit.
15 ft. 2½-in. conduit.
36 ft. 2-in. conduit.
Six ½x4-in. U S. expansion bolts with shields.
Six ⅜-in. "U" bolts with hexagonal nuts.
Labor—Two electricians and one helper, 18 days, 8½ hours each.

short pieces of 3-in. conduit at the top end of which is a type "A-88" condulet with three-hole composition cover. The 200-amp. switches are connected by No. 4/0 cable, run through 2½-in. conduit using one "L.R.-77" condulet and one "L.B.-77" condulet at the top of the box to bring the 2½-in. conduit up behind the 400-amp. switches. The wires are brought out through a type "A-77" condulet with a three-hole composition cover. The connections to busbars are made with standard clamp bus terminals.

The branch conduits feeding the various circuits are all brought out at the lower left-hand side of the switches, using an "L.R." condulet next to the box to turn the conduit upward. The conduits are run up and turn toward the end wall with standard conduit elbows, and are run underneath the wall brace supporting the busbars and back to the wall to a sheet-steel junction box whence conduits to various circuits radiate.

The eight switches on this board control circuits to which is connected 620 hp. in motors. The board is in the basement of a power house where there is a space



SPACE ONLY 3 FT. 4 IN. DEEP IS TAKEN BY THIS SWITCHBOARD FOR 1,600 AMP. AT 440 VOLTS, THREE-PHASE

of only 7 ft. 6 in. from transformers to wall. The installation leaves 3 ft. 4 in between the front of the switches and the transformers, which is sufficient room to remove a transformer in case of trouble. The framework has been built so that additions can be made when more circuits are required.

F. W. McGRAW,
Union Switch & Signal Company, Chief Electrician.
Swissvale, Pa.

Shield for Protecting Drop Cable of Crane Magnet

ON ACCOUNT of the sag usually present in the drop cable of an electric lifting magnet, it sometimes loops under the magnet or gets caught on some obstruction. Such an accident is likely to cut the cable or bruise the insulation. Sometimes an electrically operated bucket is suspended on the hook instead of the magnet and the same cable is used through different controllers. In this case injury is especially frequent owing to the great weight of the bucket and extremely rough handling.

To afford protection against such injury the writer employs a 15-ft. flexible steel hose slipped over the cable next to the magnet. The hose is flexible enough to wind around the drum nicely. Of course, the hose will in time become dented and badly crushed, but the cable will still be safe inside.

HERBERT J. WOLF.
New Haven, Conn.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Applications for the Small Rotary Converter.—L. VADOT.—The author deplores that the small-size rotary of from 5 kw. to 50 kw. output or thereabout is very rarely used, although it possesses a great many advantages. As such are mentioned its small first cost and low energy consumption on account of higher efficiency, as compared with the motor-generator, its small weight and floor space and its high power factor. Among the many uses where a small rotary proves advantageous are enumerated the charging of storage batteries, drive of variable-speed direct-current motors from alternating-current lines, motion-picture arc lamps, operation of lifting magnets and magnetic chucks, electric welding, X-ray apparatus, using alternating current and direct current at the same time, and radio apparatus, using high and low potential at the same time.—*Revue Générale de l'Électricité*, March 26, 1921.

Theory of the Three-Phase Variable-Speed Shunt Commutator Motor.—J. L. D. RIDSDALE.—A treatment of this subject by means of vector diagram and mathematical analysis.—London *Electrician*, April 15, 1921.

Lamps and Lighting

Flame Excitation of Luminescence.—E. L. NICHOLS and D. T. WILBER.—It has been discovered that many substances may be excited to fluorescence by contact with a hydrogen flame. The conditions for this excitation are described, and it is shown this luminescence differs from photo-luminescence, also from mere temperature radiation.—*Physical Review*, April, 1921.

Safety Features of Industrial Lighting.—SAMUEL G. HIBBEN.—In general, according to this paper, bad lighting is caused by one or both of two outstanding factors—(1) bare incandescent lamps, or unshielded glaring illuminants that not only do not illuminate but cause a contraction of the pupillary opening of the eye and resultant decrease in seeing ability; (2) insufficient light, which is largely due to improper lamp renewals, wrong methods of reflector and lamp cleaning, color of surroundings, or lack of efficiency in maintaining the original installation up to its initial standard. The latter factor particularly is discussed in this article.—*Transactions of Illuminating Engineering Society*, April 30, 1921.

Generation, Transmission and Distribution

Hydro-Electric Unit Operated from City Water Main.—J. B. HOLDCROFT.—A unique installation at Port Alberni, B. C., is described, where high pressure and large pipe capacity permitted a waterwheel to be attached to the water main, a municipal lighting plant being operated by this means.—*Canadian Electrical News*, April 1, 1921.

Storing Up a Year of Power.—W. L. ABBOTT.—In this article the storage and handling of coal with particular reference to prevention of fires is dealt with. Six important points are brought out as follows: (1) Coal should never be subjected to heat from outside sources, such as hot pipes, boilers and so on. (2) Foreign combustible material should be kept out of the pile. (3) The coal should be piled in uniform sizes and segregation prevented. (4) Sized coal only should be stored, if possible. (5) It is immaterial whether the storage is under cover or in the open. (6) The greatest liability to fires seems to be within the first three or four months, and during that time special care should be taken to watch the pile for evidences of combustion.—*Factory*, April 15, 1921.

Economics of Hydro-Electric Development.—A. H. GIBSON.—The possibility of economic development of a hydro-electric scheme depends essentially upon (a) whether there exists or is likely to exist a market for the energy; (b) whether the price at which the energy can profitably be sold is, first, such as the industry can afford to pay and, second, less, or at least not greater than, the price of energy from a fuel-operated station. Some figures are given to show the depreciation rate which should be applied to various elements of hydro-electric systems. These are in percentages of first cost of the installation, as shown in table:

	Per Cent
Civil engineering works, including dams, conduits, headworks, power house, etc	1.5
Pipe lines and sluicegates	2.5
Electric generators, transformers and switchgear	4.0
Hydraulic turbines and governors	4.5
Transmission lines:	
Towers	3.0
Cables	5.0
Insulators	10.0
Operating machinery in power-house cranes, hoists, etc.	6.0

Reports from the Swedish government are quoted showing the annual operating cost excluding depreciation to average slightly over 12 shillings per turbine-horsepower installed. The first cost and fixed charges are also discussed.—London *Engineer*, April 8, 1921.

Traction

Recent Railroad Electrification.—The recent electrification of a short railroad line in northeastern Oklahoma is held to afford another proof of the advantages of electricity as motive power on railways. The line is said to give excellent freight and passenger service to zinc and lead mining communities. The early extension of the electrification is contemplated.—*Electric Railway Journal*, May 7, 1921.

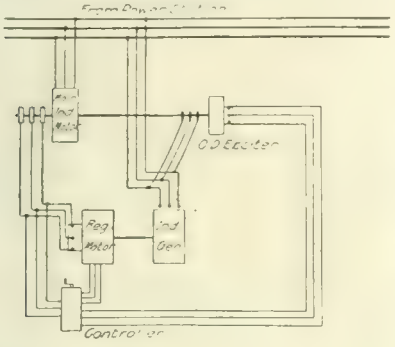
The Electric Locomotives of the Gotthard Railway.—A. MARSHALL.—The article described in detail the freight and passenger locomotives of this railway, which was opened for electric traction in September, 1920. The 15,000-volt, 16⅔-cycle machines are operated by 60,000-volt, three-phase current. All data are given for the types 1C1, 1B+B1, 1C+C1, built by Oerlikon and by Brown, Boveri in Switzerland. The Oerlikon machines use regenerative braking.—*Zeitschrift des Vereines Deutscher Ingenieure*, April 2, 1921.

Installations, Systems and Appliances

X-Rays and Their Industrial Applications.—An abstract of three lectures by G. W. C. Kaye dealing with developments and limitations of X-ray apparatus for various industrial applications.—London *Engineering*, April 8, 1921.

Considerations in Motor Applications.—PHILIP CHAPIN JONES.—The writer considers the relation of power factor and efficiency to the rated load. Motor loads are grouped into three classes, and heating effects of variable loads and overloads are considered.—*Power*, April 5, 1921.

Some Methods of Obtaining Adjustable Speed with Electrically Driven Rolling Mills.—K. A. PAULY.—After outlining the speed requirements of steel rolling mills, disclosing the need in many cases for adjustable speed over a wide range, the author goes into a discussion of the merits of the Scherbius system of speed control, both single-range and double-range, in which the slip energy of the main motor is returned to the system as



DOUBLE-RANGE SCHERBIUS SYSTEM FOR INDUCTION MOTOR SPEED CONTROL

electrical energy. A comparison is made with the Kraemer or synchronous converter system in which the slip energy is returned to the main motor shaft. The double-range Scherbius system permits of satisfactory operation at speeds below synchronism, at synchronism and above synchronism, which is said not to be practicable with the Kraemer system.—*General Electric Review*, May, 1921.

Electrophysics and Magnetism

The Thermionic Current Between Parallel Plane Electrodes.—THORNTON C. FRY.—The electrical equations applying to the velocities of thermionic emission distributed according to Maxwell's law are developed without neglecting the distribution of initial velocities, which in the first place is allowed to be entirely general. Maxwell's distribution of velocities is then considered in detail and a complete solution obtained.—*Physical Review*, April, 1921.

Measurements of Heat Conductivity of Insulations Used on Conductors in Turbo-Alternators.—P. JANET.—To determine the exact temperature gradient of the layer of insulation upon a conductor, several tubes of copper were covered with different insulating materials, such, for example, as mica and its derivatives. Calibrated thermocouples (copper-argentan) were placed next to the conductor, and on top of the insulation the tube was electrically heated, and readings were taken on a potentiometer connected to the couples. Extreme care was taken to obtain as exact and reliable data as possible. Mathematical derivations and tabulations of actually observed values are given in the paper. At the same time some dielectric tests of the insulation were made before and after the heat runs. Heating to 150 deg. C. for one hour did not seem to have any detrimental effect upon the insulation.—*Revue Générale de l'Électricité*, March 19, 1921.

Electrochemistry and Batteries

Instantaneous Current and Voltage Values in a Battery.—G. W. VINAL and C. L. SNYDER.—A study of storage-battery performance in lighting, ignition and starting service for automobiles. The study was made in the Bureau of Standards at the request of the Motor Transport Corps. Extensive oscillographic records are shown for typical automobile service.—*Journal of Society of Automotive Engineers*, April, 1921.

Designing the Storage-Battery Locomotive to Meet Conflicting Needs.—C. W. SMITH.—Complications in the problem of the design of the accumulator locomotive are discussed with the object of showing how the greatest possible reliability and battery capacity are attained.—*Coal Age*, May 5, 1921.

Telegraphy, Telephony and Signals

Failure of Lead Sheathing of Telegraph Cables.—L. ARCHBUTT.—An examination of some lead sheaths which had failed, apparently owing to inter-crystallizing fracture, were examined to determine the effects of vibration and mechanical handling on the failure of such sheaths.—London *Engineering*, April 8, 1921.

Radio Service from Paris to London.—Stations for regular communication between these two cities are located in Neuilly-Levallois, France, and Chelmsford, England. A high-frequency generator of 10 kw. to 25 kw. is used for sending. Signals are first recorded by perforation by means of a special machine upon a strip of paper and are then sent at about a hundred words per minute. The received messages are considerably amplified and are registered upon a fast-rotating wax disk similar to that of a phonograph. For transcribing, the disk is revolved much more slowly, to enable the operator to copy the message on a typewriter.—*Radioelectricité*, Vol. I, page 404.

Some Operating Characteristics of Electron Tubes.—W. C. WHITE.—It is the author's purpose not to take up the fundamental theories of operation of the tube or its circuits, but to furnish information and give help to those who professionally or otherwise experiment with these devices.—*Journal Franklin Institute*, April, 1921.

The Cathode-Ray Oscillograph and Its Application in Radio Work.—LEWIS M. HULL.—The general construction and details of the design of cathode-ray tubes are given. The brightness of the spot obtained, the sensitivity of the tube and its behavior in use are described. The various excitation sources available are compared. A number of applications of such tubes to radio research (for example, spark-gap characteristics and associated synchronizing of oscillating triodes) also are dealt with.—*Proceedings Institute of Radio Engineers*, April, 1921.

Behavior of a Three-Electrode Vacuum Tube as an Oscillation Generator.—EIJIRO TAKAGISHI.—The writer states that the subject should be handled by starting from the dynamic or derived characteristics. These differ greatly from the static characteristics, which can be experimentally determined with ease. The writer then proceeds to derive mathematically the characteristics solely from the circuit conditions.—London *Electrician*, March 25 and April 1, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

J. M. Beck to Be Principal Speaker on N. E. L. A. Public Policy Night

ANNOUNCEMENT was made early this week that James Montgomery Beck, who was Assistant Attorney-General of the United States under Presidents McKinley and Roosevelt and has been recently appointed to be Solicitor-General, has been selected as the principal speaker on public relations night at the National Electric Light Association convention in Chicago next week. Mr. Beck achieved an international reputation before America's entrance into the war by his keen analysis of the documentary statements of their cause made by European governments and the conclusive showing of the strength of the Allies' position that he founded thereon.

The state committees on public utility information have arranged an exhibit to be held in one of the convention hotel rooms of all the material that they have prepared.

On Wednesday reports from Chicago were to the effect that more than 1,100 member companies had made advance reservations and it was estimated that the attendance would reach 4,000.

Duquesne Light Offers $10,000,000 in Debentures

BEARING date of July 1, 1921, an issue of $10,000,000 in fifteen-year 7½ per cent convertible gold debentures of the Duquesne Light Company of Pittsburgh is announced. The price of the issue is 98½, which means that the investment will yield 7.65 per cent. The proceeds of the issue will be used for acquiring the fee ownership of the Colfax plant, for the acquisition of the extensive coal properties from which it obtains its fuel supply and for other extensions and additions to the property.

William McClellan Elected President of A. I. E. E.

AT THE annual meeting of the American Institute of Electrical Engineers, held in New York on May 20, results of the recent election were announced, showing that Dr. William McClellan, for many years a prominent engineer, educator and utility executive, had been elected president for the year beginning Aug. 1, 1921. President Berresford called upon Dr. McClellan, who spoke briefly of the important part which engineers should play in restoring business to a normal condition. The building up of our foreign trade was a pressing necessity, he said, since only 70 per cent of the nation's production is needed at home. Following the lead of Herbert Hoover, engineers should play a leading part in the development of such commerce.

The complete list of officers elected follows:

President—William McClellan, Philadelphia.

Vice-presidents—Walter A. Hall, Boston; N. W. Storer, Pittsburgh; William A. Del Mar, Yonkers, N. Y.; C. G. Adsit, Atlanta; John C. Parker, Ann Arbor, Mich.; F. W. Springer, Minneapolis; H. W. Eales, St. Louis; Robert Sibley, San Francisco; O. B. Coldwell, Portland, Ore., and F. R. Ewart, Toronto.

Managers—A. G. Pierce, Pittsburgh; R. B. Williamson, Milwaukee, and Harlan A. Pratt, New York.

Treasurer—George A. Hamilton, Elizabeth, N. J. (re-elected).

The above, together with the following hold-over officers, will constitute the board of directors for the next administrative year: A. W. Berresford, Milwaukee; Calvert Townley, New York; Walter I. Slichter, New York; G. Faccioli, Pittsfield, Mass.; Frank D. Newbury, Pittsburgh; L. E. Imlay, New York; F. F. Fowle, Chicago; L. F. Morehouse, New York; Harold B. Smith, Worcester, Mass.; James F. Lincoln, Cleveland, and E. B. Craft, New York.

At the meeting of the board of directors held on the same date F. L. Hutchinson was re-elected secretary of the Institute.

California Cities Plan Municipal Power Development

THE cities and organized rural districts of California will undertake the municipal development and ownership of hydro-electric power on a large scale if the plans of the League of California Municipalities are carried out. These were detailed at a meeting of the league held in Sacramento May 20, which was attended by more than fifty mayors and other officers of California cities. The purpose of the meeting was to prepare for the initiation of an act similar to the Johnson act to be placed on the next general California ballot in the fall of 1922. The Johnson act as originally prepared was written largely by officers of the league.

Governor Stephens addressed the meeting and stated that while fair returns for the honestly invested capital of privately owned public utilities should be protected, yet he hoped that districts, cities and counties would be enabled to develop hydro-electric power. Although Senate bill No. 397, known as the Johnson act, and which was designed to create a hydro-electric power commission modeled after the Ontario commission, was defeated in the State Assembly during the recently closed session of the Legislature, an act known as Senate bill No. 18, legalizing co-operative organizations of and between political subdivisions of the state which wish to join in certain undertakings, was passed. This bill has been signed.

Secretary Mason of the league asserted that the time was rapidly approaching when the diminishing supply of oil and the consolidation of the power companies would place the industries of the state under the control of the power companies.

C. H. Lee, president of the California Water Commission, said that while there was approximately 9,500,000 hp. of water power in California possible of develop-

ment, 1,000,000 hp. was developed and applications were filed for an additional 7,000,000 hp., of which 65 or 70 per cent was sought by corporations of which about half are now operating and the remainder are newly organized.

The league voted to draft an agreement under the authority of Senate bill No. 18 to form organizations to study the situation as regards sites and prepare for power development when this authority was granted; to have the state engineer, the president of the state Water Commission and C. L. Seavey, Sacramento city manager, empowered as trustees of the power interests of the municipalities to raise funds for organization, for locating power sites, for arousing public sentiment by publicity, investigating methods of obtaining power sites, drafting initiative measures and campaigning for their passage.

F. M. Feiker Guest of Westinghouse

OFFICIALS of the Westinghouse Electric Manufacturing Company tendered on Monday a complimentary luncheon to Fred M. Feiker, vice-president of the McGraw-Hill Company, who this week went to Washington to assist Secretary Hoover in the development of the Department of Commerce as an aid to American industry.

Mr. Feiker outlined the need for Government assistance to industry in the gathering of essential facts and figures and presenting them properly to business men. Gen. Guy E. Tripp, chairman of the board of the Westinghouse company, and James H. McGraw, president McGraw-Hill company, spoke of the value of such a plan and remarked on the peculiar fitness of Mr. Feiker to undertake the work. A. A. Brown, assistant sales manager of the Westinghouse company, acted as toastmaster. Those who gathered to honor Mr. Feiker were General Tripp, L. A. Osborne, vice-president Westinghouse company; J. H. McGraw, M. S. Sloan, president Brooklyn Edison Company; A. E. Allen, manager New York Westinghouse office; F. W. Smith, vice-president and general manager United Electric Light & Power Company; J. W. Lieb, vice-president and general manager New York Edison Company; Charles A. Terry, vice-president Westinghouse company; M. H. Aylesworth, executive manager National Electric Light Association; Henry L. Doherty, president Henry L. Doherty & Company, and A. A. Brown.

The Ninth Chicago N. E. L. A. Convention

THE forty-fourth convention (the ninth in Chicago) of the National Electric Light Association opens at the new Drake Hotel, on the shore of Lake Michigan, Monday night, with meetings of the executive committees of each of the national sections.

Each morning will be devoted to general sessions.

Tuesday, Wednesday and Thursday afternoons will be given over to the four national sections, some of which will hold parallel sessions.

The president's reception will be on Tuesday night; the dinner, entertainment and dance on Wednesday night, and public policy night on Thursday, with James Montgomery Beck as principal speaker.

In all seventy-two reports, papers and addresses are scheduled for presentation. Of these thirty-five have been printed.

There are no manufacturers' exhibits this year, but the Lighting Sales Bureau has arranged a demonstration of residence lighting.

A big electric vehicle show will take place during the week at the showrooms of the Commonwealth Edison Company.

The Chicago committee on arrangements is doing everything to make the 1921 convention eclipse all others. The last Chicago convention was in 1916 under the administration of E. W. Lloyd.

The first N. E. L. A. convention was also in Chicago in 1885, when J. F. Morrison was president. The membership at that time was 87; today it is over 11,000. The other Chicago conventions were in 1889, S. A. Duncan president; 1898, Samuel Insull president; 1900, S. T. Carver president; 1903, Louis A. Ferguson president; 1908, Dudley Farrand president, and 1913, F. M. Tait president.

Electron Tubes Soon in Heavy Power Service, Dr. Hull Predicts

"ONE year will see these tubes [electron tubes] in use as kenetron rectifiers for series arc lighting. Five years will see them in substations replacing rotary converters. In ten years they will be on electric locomotives, either as rectifiers, allowing the use of direct-current motors, or as variable-frequency alternators, taking their power from a high-tension, direct-current trolley line. Twenty years will see direct-current transmission lines, fed through transformers and kenetrons, at any convenient point by alternators of any frequency, and tapped by the same tubes acting as magnetron alternators, as some equivalent pliotron or combination alternator." Such was the startling prophecy of Dr. Albert W. Hull of the research laboratory, General Electric Company, before the A. I. E. E. at its annual meeting in New York on May 20.

Dr. Hull described the new vacuum tube, which is called "magnetron" because the valve control is accomplished by means of a magnetic field. Although the magnetron has been used only for weak currents, he showed a magnetron tube with an anode 4 in. (10 cm.) in diameter and 12 in. (30 cm.) long which had been operated at 5 kw. output. With larger filaments and water cooling, these tubes would be capable of handling hundreds of amperes.

No Hope for National Daylight Saving

IT HAS been decided by the committees of Congress having jurisdiction over daylight-saving bills that the subject is not to have consideration. This puts an end to the attempt to make daylight saving again national during the coming summer.

Right of Eminent Domain Granted to Indiana Utilities

PUBLIC utilities in Indiana are authorized by a law recently signed by the Governor to appropriate and condemn for their use lands of individuals and private corporations or any easements in such lands wherever such action is necessary to the carrying out of their objects. The utilities affected by the law include those engaged in the production, transmission, delivery or furnishing of heat, water, light, power and telegraph and telephone service. The law specifies that wherever

land, except in cities of the third class, is needed for the placing of buildings, structures, dams, pole lines, wires, mains, conduits, pipe lines and right-of-way this action may be taken with the approval of the Public Service Commission. It provides, however, that within the limits of an incorporated town or city the authority to appropriate does not extend to lands situated in any city block in which more than 50 per cent of the frontage is devoted to residence purposes. Utilities are also prohibited from appropriating lands within the corporate limits of a city for overflowage by backwater from a dam.

Boiler-Test Figures Using Pulverized Fuel Presented Before A. S. M. E.

INTERESTING figures on boiler tests made at the new Lakeside plant of the Milwaukee Electric Railway & Light Company were presented by Henry Kreisinger, in a paper on boiler tests, before the annual convention of the American Society of Mechanical Engineers at Chicago on Tuesday. The Lakeside plant is constructed for the use of pulverized coal only. Tests were carried out on the 1,306-hp. Edge Moor four-pass boilers, of which there are eight, each having 7,200 cu.ft. of combustion space and capable of burning 7 tons of fuel per hour at the maximum rating. On one test of forty-four hours at 138 per cent rating a boiler efficiency of 83.4 per cent and a combined boiler and economizer efficiency of 86.3 per cent were obtained. On a twenty-four hour test at 214 per cent of rating the figures were 82.3 and 86.8 per cent respectively. One test of twenty-four and one-half hours at 135 per cent of rating showed a boiler efficiency of 85.6 per cent and 90.2 per cent for the boiler and economizer combined. No deductions for boiler auxiliaries are made in these figures.

On a boiler operating at 137 per cent of rating fluegas temperatures of 432 deg. leaving the boiler were recorded, with 392 and 250 deg. entering and leaving the economizer. Mr. Kreisinger also expressed the opinion, based on experience, that it was not necessary to dry coal to about 1 per cent of moisture for pulverizing and drying and further said that most Eastern coals can be pulverized and burned with good results without drying.

John A. Stevens of Lowell cited the practice followed in Europe of preheating combustion air, and Mr. Kreisinger indicated that the practice might offer an increase in efficiency of 3 per cent, though in the cases with which he was dealing the combustion air was circulated through the furnace walls to prevent heat radiation and was therefore preheated to a considerable degree.

John H. Wilson of Chicago and E. H. Tenney of St. Louis at the fuel session on Tuesday discussed the capacity efficiency and limitations of stokers using Middle West coals.

E. G. Bailey of Cleveland outlined results from experiments with a temperature-recording device to determine ashpit losses from chain-grate stokers. The device is a steel tube or bulb filled with nitrogen and connected through a capillary tube to a recorder made up of a mercury U-tube, one leg of which is open to the atmosphere and carries a float to which the recorder pen is attached. When properly placed near the rear of the stoker its temperature seems to bear a definite relation to the amount of combustible going into the ashpit.

No Water-Power Valuations Until Personnel Is Provided

PENDING authorization by Congress permitting the employment of properly qualified engineers and accountants, the Federal Power Commission will make no effort to undertake valuations of projects already constructed. This course of action was decided upon by the commission at its meeting on March 20. The commission believes that for valuation work a personnel with specialized technical training and experience is needed. Persons with the necessary qualifications have not been assigned to the commission. In cases of this kind a license is to be issued under the condition that a valuation shall be made at the earliest practicable date and that it shall be determined as of the date of the license.

The commission has voted to recommend legislation to permit it directly to engage its personnel in addition to utilizing some of the specialists of the Departments of War, the Interior and Agriculture. In fact the commission approves the identical bill to this effect which was introduced at the last session by Representative Esch. This bill also provides for an increase in the salary of the executive secretary from $5,000 to $7,500 per annum and amends the acts in other minor particulars

States Provide for Colorado River Development Commissioners

THE governors of the states in the Colorado River basin have presented a resolution to Congress pointing out that Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming have by appropriate legislation authorized the appointment of commissioners representing these states for the purpose of entering into an agreement between these states and the United States respecting the future utilization and disposition of the waters of the Colorado River and of its tributaries. The governors urge that Congress provide for the appointment of commissioners on behalf of the United States.

Georgia Electrical Men Organize for Co-operation



MEN from all branches of the electrical industry gathered together at Macon, Ga., on May 9 and 10 to organize a state co-operative association. A few of those attending the meeting were grouped together for this photograph. More complete details of the meeting will be found on page 1177 of the May 21 issue.

Municipal Light Plant Bonds Legalized by Indiana Legislature

A LAW recently signed by the Governor of Indiana legalizes the acts of boards of trustees of incorporated towns in that state in borrowing money for the purpose of installing and maintaining municipal light and water plants and in paying the interest on such debts out of general funds. It provides also that where the State Board of Tax Commissioners has issued orders permitting the issuance of the bonds the issue shall be valid.

Pacific Coast N. E. L. A. Invites Outside Interests to Convention

AN INNOVATION is to be made at the annual convention of the Pacific Coast Section of the National Electric Light Association this year in that the final session, on the afternoon of June 10, will be made a conclave of bankers, industrial men and representatives of Western chambers of commerce. At this time the electrical industry will present its side of the broad question of the economic upbuilding of the West. An extensive survey of Western industry has been made, and the results and conclusions arrived at will be given. At the banquet in the evening addresses on this subject will be made by various men prominent in finance, commerce and industry.

Fourteen papers and committee reports from the various sub-committees of the Commercial Section and of the Technical Section have been prepared for presentation. In addition to the program of the technical section given on page 278 of the Jan. 29 issue of the ELECTRICAL WORLD, there will be the following papers: "Evaporation from Reservoirs," "Industrial Electrical Heating," "Long-Range Weather Forecasting," "Operation for Maximum Output and Operating Record," and "The How and Why of Better Industrial and Commercial Lighting."

Reports, Papers and Entertainment Program of Canadian Convention

QUEBEC CITY will be the meeting place of the Canadian Electrical Association on June 15, 16 and 17, when the association will hold its thirty-first annual convention at the Chateau Frontenac. The following program of reports and papers will be carried out:

WEDNESDAY, JUNE 15

Morning.—Report of secretary-treasurer; report of Technical Section, R. J. Beaumont, Shawinigan Water & Power Company, chairman; report of meter committee, E. Holder, Shawinigan Water & Power Company, chairman; "Electrical Standards and Their Application to Trade and Commerce," by O. Higman, director Electrical Standards Laboratory, Ottawa; report of electrical apparatus committee, W. J. S. Wurtele, Southern Canada Power Company, chairman.

Afternoon.—Report of overhead systems committee, O. V. Anderson, Toronto Power Company, chairman; report of Commercial Section, M. C. Gilman, Montreal Light, Heat & Power Consolidated, chairman; "The Consulting Engineer and the Power Company," by J. M. Robertson, Montreal.

THURSDAY, JUNE 16

Morning.—"Modern Street Lighting," by A. B. Cooper, Canadian General Electric Company, Toronto; "Electrons," by W. B. Cartmel, Northern Electric Company; "Switching Equipment," by L. B. Chubbuck, Canadian Westinghouse Company, Hamilton; "The Manufacture and Testing of High-Tension Porcelain Insulators," by A. D. Allen, Hamilton, Ont.

Afternoon.—Report of Accounting Section, D. R. Street, Ottawa Electric Company, chairman; report of Public Relations Section, D. H. McDougall, Toronto Power Company, chairman; report of accident prevention committee, Wills Maclachlan, Toronto, chairman; report of membership committee, M. K. Pike, Northern Electric Company, chairman; report from representatives on Canadian Engineering Standards Association: "Pole Specifications" by O. V. Anderson, "Electrical Appliances and Supplies" by E. C. McGovern, "Transformers" by A. A. Dion; report on activities of Toronto Section and St. Maurice Valley Section.

On Friday morning classes A and D will meet in executive session. Entertainment features of the gathering will include an excursion to Ste. Anne de Beaupré and Montmorency Falls on Wednesday afternoon, and sight-seeing and boat trips on the following day. The annual dinner, to be held at the Kent House on Wednesday evening, will be addressed by the president of the National Electric Light Association and William L. Goodwin of the Society for Electrical Development.

More Hydro-Electric Projects Licensed

FIVE licenses and seven preliminary permits were authorized by the Federal Power Commission on May 20. The licenses are to cover the following applications (the numeral is the serial number of the application): 82—Alabama Power Company; 104—The Home Colony Association; 126—John R. Love and G. A. Vonbrecht; 192—C. B. Johnson; 203—Thomas P. Mitchell.

Preliminary permits were authorized as follows: 113—Great Basin Power Company; 81—Granite Falls Manufacturing Company; 48—State of Illinois; 7—Roanoke River Development Company; 121—James B. Girand; 88—Merced Irrigation District; 20—Utah Power & Light Company.

The Alabama Power Company project covers a power development in the Coosa River at Duncan's Riffle, Ala., below the present plant at Lock 12. A concrete dam 335 ft. in height at its crest will be built. The power house will be an integral part of the dam, having provision for an ultimate installation of five units. The initial installation will be two units of 24,000 hp. each. A 110,000-volt line will be built to the company's existing plant at Lock 12. The license will provide that work must be started on or before Sept. 1 and the initial installation be completed before Sept. 1, 1924.

The Home Colony Associations' project is for only 10 hp. to supply summer homes on Kitty Creek, Wyo.

The Love-Vonbrecht project covers existing works on the Salmon River in the vicinity of Custer, Idaho.

The Johnson project is for 7,927 ft. of transmission line to be erected in Inyo County, Cal., and to connect with a 33,000-volt line of the city of Los Angeles.

The Mitchell project covers 2 miles of single-circuit 10,000-hp. line in Ouray County, Col., to be connected with the Western Colorado Power system.

The preliminary permit which is to be granted to the Great Basin Power Company covers a 3,950-hp. development on the West and North Forks of the Duchesne River in Utah. Four transmission lines of a total length of 245 miles are proposed. The applicant estimates that the cost of the project will be $1,000,000. The permit is to be limited to two years.

The preliminary permit to be granted the Granite Falls Manufacturing Company at Hickory, N. C., covers

a power project on Wilson Creek in Caldwell County to develop 8,000 hp. The power is to be used for public utility purposes. Application for license must be filed before Oct. 1.

The preliminary permit asked for the State of Illinois covers power development at four sites on the Illinois waterway which is being constructed by the State. The power sites are at Brandon Road below Joliet on the Desplaines River at Dresden Island in the Illinois River at Marseilles and at Starved Rock on the Illinois River. Locks will be located at the power sites. It is the intention to utilize the excess flow above the needs of navigation for the generation of electric power. The permit will specify that it is not to be construed as an authorization for the diversion of water from Lake Michigan.

A preliminary permit to be issued to the Roanoke River Development Company of Richmond, Va., covers a project of 10,000 primary horsepower contemplated at Buggs Island in the Roanoke River near Clarksville, Va. It is expected that 50,000 secondary horsepower will be available. The permit will be limited to two years.

The preliminary permit which is to be issued to James B. Girand of Phoenix, Ariz., covers a power project in the canyon of the Colorado River just above the mouth of Diamond Creek, in Mohave County, Ariz., for various mining and irrigation uses.

The preliminary permit to be issued to the Merced Irrigation District, Merced, Cal., covers a project on the Merced River near Exchequer, Mariposa County, Cal., in which power will be subservient to the irrigation demands. During three months of the winter no power will be developed. The power developed will probably be fed into the San Joaquin Light & Power System.

The preliminary permit asked by the Utah Power & Light Company of Salt Lake City covers a power development in Bear River, in southeastern Idaho. A total development of 21,500 hp. is contemplated at four points, as follows: Soda Point, 6,000 hp.; Lava, 6,000 hp.; Narrows, 4,000 hp.; Mink Creek, 5,500 hp. The permit will be for a period of thirty-three months.

California Electrical Men Continue Co-operative Endeavor

THREE hundred and fifty men of the electrical industry, principally from the San Francisco Bay district, met at the annual meeting and "get-together" dinner of the California Electrical Co-operative Campaign in San Francisco on May 18. L. H. Newbert, chairman of the advisory committee, in addressing the meeting pointed out that the outstanding evidence of the success of the California movement was that it has been adopted in several other sections of the country.

H. F. Jackson, general manager of the Great Western Power Company, said that the test of the full power of the co-operative movement would come in the next year or two, when the supply of electrical energy and utilization devices would exceed the normal demand in California. W. E. Creed, president of the Pacific Gas & Electric Company, pointed out that the public service corporations lay at the foundations of modern existence and that a clearer conception of this fact must be brought home to every one in industry and agriculture. He stated that the success of the financing of power development in the West depended upon informing the people of the relation of industrial growth to electrical power supply.

Calvert Townley Suggests New Method of Stimulating World Trade

SPEAKING at a banquet held at Rochester, N. Y., recently by the local section of the American Institute of Electrical Engineers and six other technical societies, Calvert Townley, past-president of the A. I. E. E. and assistant to the president of the Westinghouse Electric & Manufacturing Company, ascribed the present stagnation of industry and commerce to the breaking down of export trade and suggested as a remedy the buying up of the most promising European industries by American capital and their operation under American management, providing work at good wages for European labor, so as to create general prosperity on the other side of the water and thus restore normal purchasing power. In the meantime, he pointed out, the securities of the industries taken over could be converted through the banks into American securities.

Semi-Centennial of the British Institution of Electrical Engineers

FIFTY years ago, on May 18, 1871, the Society of Telegraph Engineers was founded in London by a small body of military officers, scientists and electricians. This body has expanded into the Institution of Electrical Engineers, which has today nearly ten thousand members. Appropriate celebration of the society's "jubilee" is made in the columns of the London *Electrician* of May 13. Only two of the original sixty-six members are still living—Col. E. D. Malcolm and Sir Herbert Jekyll. Each of these pioneers contributes a few reminiscences of the early days, and the development of the society is discussed by President L. B. Atkinson and J. E. Kingsbury.

The broadening interests of the early society are sufficiently indicated in its changes of name. In December, 1880, the title was amended by the addition of the words "and of Electricians." In 1889 the present title was adopted. It was early recognized that the society had been founded to promote electrical science in all its branches. Later it developed from a body with a purely scientific objective into what, as expressed by the *Electrician*, it now is—"the representative body of a great industry anxious to put forward its opinions on and be consulted about everything which affects electrical interests."

Amendments to Water-Power Regulations Not Acted On

THE proposed amendments to the administrative regulations promulgated in connection with the water-power act were not considered at the meeting of the Federal Power Commission held May 20. Secretary Fall could not be present at that meeting, and it is desired to have all of the members of the commission present when these amendments are discussed. Beginning with June, the commission will meet regularly on the first and third Mondays of each month.

With the idea of conserving the time of the three secretaries it has been decided that in the future hearings will be held in the first instance by the executive secretary, who will render a preliminary decision. Appeal may be taken to the commission; otherwise the preliminary decision will be presented to the commission for approval.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Railway Electrification in Germany. — A European correspondent of the ELECTRICAL WORLD writes that the Ministry of Communications has just made the first appropriation of 40,000,000 marks for the electrification of the railway line from Munich to Regensburg, one of the principal lines in Bavaria.

Growth of Utilities Mutual Insurance Company.—The seventh annual report of the Utilities Mutual Insurance Company shows a growth in earned premiums for 1920 over 1919 of $211,700, the total amount for 1920 being $704,700. Since the organization of the company the earned premiums have amounted to $2,190,200 and the dividends paid to $485,000. Assets as of Dec. 31, 1920, are placed at $1,047,400, against liabilities of $632,800.

Hydro-Electric City in Ontario Gets Clear of Debt to Commission.—Guelph, a place of 15,000 population, is the first of the twelve cities which originally went into the Hydro-Electric Power Commission enterprise of Ontario to get clear of debt to the commission, and it is now turning its attention to the improvement of the city lighting system. The total cost of the plant in Guelph was $269,533, while the total surplus and depreciation reserve amounts to $210,945, and the sinking fund and debentures paid to $62,610.

Taxing Electric Lighting.—According to our Japanese contemporary *Denkinotomo*, a search for new sources of revenue has led the local government of Tokushima Province to seek to impose a tax on electric lighting graded according to the candlepower of the lamps in use. The permission of the central government is, however, necessary before such a tax can be enforced, and the electrical industrial societies of Japan have protested vigorously and hope to prevail on the central government to withhold consent to the plan.

Prone Pressure Saves Another Life. —Irving Staples, a foreman employed by the Central Maine Power Company, a short time ago, while "shooting trouble" on the company's high-tension system and attempting to use a portable telephone set, short-circuited the line and fell back with jaws set and blackened face, apparently dead. Linemen Butler and Linnell thought he was, but nevertheless started in with the prone-pressure treatment and after twenty minutes' work were rewarded by noticing a faint trace of breathing. When a physician arrived Staples was sitting up not greatly the worse for his narrow escape, which would have been impossible save for the company's instruction of its employees in life-saving methods.

Voluntary Rate Reduction in Missouri. —The Caruthersville & Kennett Electric Light & Power Company bears the distinction of being the first to ask the Missouri Public Service Commission to reduce its charges, the receivers of the company, J. S. Wahl and W. R. Shelton, Jr., having asked for a reduction of 5 per cent in present lighting rates. The company voluntarily went into the hands of receivers last October, not being able to pay interest on its bonds. In December, 1920, the commission increased the rates of the company 25 per cent, and the receivers now ask that this rate be reduced for the six months beginning June 1.

Industrial Teachers' Scholarships in New York.—The University of the State of New York is offering twenty-five scholarships to qualified industrially and technically trained persons who desire to prepare themselves for teaching. Persons selected to hold these scholarships who satisfactorily complete the prescribed one-year resident training course are licensed for life to teach their specific occupations in the vocational schools of the state. The salaries paid vocational teachers now range from $1,800 to $3,500 per annum. Detailed information can be had from the director of vocational and extension education, State Department of Education, Albany, N. Y.

California Railroad Commission Seeks Information on Price of Crude Oil.— Press reports of a reduction in the price of crude oil, in contradiction to the expressed opinion of a Standard Oil representative testifying recently before the California Railroad Commission, have led the body named to address to the Standard Oil Company and three other large oil companies of the state a request for prompt information on present and possible future reductions in the price of the product in question. This information, the commission says, is of special importance in view of the fact that there are pending before it a number of rate proceedings affecting electric and gas utilities in which the price of oil has a material bearing.

Coast Guard Cutters to Have Electric Drive.—The first of four electrically propelled cutters that are being built for the United States Coast Guard Service was launched a few weeks ago at Oakland, Cal. It measures 240 ft. in length by 39 ft. in width and 25½ ft. in depth and has a displacement of 1,600 tons. The boat has been named the Tampa after the Coast Guard cutter that was taken from the Florida station in the war to convoy American transports and was sunk in Bristol Channel in September, 1918, presumably by an enemy submarine, every man on board being lost. One of the advantages of the new drive is that the cutters so equipped will be much easier to control and can be reversed in much quicker time than the old type.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Association of Municipal Electrical Utilities of Ontario.—The semi-annual convention of this association will be held at the Clifton House, Niagara Falls, Ontario, assembling on Thursday, June 23.

Outing of Philadelphia Section, A. I. and S. E. E.—Next Saturday, June 4, the Philadelphia Section of the Association of Iron and Steel Electrical Engineers will hold its annual outing at Valley Forge, Pa.

British Electrical Engineers to Have New President.—The council of the Institution of Electrical Engineers has selected John Somerville Highfeld, a consulting engineer of London, for the presidency of that body, which becomes vacant on Sept. 30, in succession to Llewellyn B. Atkinson.

Japanese Society Elections.—Japan has an Institute of Electrical Engineers and also a Society of Illuminating Engineers among her engineering associations. Of the former Dr. Ho Ito, professor of electrical engineering in the Imperial University of Tokyo, has recently been elected president, while Dr. E. Aoyagi, professor of electrical engineering at the Kyoto Imperial University, has been elected as head of the illuminating engineers.

Coming Meetings of Electrical and Other Technical Societies

N. E. L. A. Annual Convention—Chicago, May 31-June 3. (For program see issue of May 7, page 1065.)

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

Northwest Electric Light and Power Association—Portland, Ore., June 15-18. (For program see issue of May 21, page 1180.)

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17.

American Society for Testing Materials—Asbury Park, N. J., June 15-18.

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

City May Sue for Benefit of Its Inhabitants.—In City of Saginaw vs. Consumers' Power Company the Supreme Court of Michigan affirmed the right of a city, as representative of its inhabitants, to sue an electric utility to compel specific performance of its contract, in order that a multiplicity of suits may be avoided. 182 N. W. 146.)*

Rights of Courts and Commission in Michigan.—The Public Utilities Commission law of Michigan did not, the Supreme Court of that state has held, in City of Saginaw vs. Consumers' Power Company, deprive the courts of the jurisdiction of a controversy presented by bill by a city in behalf of itself and its inhabitants to enforce specifically a contract of a utility to furnish electricity at certain rates, there being no question of adequate service involved and no previous acquisition by the commission of jurisdiction over the matter. (182 N. W. 146.)

Service Charge Permitted for Gas but Denied for Electricity.—In passing upon a motion for an injunction sought by the Meridian (Miss.) Light & Railway Company against the city of Meridian to prevent the enforcement of domestic rates fixed by the city, the United States District Court sustained the company in regard to a service charge of 75 cents a month for gas which it desired to collect but refused to permit a service charge for electric lighting. The court, however, decided against the city in the matter of rates for electric power, holding that the city was without legislative authority to prescribe a tariff of rates for motor service.

Contributory Negligence for Court When Facts Are Undisputed.—Ordinarily the question of contributory negligence is one to be submitted to the jury under appropriate instructions, but where the facts are uncontroverted and there is no room for reasonable difference of opinion the court is under duty to determine the question as a matter of law and instruct accordingly. So declaring, the Court of Appeals of Kentucky reversed a verdict for the plaintiff in Winfrey vs. City of Owensboro and Owensboro City Railway Company and ordered new trials. This was a peculiar accident case in which wind had blown down electric transmission wires across the road. Passing drivers shoveled dirt over the wires and attempted to cross, the wagon wheels sank through to the wires, the horses were shocked, and in attempting to unharness them the plaintiff's husband was killed. The contributory negligence of the victim, a man fully aware of the danger from escaping electricity, was held by the superior court to be manifest. (221 S. W. 135.)

Company Not Liable for Death of Boy Who Climbed Tower and Grasped Wire.—Damages were awarded by a jury in a circuit court to the father of a boy killed by electric shock and burns received when he climbed a tower to a height of 35 ft. and grasped a wire passing within 12 in. or 15 in. of this tower (Bonniwell vs. Milwaukee Light, Heat & Traction Company). The Supreme Court of Wisconsin has reversed the verdict, disregarding the alleged grounds of negligence on the part of the company based on the statement that although it had allowed boys to play around and climb upon the base of the tower it had not so installed and protected its lines as to make it impossible for a venturesome boy to meet injury from its high-tension wires. The boy, the Supreme Court held, was a trespasser when he climbed the tower whether or not he was a licensee while playing at its foot, and the company, which had placed conspicuous signs of warning on its towers, had not failed in precautionary measures. (182 N. W. 468.)

Validity of Franchise Contracts.—The following statement of fundamental principles underlying franchise contracts was laid down by the United States District Court for the Western Division of Pennsylvania in American Prake Shoe & Foundry Company vs. Pittsburgh Railways Company, a suit involving franchises granted to the railway company by the city of McKeesport: "The public has an interest in every contract entered into by a public service corporation, whether it be a contract by writing and signed by both parties thereto or a contract arising by reason of the passing of a municipal ordinance and its acceptance by the public service corporation intended to be affected thereby. Such contracts, because of the interest of the public therein, are not to be classed with those personal and private contracts the impairment of which is forbidden by constitutional provisions. The public service corporation cannot charge undue and excessive rates, for such conduct would be oppressive to the public. On the other hand, the public cannot continue to use the instrumentalities of the private corporation without permitting to the owners thereof a fair return upon a fair value of such property (not dividends upon inflated capital or interest upon excessive bonded indebtedness), for such refusal would amount to confiscation. To avoid oppression on the one hand and confiscation on the other should be the mutual desire of the parties interested in such franchise contracts." (270 Fed. 812.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Rural Rates in Illinois.—The Illinois Public Utilities Commission has denied an application from the Spring Valley Utilities Company to place in effect revised regulations governing its rural electric service. Although admitting that the proposed charges appear just and reasonable, the commission was obliged to reject them because they did not conform to its uniform schedule of rural rates, to which, it holds, close adherence must be imposed.

Line Extensions in New York.—In ordering the People's Gas & Electric Company of Oswego to extend its lines a distance of about one mile to serve outlying customers provided that a certain number of signed applications for service from such connections are filed the New York Public Service Commission for the Second District said, alluding to principles established by the United States Supreme Court: "This company is in a prosperous condition, and there is no claim that suffering a small loss on the proposed extension would render its business as a whole unprofitable. While this company holds its franchise it is fair to presume no other company could procure one to operate in this territory. The applicants can get no electricity unless they are supplied by this company. It is the duty of the company to supply their needs, if practicable. The cost of the extension is not the only matter for consideration."

"Going-Concern Value."—In passing on an application for an increase in natural-gas rates, the Montana Public Service Commission took occasion to reiterate its previously stated view of "going-concern value" as follows: "There can be no question of our duty to make an allowance for 'going-concern value' in a rate case involving an established utility, and here we must be careful to determine what going concern value is: 'The value which inheres in a plant where its business is established, as distinguished from one which has yet to establish its business.' The test is whether the bare bones are assembled in place, connected to function, and under human management, in motion rendering service to a dependent clientele. Neither the absence of good will nor of remunerative returns necessarily disparages the reality of 'going-concern value.' Consumers may be positively hostile to the plant, which may just be able to meet operating expenses, and yet the plant possesses 'going concern value' because its business is established."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Samuel Insull, president of the Commonwealth Edison Company and chairman of the board of directors of the People's Gas Light & Coke Company, was born in London, England, on Nov. 11, 1859. He was educated in private schools at London, Reading and Oxford, England, and came to America in 1881. Mr. Insull began his business career as private secretary to Col. George E. Gouraud in London from January, 1879, to February, 1881. Colonel Gouraud was Thomas A. Edison's representative in London in connection with telephone and other matters. During the time of Mr. Insull's connection with Colonel Gouraud the Edison Telephone Company of London was organized. In March, 1881, Mr. Insull came to the United States to act as private secretary to Mr. Edison, the arrangements under which he obtained this connection having been made through Edward H. Johnson, whose acquaintance he had made in London. Mr. Edison and the Edison Electric Light Company established headquarters at 65 Fifth Avenue, New York, and started the commercial development of the Edison central-station light and power system in February, 1881. Mr. Insull's first duties as Mr. Edison's private secretary were to assist him in the establishment of the various manufacturing concerns which were founded in connection with the commercial development of the electric lighting system. These establishments were the Electric Tube Company, the Edison Lamp Company and the Edison Machine Works. Mr. Insull's duty, besides having general charge of Mr. Edison's other business affairs, was to take care of the financing of the three establishments in question and to advise and assist in the financing of Bergmann & Company, in which Mr. Edison had also acquired an interest. In 1887 the Edison Machine Works, which had been established on the East Side of New York in 1881 and which had ultimately absorbed the Electric Tube Company—established in 1881 at 65 Washington Street and later on having a shop in Brooklyn—were moved to Schenectady, N. Y. At this time Charles Batchelor was general manager of the Edison Machine Works, Mr. Insull was secretary and treasurer and John Kruesi was assistant general manager.

Mr. Insull took up his residence in Schenectady in 1887 and assumed, at Mr. Edison's request, the general management of the Schenectady works with Mr. Kruesi as his assistant, Mr. Batchelor confining himself mainly to work at Orange, N. J., in Mr. Edison's laboratory. The development and management of the Schenectady works were under Mr. Insull's charge from their establishment at Schenectady in 1887 until 1892. He continued as general manager until 1889, when with the Edison Light Company the various Edison manufacturing concerns were consolidated into the Edison General Electric Company, of which he was second vice-president in charge of the manufacturing and selling departments until 1892. At that time another consolidation, with the Thomson-Houston Company, resulted in the organization of the General Electric Company. Mr. Insull continued as second vice-president of this new company until June, 1892, when he resigned.

Mr. Insull then became president of the Chicago Edison Company and of the Commonwealth Electric Company, 1892-1907, and later of the Commonwealth Edison Company, after the consolidation in 1907. He is in addition chairman and president of the People's Gas Light & Coke Company of Chicago, president Public Service Company of Northern Illinois, president Middle West Utilities Company, chairman executive committee Chicago Elevated Railways, chairman board of directors Chicago, North Shore & Milwaukee Railroad and Chicago & Interurban Traction Company, member of committee Chicago and City Connecting Railways Collateral Trust, and chairman board of directors Northwestern Elevated Railroad Company, South Side Elevated Railroad and Metropolitan Elevated Railroad Company of Chicago. These various companies have a gross business of more than $100,000,000 per annum and have securities outstanding of about $470,000,000.

Union College of Schenectady, N. Y., on June 13, 1917, conferred upon Mr. Insull the degree of doctor of science in recognition of his achievements as an organizer and administrator.

During the war Mr. Insull, as chairman of the Illinois State Council of Defense, devoted his entire time to the war work carried on in the state as the active head of the body named.

He is a member of the American Institute of Electrical Engineers, of the Institution of Electrical Engineers (British) and of numerous other technical bodies.

William T. MacPherson has been appointed chairman of the central committee on co-operation maintained by the Public Service Company of Northern Illinois to govern relations between company and employees. Mr. MacPherson, who takes the place of J. L. Hecht, recently elected assistant to vice-president, will be in the general office of the company at Chicago. He began his employment with the Northwestern Gas Light & Coke Company in 1911, going into the organization of the Public Service company when it took over the properties of the former corporation. On being mustered out of army service in 1918 he was made superintendent of District O and held that position until recently.

Owen D. Young, vice-president of the General Electric Company, was elected a director of the Merchants' Association of New York City at its annual meeting, May 17.

Obituary

Col. Charles M. Jarvis, for many years one of the outstanding figures in the steel-structure production industry, died May 21. He was well known in the electrical field, particularly in the nineties, when as president and chief engineer of the Berlin Iron Bridge Company he designed and built numerous steel structures for electrical generating and manufacturing plants. Later he organized the American Bridge Company as a subsidiary of the United States Steel Corporation. This organization also does extensive work in the electrical field in building construction and transmission-line tower fabrication.

Col. J. F. Strickland, a well-known pioneer in the development of electric light, power and railway service in Texas, died in Dallas on May 21. Mr. Strickland was born near Gadsden, Ala., Dec. 9, 1860. He moved to Texas in 1878 and had been closely associated with public utilities since 1897. At that time he was engaged to manage an electric light business at Waxahachie, Tex., and to operate a mule-drawn street-car line. In 1906 he organized the Texas Traction Company, which built an interurban line between Dallas and Dennison. In 1912 he organized the Southern Traction Company, which built lines between Dallas and Waco and between Dallas and Corsicana. These two companies were merged in 1917 under the name of the Texas Electric Railway, whose lines totaled 215 miles in length. In 1912 Colonel Strickland was the head of a syndicate which controlled the electric light properties in Waco, Cleburne, Hillsboro, Waxahachie, Sherman and Bonham. These properties he sold to a new company, known as the Texas Power & Light Company, which now serves ninety-four communities. At the time of his death Colonel Strickland was president of the Texas Power & Light Company, Dallas Power & Light Company, Dallas Railway Company, Texas Electric Railway and also Dallas Securities and Union Trust companies. He was one of the organizers of the Southwestern Electrical & Gas Association and had been prominent in all electrical affairs of the Southwest, including the Jovian Order, with which he was early identified.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Returning Market in Air-Circuit-Breaker Field

ALTHOUGH the market for air-break circuit breakers can be characterized as only fair, nevertheless reports from manufacturers indicate a real upward trend in business. In general March has been better than February and April better than March, while May has started out at a still better rate than April. Much of this business, however, has resulted from intensive sales efforts and has not come by any waiting policy. The market presents a spotty tone at times rather than an even flow of business. But the total adds up fairly well, and it is felt that by the late summer or fall this business will have picked up considerably.

A feature of the ordering is the quick shipments that are so often required. Apparently customers have waited till the last moment to order, and generally they have been accommodated. Shipments from factory stock are commonly made, and up to two weeks is about as long as is necessary to fill a bill. Whole panels using air-break equipment seldom take more than three weeks now. Much of this air-break equipment can be stocked and most manufacturers are working toward this end.

Industrial plant buying is very quiet. Utilities are providing considerable activity, and the same can be said for hotels, apartment houses, etc., for use on either street service or isolated plant lines. For the large station boards there is little market at present. Electric railway buying, both for station and for substation boards, is reported extremely dull.

Factory operation is well below capacity, probably 50 per cent, and overhead and labor charges are still heavy under these conditions. Raw-material prices are down considerably, it is true, but with labor entering into the breaker cost so materially certain producers have made no change in prices. On the other hand, there have this year been recessions from the peak of from 10 per cent to 25 per cent by certain manufacturers.

Noticeable Pick-up in House Meter Business

CONSIDERABLE activity is reported in sales of integrating watt-hour meters for residential use. For the time being industrial concerns are making few extensions and sales of power meters are very quiet. One of the more active sources is shown to be among summer-resort customers because central stations have made it a practice in several communities to remove meters from summer places after these have been closed for the winter and use them in needed locations on their lines. These meters have filled a temporary demand and new ones are now being bought to supply the summer demand again. Suburban wiring of old houses also is enlarging the meter demand.

Central-station companies in general througout the country are buying only as needed, but several of the larger ones have begun to look forward a bit and have placed orders which will form the basis of a fair stock. This is rather more noticeable in the eastern and central belts of the country, where the demand is such as to provide a really fair meter business.

Meter manufacturers are not working to their full capacity but are operating sufficiently to supply present demand and at the same time lay aside stocks in large enough quantity to enable them to fill orders from stock and still not have these stocks topheavy. The gradual working up to this condition and the holding of a constant level is the manufacturers' aim. Factory stocks now are not such in every case that they would be able to satisfy a real summer demand and a buying spurt, it is felt, would work stocks down to a low level.

According to the permits for buildings filed during the month of April the increase in building activity should be pronounced in the months to come. Compared with the permits filed for the first three months of this year, April stands out well. It will probably be midsummer before these permits come through to the electric wiring stage, but the meter outlook is already better than it was a month ago and it is believed will become still better as the year advances.

Similarity of Forms and Colors for Jobbers' Consideration

TWO of the subjects submitted for discussion at the meetings of the Electrical Supply Jobbers' Association, which came to a close at Hot Springs, Va., on May 27, were the standardization of methods and forms within the jobbing house and the standardization of paper color for discount sheets.

The committee on methods and forms, F. E. Stow chairman, in its report submitted recommendations on the general methods to be followed and forms to be used in the purchasing, receiving, shipping and charging departments in electrical supply jobbing houses. A standard purchase form shown carried only two requests—that the order number be placed on invoices and packages and that the bill of lading be inclosed with the invoice. The size of sheet, 8½ in. x 11 in., and the arrangement of printing were definitely recommended.

For the receiving clerk a bound book containing receiving forms printed in accordance with the sample presented was recommended by the committee. For shipping and charging departments it was recommended that every jobber establish and maintain a stock record system, suggestions for which were presented.

To eliminate the confusion frequently experienced with the varieties of colors used for discount sheets covering the different classes of the trade samples of two weights of paper in four colors were prepared for presentation at the convention. The scheme would allot russet brown paper for distributers' lists, goldenrod for jobbers' prices, blue for contractor-dealers' prices and pink for consumers.

Lower Prices Quoted on Brass Rods, Sheets and Tubes

REDUCTIONS in brass prices of the order of 1 cent per pound were announced last week in manufacturing circles. Makers of schedule material expressed to the ELECTRICAL WORLD their satisfaction in this reduction upon receipt of the new price lists. At present business in the brass field as related to electrical production is much below normal, but a leading producer of socket-shell material said last week that the May business had been considerably better than that of April. The chief demand just now is for copper products. Competition for business is very acute. Reductions in wages and salaries of the order of 10 per cent have lately been made in the brass industries, and some

of the mills are running on half to two-thirds time. A 10,000-lb. order looks large today.

There has been no change in the price of copper products since April 18, according to a representative manufacturing establishment. The new base prices for brass in quantity lots as issued by a leading house are as follows: Sheet metal, high brass, 16¼ cents per pound; low brass, 17⅜ cents. Wire, high brass, 17¼ cents; low brass, 18¾ cents. Rods, high brass, 14½ cents; low brass, 18¾ cents. Brazed tubes, brass 27½ cents. Seamless tubes, high brass, 20 cents; low brass, 21½ cents; copper, 22 cents; copper sheets, 20.50 to 20.75 cents; copper bottoms, 28 to 28.25 cents; copper rods, round, 19.25 cents.

Swiss Electrical Manufacturers' High Production Costs

THE Swiss electrical industry, which has always been dependent upon exportation, is finding itself in a very critical position, according to the ELECTRICAL WORLD'S correspondent in Switzerland. This statement applies especially to the large plants turning out all kinds of electric machinery. In order to be able to compete with foreign manufacturers it will be necessary to reduce the cost of production as well as the wages of the workmen. As to the latter a comparison was recently published by the Association of Swiss Machinery Manufacturers showing the average wages per hour of adult workmen in the machinery and metal industries at the end of 1920 as follows:

	Home Currency	Swiss Currency
Germany	6 00 to 6 50 marks	59-63 centimes
Austria	35 00 crowns	61 centimes
Italy	2 40 lire	58 centimes
France	2.15 to 2 80 francs	88–115 centimes
Belgium	2 30 francs	99 centimes
Switzerland	1 76 francs	176 centimes

From these figures it will be seen that wages in Switzerland are considerably higher than in any of the competing countries. Furthermore, Switzerland has to import most of the raw material used in her electrical industries, and only a reduction in the cost of production as well as a reduction in wages will enable the Swiss plants to compete successfully in foreign markets.

Schedule Material Makers More Than Holding Their Own

MANUFACTURERS of schedule material, while operating considerably below their plant capacity and on shortened weekly time, spoke, when visited by a representative of the ELECTRICAL WORLD last week, of a real improvement in business conditions. There is a feeling abroad in the trade that the low point of the depression is now well astern. In one representative establishment, for example, actual orders received during the first fifteen days of May correspond to an index number of 100. The corresponding orders for the first half of April on this scale were 68, for March 90, for February 93, and for January 68. This included both domestic and foreign business booked during the first fifteen days of the above months and indicates a real improvement in trade. Another good-sized concern asserted that while the plant is running four days a week just now an expected slump in orders during May did not materialize. The originating business does not appear to be confined to one section of the country but is well spread around, and in one case at least foreign orders are as high as 40 per cent of normal. In the face of the present exchange situation this is considered a remarkably good showing.

During the expansion period many manufacturers by vigorous efforts accumulated heavy stocks of raw material purchased at high prices. A large amount of this material is still on hand to be worked up. This runs into big figures and in one case easily approaches half a million dollars. It has not yet been possible for such manufacturers to take active advantage of the recessions in the prices of copper, brass and other commodities entering into their own output. Undoubtedly as soon as existing raw material supplies in the factories run low enough purchases of the raw commodities at lowered rates will be made on a much larger scale. Just as manufacturers wish to liquidate these stocks before committing themselves to large purchases many jobbers desire to dispose of their supplies of sockets, switches, etc., before placing large orders with the factories.

The improvement in the building trade in some parts of the country where construction has been at a standstill for a considerable time is helping, even if moderately, to improve conditions in the production and sale of wiring devices. Some price adjustments have occurred and others are naturally to be expected from time to time, but it is pointed out that drastic cuts in one or two lines by concerns of small size and very limited facilities by no means prove that prices can be sharply cut in relation to the thousands of items which make up this great class of electrical material.

Labor conditions now are much better from the productive standpoint, although wages have not been reduced much as yet. Domestic-appliance fittings are moving reasonably well, and the outlook for the conservative manufacturer is believed to be very much better than it was even a few weeks ago.

The Metal Market Situation

FURTHER improvement is noted in the copper market and prices have again stiffened. The two factors responsible for this are the continued gain of the statistical position and strong export buying. Domestic consumers have been feeling out the market but they have not purchased to any great extent. Total sales of copper for export last week are estimated at about 24,000,000 lb., of which total Germany and France were large buyers. The export price at present is about 13.25 cents f.a.s. New York.

Producers have raised their prices to 13.37½ to 13.50 cents delivered for prompt, May and early June shipment, but late June is held at ⅛ cent advance over that and July at 13.75 cents delivered. For the entire third quarter from 13.75 cents to 14 cents is asked, and there seems to be some speculative interest in August and September deliveries at those prices. As noted elsewhere this week new lists have been issued reducing brass and bronze products about 1 cent per pound.

Lead buying is very small as demand has fallen away to a large extent following the recent price increases. The domestic market for zinc is inactive, foreign buying is flat and prices are easy. Tin shows no evidence of resumption in demand either, and consumption in England is almost at a standstill by reason of adverse conditions such as the coal strike.

The scrap metal market displays little life. Buying of scrap copper, especially heavy metals, is the main feature and prices there are slightly firmer.

NEW YORK METAL MARKET PRICE

	May 17, 1921	May 24, 1921
Copper	£ s d	£ s d
London, standard spot	74 2 6	74 0 0
	Cents per Pound	Cents per Pound
Prime Lake	13 00—13.25	13 25
Electrolytic	13 00	13 12½-13 50
Casting	12 25	12 62½
Wire base	14 50—15.00	14.75—15 00
Lead, trust price	5 00	5 00
Antimony	5 25	5 25
Nickel, Ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.35	5.25
Tin	33 00	32.25
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 25 –10 62½	10 50—10 75
Brass, heavy	5 25 - 5 50	5 25— 5 50
Brass, light	4 00 - 4 12½	4 00— 4 25
Lead, heavy	4 25— 4 50	4 25— 4 40
Zinc, old scrap	2 50— 2.75	2.50— 2.75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

THE tone in the supply jobbing field is distinctly upward, coming from an increasing number of orders and inquiries that have turned to orders rather than from larger orders in themselves. New York, St. Louis, Atlanta and Boston territories show better return in this respect, the district outside of Chicago is active, while Chicago itself is quiet. The Northwest jobbers too are somewhat better off. The Intermountain section is quiet, and California, except in the south, is not very active. Building labor difficulties still affect business in and around San Francisco and in Chicago, but otherwise April activity showed a favorable increase over the first three months of the year.

Ability of manufacturers to make quick shipments on supplies permits jobbers to run close to the edge on their stocks, and they are reordering only to keep stocks in a sufficiently liquid condition to handle current trade. There has been a 25 per cent reduction in "Nail-it" knobs, and locally wire, flexible armored conductors, pipe and schedule material have shown softening tendencies.

NEW YORK

A general improvement to trade last week is indicated by reports received from jobbers, most of whom notice a slight but distinct increase in sales covering the whole electrical supply line. Orders were not larger in themselves but were received in greater number.

A 25 per cent price decrease on "Nail-it" knobs has been made. Prices on armored conductor are being cut materially, also on schedule material. Conduit and rubber-covered wire quotations are soft too. Some activity in fan buying is reported recently. Stocks in almost every line are good, while overstocks are reported on very few items, chiefly socket heating devices, some lines of schedule material and wire.

Buying is only for maintenance, and the trade seems satisfied that business depression will last until about September. There are hopeful signs in the building industry, however. The strike of 12,000 building trades workers in Westchester County has been settled with a cut in wages of $1 per day, and the tie-up of the local brick supply through the strikes of the brick handlers and of the barge captains now seems to be nearing an end. The value of building permits issued in New York City during April totaled about $30,000,000, compared with a total of $63,000,000 for the entire first quarter.

Outlet Boxes.—The supply is uniformly good, but demand is spotty. In lots of 100 the quoted discount on black boxes ranges from 45 to 50 per cent and on galvanized from 40 to 45 per cent.

Flexible Armored Conductor.—The average nominal market for No. 14, two-wire, double-strip, at present is about $55 to $57 in 1,000-ft. lots, but prices in this territory are being cut right and left. Quotations far below the above prices have been reported, but it is doubtful if they are legitimate offers. Demand is light and stocks are fair.

Lock-Nuts, Washers and Bushings.—Although cable connectors have dropped as reported last week, no price change has occurred on this material. Several jobbers are allowing 50 to 55 per cent discount in standard packages, but others give as high as 65 to 68 per cent off. Good supplies are held, but demand is light.

Rubber-Covered Wire.—The market is weak and stocks are still fairly large. From $6.75 to $7 per 1,000 ft. is quoted this week on 10,000 ft. of No. 14 single-braid.

Heaters.—Some few were sold early this month during the cold weather which prevailed, but the spring season has been a disappointment and supplies on hand now will have to be carried over. Stocks are spotty. All jobbers exercised great caution in buying, and as a result a goodly number are cleaned out, while on the other hand stocks up to 3,000 are reported.

Porcelain.—A decrease in the price of "Nail-it" knobs, effective May 20, has been announced. The cut, which is made by increasing the discount 8⅓ points, amounts to about 25 per cent. Tubes and cleats are not affected by the change.

Schedule Material.—Considerable price cutting is being done, but supplies are not moving. One jobber at least is overstocked on sockets, but in general it is only on a few special items that a surplus is carried because houses are merely replenishing stock and no more.

CHICAGO

Another quiet week has passed with the electrical industry apparently doing better than most other lines. The local employment situation is no better.

Outside of Chicago things are gradually improving, and it is only a matter of time till Chicago trade is favorably influenced thereby. In the electrical jobbing trade the statement is frequently made that while inquiries are no more numerous than during March and April more of them are being turned into orders than before. Business is notably better in schedule material and in inside wire, and many rewiring and alteration jobs are under way.

In certain places it is felt that the local construction labor trouble will be settled before June 1, and if that is true an immense volume of work will immediately proceed. In anticipation of such a conclusion to the negotiations now being carried out dealers are building up stocks of construction materials. Prices in general are a little lower, and it is felt that a gradual decline will be in evidence for some time.

Wire.—Copper wire, bare, has registered no change, 16½ cents per pound still ruling on lots of ordinary size. No. 14 rubber-covered, at $7 per 1,000 ft. in 10,000-ft. lots, is unchanged. On smaller quantities 25 cents more is asked. Weatherproof is easier, on a 15-cent base, the No. 6 triple-braid now being offered at 16½ cents per pound in quantities of 1,000 lb.

Flexible Armored Conductor.—No. 14, two-wire, double-strip, at $57.50 per 1,000 ft., represents a drop of about 5 per cent. Sales have been very slow but are better now. The local trade seems to expect lower prices in the near future, although some few contractors and dealers are now acquiring stock.

Black Conduit.—In spite of the fact that it was said the price of conduit had anticipated the April reduction in steel further price recessions have occurred. In 1,000-lb. lots ½-in. black conduit is now offered at $59 per 1,000 ft.; in 5,000-lb. lots it is $1 less. Price cuts have developed a fairly lively demand, particularly from the country districts.

Knobs, Tubes and Cleats.—Overstocks never having developed trade is good as demand is heavy on account of the large amount of alteration and rewiring work being done. Split knobs, without nails, No. 5½, are quoted at $17 per 1,000 in barrel lots, the "Nail-it" variety at $23. Tubes, ⅝-in. x 3-in., in similar quantity, are $8 per 1,000.

Lock-Nuts and Bushings.—In common with other wiring accessories these are in good demand, jobbers' price on lock-nuts being $1 per 100, and on bushings $1.85 per 100.

Fuses.—Owing to decreased industrial activity trade in fuses of large size is dull. Small sizes are in good demand. Non-renewable type, most in demand on country orders, are quoted at $13.40 per 100 on the 0-amp. to 30-amp. size and $20.10 per 100 on the 30-amp. to 60-amp. size, 250-volt rating.

BOSTON

A marked improvement was evident at the beginning of the week in the volume of orders handled by electrical jobbers and manufacturers in various lines. It is felt in many quarters that a distinct advance is being made toward better times. Collections are holding up reasonably well, and on the whole the tendency is toward improved conditions. Raw materials are plentiful and the prices of these have been pretty thoroughly liquidated, according to leading industrial executives. The gradual liquidation of labor continues, with decided improvement in individual efficiency. Jobbers' stocks are being replenished by moderate purchases. Deliveries are excellent, and prices, while firm in many lines, exhibit a downward tendency in wiring material of the heavier sort. Building and engineering contracts in New England for the week ended May 17 totaled $3,796,600, an excellent showing compared with most recent years. Full recovery of electrical contracting business is retarded by labor troubles. A little more expansive buying by central-station companies is reported. It has been announced that construction work on war vessels will occupy the Fore River shipyard to the extent of about $40,000,000 during the next two years.

Wire.—Sales of rubber-covered wire became active last week, one house disposing of about 600,000 ft. of No. 14. Stocks are good, and in lots of 5,000 ft. to 25,000 ft., $7 per 1,000 ft. is a going price. Above 25,000 ft. no fixed prices prevail, a typical figure being $6.75 per 1,000. Moderate sales of weatherproof are noted on a 16½-cent base, and bare copper wire is selling around a 15½-cent base. Some steam-railroad wire purchases featured the market.

"Nail-it" Knobs.—A leading house reduced prices Monday as follows: Less than unit quantity, $40 to $35 per 1,000; unit quantity, $32.75 to $25 per 1,000; standard package quantity (barrel lots), $27 to $21 per 1,000. This change is expected to stimulate sales perceptibly. Stocks are ample.

Flexible Armored Conductor.—This material is moving better than of late. Increased building construction is absorbing more and scattered orders of small-size help to swell the total. Deliveries are good, No. 14 double-strip selling at $65 per 1,000 ft. in coil to 1,000-ft. lots.

Fittings.—Prices are steady with fair sales only. All armored conductor fittings except couplings are selling at 25 per cent off double manufacturing list in less than standard-package lots, with 40 per cent off on 2,500 assorted. Connector prices range from $9 per 100 in less than standard packages to $6.50 per 100 in lots of 500 only.

Non-Metallic Flexible Conduit.—Some ⅜-in. conduit is moving, a representative price in 5,000-ft. lots being $21.

Dry Cells.—A pretty active demand is reported for automobile service. The No. 6 cell brings $37.35 per 100 in barrel lots, the ignition type moving at $38.35.

Rigid Conduit.—The market is rather dull on account of the slow revival of building operations. Some pipe is moving, however, in small orders. Black conduit in 2,500-lb. lots sells for $67.30 per 1,000 ft. in the ½-in. size and for $131.20 in the 1-in. diameter. Galvanized pipe in these sizes is quoted respectively at $72.40 and $141.40.

Appliances.—A few fans were sold Monday as a result of the sudden but short-lived spurt of hot weather. Reduced prices on flatirons, it is believed by leading distributers, will increase buying.

ATLANTA

While business for the month of May has not so far equaled in volume that of March, jobbers report an increasing display of interest on the part of dealers and contractors in the small towns and outlying districts. There is a marked increase in the number of inquiries being received, and while orders continue to be small in size the volume is slowly increasing. The organization of banking houses to assist in the export of Southern products and the establishment of local branches under the federal farm-loan bank act is serving to create a feeling of confidence in the agricultural sections, and this, of course, is reflected in a better outlook in the small communities. Inquiries from large industrial plants continue to be received, and quite a number of additions and improvements are being undertaken. Wage reductions in the building trades are stimulating the construction of small residences and commercial houses and also repairs.

A general improvement in operating conditions is expected to stimulate maintenance and new construction work on the part of small central-station companies and municipalities within the next sixty or ninety days in anticipation of fall requirements.

Fans.—The unseasonable weather has served to check the movement of both desk and ceiling fans, though this check is but temporary. Stocks are on hand in sufficient quantities to last until July 1, and jobbers anticipate a good season.

Heating Devices.—Despite a reduction of 10 per cent little or no volume to sales is noted. Flatirons continue to hold a fairly steady gait, but hollow ware might be said to be dead. Jobbers report heavy stocks in all lines.

Safety Switches.—The demand continues to increase slowly, the most popular sizes being the two-pole, 30-amp., and three-pole, 60-amp. and 100-amp. Although one manufacturer has announced a price reduction the other manufacturers state that no reductions are contemplated in their lines. Fair stocks are on hand with shipments good.

Tape.—A brisk movement has followed a price reduction of 15 per cent and stocks have become very spotty. One of the leading jobbers is having to bring in shipments by express to meet the demand. Black friction tape is quoted at 40 cents per pound and shipments average two to three weeks.

Call and Signal Systems.—In spite of the large number of inquiries and quotations that are outstanding this line continues dull, buyers apparently holding off on account of prices. Jobbers report ability to get shipments very promptly.

Distribution Transformers.—A steady though not large sale of transformers, particularly in sizes up to 5 kw., is reported with occasional large sizes in demand. This will increase slightly as the damage from lightning during the summer season begins to be felt. Stocks are in excellent shape and shipments satisfactory.

Lightning Arresters.—A fair volume of sales is reported, but it is not up to expectations or to that of former seasons. The compression type is selling comparatively well. Stocks have been allowed to run rather low in certain types, but shipments are satisfactory. A price reduction of 10 per cent was announced recently.

Single-Phase Motors.—Supply has caught up with demand in this line and the movement is rather sluggish.

ST. LOUIS

There was but one occurrence of note of an industrial nature during the past week—the reopening of the largest automobile assembly plant here on a 20 per cent production basis. This gives employment to a good many men, and the result is a feeling on the part of the general public of increased stability in business. Electrical jobbers report a marked increase for the week in sales of general supplies. The demand for electrical materials entering into construction enterprises is still quite slack. There is an underlying feeling that the costs of building materials are higher locally than should be the case, and investigations are being conducted by the state. Because of the slow reductions in materials and labor there is a tendency to postpone construction work still further.

Stocks in the hands of the electrical jobbers are considered to be kept on a low basis. This can readily be done, for the manufacturers in general are maintaining ample stocks to meet all immediate requirements. Some are increasing their stocks of copper wire because of the extremely favorable prices now prevailing.

Only a small amount of new power business is reported by the utilities because of the lack of industrial activity. A number of large inquiries are on hand, however, and betterment is expected this fall.

Fuses.—An increase of fourteen points in the discount on renewable fuses is reported by a large jobber this week. On this basis, 30-amp. renewables in standard packages are selling at 29 cents each, net. Non-renewable, N.E.C., 30-amp. fuses in standard packages sell at 9 cents to 10 cents each. A continued steady demand is experienced in all kinds and sizes.

Lamp Cord.—Stocks of lamp cord may be a trifle too heavy, and the demand is quite low. Prices remain firm, No. 18 twisted cotton pair being quoted at $16 per 1,000 ft. in 5,000-ft. lengths.

Wire.—Some improvement in the demand for all kinds is reported, probably due to the extremely low prices prevailing. No. 14, rubber-covered, is quoted from $6.50 to $7.00 per 1,000 ft. in 5,000-ft. lots, the general quotation being $6.75. Special brands of wire are selling in large lots as low as $6.35. The St. Louis base on bare copper wire is about 15½ cents, and that for weatherproof from 15 cents to 16 cents.

Flexible Armored Conductor.—Very little demand was experienced last week. The price remains at $60 per 1,000 ft. in 5,000-ft. lots and is firmly maintained, though stocks are somewhat heavy.

Conduit.—A steady but low call for conduit is found, the demand being principally for minor changes in industrial plants. The ½-in. black is selling from $61 to $70 per 1,000 ft. The tendency is to keep stocks at a minimum in the expectancy of lower prices.

Knobs and Tubes.—Prices are being firmly maintained. "Nail-it" knobs are quoted from $24 to $28 per 1,000 and 2½-in. tubes at about $8.50 per 1,000. The demand is low and consists of small replenishments of contractors' stocks.

SAN FRANCISCO

There is a large amount of building in southern California, but it has fallen off to a mere trickle in the San Francisco Bay district because of the building strike. Appliance business has been mending steadily during the present month, although the volume is still far short of last season.

The labor situation in San Francisco is particularly critical. Building operations are virtually at a standstill and a bitter fight to a finish is expected. It is probable this fight will be extended to neighboring counties and that building operations there will soon be similarly affected. Disappointing news comes from Washington in the refusal of the Senate to sanction an expenditure ultimately amounting to $20,000,000 on a naval base for which a site had been selected in Alameda, opposite San Francisco. It is confidently felt, however, that the base is not finally lost.

Household Material.—Appliance dealers report better selling conditions during May with a trend toward normal. Although schedule material and wiring staples have dropped household appliances have changed very little in their retail prices since last fall. The standard washing machines still average $160 or $170 and the standard vacuum cleaners about $60 f.o.b. Pacific Coast. Some dealers assert that even price reductions will not stimulate the buying public, who seem to be withholding their purchases as much for doubt of events in the immediate future as for lower prices in definite articles. Sewing machines are receiving special attention, a number of demonstrations of table-top machines being reported as well as an increase in sales on the portable types, all makes seeming to participate in the sales increase. Dishwashers are especially active, nearly every dealer and department store displaying or demonstrating a sample.

Schedule Material.—The building strike has caused an almost complete cessation of jobbers' orders from the districts affected. Not only have the stock orders dwindled, but even the small pick-ups of semi-special articles have dropped off, and this is a valuable gage of existing business. Local manufacturers' stocks are very good and jobbers are depending upon them without purchasing unduly large quantities. Renewable fuses have decreased about 30 per cent in package-quantity prices. Stocks are very good, and the sales have dropped off and are principally for refills with spasmodic orders for the larger cases.

SALT LAKE CITY—DENVER

Business generally was sluggish during the past week. Jobbers are coming to the point of accepting the prevailing conditions for what they actually are and increasing their efforts accordingly to find an outlet for merchandise.

Few applications for building permits have been filed in the past week in the larger city centers. Construction of buildings involving big investments is scarcely known. Contractor-dealers, however, are finding relief in the small-home-building campaign that is now launched. That it will grow in volume as the season progresses is the belief. Complaint is heard on every hand that the high price of skilled labor is the biggest obstacle to general construction work. Indications point to the gradual, though slow, absorption of unemployed labor in agricultural and other industries.

Banks are not yet in a shape to relax their rigid stand in money matters, and loans are still next to impossible to obtain. This stringency is reflected particularly in collections, which show little improvement from week to week. June 6 to 11 has been designated jobbers' week in the Intermountain region. Dealers who can be induced to come to jobbing centers to make purchases will have their railroad fares rebated to them, provided that their purchases reach a scheduled amount.

Fans.—Fan business to date is disappointing. The weather continues cold and stormy and dealers show little interest in stocking. Jobbers are well prepared to meet demands in any quantities and look for a big movement with the advent of the first spell of hot weather.

Lamps.—Incandescent lamps are moving slowly as the active season tapers off. Dealers have had a good year and there is no complaint of excessive stocks.

Lamp Cord.—The growing use of lighting fixtures is making big inroads on the lamp-cord business. Supply on hand is ample for all needs.

Street-Lighting Installations.—Cities and larger towns are making inquiries into street-lighting possibilities. The general wave of civic improvement is given as the cause of the unusual interest. Several big contracts have recently been completed.

SEATTLE—PORTLAND

Manufacturers in this district report that there is a considerably stronger feeling of optimism abroad than there has been for some little time past. This, however, has not as yet expressed itself in increased volume of business. Collections remain slow, although they are no worse than they have been. Jobbers report a slight increase in business for the week, but this change is so little that it would not be worthy of note were it not that it is felt. While it is hoped it indicates the general trend there are many conditions which at the present act to offset this slight improvement. However, the general tone is more optimistic. Credits are very tight. Many smaller businesses are holding on by sufferance at the present time. The contracting business is decidedly spotty. Reports from Portland indicate that a large number of residences are being constructed. The electrical workers' strike, called in defiance of the general agreement, has been temporarily adjusted, but will probably become acute again on Sept. 1, at the expiration of the present agreement.

Dealers are finding business in general to be very slow. Apprehension is felt in some places as to what may be the development in the next few months. The maritime strike has tied up exports to a very considerable extent. Many boats are loaded and ready to leave Portland, Seattle and other Northwestern ports, but they cannot obtain crews.

Conduit.—At present there are no big orders; in fact, Seattle jobbers report sales 50 per cent under those of last year. This condition is attributed to light building of larger-sized structures, but here, where considerable construction of moment has started and a large amount is projected, the conduit situation is expected to improve materially at once. Stocks are in excellent shape and replacements easy to obtain.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Atlanta Jobber Continues After Fire Damage

The place of business of the Gilham-Schoen Electric Company, Atlanta, Ga., jobbers and Westinghouse distributers in that district, was badly damaged by fire in the early morning of May 16. Most of the damage was covered by insurance. Although experiencing considerable inconvenience, the company is continuing to carry on the business as usual.

"Ingeniería Internacional" Issues New Foreign Trade Bulletin

In its desire to work closely with the manufacturers of engineering and industrial equipment in this country in the building up of their trade with Latin America, *Ingeniería Internacional*, published by the McGraw-Hill Company, Inc., at Tenth Avenue and Thirty-sixth Street, New York, has issued Volume 1, Number 1, of "International Engineering," a foreign trade bulletin. Printed in English, its function and purpose are to show how American manufacturers may cement sound economic and commercial relations with the great potential market in the Spanish-reading countries and to explain and interpret the work of *Ingeniería Internacional* in forwarding these purposes."

High Average Sales in Apex Cleaner Contest

According to R. J. Strittmatter, sales manager of the Apex Electrical Distributing Company, Cleveland, there is no question as far as that company is concerned as to the value of prize contests as a stimulant to the salesman. The experience gained from the contest just closed merely serves as a repetition of the results of former contests. The sales contest was on "Apex" electric suction cleaners for wholesale selling organizations of the company's distributers and the retail salesmen of these distributers' dealers.

For the seven weeks' duration of this contest the winning salesman in the first class averaged better than 100 cleaners a week. He was located with the company's Utica (N. Y.) distributer, in a territory which previously had been characterized as very poor. In the retail division the winner was located in Cedar Rapids, Iowa, and he averaged twenty-one cleaners per week in this period.

Another contest is about to start for dealers in the smaller towns, and the company expects a real stimulant to its sales during the ordinarily slow months of June and July.

Penn Electrical Occupies New Quarters

The Penn Electrical Engineering Company, electrical supply jobber of Scranton, Pa., has acquired its own building at 517-521 Ash Street. In moving to these quarters the entire organization is brought together—offices, warehouse and repair shop—in the endeavor to provide the maximum of service.

Line Equipment Sales Agencies for Raymond Roth

Raymond Roth has located at 30 Church Street, New York City, where he has opened a district sales engineering office, covering the central Atlantic district, representing Schweitzer & Conrad on switching and protection equipment, the G. & W. Electric Specialty Company for distribution specialties, the Hopewell Insulation & Manufacturing Company, and the MacGillis & Gibbs Company on cedar posts, poles and ties.

New Jobber Incorporates in Syracuse

The Baldwin-Hall Company, Syracuse, N. Y., has been incorporated to do a wholesale business in electrical supplies and electrical machinery. Fred S. Baldwin is president and William H. Hall, Jr., is secretary and treasurer. The company has purchased the four-story building at 309 East Water Street, in a location well adapted to wholesale electrical business.

Jacobus Arresters to Be Sold by Multiple Electric Company

Following the introduction of the Jacobus vacuum lightning arresters on railroads in the United States, it has been decided to prosecute the sale of this apparatus most extensively throughout the United States and Canada. With this end in view E. Jacobus advises that the entire sale has been placed in the hands of the Multiple Electric Products Company, Inc., 450 Fourth Avenue, New York City, manufacturer of "Atlas" multiple fuses, through the offices and sales organization of which both this country and Canada will be covered.

"Creative Credit Management" Is New Slogan of Credit Men

Broad Financial Educational Program Among Contractors and Dealers, Based on Conception by Credit Managers of Their Opportunities, to Be Carried Out

"Creative credit management" is to be the new slogan of the electrical credit managers of the United States if the spirit and purpose of the twenty-second annual convention of the National Electrical Credit Association, held at Richmond, Va., May 19 and 20, hold firm throughout the coming association year. For too long a time electrical credit men have concentrated on problems of credit restrictions and difficulties of collections. This is the opinion of the association leaders, who are now making plans to carry out a broad financial educational program among electrical contractors and dealers and to bring credit managers to a larger conception of their opportunities to help build credits and increase sales.

This new spirit and these forward-looking plans were evidenced throughout the proceedings of the convention, the program of which was published in these columns on May 14. "Better Business Methods," a discussion and demonstration by J. A. Corcoran, General Electric Company, was one of the features of the convention, and the enthusiastic attention with which Mr. Corcoran was received and the discussion that followed indicated the purpose of the credit men present to acquaint themselves more thoroughly with successful merchandising methods.

Robert Edwards, Jr., of New York, was elected president of the association for the ensuing year; Clarence Kaeber, of Philadelphia, was elected vice-president, and Frederic P. Vose, Chicago, was re-elected secretary-treasurer.

Not the least interesting features of the convention were a tour of Washington and of Richmond and the battlefields surrounding the city and a golf tournament on the links of the Virginia Country Club.

The convention referred to the board of managers a number of important questions for action, including the question as to whether the territory west of the Connecticut River in the State of Connecticut, now a part of the New York Electrical Credit Association territory, should be ceded to the Electrical Credit Association, New England Division; the place for the 1922 convention; the establishment of a policy with reference to cash discounts, and the appointment of a committee on publicity and the working out of a definite program for that committee during the forthcoming year.

The Monitor Controller Company, Baltimore, has established a Cleveland office at 420 Permanent Building, in charge of Robert Notvest.

The Kentucky Electric Lamp Company, Owensboro, Ky., has filed notice of increase in capital stock from $100,000 to $200,000.

The Cook Electric Company, Newark, N. J., has filed plans for the erection of a one-story plant, 40 ft. x 75 ft., at 360-64 Jeliff Avenue, to cost about $20,000.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, in order to co-operate more closely with its jobbers in the Middle West, has established a branch office at 1711 Grand Avenue, Kansas City, in charge of J. N. LaBelle, formerly assistant manager of the Chicago branch. The Kansas City branch includes Kansas, Nebraska, Oklahoma, Texas, Arkansas, western Louisiana and western Missouri. Mr. LaBelle will be assisted by Emery Harris, who will make his headquarters at Omaha, Neb., and R. Brice Shipley, who will travel in Oklahoma, Texas, Arkansas, western Louisiana.

The Display Stage Lighting Company, 314 West Forty-fourth Street, New York City, has filed notice of an increase in capital stock from $50,000 to $100,000.

The Reliance Electric & Engineering Company, Cleveland, has removed its Chicago office to Room 2013 Fisher Building. Edward F. J. Lindberg is district manager.

The M. J. Dougherty Company, Twenty-fifth Street and Washington Avenue, Philadelphia, announces a change of address of its Atlanta representative to Candler Annex. This office is in charge of Messrs. McKee and Wright, whose territory takes in the States of Florida, Georgia, Alabama, Tennessee, North Carolina and South Carolina.

The Fidelity Electric Company, Lancaster, Pa., has made arrangements with A. Edgar Goetz, 55 Barclay Street, New York City, to carry a stock of its motors, particularly in fractional sizes.

Foreign Trade Notes

PROPOSED WATER-POWER DEVELOPMENT IN JAPAN.—According to J. K. Steele, an official of the Oriental Steamship Company, Japan, is considering a water-power development that may involve the purchase of machinery and equipment in this country involving an expenditure of about $50,000,000.

WORLD FAIR FOR JAPAN IN 1922.—Announcement is made in a recent issue of the *World Salesman* of a fair to be held in Tokyo in March, 1922, which will be the largest of its kind ever held in Japan. The exhibition will consist of two blocks, connected by cable cars, which will comprise halls for educational, agricultural, electric, industrial and other exhibits; also halls for foreign products.

THE RECORD ENGINEERING COMPANY, LTD., Tutbury, Burton on Trent, England, manufacturer of internal-combustion engines, high-speed steam engines and steam traps, announces that because of the increase of its new business it has gone into voluntary liquidation with a view to reconstructing a much larger company to enable its demand to be met. Naturally the whole of the additional share capital is taken up by the present holders and their associates.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

ELECTRIC GENERATOR FOR FIJI ISLANDS.—The municipality of Suva, Fiji Islands, according to the *Electrical Industries*, will receive tenders until June 30 for a 200-kw., 480/520-volt, three-wire direct-current generator, directly connected to a 300 h.p. vertical Diesel oil engine, together with accessories for generator and panel.

IMPROVEMENTS TO TELEPHONE SYSTEM OF MARANHAO, BRAZIL.—The Companhia Telephonica do Maranhao, according to reports from Consul Pickerell, has decided to remodel its plant completely and will require some 600 new instruments and other apparatus. The name and address of the director of the company may be obtained by referring to file No. 27,352.

ELECTRICALLY OPERATED PUMPS FOR MELBOURNE, AUSTRALIA. — The Board of Works, Melbourne, Australia, according to *Electrical Industries*, will receive tenders until Aug. 30 for four electrically operated centrifugal pumps, each having a daily capacity of 12,000,000 gal.

BIDS FOR THE ELECTRIFICATION OF THE SANTIAGO-VALPARAISO RAILWAY.—Bids will be received by the Railway Council until June 30, 1921, for the electrification of the first zone of the railway running from Santiago to Valparaiso. The cost, including electric locomotives, is estimated at 40,000,000 pesos.

CITIES OF PUERTO PLATA AND SANTIAGO TO PURCHASE LOCAL ELECTRIC PLANTS.—W. A. Bickers, council at Puerto, Plata, Santo Domingo, reports that negotiations have been nearly completed whereby the cities of Puerto Plata and Santiago will purchase their local electric plants. The price will be $400,000 in bonds, of which Puerto Plata will contribute $100,000 and Santiago $300,000. The most urgent improvement needed at present is the substitution of incandescent lamps for the arc lamps now in use for street lighting, and also many new iron poles as well as other materials for improving the transmission line to Santiago. Literature on electrical supplies and equipment may be addressed to the Honorable Ayuntamiento at Santiago and Puerto Plata.

CONCESSION FOR ELECTRIC TRANSMISSION LINE IN CHILE.—The Compañia General de Electricidad Industrial, a Chilean firm, according to a decree published in the Diario Oficial, has been authorized to erect a transmission line for the distribution of electricity between Rancagua and Paine, a distance of about 25 miles.

L. G. HAWKINS of L. G. Hawkins & Company, London, who represent the European interests of Landers, Frary & Clark and Edward Miller & Company, was due to arrive in the States on May 24. Manufacturers desiring to communicate with him should write in care of Landers, Frary & Clark, New Britain Conn.

EXTENSION OF DATE FOR OPENING TENDERS FOR ELECTRIFICATION OF RAILWAYS IN SOUTH AFRICA. — The date for receiving bids for equipment in connection with the electrification of the Cape Town-Simonstown and the Durban-Pietermaritzburg railway lines in South Africa has been extended from June 22 to July 5. Tenders should be addressed to High Commissioner for the Union of South Africa, Trafalgar Square, London, England.

New Apparatus and Publications

COMPENSATOR. — The Industrial Controller Company, Milwaukee, has recently placed on the market its new type "C" alternating-current compensator.

OIL CIRCUIT BREAKER.—Type F-10 oil circuit breaker, with an interrupting capacity of 10,000 amp. per phase at 15,000 volts, has been put on the market by the Condit Electrical Manufacturing Company, South Boston 27, Mass.

SWITCH BOX.—The Multiple Electric Products Company, 450 Fourth Avenue, New York City, has developed a switch box for lighting circuits where exposed molding or conduit wiring is employed.

INCLOSED SWITCHES. — The Wadsworth Electric Manufacturing Company, Covington, Ky., is distributing catalog No. 3, covering its "Compro" inclosed and externally operated switches.

WIRING DEVICES.—The Fernando C. Mesa Company, Irvington, N. J., is distributing bulletin No. 2 covering its electrical wiring devices.

PIPE STILLS. — The Power Specialty Company, 111 Broadway, New York City, is distributing bulletin 202, covering its pipe stills for oil refining.

AMPERE-HOUR METER.—The Sangamo Electric Company, Springfield, Ill., has issued bulletin No. 56, superseding bulletin No. 38, describing the Sangamo ampere-hour meter for controlling electroplating operations.

BATTERY-CHARGING BOARDS.—Bulletin L-1210, distributed by the Allen-Bradley Company, Milwaukee, describes its type L-1210 unit-panel battery-charging boards for electric vehicles and trucks.

AUTOMATIC COUNTERS. — The Root Company, Bristol, Conn., has issued catalog No. 31, covering the different types of "Root" automatic counters.

ELECTRIC HOISTS.—The Allis-Chalmers Manufacturing Company, Milwaukee, has issued bulletin No. 1819, covering its electric hoists.

OIL ENGINES.—The Anderson Foundry & Machine Company, Anderson, Ind., is distributing a folder describing its type "K" Anderson oil engines.

MAGNETIC PULLEYS. — The Dings Magnetic Separator Company, Milwaukee, is distributing a leaflet describing its magnetic pulley-type separator.

CONTROL APPARATUS — "Safest in the World" is the title of a sixteen-page book recently published by the Cutler-Hammer Company, Milwaukee, describing the new line of control apparatus recently developed for use with high-speed newspaper presses.

New Incorporations

THE MILLVALE (PA.) LIGHT COMPANY has been incorporated with a nominal capital of $5,000 to operate a local light and power system. C. J. Braun, Jr., 435 Sixth Street, Pittsburgh, is treasurer.

THE J. COMER JONES POWER & PUMP COMPANY, Boston, Mass., has been incorporated with a capital stock of $20,000 to manufacture electrical pumping machinery, etc. William E. Fennell is president and J. Comer Jones, 21 Winchester Street, Brookline, is treasurer.

CHARLES TISCH, INC., Brooklyn, N. Y., has been incorporated by J. J. Ryan, M. and Charles Tisch, 31 Irvington Place. The company is capitalized at $300,000 and proposes to manufacture electrical appliances and equipment.

THE RADIUM LIGHT O' DAY COMPANY, Newark, N. J., has been incorporated with a capital stock of $300,000 to manufacture electric lighting equipment. The incorporators are Ralph W. Dempwolf and Charles O. Johnston, 142 Market Street, Newark, and John S. Townsend, Haddonfield.

THE MODERN ELECTRICAL SUPPLY COMPANY, Newark, N. J., has been incorporated by A. and Max Schechter and William Lacks, 260 Springfield Avenue, Newark. The company is capitalized at $50,000 and proposes to manufacture electrical equipment.

THE SUPERIOR INCANDESCENT LAMP COMPANY, 593 Ogden Street, Newark, N. J., has been organized to manufacture electric lamps. Philip H. Harrison, 57 Babcock Place, West Orange, N. J., is interested in the company.

THE MacLAREN ELECTRIC APPLIANCE CORPORATION has been incorporated under the laws of Delaware with a capital of $2,500,000 to manufacture electrical appliances and similar equipment. C. M. Hicks, 291 Broadway, New York City, is representative. The company will operate in New York.

THE DAVENPORT (IA.) ELECTRICAL CONTRACT COMPANY has been incorporated with a capital stock of $20,000 and proposes to manufacture electrical goods and conduct an electrical contracting business. The incorporators are H. M. Heysinger, president; Richard Copley, vice-president, and George Hahn, secretary.

Record of Electrical Patents

Notes on United States Patents

(Issued April 26, 1921)

1,376,307. INSULATOR; Frank M. Amos, Wheeling, W. Va. App. filed April 9, 1920. Split knob insulator cannot come apart.

1,376,365. PROCESS OF PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, New York, N. Y. App. filed Dec. 24, 1917. Eroding by electrolytic action.

1,376,366. SOLUTION OR BATH FOR USE IN ELECTRICALLY PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, New York, N. Y. App. filed Dec. 24, 1917. Applied to annealed or hardened metals.

1,376,367, 1,376,368 and 1,376,369. SOLUTION OR BATH FOR USE IN ELECTRICALLY PREPARING STENCIL PLATES, DIE PLATES AND THE LIKE; Gotthold E. Wertheimer, Astoria, N. Y. App. filed May 16, 1918. Applied to annealed or hardened metals.

1,376,371. AUTOMATIC TELEPHONE SYSTEM; George A. Yanochowski, Chicago, Ill. App. filed Oct. 2, 1916. Metallic line.

1,376,379. SILVERWARE CLEANING AND WASHING MACHINE; George H. North, Cranston, R. I. App. filed May 17, 1920.

(Issued May 3, 1921)

1,376,391. TELEPHONE TOLL CIRCUITS; Oscar M. Arnold and John F. Toomey, New York, N. Y. App. filed Feb. 24, 1919. Private-branch exchange.

1,376,393. REVERSING MECHANISM FOR CYLINDER WASHING MACHINES; Fritz Balzer, Chicago, Ill. App. filed June 8, 1916.

1,376,396. RAIL BOND; John R. Brown, Mansfield, Ohio. App. filed Nov. 9, 1918.

1,376,399. ELECTRICAL MEASURING INSTRUMENT; Lewis W. Chubb, Pittsburgh, Pa. App. filed July 3, 1916. To measure root-mean-square of voltage.

1,376,400. MEANS FOR ELIMINATING DISTORTED HARMONICS FROM ALTERNATING-CURRENT GENERATORS; Lewis W. Chubb, Edgewood Park, Pa. App. filed Feb. 13, 1917.

1,376,401. CONNECTOR; Edward M. Claytor, Wilkinsburg, Pa. App. filed July 28, 1917. For testing purposes.

1,376,408. TROLLEY WHEEL; William B. Cullen, Westfield, Mass. App. filed July 21, 1919. Improved bearing surface.

1,376,415. ELECTRIC RANGE HEATING ELEMENT; Frank F. Forshee, Flint, Mich. App. filed May 15, 1919. Quickly connected.

1,376,417. BALANCING MEANS FOR POLYPHASE SYSTEMS; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 4, 1916. Machine used as shunt-phase balancer.

1,376,418. RELAY SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Sept. 9, 1916. For protecting parallel-connected feeder circuits.

1,376,419. POLYPHASE DISTRIBUTING SYSTEM; Charles L. G. Fortescue, Pittsburgh, Pa. App. filed Sept. 30, 1916. Phase-balancing means.

1,376,420. PHASE BALANCER; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1916. For maintaining symmetrical condition.

1,376,421. SINGLE-PHASE MOTOR; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Dec. 24, 1918. Commutator type.

1,376,422. POLYPHASE DISTRIBUTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 18, 1916. For maintaining symmetrical conditions.

1,376,423. PHASE DISTRIBUTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 18, 1916. For maintaining symmetrical polyphase conditions.

1,376,424. REGULATING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1916. To compensate for line losses.

1,376,425. MEANS FOR ELIMINATING HARMONICS IN POLYPHASE ALTERNATORS; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Jan. 29, 1917. For preventing flow of harmonic current.

1,376,426. MOTOR-CONTROL SYSTEM; Adolph A. Gazda, Wilkinsburg, Pa. App. filed Sept. 30, 1916. For printing presses and similar machines.

1,376,428. SELF-COMPONDING PHASE CONVERTER; Rudolf E. Hellmund, Swissvale, Pa. App. filed July 11, 1916. Component voltages automatically regulated.

1,376,429. PHASD-CONVERTER EXCITING SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. Component voltages automatically regulated.

1,376,430. METHOD OF AND APPARATUS FOR EXCITING PHASE CONVERTERS; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1916. Component voltages automatically regulated.

1,376,431. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 8, 1917. Accelerating and regenerative operation.

1,376,432. SYSTEM OF CONTROL FOR INDUCTION MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 7, 1917. Operated in cascade, with predetermined load distribution.

1,376,433. WINDING FOR DYNAMO-ELECTRIC MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Aug. 10, 1918. Alternating-current motors of closed-slot type.

1,376,434. METHOD OF AND APPARATUS FOR OPERATING INDUCTION MACHINES; Rudolf E. Hellmund, Swissvale, Pa. App. filed Oct. 24, 1916. Starting and regulating induction machines.

1,376,452. CONTROLLING AND REGULATING APPARATUS FOR DYNAMO-ELECTRIC MACHINES; Friedrich W. Meyer, Milwaukee, Wis. App. filed Dec. 8, 1917. Use of direct-current motors, etc., on alternating current.

1,376,453. CONTROLLING AND REGULATING APPARATUS FOR ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES; Friedrich W. Meyer, Milwaukee, Wis. App. filed Jan. 21, 1918. Sensitive and stable regulation.

1,376,455. SYSTEM OF PRESSURE REGULATION; Edward T. Moore, Syracuse, N. Y. App. filed April 22, 1915. Employed in connection with pulpwood grinders.

1,376,470. LIQUID RHEOSTAT; Joseph Slepian, Wilkinsburg, Pa. App. filed April 18, 1919. To prevent corrosion of electrodes by sea water, etc.

1,376,471. APPARATUS FOR THE PRODUCTION OF A CHLORINE SOLUTION; Maurice G. Slocum, St. Joseph, Mo. App. filed Nov. 29, 1919. For strengthening solution of sodium chloride.

1,376,485. ELECTRIC HEATER; Edmond Verstraete, Belleville, N. J. App. filed Oct. 30, 1919. For ranges, etc.

1,376,486. ELECTRICAL INSULATOR; Kalman von Kando, Vado Ligure, Italy. App. filed Dec. 9, 1914. Trolley support.

1,376,495. ELECTROLYTIC CELL; John M. Williams, Guthrie, Okla. App. filed Sept. 5, 1916. For electrolyzing common salt.

1,376,501. COMBINED RIVET HEATER AND RIVETER; Alfred L. Atherton, Pittsburgh, Pa. App. filed Sept. 11, 1920. Heated by passage of current.

1,376,509. STEAM GENERATOR AND SUPERHEATER; Andrew J. Borst, Jr., Buffalo, N. Y. App. filed April 4, 1917. Electric current as heating medium.

1,376,512. ATTACHMENT FOR SMOOTHING IRONS; Ronald E. Campbell, Columbia, S. C. App. filed March 25, 1920. To convert sadiron into electric iron.

1,376,513. SAFETY ATTACHMENT FOR ELECTRIC IRONS; Ronald E. Campbell, Columbia, S. C. App. filed Sept. 8, 1920. Connection broken when handle is released.

1,376,563. PROCESS FOR THE PREPARATION OF PURE ALKALINE ALUMINATES; Paul Miguet, St. Julien-Montricher, France. App. filed Nov. 3, 1919. Free from acid oxides.

1,376,566. STORAGE BATTERY; John H. Murphy, New York, N. Y. App. filed May 12, 1920. Central lead grid serving as a brace against which outer layers of corrugated and perforated lead plates are placed.

1,376,581. PROCESS AND APPARATUS FOR THE PRODUCTION OF LEAD OXIDE; Harry S. Reed and Henry L. Publow, East Lansing, Mich. App. filed Sept. 17, 1920. From basic carbonates.

1,376,592. VARIOMETER; John S. E. Townsend, Oxford, England. App. filed April 10, 1918. Two ranges of inductance.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

LINCOLN, ME.—The Bangor Railway & Electric Company has acquired the property of the Lincoln Light & Power Company. Extensive improvements are contemplated.

TOWNSHEND, VT.—The Public Service Commission has granted permission to the Townshend Electric Company, recently organized with a capital of $10,000, to supply electricity in Townshend. The company plans to erect a transmission line from Townshend to Newfane, where it will secure energy from the system of the Twin State Gas & Electric Company.

GREAT BARRINGTON, MASS. — The South Berkshire Power & Electric Company has acquired the Rockdale Mills and adjoining property at Rockland, to be used for extensions to the company's electrical system.

BRIDGEPORT, CONN.—The Crane Company, Chicago, Ill., is contemplating extensions and improvements to the power house at its local plant on South Avenue to cost, including equipment, about $125,000.

LYME, CONN. — The Lyme Electric Power Company has closed a contract with the Lyme lighting committee to supply electricity in Lyme. The line will extend from the lower Lieutenant River Bridge northward, a distance of 7 miles. Negotiations are under way, it is reported, to continue the line to Pleasant Valley.

TORRINGTON, CONN.—Steps have been taken by the Business Men's Association to secure an ornamental lighting system in the business district of the city.

Middle Atlantic States

ALBANY, N. Y. — The installation of electrically operated equipment at the city filtration plant is under consideration. The cost has been estimated at about $60,000.

BUFFALO, N. Y.—The City Council is considering the installation of a new lighting system on Genesee Street from Jefferson to Bailey Avenue.

CAPE VINCENT, N. Y.—The E. W. Coon Company contemplates rebuilding its cold-storage plant, recently destroyed by fire, causing a loss of about $400,000. Electric equipment, mechanical apparatus and refrigerating machinery will be required.

KENMORE, N. Y.—The installation of a new lighting system in the business district of Kenmore is under consideration by the village authorities.

LONG ISLAND CITY, L. I., N. Y.—The Quadri Color Company, 310 East Twenty-third Street, New York, contemplates the erection of a two-story plant, 104 ft. x 283 ft., at South Jane and Sunswick Streets and Van Alst Avenue, Long Island City, to cost about $400,000 with machinery. Motors and other electrical equipment, transmission and mechanical apparatus will be required. Hans A. Obst is president. E. G. Perrot, Woolworth Building, New York, is architect.

NIAGARA FALLS, N. Y.—The Milling & Lighting Company has applied to the Public Service Commission for permission to erect a new transmission line from its power plant to Nicholville.

NIAGARA FALLS, N. Y. — Arrangements have been made by the Niagara Falls Power Company to issue $6,000,000 in bonds, part of the proceeds to be used for the erection of its new hydro-electric plant. It is proposed to increase the output of the plant from 486,000 hp. to 673,500 hp. Foundation work for the new station is under way.

DOVER, N. J.—Arrangements are being made by the New Jersey Power & Light Company to extend the street-lighting system at Mount Arlington Borough to Jefferson Township, in the Lake Hopatcong section.

EAST ORANGE, N. J.—Negotiations are under way between the City Council and the Public Service Electric Company for the installation of an underground conduit system on Main Street in connection with the widening of the thoroughfares.

MADISON, N. J.—The Council has authorized an investigation for ascertaining the present condition of the municipal electric power plant and estimated cost of proposed improvements.

NEWARK, N. J.—The City Commission is considering the erection of a new municipal market building, 150 ft. x 604 ft., in the vicinity of Mulberry Street. The plans provide for the installation of a power plant, complete electrical equipment and electric signal system. Frank Grad, 245 Springfield Avenue, is architect.

ALLENTOWN, PA.—The City Council is considering extending the floodlight system on Hamilton Street to the Lehigh River Bridge.

ALTOONA, PA.—Bids will be received by the board of directors of the School District of Altoona until June 6 for building a central heating and power plant. Wood, Hulse, Yates & Company, 233 Broadway, New York City, are engineers.

WILKES-BARRE, PA.—The Lehigh & Wilkes-Barre Coal Company, 16 South River Street, is considering enlarging its steam power plant at Green Mountain colliery and installing additional equipment.

ANNAPOLIS, MD.—The Harper's Ferry Electric Light & Power Company has applied to the Public Service Commission for permission to extend its lines.

BALTIMORE, MD.—Arrangements have been made by the Board of Education for an appropriation of $250,000 for the installation of new heating and ventilating systems, with electrically operated equipment, in seventeen public school buildings. New power houses will also be erected, with equipment in fireproof partitions.

CUMBERLAND, MD.—An ordinance has been passed by the City Council requiring the installation of underground conduit lines on Mechanic Street by the Edison Electric Illuminating Company, Pennsylvania Railroad Company, Postal Telegraph Company, Western Union Telegraph Company and the Chesapeake & Potomac Telephone Company. An ornamental lighting system will also be installed.

THURMONT, MD.—Plans have been approved by the Council for the erection of a substation to be used as an auxiliary to the electric lighting plant.

AMHERST, VA.—The Amherst Electric & Power Company is considering the installation of a lighting system. W. A. Baldock is proprietor.

LYNCHBURG, VA.—A movement has been started by the City Council for the installation of a municipal electric light plant.

MONTVALE, VA.—H. M. Stephens & Son are considering the erection of a three-phase electric transmission line from Bedford to Montvale. Bids are being asked, it is understood, for copper wire, transformers, meters, electric fixtures, etc.

WASHINGTON, D. C.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive bids until June 14 for furnishing flashlights and batteries for various Eastern and Western yards. Schedule 8056.

North Central States

BATTLE CREEK, MICH.—Plans are under consideration for remodeling the ornamental lighting system in the business district. It is proposed to replace the five-lamp cluster with single lamps.

DETROIT, MICH.—The Board of Directors of the Harper Hospital Association, it is reported, will take bids at once for a two-story addition, 88 ft. x 105 ft., to the power house to cost about $85,000. Albert Kahn, 1000 Marquette Building, is architect. Dr. Stewart Hamilton is superintendent.

CHILLICOTHE, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 6 for the installation complete of an electric dumbwaiter in the United States Post Office at Chillicothe, Ohio. James A. Wetmore is acting supervising architect.

NEWCASTLE, IND.—Bids will be received by the city clerk until June 6 for materials and equipment for a street-lighting system to cost about $11,500.

CHICAGO, ILL.—The Waterway Paper Company, Kedzie Avenue and Thirty-second Street, is having plans prepared for the erection of a new one-story factory 80 ft. x 180 ft., and power plant, to cost, including machinery, about $175,000. Frank D. Chase, Inc., 645 North Michigan Avenue, is architect and engineer.

FLORA, ILL.—Improvements to the municipal lighting system is under consideration.

GALESBURG, ILL.—Plans are being prepared by the city engineer for the installation of a fire-alarm system.

ROCKFORD, ILL.—The Rockford Electric Company contemplates an expenditure of $241,000 for improvements to its plant. The plans provide for building an outdoor switchboard, switch track and coal yard. Adam Gschwindt is general manager.

PRINCETON, WIS.—The Princeton Power & Light Company has increased its capital stock from $30,000 to $50,000, the proceeds to be used for the purchase of additional generating equipment.

TWO RIVERS, WIS.—Vaughn & Meyer, engineers, Security Building, Milwaukee, have prepared plans for improvements to the municipal electric plant, including remodeling switchboard and changing to the three-phase system, erecting steel poles and rebuilding electric distribution system. Joseph Doleysh is city clerk.

DARWIN, MINN.—The sum of $10,000, it is reported, has been raised to provide for electrical service in the village of Darwin.

COLUMBIA, MO.—The board of directors of the University of Missouri contemplates the construction of a steam-operated power house and heating plant at the institution. James P. Jamieson, Security Building, St. Louis, Mo., is architect.

SEDALIA, MO.—Plans for extensions to the ornamental street-lighting system have been approved by the Chamber of Commerce. The plans provide for 178 standards to cost about $37,500.

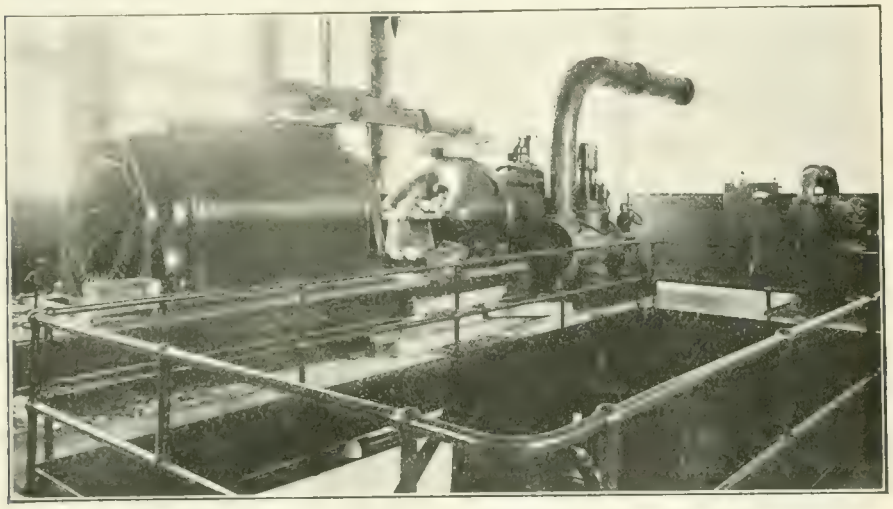
UNIONVILLE, MO.—Plans are being prepared for the construction of a municipal electric light and power plant to cost about $84,000. The Hennington Engineering Company, National Building, Omaha, Neb., is engineer.

DICKINSON, N. D.—The State Board of Administration contemplates the construction of a power plant to cost about $40,000 at the Dickinson Normal School. C. L. Pillsbury, Minneapolis, Minn., is engineer.

GRAND FORKS, N. D.—Additions to the power plant at the University of North Dakota to cost about $20,000 are contemplated by the State Board of Administration.

PAWNEE CITY, NEB.—Plans are being prepared for an addition to the municipal plant to cost about $85,000. E. T. Archer & Company, New England Building, Kansas City, Mo., are engineers.

HORTON, KAN.—Bids will be received by I. Griffith, city clerk, until May 31 for furnishing one Diesel engine and generator to be installed in the light and water plant.



THE 5,000-KVA. UNIT BEING ADDED TO THE EASTERN TEXAS ELECTRIC COMPANY'S PLANT AT PORT ARTHUR. THE ADDITION WAS BUILT BY STONE & WEBSTER

Southern States

CHESTERFIELD, S. C.—The plant of the Teal Light & Power Company, 7 miles from Chesterfield, was recently damaged by fire, causing a loss of about $12,000.

JACKSONVILLE, FLA.—Bonds to the amount of $1,000,000 have been voted for improvements to the municipal docks. Considerable electrical equipment will be required.

ORLANDO, FLA.—Investigations of the electric power plant are being made under direction of the Council with a view to installing new equipment or abandoning the station and erecting a new plant. Alvord & Burdick, 8 South Dearborn Street, Chicago, Ill., are engineers.

QUINCY, FLA.—Bonds to the amount of $175,000 have been voted for a municipal hydro-electric plant.

COOKEVILLE, TENN.—The erection of a dam at Burgess Falls is contemplated by the city officials. The project includes a 400-hp. hydro-electric plant. A. P. Barnes is Mayor.

MEMPHIS, TENN.—Extensions will be made to the river terminals at an estimated cost of $950,000. Considerable electrical equipment will be required. W. B. Fowler is city engineer.

BIRMINGHAM, ALA.—The Corona Coal Company contemplates the erection of a new electric power plant and coal washery at its Townley Mines. Electrically driven equipment will be installed.

DUNCAN, OKLA.—Bonds to the amount of $300,000 have been voted for the construction of a new 800-kw. municipal electric plant, distribution system and an ornamental lighting system. Benham & Mullergran, Firestone Building, Kansas City, Mo., are engineers.

EDINBURG, TEX.—At an election to be held May 31 a proposal to issue $30,000 in bonds for an electric light plant will be submitted to the voters.

Pacific and Mountain States

TACOMA, WASH.—The city has purchased a site at North Twenty-first and Adams Streets to be used as a site for a new transformer station for the municipal light department.

SAN FRANCISCO, CAL.—Application has been made to the Railroad Commission for permission to erect a transmission line from the Kerckhoff plant of the San Joaquin Light & Power Company to connect up with the system of the Pacific Gas & Electric Company.

DUCHESNE, UTAH.—The Great Basin Power Company, Salt Lake City, is having surveys made for the development of a 10,000-hp. hydro-electric plant, to include an earth dam 110 ft. high and an irrigation system to cover 25,000 acres. The cost is estimated at $1,500,000. H. A. Strauss, Walker Bank Building, Salt Lake City, is engineer.

Canada

KEMPTVILLE, ONT.—Preparations are being made for the erection of a transmission line by the Hydro-Electric Power Commission of Ontario from Merrickville to Kemptville.

Electrical World

New York, Saturday, June 4, 1921

Washington Sends a Message of Encouragement

WE HAVE recently received a very heartening message from the government to American business. The President, the Vice-President and the Secretary of Commerce gathered with the leading business men of the country to commemorate the one hundred and twenty-fifth anniversary of our oldest and greatest business newspaper. They united in an earnest effort to interpret to the business men of the United States the business purposes of the administration. They outlined an attitude of reasonableness and helpfulness that if consistently maintained will bring the stimulus and strength to business that we need so greatly.

Now the electrical industry—in its many branches—is before all else a business. It is a business singularly vital to the commercial health and prosperity of the community and the nation. This message, therefore, has been spoken to us no less than to other groups of business men, and it has been addressed to us as individuals for the encouragement and guidance of the day's work.

In a word, the message is this: that honest business is to be helped and not restricted, that the bigness of business is not to react to its prejudice so long as it is fair, that the true function of the government is and will be to work for business in intimate practical co-operation. To this end the Department of Commerce is proceeding to develop a new, enlarged program of service to every branch of trade. And Secretary Hoover appeals to the business press of each separate trade to aid in defining and disseminating the service to its own industry.

This is good tidings. But the extent of the benefit it brings must depend upon the degree to which it is utilized. The amount of personal help that comes to any single man will be in the measure of the intelligence and zeal with which he seeks it and applies it in his work. That is the point that every man in the electrical business must keep in mind.

As the plans unfold, the ELECTRICAL WORLD will report and present to the electrical industry these new services which the government has promised. This will be in accordance with the plan of Mr. Hoover, who pointed out that the business paper is the medium within each trade for the prompt and useful distribution of this practical and profitable information and advice, which will come in steadily improving quality and quantity. Watch in the ELECTRICAL WORLD, therefore, for this new help *for you* from Washington.



Milan Raynard Bump

Who brings to the National Electric Light Association as president-elect a broad national point of view gained through engineering studies and executive supervision of properties in more than half of the states of this country

AN ENGINEER of broad experience with a comprehensive understanding and appreciation of all phases of the electric light and power business has been chosen to lead the National Electric Light Association during the coming administrative year. Milan R. Bump, the fourth member of Henry L. Doherty & Company to become president of the N. E. L. A. Since 1910, except for a few months six years ago when he was vice-president of the Picher Lead Company, Mr. Bump has been chief engineer of the Doherty organization in charge of all engineering and of the construction and operating departments of the public utility division. Later he became a member of the executive committee of the company in charge of the oil transportation, refining and marketing divisions and the natural-gas division.

Mr. Bump was born at [illegible], Wis., March 18, 1881. His boyhood was passed in Spokane, Wash., where he received his early education in the public schools. At the age of twenty-one he was graduated in electrical engineering from the University of Wisconsin. Immediately he entered upon engineering work with the Washington Water Power Company. A year later, however, saw him back at the university, where he was an instructor in electrical engineering for a year. In 1904 he became associated with Henry L. Doherty as the first cadet engineer of the Doherty training schools. Until 1906 he was engaged in the gas department of the Denver Gas & Electric Light Company. In the year just named he was selected as examining engineer for Henry L. Doherty & Company and sent to Joplin, Mo., the great lead and zinc district. There he remained until 1909, consolidating several utility properties to form the Empire District Electric Company, of which he became treasurer and general manager. He also designed and erected a large modern steam plant and an extensive transmission system covering that entire mining field. In 1910 he left Joplin for New York to take up his present duties. During his first five years as chief engineer of the Doherty organization Mr. Bump was engaged largely in examining for purchase and revamping many of the utility properties of the Cities Service Company subsidiaries.

In his work of rehabilitating sick utilities Mr. Bump has become a firm believer in the value of good public relations. It is not surprising therefore to find in him one of the most ardent advocates of customer ownership of public utility securities. He is a thorough student of public utility problems even though they be apart from engineering, and through his executive touch with properties in more than half the states he brings to the N. E. L. A. a well-balanced national point of view that should prove of immeasurable value to the electric light and power industry.

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Government Reorganization and Bureaucratic Inertia

INERTIA, the greatest natural obstacle to human progress, whether individual or collective, grows with the growth of the body whose action it impedes, and where, as at Washington, the political concerns of a vast nation center, only constant vigilance and effort can resist its paralyzing effect. Government departments by the nature of their being become lazy and complacent, and when new blood is injected into executive veins the first effect on the bureaucratic system is not a reaction to the stimulus but an effort to smother the new blood with the old while performance goes on in the old, imperfect way. There is some fear that this may be the fate of the promising movement for governmental reorganization which, having its origin in a demand from all parts of the nation for greater efficiency and economy in government, was hailed by some super-optimists as all but accomplished when the new federal administration took hold. In reality, before this work can even be started, traditions must be exploded, opponents thwarted and Congress convinced. At the present rate of progress two years hence appears as the earliest date when new machinery will really turn. This is far too long a time to wait. If anything worth while is to be done while the country is in a reforming mood and before enthusiasm dies out, insistence and persistence must mark the daily mood of those whose duty it is to lead this movement—whether they be the engineers, eager to place at the service of their eminent confrère in the Department of Commerce proper instrumentalities with which to accomplish his great task, or the business press, to whose power President Harding recently paid so high a tribute, or the commercial world in general, so dominant a part of the nation's life and to whose ideals of honestly won success government co-operation intelligently directed can contribute so much.

Need of Qualified Counsel in Hearings Before Regulatory Commissions

THE law's delay of which Hamlet complained often prevails in an aggravated form in the rate hearings of public service commissions, but with this difference as compared with court procedure, that it is due not so much to red tape and obstructive legal tactics as to the incompetency of the opposing counsel. In too many cases these lawyers, however learned in the statutes they may be, know little of public utilities or of the principles that govern their valuation. They are neither rate experts nor valuation engineers, let alone electrical technicians. In many recorded cases they have frittered away the commission's time and added thousands of dollars to the cost of the proceedings because of their unfamiliarity with the specialized statistics and engineering that enter so largely into the arguments. There are many courts, and it is sometimes possible to expedite the progress of a cause by transferring it from one court to another; but there is in each state only one commission where a given rate case can be heard. Would it not be logical to require that those who desire to practice before regulatory bodies, where calendars are usually crowded, and where in many states executive funds are insufficient and trained staffs are too small, should pass an examination to establish their competency? If all the counsel were specialists in this specialized field, justice would be surer and the utilities and the public would both be served.

An Epoch-Making N. E. L. A. Convention

THE greatest number of electric light and power company executives ever yet assembled by the National Electric Light Association met in convention in Chicago this week. In depth, breadth and height the convention was a record one. The association has at last found its stride and in a single bound has leaped beyond the petty detail of routine to the larger and more vital questions of public relations and finance. Not that the engineering problems involved in the generation, transmission and distribution of electricity were neglected—the numerous and exhaustive reports of the association's excellent engineering committees disprove that—but that the dominant issues confronting the industry were brought out and accentuated in a way to command respect and rivet attention.

There can be no question that a satisfactory solution of these problems is imperative if the industry is to continue to go forward. Neither can there be any doubt as to the determination of the National Electric Light Association to knuckle down to the task. The utilities no longer fool themselves or the public as to their rights and privileges. The commissions, the courts and public opinion have taught them otherwise. What they now seek is a wider appreciation of the difficulties under which they, as regulated monopolies, operate and public good will in their solution. Not satisfied to trust entirely to their own best judgment as to the proper course to pursue, the counsel of public service commissioners, publicists, government officials, captains of industry and others has been sought, and the result has been astonishing. Whereas the utilities previously saw their opportunities for service as through a glass darkly, they now see them face to face. Thus a new spirit animates the National Electric Light Association. It is no longer the old association. Wideness of vision and bigness of purpose are now its chief characteristics, and these were revealed at the convention this week. The enlarged program has met with the hearty approval and support of the manufacturers, and now that the

supply jobbers are to have a seat at the council table, who can tell how great progress is in store? All branches have caught the spirit and are inclined to help the public utilities win financial and popular support. It remains but to put some co-operative plan into action whereby manufacturers, jobbers, contractors, central-station companies, investment bankers, chambers of commerce and other bodies will join in an effort to that end.

If the enthusiasm just inspired at Chicago can be maintained—and there is no reason why it cannot be even increased—the financial thirst of the industry can be largely assuaged. The will to serve has been established.

Ratings of Pin-Type Insulators

IT HAS been known for a long time that the present method of rating pin-type insulators has grown up in a haphazard way, probably being largely influenced by the common practice of calling for other equipment on the basis of the nominal rating of the circuits on which it is to be used. This practice is necessary with generating and transforming equipment, where adequacy of design is a factor that must be worked out by the factory designer. Its application to insulator practice has only resulted in confusion, because the factory designer necessarily is precluded from knowing the conditions under which insulators of any given rating may be used. System load and capacity, length of lines, the presence or absence of climatic conditions or lightning disturbances, the presence of salt, excessive amounts of dirt or chemicals in the atmosphere and other conditions play an important part in the rating of insulators which are to be used in any particular case.

The impracticability of considering all these conditions in assigning a normal line voltage rating for catalog purposes has led to a great amount of confusion in the selection of pin-type insulators, with results that have in many cases permitted serious and expensive line interruptions. With only flashover voltages listed, it would seem possible to suggest limits for factors of safety covering given conditions which could be tabulated in much the same way that data on factor of safety are tabulated in the literature dealing with structural materials. Such a method should at least avoid misleading results and, if properly carried out, insulator problems than has usually been accorded to them.

In this connection it is interesting to note that the elimination of the present method of rating pin-type insulators by nominal line voltages and the substitution of the wet and dry flashover voltages in catalogs as the only voltage rating are under consideration by a committee of the American Institute of Electrical Engineers. The National Electric Light Association through the overhead systems committee is co-operating in the study. It is to be hoped that the committee will receive a full expression of opinion from interested engineers and find a solution that will do away with the present confusion. It is, of course, assumed that if the proposed method of rating is adopted it will be accompanied by satisfactory test specifications which will make certain that all ratings for these insulators can be given on the same basis.

Rapid Progress in Hydraulic Power Developments

ONE learns to look for material of great technical value in the annual reports of the committees of the National Electric Light Association. This year a new committee comes to the front charged with reporting on matters connected with hydraulic power, and its conclusions form no exception to the rule we have just noted. Two points to which the committee gives special consideration are of particular interest and importance. First comes the matter to which we have more than once made reference, the very great improvement in the design of waterwheels during the past twenty years or so. Up to the time that the waterwheel began to be extensively used in hydro-electric plants it had undergone few changes for the better in several generations. In two particulars it was especially faulty—efficiency at moderate outputs and specific speed. Both these failings were probably due less to the incapacity of the designers than to lack of insistent demand, which is the only spur to renewed improvements in an old and somewhat standardized product. Until the period of rapid growth in electric power transmission waterwheels were generally used under conditions of fairly steady and fairly high load. When running at all they were running somewhere near designed full load, and since the transmission of power was generally by extensive systems of shafts and belts a relatively high speed of the wheel was not of great importance.

Within twenty years the maximum efficiency of good-sized waterwheels has been lifted by approximately 10 per cent, and the point of maximum efficiency has dropped back from full load to a point between half and three-quarters load. In recent wheels the efficiency curve has been particularly flat, staying above even 90 per cent from half load to full load. The origin of the improvement has been in the more careful design and finish of runners and their cases to avoid friction and eddying. Moreover, the speed of the wheels for given output has been very considerably increased again by design with special reference to this quality, so that direct coupling to generators is feasible under conditions that would have been regarded as quite impossible even ten years ago. Incidentally there has been steady effort to improve the draft tubes with respect to smoothness and facility in getting the water out of the way after passage through the wheels. A number of patented designs more or less similar in result have recently appeared, all of them tending to the same good end of stiffening the working head by facilitating the escape of water. The gain in the net efficiency of the wheels, including their settings, is not immaterial, and the results have been on the whole very gratifying.

Secondly, the report deals in some detail with the study of water supply from the standpoint of rainfall and run-off. There are comparatively few streams in which there has been long-continued and explicit study of flow relation to rainfall and the character of the drainage area. One has to go more or less upon general data, and in the report before us some rather interesting matter is given concerning such data for the Appalachian territory. It is shown, for example, graphically that the rainfall on the southeastern and western slopes varies very radically not only in absolute amount but in respect to the altitude of the territory concerned. On the southeastern slope the rainfall at high altitudes is double that on the western side, while at low altitudes

the figures are approximately equal. Once the data from various stations are put in shape, it becomes a fairly easy matter to estimate the probable available rainfall at any point. But these data vary greatly as one passes to another part of the country, so that generalizations can be made over only a limited area.

Still another feature of the report deals with the study of losses by evaporation, which limit the storage facilities as well as the flow itself. In the common case, where storage is fundamental to economy of operation, more thorough study of the evaporative losses becomes imperative, and we hope that the subject will be given steady attention by the new committee.

Operating Practice with Overhead Lines

AS USUAL, the report of the overhead systems committee to the National Electric Light Association is full of important matter. One can barely touch the high spots in editorial comment, for the report is both long and thorough, being particularly devoted to searching out the results of actual practice by carefully prepared questionnaires. Two of the long-mooted matters which come to the front are the practical properties of the delta-connected and star-connected circuits and the usefulness of ground wires in protecting them. As between delta and star connection there has been long dispute, each system having certain theoretical advantages, it being assumed in this connection that the star system is more or less thoroughly grounded. A questionnaire dealing with all phases of the matter was sent out, and an examination of the many replies seems to show that as a matter of actual practice the grounded star has "made good." Not a few companies which started operations with delta connection have more or less completely shifted over to the other construction. It is, of course, plain that a grounded system runs some chance of interference that is less probable on an ungrounded delta system, but, on the other hand, plant after plant has found that the surging conditions are greatly ameliorated by passing to the grounded star. Practice differs as to thoroughness of the grounding, a matter which seems to depend considerably on local conditions; but a return to star connection is unmistakable, as it has been indeed for some years past, and the report before us confirms the judgment which has been gradually forming.

Another matter in which the results are perhaps less readily foreseen is the question of protection of lines by grounded conductors strung over them. Little used in the very early years of power transmission, the practice has steadily spread, chiefly because of its real or supposed value as against lightning. The committee's questionnaire brought in a large amount of practical information, and while it is far from homogeneous, it leaves a strong impression of doubt concerning the value of overhead ground wires. The records seem to indicate that such wires afford a probable protection to insulators of unknown magnitude, an immaterial amount of protection to station apparatus, and an effect on general disturbances of the line, including lightning, which is of decidedly doubtful import. The summary certainly does not show the great protective value which was firmly believed in over a considerable period, and the whole question is left by the committee as one on which much further information needs to be obtained before deciding whether the practice is good, bad or indifferent.

One more phase of the committee's work deserves comment. In this case the results are of a very definite character, the subject being preservative treatment of wooden poles, which we have preached off and on for a long period past. The favorite treatment indicated is with some variety of creosote oil or an equivalent substance. Sometimes the whole pole is treated, more frequently the butt, since rotting usually takes place at the ground surface. Of late it has become a frequent practice to puncture the butt of the pole in many places to permit the more ready entrance of the oil under treatment. Very little accurate data are to be obtained as to the results of treatment by various plans, since it is almost impossible to find out just how thorough the work has been or just what the ground conditions are against which the pole has to contend. Broadly, however, the indications of more than a decade of experience are that the controlling factor is the thoroughness with which the preservative has penetrated the pole. If it has soaked in well, a very considerable increase in the life is generally found, a large proportion of the treated poles remaining perfectly sound after a dozen years' use. The treated poles which were found rotted showed lack of penetration. Seasoned poles obviously can be more thoroughly treated than unseasoned ones and give correspondingly better results. Coal tar and crude oil, sometimes used, seem to have proved relative failures, probably less on account of their actual properties than by reason of their failure thoroughly to penetrate the wood. At the present time, when poles are unpleasantly expensive, and getting scarcer at that, the moral is a clear and obvious one.

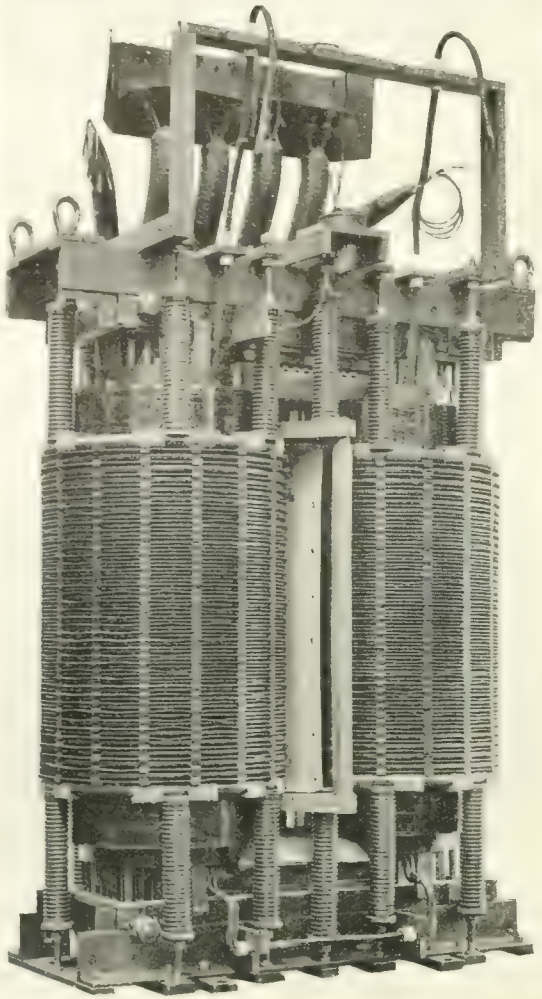
How Far Should Industrial-Plant Metering Be Carried?

JUST how far metering should be carried in the industrial plant is a problem which will bear careful investigation. It is one of those points where the electrical engineer, plant management and accounting department of an industry come together on a common ground—namely, the cost of the finished product. In most cases the probability has been that metering has not been carried to the point of being able to determine the department power or lighting costs, to say nothing of these costs per unit of product.

The charging of power costs to overhead expense may result in the selling of certain products at a loss, although the entire output of a plant may bring a reasonable profit. Therefore the application of power costs to departmental production of units is a better method of cost analysis. To be sure, the expense attendant on ascertaining such costs must be justified. Hence for an item requiring only relatively small energy consumption for its production the installation of elaborate metering facilities would not be warranted. There is, however, a happy medium that lies in permanent metering installations where they are justified and periodic departmental tests where the energy consumption is not such an important part of the expense.

Here again is an opportunity for the industrial electrical engineer to follow production costs with the management and, through studies in determining the cost of electric power per unit of product, to find new methods of cutting production costs and increasing the efficiency of his equipment and department.

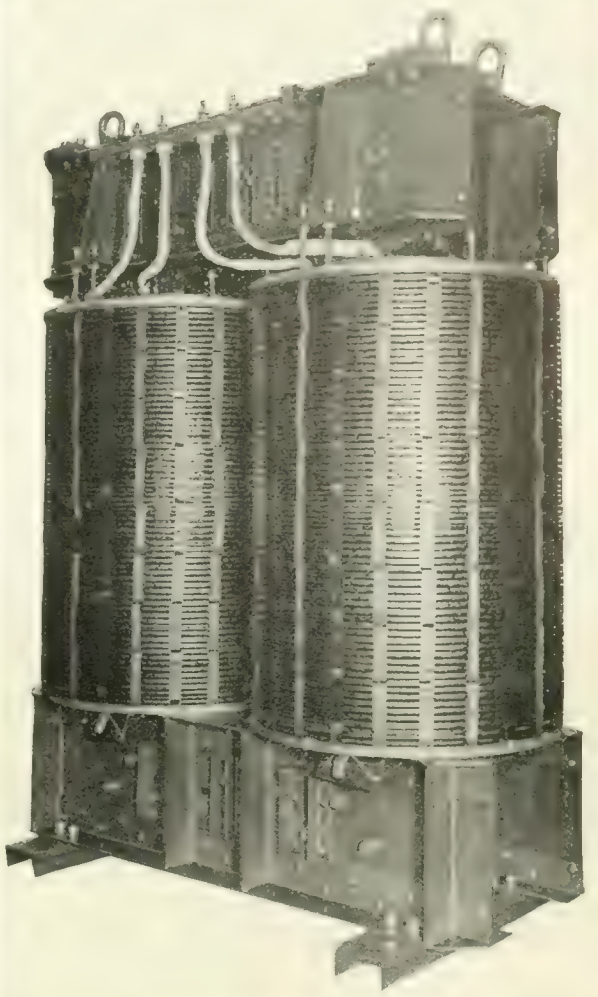
A New Pinnacle in Voltage Rating Reached in Power Transformer Design



PRIOR to 1919, 150,000 volts was the maximum commercial potential for which power transformers had been required. In 1919 the next step was made when the Great Western Power Company decided to go into 165,000-volt transmission. It was in 1920, however, that the noteworthy increase to 220,000 volts was made by the Southern California Edison Company and the Pacific Gas & Electric Company in adopting 220,000-volt transformers for long distance transmission. In meeting the requirements of this higher voltage service the manufacturers were faced with unusual problems which they have solved successfully. These developments were emphasized by the Electrical Apparatus Committee of the N. E. L. A. in its report delivered at the annual meeting this week.

On the left in this illustration is shown a 165,000-volt transformer with concentric circular coils, rated at 7,500-kva., developed by the General Electric Company. The 220,000-volt transformers of this company are of the same general character but since they are intended for operation on a system having a solidly grounded neutral, the line terminal is connected to the middle point of the high-voltage winding, joining alternate high-voltage coils on the two legs in series—the upper and lower halves of the two windings being in multiple. This results in approximately ground potential on the coils adjacent to the top and bottom horizontal core members.

On the right is the 16,667-kva., 60-cycle, 220,000-volt, transformer developed by the Westinghouse Electric & Manufacturing Company. Gradation of insulation is carried out in the same general way. The unit requires floor space of 11 ft. by 14 ft. 5 in.; the height of the tank is 14 ft. 9 in., and the height of the high-voltage bushing is 22 ft. 9 in. The cores and coils complete weigh 58,000 lb., and the weight of the unit complete with oil is 158,000 lb.



Optimism Keynote of N.E.L.A. Convention



Proceedings at Chicago Sessions Epoch-Making—Broad Aspects of Public Relations, Finance, Operation and Business Getting Discussed by Leading Executive and Engineering Talent of Industry and by Public Service Commissioners—Attendance of the Pre-War Kind in Number and Geographical Representation

THE convention of the National Electric Light Association held in Chicago this week marked the reawakening of that body to the vital problems confronting it and a determination to cope with them energetically and intensively to the end that the electrical industry may continue on its march of progress undaunted and unchecked.

Finance and public relations were the major topics up for discussion, and probably at no other time in the history of the association have so many executives, engineers, bankers and influential heads of the manufacturing and the jobbing trades been in attendance to take part in the deliberations and to support the various movements leading to the industry's upbuilding.

The questions of regulation were discussed from all angles by managers of utilities and by public service commissioners. Public relations, to the betterment of which the association has devoted so much time and publicity during the past few months, received earnest consideration. From without the industry manufacturers, bankers, publicists and government officials contributed their impressions of how utilities may best win public recognition and support, while from within the testimony of executives and others showed that the electric public utilities of the country are doing their part through excellent service at fair rates and through various channels of public information to carry the message of the utilities to the man in the street.

If there was any one outstanding feature of the convention which overshadowed all else, it was the high caliber of the men in attendance and the evident desire on the part of all to co-operate to the limit in all matters affecting the electric light and power business. Inductive interference problems which have been a subject of contention between the power and telephone companies for years are now in a fair way of amicable solution. The bond of fellowship which already unites the manufacturers of electrical apparatus has by constitutional amendment been extended to the jobbers also, so that a more harmonious relationship between all the branches of the industry is now virtually assured.

Samuel Insull in a masterful address on future expansion in the use of central-station power touched on some of the vital issues of the day and gave wholesome advice on superpower systems. It is fair to say that no session of the very many held during the week was without its important feature. In fact, the program was so crammed with excellent reports, papers and addresses that their immediate absorption and appreciation was out of the question during the sessions of the convention. Of more than passing interest were the addresses of President Insull, Halford Powell, Jr., Sidney Z. Mitchell, United States Solicitor-General James M. Beck, and Commissioners James A. Perry and E. I. Lewis.

While the serious side of the convention took almost all of the time, there was still enough left to enjoy the entertainment features planned by Homer E. Niesz and his committee. The big event in the entertainment program was "Derby Night." Electric horse racing, music and dancing made the evening one of fun, frolic and festivity.

First General and Executive Session

President Insull Reviews Present-Day Problems—Executive Manager Aylesworth's Report—Membership Gains 1,500

A MASTERFUL analysis of the fundamental economics affecting electric light and power company service, in which the attention of the industry was focused on the points of primary interest, was made by Martin J. Insull in his presidential address. Mr. Insull saw the industry in a wonderfully strong position but in need of tremendous sums of money to take care of the program of expansion demanded by the public. Money, he believed, must be obtained from the public, which necessitated therefore careful attention to good public relations. Finally, he saw the cessation of municipal regulation and operation in favor of state

regulation. The small-town plant was going. The big system feeding the small towns from a transmission line was taking its place.

"In general," said Mr. Insull, "the electric light and power business continues its growth. It is estimated that there is necessary and will be installed 1,000,000 kw. of generating capacity during this calendar year. We may, therefore, look forward to a promising future.

Financing

"It is estimated that for the next five years the electric light and power industry, in order to provide for the demands that will be made upon it by the public, will require approximately $1,000,000,000 per year. This vast sum will be spent for the necessary steam and hydro-electric generating equipment and transmission and distribution systems with all the appurtenances necessary to give service. If it cannot be provided, the public will be the sufferer. Where is it to come from?

"Under our regulatory laws, after paying all our operating expenses and providing depreciation, we have left only a fair return upon the actual amount of money invested in our properties for the public use. After paying a return to the people that have invested their money in the industry there is comparatively little left for further expansion such as we have been contemplating. It, therefore, must come from the investors, who are that part of the public that are thrifty and willing to invest their money in our industry because they have a firm belief in its stability and safety.

Public Relations and Regulation

"On entering this period of vast money requirements we should give this question of our public relations the most careful consideration, as upon this very largely depends our ability successfully to take care of the anticipated requirements of the public. Under present regulatory conditions the public through their representatives determine the class of service we shall give, the rates we shall charge and the securities we shall issue. These representatives cannot help having their judgment more or less affected by public opinion. Equally true is it that those who spread their erroneous ideas as to the utility business in political campaigns are catering to an existing public opinion that we largely by our silence have allowed them to form. The investor would be more easily attracted to our business, which is one affected by a public interest, if he knew that it had behind it a generally favorable public opinion.

"During the past year various states have agitated the question of a change in the public utility laws so far as commission regulation is concerned. In most of the states it has been only agitation. In one state it resulted in the abolition of the state commission for the regulation of utilities, but it seems to be the consensus of opinion of those informed that it is only a matter of time when regulation must again take its place as it should in the advancement of the development of that state. In other states the agitation has taken the popular line of home rule by municipalities of their own utilities. In still another state the reverse position has been taken, and home rule has been submerged into state regulation. It can only be that the exponents of the home-rule ideas have lost sight of the great development in this industry that is taking place every day. They are not to be blamed for this, for many within the industry have not a full insight into these great developments."

Executive Manager Aylesworth's Report

An epitome of the year's work of the association was contained in the report of Executive Manager M. H. Aylesworth. The accomplishments had been gratifying, he stated, and while some might have felt that the association had been entirely too strenuous and ambitious in its program, the emergency had been great and the effort had been pitched accordingly. The result had been tremendous progress toward satisfactory alleviation of trouble caused by inductive interference, toward close co-operation between all branches of the electrical industry, toward the adoption of a uniform classification of accounts, toward obtaining rules and regulations which by their reasonableness will invite investment and toward better public relations.

The program for dividing the country into geographical divisions was going ahead rapidly, Mr. Aylesworth announced, and ten of the thirteen proposed divisions had already been organized and the other three were being formed.

Work at headquarters had been divided into four departments—engineering, service, committee activities and publicity. The engineering department, besides rendering direct service to many companies, had been co-operating with technical committees in handling inductive interference, safety rules, standardization, etc. During the year ended March 21 the service department replied to more than a thousand requests from member companies besides supervising the publication of *Rate Research* and the "Rate Book," assisting in the formulation of a uniform classification of accounts in co-operation with the National Association of Railway and Utility Commissioners and assisting in matters pertaining to rules and regulations of the Federal Power Commission. The department of committee activities had through the co-ordination of committee work obviated much effort that would otherwise have been duplicated. The national good-will campaign was planned and carried on by the publicity department. This department had sent out millions of booklets prepared by it and had written numbers of advertisements, articles for the magazines and the newspapers, besides assisting local companies in their publicity problems.

Membership

A gain of approximately 1,500 in membership over the preceding year was shown by the membership committee, of which Walter Neumuller was chairman. The total membership on April 30 was 11,106. Efforts were made this year to build the association through quality rather than quantity membership. The committee recommended that manufacturers, jobbers and contractor-dealers and their employees be divided into geographical divisions.

Technical Advisory Committee

The technical advisory committee, comprising Profs. Elihu Thomson, A. E. Kennelly of Harvard and Charles F. Scott of Yale considered some of the larger engineering problems and the probable trend of developments in the power industry together with their limitations. The committee contended that the immediate problem of producing power was not the discovery of a new method but the extension of the economical methods now available. It did not look for

any greater efficiency in steam-turbine practice and was of the opinion that any radically new method of producing power was not to be expected. Marked advances were being made in insulator manufacture both in form and in material, and without question improvement in cable construction for high-potential transmission in cities would become more and more a dominant factor. In the estimation of the committee there was an undoubted trend toward a single universal frequency.

PROGRESS IN WIRING SUPPLIES STANDARDIZATION

The first consideration of standardization in the report of the wiring committee, R. S. Hale chairman, was in connection with attachment plugs and receptacles. A large number of the manufacturers have adopted the parallel blade as standard. Member companies are urged to use standard makes where attachment plugs are required.

Reports were deferred in connection with the standardization of attachment plugs and receptacles for amperages larger than those allowed on lighting circuits and for 220 volts, etc., and also on appliance-plug standardization. As to plug connections for brackets and ceiling fixtures, the manufacturers recognize the desirability of this development and the importance of interchangeability. Lectures on wiring in printed form have been obtained and are now available.

Heater-cord tests have been completed and published. The committee now intends to make available to purchasers standards with which they can compare the cords on the bracket in order to encourage improvement in cord quality. At the same time work is being continued on abrasion tests. A standard form for use in purchasing cords has been prepared.

The committee is still of the opinion that in grounded systems the neutral should be solid from the generator or transformer to the lamps except so far as regards switches that may be needed for testing purposes, and that the size of the wire should be fitted to the maximum load rather than to a theoretical manufacturer's rating of the energy-using devices.

Second General and Executive Session

Samuel Insull and James A. Perry Make Notable Addresses—Superpower Survey Discussed—Reports of Rate Research and Lamp Committees

THE main meeting room was packed on Wednesday morning, at which time addresses were made by Samuel Insull, president of the Commonwealth Edison Company of Chicago, and James A. Perry, president of the National Association of Railway and Utility Commissioners. An abstract of Mr. Insull's address is printed elsewhere in this issue, and one of Mr. Perry's address will be given next week. The address of Mr. Insull and his reference to superpower surveys brought forth some discussion from Sidney Z. Mitchell, president of the Electric Bond & Share Company, New York City, and M. S. Sloan, president of the Brooklyn Edison Company. Mr. Mitchell cited the vast interconnected networks of the Northwest and Pacific Coast and of the Southeastern section of this country as evidence of the fact that economical methods of production and distribution of electricity are already in existence and that further developments in the superpower field will come as an evolution from within the industry. The difficulty confronting the Northeast section of the country was not attributable to the industry but to the archaic laws still in existence.

In reporting for the Superpower Survey M. S. Sloan said that the government had appropriated $100,000 for the study and that a number of utilities and manufacturing companies had contributed $50,000 more to complete the work. The chief difficulties were legal and financial rather than engineering. It was the purpose, he said, to seek a federal charter because of limitations imposed by state laws and the charters of the

President-Elect Bump and Four Executives Well Known to Electrical Men







A—M. R. Bump, chief engineer Henry L. Doherty & Company, New York City (N. E. L. A. (President-elect.
B—J. R. Lovejoy, vice-president General Electric Company, Schenectady, N. Y.; W. C. L. Eglin, vice-president and chief engineer Philadelphia Electric Company; E. W. Rice, Jr., president General Electric Company, Schenectady, N. Y.
C—John W. Lieb, vice-president New York Edison Company, New York City.

large public utilities involved. The committee was unanimous in its opinion that the superpower system should be controlled by the existing public utilities and financed by private capital.

W. S. Murray, chairman of the Superpower Survey, in replying to the comments of Messrs. Insull, Mitchell and Sloan, said he agreed with them that the system should be wholly within the control of the existing public utilities and financed by private capital. He paid a high tribute to the electric public utilities for their excellent and efficient work in power production and distribution.

Employee Organizations

The committee on company employees' organizations, David Darlington chairman, which succeeded the committee on company sections, was engaged largely in advisory work along the lines of new organizations, education, handbooks and publicity. Because of the local nature of such organizations the committee pointed out the limited nature of the work that could be done by a national committee. It was thought that the value of this work could be greatly increased with the completion of the geographical organization of the national association.

Rate Research Committee

The service furnished to association members through the publication of *Rate Research* and the "Rate Book" was emphasized in the report of the rate research committee, of which Alex Dow was chairman. Two hundred member companies now subscribe for 314 copies of *Rate Research*. The committee recommended that one copy of it should be furnished to every company as a part of the service covered by the annual dues. The 1921 edition of the "Rate Book" is being enlarged to include cities of between 20,000 and 25,000 population.

Little progress toward unification of power-factor practice was reported, and the committee thought it unlikely to come about in the near future.

The committee discussed the problem of rate making for electric ranges and cautioned companies against undertaking that business at rates that did not take due account of all costs, with special reference to effect on peak load, as that would commit the company to a so-called increment cost rate for years to come.

Inductive Interference

R. H. Ballard of Los Angeles, in reporting for the public policy sub-committee on inductive interference, told of the meetings held between executives of the National Electric Light Association and the American Telephone & Telegraph Company for the purpose of correlating their activities and jointly working out solutions to inductive-interference problems. While the engineers will continue their work, it was agreed that no precedents would be invoked in establishing the rights of either the telephone or electric light companies, but that both interests would seek the best economic solution of the problem. Bancroft Gherardi vice-president of the American Telephone & Telegraph Company, indorsed Mr. Ballard's statement and pledged the hearty support of telephone engineers in the work.

Lamp Committee

Continuing its policy of former years, the lamp committee, Frank W. Smith chairman, published in its report data for the past year which bring its curves, tables and charts up to date to the end of 1920. Special attention was given to the consideration of the correct terms to use to indicate the efficiency of the incandescent lamp. It was the endeavor to get away from the former term of "watts per candle," which was a designation of specific consumption rather than efficiency, and substitute for it "lumen" and "lumen per watt" as basic units for measurement of light output and of lamp efficiency. The larger manufacturers on Jan. 1, 1921, adopted this nomenclature. In addition, during the past year a revision of the standard specifications for incandescent lamps was undertaken.

The total sales of tungsten-filament lamps, excluding miniature sizes, in the United States during the year 1920 amounted to 202,000,000—an increase of 19 per cent over the previous year. In addition there were 9,000,000 carbon lamps sold, or 4,000,000 fewer than in 1919.

Special attention was given to voltage standardization, and the 1920 report, through a sub-committee report, went with much detail into the results of a questionnaire sent out to member companies inquiring as to their practice on standardization of voltages. A large increase is indicated in the demand for the standard voltages, particularly 115 volts to 120 volts. The 115-volt standard showed the greatest increase last year, the 120-volt increased but slightly, while the 110-volt standard continued even. Tabulations indicated that the past year had shown a very marked progress in the percentage of complete voltage standardization, and of the 520 member companies which replied to the committee's questionnaire this complete standardization rose from 79 per cent in 1920 to 96 per cent in 1921.

Third General and Executive Session

Water-Power Development Plays Chief Part in Day's Discussions—Federal Act Is Discussed—Success of Negotiations with New Commission

THE subject of hydro-electric developments, particularly in the Far Western sections, was given a prominent place on the program for Thursday morning. John A. Britton of the Pacific Gas & Electric Company, in a glowing portrait of California and its possessions, pictured the trend of development in that state from the days of the pioneers to the present, showing how, though at the present time out of a maximum of 9,000,000 water-hp. only 1,000,000 hp. is developed, the program adopted in California for the next five years will necessitate new plants at the rate of 100,000 hp. a year. He paid a high tribute to H. J. Pierce for his work in behalf of proper water-power legislation.

The committee on water-power development, Franklin T. Griffith chairman, reported on its meetings with the original Federal Power Commission in Washington early in February, 1921, at which time Secretary Merrill submitted to it the rules which he and his staff had prepared. After a prolonged discussion with Mr. Merrill and finding the rules too technical and severe, and to the committee's mind not a correct interpretation of the act, the committee declined to approve them. The Federal Power Commission then in existence, however, adopted the full set of rules and regulations on Feb. 28, including eleven rules which the committee agreed to and nine to which it could not agree.

The new Federal Power Commission took office March 4, and the N. E. L. A. committee immediately requested

a hearing, which was granted and held on March 25, 1921. At this hearing the committee frankly stated to the commission its views as to the rules then in force. After the hearing the committee remained in Washington for two weeks in conference with Secretary Merrill and his staff, at which time an agreement was reached as to revision of the rules with one exception. These revised rules were adopted by the commission on May 28, 1921, and are now in force. In the opinion of the committee, these rules provide a workable basis for administration of the water-power act.

THE NEW WATER-POWER ACT

In discussing the report of the water-power committee, Henry J. Pierce of Seattle, Wash., who took a very prominent and vital part in insuring the passage of a reasonable water-power act, said:

"The water-power act of June, 1920, with the broad and liberal interpretation and construction placed upon its administration by the revised rules and regulations recently adopted by the Federal Power Commission, and which were largely prepared by the water-power committee of the National Electric Light Association, opens up the way for the speedy development of the water powers of the country. Up to the present time 223 applications for preliminary permits and licenses, for development of an aggregate of over 15,000,000 hp., have been made to the Federal Power Commission.

"The difficulty of utilizing our hydro-electric resources is that 70 per cent of the primary power used for manufacturing purposes is east of the Mississippi River, while 70 per cent of the hydro-electric resources of the United States are west of the Rocky Mountains. The total amount of primary power developed and used at present east of the Rocky Mountains for all purposes other than by railroad locomotives is 37,000,000 hp., and the total hydraulic resources of that region are about 15,000,000 hp., so that if every water power existing east of the Rocky Mountains were developed there would still be a shortage of 22,000,000 hp. to be supplied for present uses by steam. On the other hand, 40,000,000 water-hp. can be developed west of the Rocky

Prominent Executives Snapped Between Sessions in Drake Hotel, Chicago













A—Walter H. Johnson, vice-president Philadelphia Electric Company; I. E. Moultrop, assistant superintendent of construction Edison Electric Illuminating Company of Boston.

B—Arthur B. Lisle, general manager Narragansett Electric Lighting Company, Providence, R. I.

C—Frank W. Smith, vice-president and general manager United Electric Light & Power Company, New York City.

D—Bowen Tufts, manager C. D. Parker & Company, Boston, Mass., and president New England Geographic Division, N. E. L. A.

E—R. H. Ballard, vice-president and general manager Southern California Edison Company, Los Angeles, Cal.; H. T. Sands, president Haverhill Electric Company, Haverhill, Mass.; L. L. Elden, electrical engineer Edison Electric Illuminating Company of Boston.

F—O. B. Coldwell, vice-president Portland Railway, Light & Power Company, Portland, Ore.; John A. Britton, vice-president and general manager Pacific Gas & Electric Company, San Francisco, Cal.; F. R. Coates, president and general manager Toledo Railways & Light Company.

Mountains, and but 5,000,000 primary horsepower is used, of which 2,000,000 hp. is developed by steam and 3,000,000 hp. by water power. This leaves 38,000,000 hp. west of the Rocky Mountains now going to waste and yet to be developed.

Arthur Williams Discusses the Electric Vehicle

In the electric vehicle the central station has an opportunity for an exceedingly profitable business, Arthur Williams of the New York Edison Company declared in his address at this session. He went on to point out the value of a thorough study of this method of transportation not only to the utilities but also to business at large.

Harford Powell, Jr., editor *Collier's Weekly*, made one of the hits of the convention in a trenchant address upon "Contact with the Public." He championed man-to-man relations between utilities and people, emphasizing the vital importance of sympathetically comprehending the viewpoint of the average citizen in public utility administration down to the humblest employee.

Accident Prevention

To health promotion, fire protection, operating methods and organization interest particular attention was given during the past year by the accident prevention committee, of which Charles B. Scott is chairman. Special consideration was given to electrical explosions or short circuits of great magnitude, the committee recommending that more study be bestowed upon the design and installation of current-limiting reactors, circuit breakers, instrument transformers and protective devices. In addition, ample clearances should be provided before interconnection with systems of large capacity are made.

Fourth General and Executive Session

Head of the Italian Railway Electrification Speaks—Election of Officers and Section Chairmen for the Coming Year

LOUIS A. FERGUSON, chairman of the committee on steam-railroad electrification, presented a report favoring the co-operation of electrical interests in studying transportation possibilities and problems, both technical and economic. Referring to the necessity for establishing railroad credit, the report declared that it is unthinkable that the American railroads should be subjected to the dread palsy of governmental operation.

W. C. L. Eglin filed the report of the committee on the president's address. John W. Lieb, representing the association on the National Industrial Conference Board and United States Chamber of Commerce, commended the work of these organizations in a comprehensive description of their activities.

Guido Semenza, head of the Italian railway electrification commission, gave an interesting talk on water power and interconnection developments in Italy.

The convention came to a close with the election of officers as follows: President, Milan R. Bump; first vice-president, Frank W. Smith; second vice-president, Walter H. Johnson; third vice-president, Franklin T. Griffith; fourth vice-president, James E. Davidson; treasurer, Harry C. Abell (re-elected); executive committee for three years, R. F. Pack, I. E. Moultrop, E. W. Rice, Jr.; to fill vacancy caused by resignation of D. H. McDougall, Rawson Collier; jobbers' representative, W. E. Robertson. Section chairmen had previously been elected at the respective sessions as follows: Technical Section, N. A. Carle; Commercial Section, R. H. Tillman; Accounting Section, E. J. Fowler; Public Relations Section, Martin J. Insull.



MARTIN J. INSULL
Vice-President
Middle West Utilities Company



M. H. AYLESWORTH
Executive Manager
N. E. L. A.



FRANK W. SMITH
Vice-President and
General Manager
United Electric Light & Power Co.



WALTER H. JOHNSON
Vice-President
Philadelphia Electric Co.



FRANKLIN T. GRIFFITH
President
Portland Railway, Light & Power Company



J. E. DAVIDSON
Vice-President
and General Manager
Nebraska Power Company

Retiring President Insull, elected new chairman Public Policy Committee; Executive Manager Aylesworth and the four vice-presidents elected for the coming year

Samuel Insull Outlines Future for Co-ordinated Service

President of Commonwealth Edison Company Emphasizes Fundamental Soundness of Private Development and Comments on Interconnection and Superpower

IN A STIRRING address Wednesday morning to an audience which crowded the main auditorium of the Drake Hotel, Samuel Insull, president of the Commonwealth Edison Company, surveyed the problems which central-station-company men now face. In contrasting the results of the recent industrial depression on business Mr. Insull pointed out that the central-station industry has felt the pressure in the shape of a decreased percentage of increased growth and a difficulty in acquiring the necessary funds to provide plant and equipment to take care of business offered. He urged, however, that business-getting departments should show new vigor and try to get in a position where monthly receipts will show increases.

In pointing out that the universal use of electric service means greater diversity and consequently high load factor, Mr. Insull referred to the situation in Montana, where there is a load factor of 78 per cent and a consumption of energy of 2,000 kw.-hr. per capita, and to similar conditions on the Pacific Coast, where there is a load factor of about 60 per cent and a consumption of about 1,200 kw.-hr. per capita. In New York City, Mr. Insull stated, the load factor is about 40 per cent with a kilowatt-hour per capita sale of 450 kw.-hr. Chicago has a load factor of about 45 per cent and a consumption of about 700 kw.-hr. per capita. He pointed out that these various percentages depend on the nature of the business served and referred to an address which he made before the American Institute of Electrical Engineers in New York, predicting that if Greater New York and the territory immediately tributary to that city were interconnected and steam railroads electrified, a load factor similar to that existing on the Pacific Coast and in Montana was possible. He stated that the difference between the load factor of New York and Chicago of about 12½ per cent is owing to the fact that all the energy consumed within the latter city is produced under one organization.

By the aid of a map of the States of Indiana, Illinois, Wisconsin, Michigan, Ohio and Kentucky Mr. Insull showed the status of interconnection of the systems which he operates. The territory from northwest of St. Paul and Minneapolis to St. Louis and Louisville on the south is interconnected today practically in one system, with the exception of about 115 to 120 miles in three separate gaps, where the interconnection has not been made partly because of the cost of money and partly because at this particular moment the industrial advantages to be obtained are comparatively slight. Atlantic seaboard. On this subject Mr. Insull said in warrant. The Commonwealth Edison Company contemplates building at Waukegan, north of Chicago, just this side of the Wisconsin border, a large power station on the lake, which while taking care mainly of the territory immediately north of Chicago and supplementing the small water powers and steam stations on the various rivers of northern Illinois, will virtually act as a steam reserve across to the Mississippi River and away up into central Wisconsin.

This discussion of the Middle West interconnection led to comments on the Superpower System for the Atlantic seaboard. On this subject Mr. Insull said in part:

"The map behind me represents Illinois, Indiana, portions of Michigan, Wisconsin, Ohio, Keokuk and St. Louis. With virtually the same population it produces about the same kilowatts, burns 13 per cent more coal because of the lower efficiency of the fuel, and produces 40 per cent more energy from water power than is produced in the territory of the proposed Eastern superpower scheme. We have not called it by the same name, but we have been actually doing the same work that it is proposed should be done on the Atlantic seaboard. We have some advantages. We have possibly more enlightened legislation on the subject. The question of condemnation under the law of eminent domain is accorded to us to a greater extent in the territories of the Mississippi Valley than it is accorded in the territories along the Atlantic seaboard. That to my mind is probably one of the most important things. The necessity compelled us to go ahead. I have had to learn the fact that the greater the territory that you can cover the greater is the diversity of the demand for your product and that consequently the better are your operating conditions because of your better load factor.

"As to the superpower scheme, I do not want to be taken as being in any way unfriendly to that scheme. I want to emphasize here the importance of the National Electric Light Association and its member companies taking a far more active part in this situation than we have done in the last year or so. Remember, we are likely to get legislation through Congress, or proposed legislation presented to Congress, that may be very desirable for the people operating within the territory, the comparatively small territory, along the Atlantic seaboard, but might be very undesirable for people putting out just as much energy in the Mississippi Valley or the Rocky Mountains or on the Pacific Coast.

"I should like to see every committee of this association watch the progress of any plans of federal control of our business. I think we can be of great help in the rehabilitation of steam railroads of this country, but I am not one that believes in universal electrical propulsion of railroads immediately. I believe that the economic way to get around to that proposition is to develop our production of energy along economic lines and to develop the transmission of that energy throughout the country on economic lines; to see to it that at any time where electrification of steam railroads is desirable in some particular locality we shall be able to take care of it. I see no reason why we should not finance that operation right up to the point where our energy is taken by the prime mover of the railroad—that is, the locomotive—and in that respect I think we can be of very great assistance; but in all these investigations—and I have studied some of the figures sent out from Washington—there should be the stabilized knowledge that exists in this industry and in this association and its members as the result of forty years of work in the manufacture of energy. The nation is entitled to the benefit of it, the industries are entitled to the benefit of it, and we are entitled to the benefit of it to the extent that it will stabilize our investment to a greater extent than it is stabilized today and will help to reduce the cost of our product and enable us to sell it at cheaper prices to all of our customers, as well as to those who want to purchase it in very large quantities."

Edward N. Hurley Discusses Knowing One's Customers

IN HIS address on "Do We Know Our Customers?" before the Public Relations Section, Edward N. Hurley, Hurley Machine Company, emphasized the importance of the human element in business. Managers of corporations who do not know what the man in the street is thinking about and have a feeling that their company is so large and powerful that they do not have to give special attention to their old customers are living in the past, he said, and it is only a question of time before reaction will start and it will then require heroic work on the part of the new management to save the property.

Not over 7 per cent of the executives, advertising agencies and sales managers of the corporations in this country have correct information as to the facts and figures regarding their customers, prospective customers or the merchandising methods of their distributers and dealers, Mr. Hurley continued.

Mr. Hurley suggested that the executives of all the electric light and power companies in the country ascertain by personal letters to their customers the general feeling of those customers regarding the electric service they are receiving. In connection with this he said:

"I firmly believe that a national survey along the lines indicated would show that the vast majority of the consumers of electric light and power are absolutely satisfied with the service they receive and have confidence in the managers and men who have built up and developed the great electrical industry."

Public Policy Meeting and Electric Vehicle Luncheon

AT THE public meeting under the auspices of the public policy committee on Thursday evening the principal speaker was James Montgomery Beck, who last week received from President Harding an appointment to be Solicitor-General of the United States. His topic was "Benjamin Franklin, the Pioneer Electrical Engineer and Philosopher."

Sidney Z. Mitchell, Electric Bond & Share Company, presented the report of the public policy committee. An abstract of this report, which touched upon the very fundamentals of the industry, will be found in the report of the Public Relations Section.

Electric Vehicle Luncheon

Three hundred delegates and fourteen of the foremost leaders of the industry assembled Wednesday noon at the Hotel Drake and received in ninety minutes more testimony as to the value of storage-battery transportation than probably ever before was conveyed to an audience in an equal period of time. The array of distinguished men who by their presence indorsed the electric car and the character of the speakers who "stood up and were counted" for "electrics" made the occasion literally unique in the annals of commercial transportation.

F. J. Bridges of the Hydrox Company, Chicago, for fifteen years a purchaser and user of motor transportation, testified that within 30-mile to 35-mile running limits the electric vehicle operates at lower cost than horses and meets the requirements in better fashion than its other competitors. Samuel Insull, president Commonwealth Edison Company, emphasized the low central-station investment required to care for electric trucks and the value of this load from the revenue and off-peak standpoints. John W. Lieb showed how the electric truck, industrial and road types, can reduce the cost of commodity handling. Arthur Williams, after paying an earnest tribute to the work of James H. McGraw in spreading the vehicle gospel, cited sales instructions of a gasoline truck maker, indicating that competitors have a genuine fear of the "electric" in certain fields. Mr. McGraw, speaking from twenty years' personal interest in electric vehicle development, maintained that, in view of the accomplished results, the time has come for a change in the psychological attitude toward electric vehicles. He paid a high tribute to Chairman E. S. Mansfield's constructive work in the electric vehicle field. The meeting closed with the general feeling that a new day has dawned in storage battery transportation.

Current Aspects of Utility Regulation

SPEAKING at the Thursday session on "Current Aspects of Utility Regulation," E. I. Lewis, formerly chairman of the Indiana Public Service Commission and now by appointment of President Harding a member of the Interstate Commerce Commission, reviewed in a dramatic way the abnormal business conditions that arose upon the signing of the armistice. Continuing, he said:

"We came up to the present year of our Lord 1921 dazed. Commodity prices began to break. Labor was becoming so easily available that employees began again to show efficiency. The lordly coal supply man lapsed back into the almost forgotten habit of taking his hat off to the trade. Red figures began to go black. Regulating officials and public utility managers began to see mirages of reductions in rates.

"Let us see if we can analyze the situation. Why are utility rates failing to fall readily and comparably with commodity prices? One reason, forgotten by a public that generally will be reasonable when it stops to reason, lies in the fact that utility rates, as a whole, did not advance comparably with commodity prices. One may truthfully say that utility rates have advanced very little from the pre-war levels. When every one else—corporation, farmer, laborer, wholesaler, retailer, property owner—sailed away on the wild war-period flight, the public utilities and common carriers alone were anchored to mother earth by regulation at no time overgenerous and often close to the point of starvation.

"Still another reason for failure of public utility rates to drop: While public and industrial demand called for expansion of plants there is now generally present a vast amount of physical emaciation. It can no longer be ignored. When the war was upon us President Wilson commanded scrupulous husbanding of men, materials and money for the big job of winning the war. Maintenance and rehabilitation suffered. Then followed the most unfavorable financing period utilities have known and constantly mounting operating costs, accompanied by increasingly unfavorable financial showings. The result is that many utilities emerge from the years 1917-1920 in depleted physical condition."

Mr. Lewis condemned certain specified practices of some utilities and ended with an eloquent and well-reasoned plea for an era of better understanding between the three bodies concerned—the utilities, the commissions and the public.

Addresses of Section Chairmen

High Spots in the Work of the Public Relations, Technical, Commercial and Accounting Sections During the Past Year

A BRIEF report of accomplishment and a few recommendations were made by James E. Davidson, chairman of the Public Relations National Section. This section, now completing its first year, undertook to better relations between the light and power utilities and labor, electrical manufacturers, jobbers and dealers, and particularly with the public, and to promote co-operation with investment bankers. An important part of this work was the preparation and distribution of publicity material, such as the "Kilo Watt" Series, which has now gone over the ten-million mark for the first and second series; booklets, addresses and advertisements, including the association's own campaign in the *Saturday Evening Post*.

Co-operation was obtained from the Investment Bankers' Association of America, which passed helpful resolutions and sent publicity material specially prepared for the purpose to its customers.

Public utility information bureaus have been formed in ten states, and the report urged that similar bureaus be formed in other states as quickly as possible.

The manufacturers and electrical trade press are thanked for their generosity in the co-operative advertising campaigns, and particularly the McGraw-Hill Company, which, the report stated, rendered especial service through its *Collier's Weekly* campaign, "which has particularly benefited this movement."

The committee made a number of recommendations. Every company is urged to do at least a part of its financing by the sale of securities to the public. One or more employees of each company should be groomed to make talks before local organizations. A wider subscription to the "Kilo Watt" series and other booklets is urged. All material prepared by the publicity department should be ordered by the state committee on public utility information for regular distribution. The formation of a committee on relations with educational institutions which will arrange for lectures, booklets, etc., is recommended, so that students at colleges and other institutions of learning shall be taught the economic position of the utility. All employees of the electrical industry should be informed so that they may talk intelligently of the utility.

TECHNICAL SECTION

Some inquirers have raised the question whether the N. E. L. A. should devote so much time to technical work, especially when there are so many engineering societies in the country apparently working to the same end. I. E. Moultrop, chairman of the Technical Section, pointed out that the N. E. L. A. does not duplicate the work of any other society, but rather takes up the work where the engineering societies leave off. Engineering societies by their constitutions are prevented from doing commercial work, but the N. E. L. A. is not restricted in this way. Attention was also called to the important progress which has been made toward co-operation with the communication companies in the solution of inductive-interference problems.

The frequency and place of committee meetings deserve further study, Mr. Moultrop asserted, although the problem will be somewhat simplified when each geographical division has a technical organization functioning with the national committee. He indorsed the plan adopted this year when a group of committees met in New York and accomplished more collectively in two or three days than could have been accomplished by the separate committees in the same time. He also reviewed briefly the activities of the technical committees.

COMMERCIAL SECTION

M. S. Seelman, Jr., the chairman of the Commercial National Section, pointed out in his address that if executives are to get the most and best out of their properties they must think along broad commercial lines. The commercial elements of their organization should be encouraged and developed and have the fullest possible scope in all dealings with customers and all relations between public and company.

Reviewing the work of the Lighting Sales Bureau, Mr. Seelman pointed out that the same opportunity to improve conditions and increase income that has been shown by the industrial campaign exists in the field of home lighting and called attention to the home-lighting demonstration at the convention. The work of the Power Sales Bureau for the past year was based upon the postulate that the present job of the power salesman is to help the central-station company's management to secure the largest return on a given investment and at the same time, in order that the element of mutual advantage may be present, to obtain for the customer a profitable investment in purchased power.

A real begining was made this year in the testing of electrical appliances, and in some respects this work has been pure pioneering. It is hoped to put the business of merchandising appliances on the same business basis on which the business of merchandising lamps now rests so far as regards the standardizing of the tests of the lamps and the resulting superior average product. Closely related to merchandising is the question of advertising and publicity, which has called for an increased use of the electrical page and the working out of the model electrical home idea.

Valuable information was given on electrical vehicles, covering among other things the progress made in establishing electrical garages.

ACCOUNTING SECTION

Reviewing the work of the Accounting Section for the past year, Chairman J. C. Van Duyne outlined the organization of the various committees. Of the twelve committees previously organized it was directed by the section that two—one on uniform classification of accounts and relations with other associations and one on form of annual reports to commissions—be consolidated; that three be discontinued, namely, the insurance committee, now a national committee, the merchandising accounting committee and the motor-vehicle records committee, both of the latter having fulfilled their functions.

Organization under the geographic division plan has progressed throughout the year, and a fairly complete tie-in between the division accounting sections and the national Accounting Section has been made possible.

Commenting on the standardization of accounts as prescribed by state commissions, Mr. Van Duyne reviewed the progress made since 1914 and also the work of the joint committee of the electric and gas associations which collaborated with the Association of Railway and Utilities Commissioners in formulating a uniform standardized classification of accounts for adoption by all states.



Technical Sessions

Program

TUESDAY, MAY 31
Address of chairman, I. E. Moultrop.
Report of committee on electrical apparatus, R. F. Schuchardt.
Report of committee on safety rules, Thomas Sproule.
PARALLEL SESSION
Report of meter committee, W. L. Wadsworth.
WEDNESDAY, JUNE 1
Report of committee on overhead systems, W. K. Vanderpoel.
Report of committee on inductive interference, A. E. Silver.
THURSDAY, JUNE 2
Report of committee on hydraulic power, Markham Cheever.
Report of committee on prime movers, N. A. Carle.
PARALLEL SESSION
Report of committee on underground systems, F. E. Ricketts.

I. E. MOULTROP, chairman of the Technical Section, in reviewing the activities during the past year, dwelt upon the importance of the work of technical committees, saying that they do not duplicate the work of other societies but co-operate with them to advantage. During the year 300 men have been at work on the technical committees. An interesting plan was successfully carried out this year, he said, when 250 men met simultaneously with their committees in New York. More was accomplished at this time, he believed, than could have been done by the separate committees. He also called attention to the work of the hydraulic power committee, which functioned this year for the first time.

Of particular importance was the co-operative spirit entered into between N. E. L. A. representatives and the communication companies in the matter of inductive interference. Mr. Moultrop also spoke of the activities of the consultant group, composed of Profs. Elihu Thomson, A. E. Kennelly and Charles F. Scott.

Prime Movers

The specification of lubricating oils and the economy of burning powdered coal were discussed, following the prime mover report by N. A. Carle, chairman. The comments on burning pulverized fuel developed into a lively and almost heated discussion in which ardent and eloquent advocates of both forms of combustion took part. Lubricating oil is particularly interesting, it was said, because there has been a mystery enshrouding the subject for several years that should now be dispelled. The report is abstracted on page 1311.

The recommendations on lubricating oil are the first that have been submitted and are very important and valuable, it was said. Opinions of oil refiners, turbine manufacturers, operating companies, the Bureau of Standards and others have been considered in preparing the recommendations. In commenting on the report, Mr. Larsen, Sinclair Oil Refining Company, claimed that some of the tests recommended are not absolutely necessary and should be made optional. He expressed the belief that tests of viscosity, acidity, emulsion, corrosion, flash temperature, etc., should be sufficient.

The viewpoint of the Bureau of Standards was expressed by W. H. Herschel, who said that the routine tests were based on government specifications and declared that it is a mistake to establish too many new specifications in view of the increased price which oil refiners would consequently have to charge.

Viewpoints of three manufacturers were expressed by E. H. Sniffen of the Westinghouse Electric & Manufacturing Company, A. C. Flory of the Allis-Chalmers Manufacturing Company and R. B. Beale of the General Electric Company, each expressing the opinion that operating engineers are in a better position to determine the basis for lubricating oil specifications than are manufacturers.

Opinions of three operating companies were expressed by R. J. C. Wood, Southern California Edison Company; H. M. Cook, Brooklyn Edison Company, and W. L. Abbott, Commonwealth Edison Company. Mr. Wood referred to deposits of iron oxide and emulsification which had been particularly troublesome. In one case the deposit in an oil tank was found to consist of 60 per cent iron oxide caused by acid in the oil eating the oil pipes. The acid also corroded the oil-pump valves.

Mr. Cook called attention to increased trouble with corrosion where salt water is used for cooling oil and said that this trouble can be minimized by using monel-metal instead of brass. Mr. Abbott said that it had been his experience that emulsion may be converted to pure oil and water by heating to 250 deg. F., but it is usually cheaper to buy new oil.

In commenting on the fuel-oil situation, Mr. Larsen advocated the burning of low-gravity fuel oils since they have a higher B.t.u. content per gallon, are cheaper per volume and are not so easily cracked as higher-gravity oils. Furthermore, they are not subject to such extreme fluctuations in price.

An unusually entertaining and exciting discussion for a technical session took place when advocates of powdered-fuel burning equipment and stokers were

given an opportunity to present the merits of the equipment they favored. Manufacturers and operating engineers took part. Among them were John Anderson, Milwaukee Electric Railway & Light Company; W. J. Santmyer, Puget Sound Light & Power Company; H. D. Savage, Combustion Engineering Company; F. A. Sheffler, Fuller Engineering Company, and Joseph Harrington, Brady Foundry Company.

Mr. Santmyer, who was introduced as the engineer who had burned 120 acres of mud flats, referred to experiments of burning powdered fuel in the Northwest, particularly in twelve plants around Seattle. "Powdered-fuel plants have come to stay," he declared emphatically. Efficiencies are obtained which are unbelievable, boilers can be forced to remarkable overloads, and equipment is particularly flexible in operation. In an endeavor to substantiate these statements he referred to one 500-hp. installation where the boilers could be put on the line and made to carry 300 to 400 per cent rating in forty minutes.

In defending the high expenditures often attributed to powdered-fuel plants Mr. Sheffler pointed out that the excessive expense often cited is due to including the cost of considerable equipment which displaces apparatus ordinarily used with boilers fired by other means. While he did admit that powdered-fuel equipment cost more than other combustion equipment under some conditions, it is usually less expensive for stations rated at 5,000 hp., or greater, he declared.

The excitement started when Joseph Harrington took the side of the stoker manufacturers and commenced to show what a competitor powdered-fuel equipment has in modern stokers. He asked: "What does efficiency amount to if it doesn't reduce the total cost?" If stokers are assumed to have 80 per cent efficiency and powdered-coal installations are assumed to have 85 to 88 per cent efficiency, the relative costs of the installations will be in about the same proportion, so that the powdered-fuel installations will have to have considerable offsetting advantages to justify their use. Furthermore, he pointed out, burning of powdered coal adds complications and probability of breakdown. What is needed is simplification, reliability and low total operating costs. Contending that costs of pulverizing coal increases very rapidly as the percentage of inert material goes up, he questioned the economy of burning any powdered coal containing more than 15 per cent ash or 8 per cent moisture. He decried the comparisons which had been made between powdered-coal installations and obsolete stoker installations, saying that modern stokers can burn anything from lignite to anthracite coal and have horizontal efficiency curves from 150 to 250 per cent rating, can increase from 150 to 250 per cent rating in three to four minutes and can burn coal containing 40 per cent ash without clinker formation of excessive maintenance expense. Powdered-fuel combustion is limited in the small amount of excess air which can be admitted, he declared, because of the excessive furnace temperatures which destroy the brickwork. In stokers, on the other hand, the brick deterioration is much less with the same reduction in excess air. As to forcing rates, he contended that modern stokers can burn up to 60 lb. of coal per square foot per hour and in a few months new stokers will be made available which will burn as high as 100 lb. of coal per square foot per hour. In closing he declared that he was in favor of powdered-coal combustion under certain conditions, but held that what the industry needs now are facts that will permit equitable comparisons.

Mr. Santmyer contended that in the Northwest coals containing 28 per cent moisture and 16 to 22 per cent ash have been burned, and the cost of drying, pulverizing and delivering to the furneces is only 72 cents per ton.

Mr. Anderson was a very enthusiastic supporter of powdered fuel and expressed one operating engineer's viewpoint when he said that the new Lakeside plant at Milwaukee has developed unbelievable efficiencies, gives the best performance which can be expected, and all at an operating and maintenance expense which is considerably less than before. He expressed the hope that the stoker which Mr. Harrington prophesied would materialize, but said that he could not believe that any engineer could present a reasonable argument for installing stokers after seeing the powdered-fuel installation in the new Lakeside plant. He concluded by saying that in the Oneida plant, which has six stoker-fired boilers and five powdered-coal boilers, the powdered-fuel installations are always used when extra forcing is necessary.

An Operating Code Being Formulated

There are many excellent operating rules and regulations in effect, but there are as many different kinds as there are operating companies. Recognizing this fact, the prime movers committee, of which N. A. Carle is chairman, has started the compilation of all operating rules in order that the best ideas may be selected and made available for operating companies. So far considerable progress has been made in developing the probable scope of the recommendations which it will eventually make, but the actual collection of rules and regulations remains to be completed. In outlining this work Mr. Carle points out that just because a company does not have printed rules entitled "Operating Code" is no reason why it cannot compile what rules it has in the form of blueprints, typewritten sheets, verbal instructions, etc., and send them to the chairman of the prime movers committee. By doing so no company will obligate itself to observe these practices, since the information is only desired in order to prepare a collection of recommended practices. After all the rules have been compiled, the recommendations will be published so that a discussion by correspondence may be conducted. Following this a public hearing will be held and thus a tentative code will be devised.

Mr. Carle emphasized that this code is not going to be forced on operating companies. It will be for their voluntary use only. He also pointed out that it will supplement the existing A. S. M. E. code, which covers only the requirements at the time of accepting equipment and conducting performance tests. The N. E. L. A. code will apply to those conditions which exist for fifteen to twenty years of operation after the installation of apparatus.

Hydraulic Power

On account of the rapidly growing importance of water power it was decided at the convention at Pasadena last year to organize a hydraulic power committee to give special consideration to problems of water-power development and operation. During the first year of the committee's existence, under the chairmanship of Mark-

ham Cheever, a great deal of time was required to work out the organization in preparation for comprehensive activities.

Of the technical problems considered by the committee, the development of efficient draft tubes, the control of tailwater level, the relation between rainfall and stream flow, evaporation, and the operation of hydroelectric plants for maximum output received the most attention.

Regarding the design and construction of waterwheels attention is called to the 55,000-hp. turbines to operate under 305-ft. (93-m.) head for the Queenston-Niagara station of the Hydro-Electric Power Commission of Ontario, a distinct advance in the size of reaction wheels. Mention is also made of the use of 22,500-hp. turbines under 800-ft. (245-m.) head at the Kern River No. 3 station of the Southern Califronia Edison Company. This represents the highest head to which reaction wheels have been applied. Another feature of even greater interest is the improvement in efficiency curves. The flat curves of newer wheels, and particularly the high value at part gate opening, are of the greatest importance to the operator in obtaining maximum energy output from available water supply and under varying load conditions met in practice. Progress has also been made in the application of high-specific-speed, unshrouded, propeller type of runner to low heads.

A moving picture of the Pitt River developments now under way in California by the Pacific Gas & Electric Company enlivened the discussion of the hydraulic power committee's report. John A Britton outlined the major features, including the river flow, which is remarkable for its constancy, and P. M. Downing pointed out that eight plants, of which three are under design or construction, will be eventually constructed over a length of 35 miles of river between Fall River and Big Bend. A total of 500,000 kw. will be developed.

W. N. Ryerson of Duluth outlined some penstock troubles that have been encountered, mentioning the splitting of redwood staves and corrosion of steel pipes. The conclusion has been reached that treatment of steel is useless unless the metal has been thoroughly cleaned by sandblasting.

W. W. Tefft said that the chief object of his development is not the production of a head increaser, but to reduce the length of the spillway section of the dam and lower construction costs. The use of bursting plates is a waste of money, R. J. C. Wood of Los Angeles asserted, unless plates are put at the point where trouble occurs.

In California a marked difference of available water is experienced in years when rainfall is equal if the preceding seasons have been either wet or dry. For



N. A. CARLE
Chief Engineer
Public Service Electric Co.



R. F. SCHUCHARDT
Electrical Engineer
Commonwealth Edison Co.



W. K. VANDERPOEL
Superintendent
Public Service Electric Co.



MARKHAM CHEEVER
General Superintendent and
Chief Engineer
Utah Power & Light Co.



W. L. WADSWORTH
Superintendent of Meters
Minneapolis General Electric Co.



F. E. RICKETTS
Superintendent Electric Stations
Consolidated Gas Electric Light
& Power Co.



A. E. SILVER
Electrical Engineer
Electric Bond & Share Co.



THOMAS SPROULE
Assistant Superintendent
Public Service Electric Co.

Chairmen of technical committees who presented reports at the Chicago convention: Mr. Carle, committee on prime movers; Mr. Schuchardt, committee on electrical apparatus; Mr. Vanderpoel, committee on overhead systems; Mr. Cheever, committee on hydraulic power; Mr. Wadsworth, committee on meters; Mr. Ricketts, committee on underground systems; Mr. Silver, inductive interference; Mr. Sproule, safety rules.

this reason, in estimating water supplies available in any season the records of the preceding seasons must be considered.

Electrical Apparatus

New practices and tendencies in the use and operation of electrical apparatus were the subject of an entire afternoon's discussion. The report of the committee, of which R. F. Schuchardt is chairman, is presented in abstract on page 1314 of this issue. Among the subjects which elicited the most interest in the discussion were the following: Closed system of generator ventilation, methods of maintaining heat balance, auxiliary drive, radio-telephoning for load dispatching, protection of reactors, oil-circuit-breaker rupturing capacity, and standardization of service voltage.

H. R. Summerhayes, General Electric Company, called attention to stresses as high as 200 lb. per inch in reactor conductors. Theoretically, he said, the closed system of ventilation should permit the use of nitrogen as the cooling medium for generators, but difficulty would be experienced in avoiding its dilution with oxygen that might leak in. However, the system does facilitate the use of CO_2 for fire extinguishing. A central starting bus for auxiliary motors was favored because it permits the use of large enough circuit breakers to clear faults. Kenetrons are being used for high-voltage direct-current tests, Mr. Summerhayes declared, but they alone are not strong enough to break down faults at the present stage of development. For this purpose mercury rectifiers with their coils connected for maximum voltage have been used. The more extensive use of mercury rectifiers in Europe is due to the higher efficiency obtained with the higher voltage used there, he contended.

R. J. C. Wood, Southern California Edison Company, asked what the lowest voltage at which differential relays would operate should be, pointing out that too low a value might cause unnecessary interruption of service whereas too high values might permit great fire damage.

B. G. Jamieson, Commonwealth Edison Company, Chicago, suggested that some information be compiled on the application of automatic control to feeder circuits. Considering reliability, he contended that it is preposterous to think of a reactor ever failing and said that the Commonwealth Edison Company is connecting auxiliary motors between bus sections to prevent losing them in case one bus section "goes down."

Manufacturers have promised static apparatus that can be used in place of rotating apparatus to supplement the kenetron for high-voltage direct-current testing, he said.

F. W. Smith, United Electric Light & Power Company, New York, urged that information be obtained regarding the performance of alternating-current motors for elevator service where the speed is 350 ft. per minute or more.

F. C. Hanker, Westinghouse Electric & Manufacturing Company, expressed a general need of experience from operating companies with high-potential tests for generators. Tests will be completed shortly, he declared, from which manufacturers can judge the rupturing capacity of oil circuit breakers more accurately.

Three interesting practices of the Detroit Edison Company were related by Alex Dow, namely, (1) the operation of house turbines in parallel with the main generators without experiencing the troubles usually anticipated, (2) the segregation of power supply and provision of network interconnection that prevent the failure of one station pulling another down or requiring the indiscriminate disconnection of loads, and (3) the use of radio telephony for load dispatching. The house turbine is run on the throttle to prevent its seizing the load in case of drop of main generator frequency. To avoid its slowing down with the rest of the system during a disturbance, low-voltage or low-frequency relays might be used to separate it electrically from the main units, but this method is not entirely satisfactory.

Just enough interconnections are provided between the networks served by the Delray and Connors Creek stations, said Mr. Dow, to assure synchronism and the exchange of energy necessary for economical system operation. Neither direct linking nor indifferent feeding is employed. Instead there is exchange capacity equivalent to the rating of one large turbine, and the connections can be made between centers of load. Switching facilities are provided so that if more than one turbine goes down in a station a load equivalent to that carried by the additional generators dropping out of service can be disconnected, but this is not done indiscriminately. Furthermore, no network switch, in case of a circuit fault, is required to interrupt the total current that can be supplied by the stations jointly.

Nicholas Stahl referred to some very satisfying experiences of the Narragansett Electric Company of Providence, R. I., with the closed system of generator ventilation in which the heat from the generator is used to raise the temperature of the boiler-feed water. Arrangements are made for converting the system to a straight-through ventilating system when desired or of recirculating the cooling water when all heat cannot be absorbed by the feed water.

P. D. Martin, Philadelphia Electric Company, declared that the cost of alternating-current auxiliary motors with neutrals brought out is only 1 per cent more than the cost of those not so equipped, hence differential control is not more expensive than overload protection and more desirable. He referred to the protection of auxiliary motors in the Philadelphia Electric Company's new Delaware station.

V. E. Alden, Consolidated Gas, Electric Light & Power Company, Baltimore, referred to an instance where an entire station was shut down by losing its electrical connection with a paralleled system because the low-voltage releases on the forced-draft fans tripped out. Recurrence of this trouble will be avoided by the latches which have been put on all low-voltage relays to cut them out during emergencies of this kind. He expressed a decided preference for direct-current drive.

D. L. Galusha, Dwight P. Robinson Company, Inc., referred to a recent experience at Colfax station of the Duquesne Light Company which demonstrated the ability of the auxiliary drive system installed there to maintain service.

A. F. Bang, Pennsylvania Water & Power Company, discussed methods of fighting fires, favoring carbon

tetrachloride for small fires around energized equipment where the poisonous gases emitted will quickly disperse, soda or bromide solutions where the fires are larger but electrical circuits de-energized, and sand or sawdust for still larger fires, but not in oil switches where the conflagration can be covered.

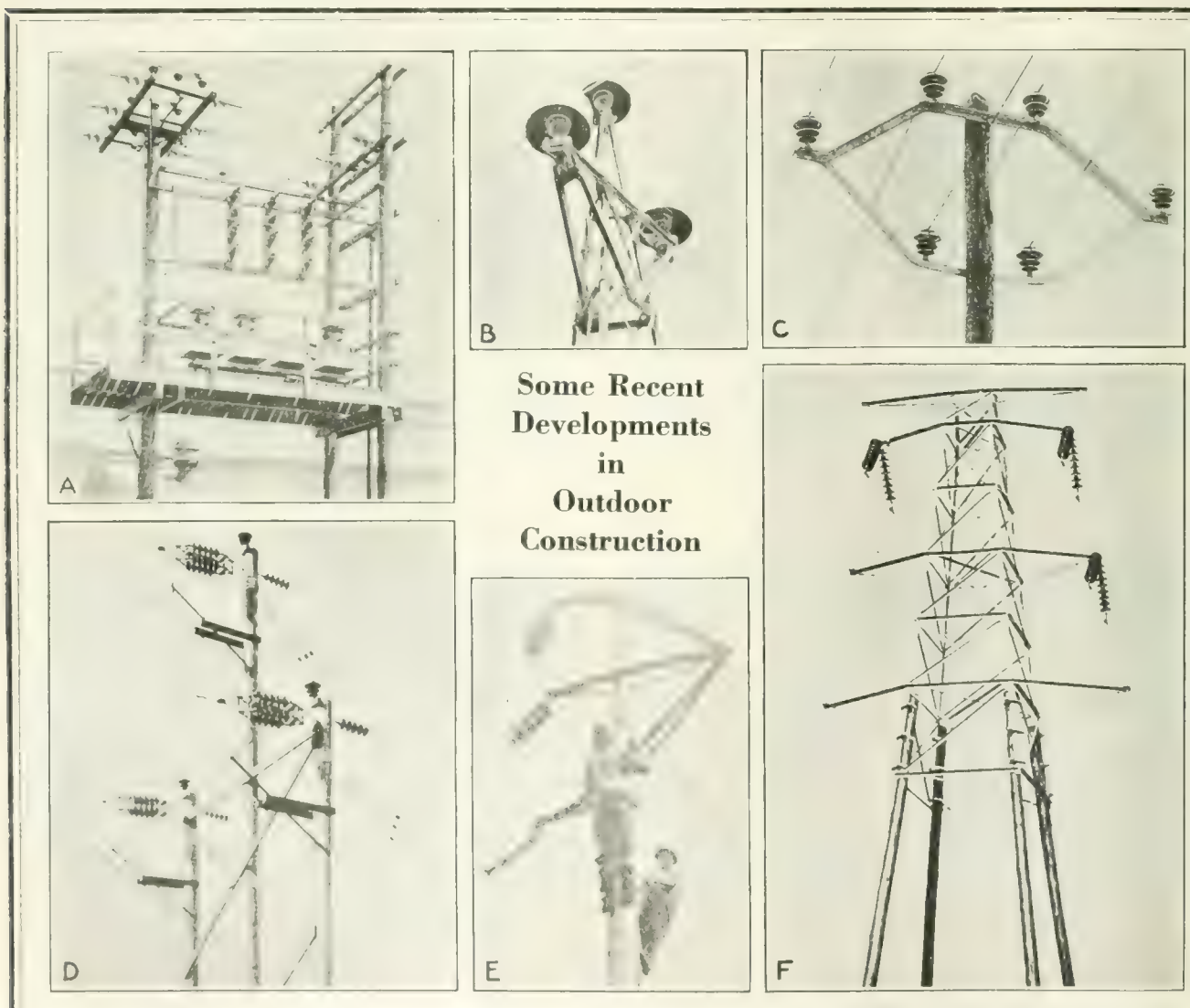
W. L. Abbott, Commonwealth Edison Company; I. M. Stein, R. E. Argersinger and Prof. C. F. Scott, Yale University, also spoke.

Overhead Systems

The collection of data from operating companies regarding present-day practice is the outstanding feature of the report of the overhead systems committee, W. K. Vanderpoel chairman. It includes a study of the value of overhead ground wires, the most desirable pole spacings, conductor arrangements and spacings, relative merits of the delta-connected and star-connected systems, advantages and disadvantages of a grounded system and method of establishing such a ground, merits of loop transmission, insulator testing and related subjects. An intensive study was also made of wood poles with a view to revising the specifications. Although overhead ground wires do afford some protection to insulators, the extent and value of this protection are uncertain. Furthermore, they do not afford any more protection to the poles than individual ground wires on each pole unless grounding conditions are exceptionally poor. However, there is evidence that ground wires do afford protection to station apparatus, but the evidence is not conclusive as to the extent of such protection. Their value in reducing disturbances depends upon type of relays employed, individual ground conditions and other local conditions.

The possibility of controlling flux distribution by means of horns or guard rings was shown by A. O. Austin by means of stereopticon pictures. Insulated horns or rings reduce the tendency to arc over, though in general rings are less effective than horns. The possibility of improving conductor conditions by wire-mesh caging over the conductor was also shown.

Fifteen to twenty-five per cent in investment charges is saved or at least prevented by temperature indicators on distribution transformers, declared L. L. Elden, who also said that these devices enable better loading of transformers than mere estimating of loads.



A—Oxide film arrester installation. B—Hoods on insulators to protect them from dust deposits. C—Double wishbone arms for double-circuit line. D—Wood-pole strain tower for long spans. E—Bow-arrow arms at turn in line. F—Steel tower top supported on wood stilts when steel was difficult to secure.

E. M. Herr, president of the Westinghouse Electric & Manufacturing Company, expressed the sympathetic interest manufacturers feel in this movement. He praised the exhibit of N. E. L. A. publicity material at the convention and urged further vigorous team play.

Underground Systems

Special attention to the importance of correct splice making is called in the report of the underground systems committee, F. E. Ricketts chairman. Records of operating trouble with high-tension cable are said to show that about 37 per cent of the number of breakdowns occur in splices. The most important considerations in making a successful splice are mentioned in the report, the specifications used by one company being given in an appendix. Attention is particularly called to the importance of making a yearly survey of the temperature in crowded duct lines, as the maximum rating depends on the maximum duct temperature prevailing. Experiences of some of the larger companies with "hot spots" in their duct lines are related, and the means they have employed to combat this trouble are given, such as artificial ventilation and sprinkling of the duct lines with water.

Cracking of lead sheathing, said C. H. Shaw, New York, in discussion, is due principally to careless handling and installation. Another cause is crystallization by vibration, according to E. R. Northmore, Los Angeles. D. W. Roper said this trouble was caused by the turns of the cable rubbing against each other during shipment and has been prevented by greasing the cables before reeling. An addition of 2 per cent to 3 per cent of tin in the lead will also alleviate this fault. F. E. Ricketts said that the Baltimore company adds 1 per cent of antimony for the same purposes and secures very good results at a smaller cost.

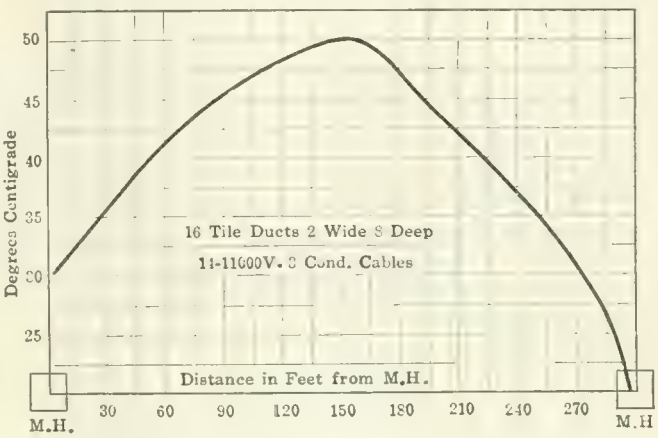
Discussing higher voltages for underground cables, Mr. Roper said that the Commonwealth Edison Company is planning to distribute 33,000 volts over cables which during the last two years have been installed for 22,000 volts. No trouble is expected with the higher voltage. He mentioned a test on some 12,000-volt cable lasting two weeks in which the cable was subjected to 33,000 volts at 100 deg. C., followed by another test of equal duration at 35,000 volts and the same temperature before a breakdown occurred at the end bell. The insulation was $\frac{13}{64}$ in. thick on conductors and $\frac{6}{64}$ in. on the belt. He referred to a 33,000-volt cable in service in England with $\frac{1}{2}$-in. and 0.4-in. insulation respectively.

Use of underground cable in France for 33,000, 48,000 and 60,000 volts was described by Jules Delon, Compagnie Générale des Cables de Lyon. Since 1914 there has been a 30-km. length of 33,000-volt cable in Normandy transmitting 6,000 kw. to 7,000 kw. at 50 cycles three-phase. The cable is armored with steel tape and is buried directly in the ground. The belt insulation is 5.5 mm. thick, and the insulating compound has a mineral-oil base. The maximum working temperature is 50 deg. C. Another three-conductor cable laid in the ground transmits 9,000 kw. of 50-cycle energy at 48,000 volts with an ungrounded neutral. In Paris three single-conductor cables will be laid soon to carry 30,000 kw. at 60,000 volts. The insulation is 15 mm. in thickness.

The joints in the 33,000-volt cables are made every 760 ft. A cast-iron junction box is employed for the three-conductor cables, and the conductors are separated by a porcelain sleeve and compound, no wrapping being done. The 60,000-volt cable has a lead sleeve for the joints, which are filled with compound, and no wrapping is used. The filling compound has the same melting point as the impregnating compound. For risers on the three-phase cables a cast-iron box and porcelain insulator are employed. For the single-conductor cable a copper bell and a porcelain insulator are used.

To eliminate trouble in cable risers, the Commonwealth Edison Company is changing from single-conductor potheads to four-conductor, said Mr. Buck. H. G. Hall said that the Detroit Edison Company is experimenting with single-conductor and three-conductor pothead for 25,000-volt risers.

Mr. Shaw said that on account of the relatively high price of fuel the New York Edison Company has found it economical to install additional cables to reduce the energy loss in cables 30 per cent to 40 per cent. This



HOW TEMPERATURE VARIES ALONG A TYPICAL DUCT RUN

emphasized the fact that there is another factor which should limit cable load besides the common limit which is imposed by destruction of the insulation on overheading.

Discussing instruments for measuring duct temperature, M. I. Stein, Leeds & Northrup Company, stated that the thermocouple serves well for surveys, while the resistance thermometer is better for a station recording instrument.

Meters

Interest in metering applications has centered during the past year on the determination of integrated values of reactive kilovolt-amperes, according to W. L. Wadsworth, chairman of the meter committee. Fourteen methods in use for measuring reactive hours for the purpose of determining power factor were investigated. Other work which was taken up was the detailed course for metermen, which, although not finished, is in such shape that the work may readily be continued and completed. Along the lines of standardization of meter and instrument design, it was recommended that manufacturing companies develop bottom-connected watt-hour meters with separate terminal chambers in ratings up to and including 50 amp., two-wire and three-wire. The standard rotation for meter elements should be in a counter-clockwise direction when observed from above. For demand meters it was the consensus of opinion that scales should be made longer. For single-

phase meters this would be approximately 150 per cent of full-load rating of the meter, such capacity being regarded as volts times amperes; for polyphase meters, 125 per cent to 130 per cent full-load capacity with a tolerance of plus 5 per cent.

DISCUSSION OF METER COMMITTEE'S REPORT

The discussion on the report of the meter committee centered around operating conditions and difficulties. The chairman made it plain that the committee was anxious to receive suggestions along this line on which it might work in the future. Considerable opposition was voiced against dividing the "Metermen's Handbook" into two volumes on its revision. The importance of educating metermen was brought out, and in this connection it was announced that Yale University is to conduct a metermen's course during the summer. Other schools are doing likewise.

Alex Dow, chairman of the rate research committee, emphasized the need for a metering device that could be used in arriving at a just basis for penalizing low-power-factor loads and crediting high-power-factor loads in rate schedules. He showed that a device as accurate as the watt-hour meter was not needed so much as a device that can be used over a wide range of loads and be inexpensive enough to cause it to be freely employed. Mr. Dow expressed the opinion that the utility commissions would approve the use of such a device on the basis of the justice in charging for service which it would make possible. Such a device would be used with an ordinary watt-hour meter, and the ratio of kilowatt-hours to kilovolt-ampere-hours would be used as the factor in establishing the rates for power service where the question of power factor is involved.

The new kva. demand meter recently placed on the market by the Esterline Company was explained by D. J. Angus, the inventor.

Inductive Interference

There is an increasing necessity for the co-ordination of power and communication services using the highways for delivering the various public services to the users, according to the inductive interference committee, A. E. Silver chairman. In the past, with a more scattered demand for these services, the avoiding of inductive interference by separation of facilities has been extensively advocated as a general policy by the communication interests and was for a long time practicable of accomplishment to a varying degree. However, with increasing community concentration the fallacy of believing that superior rights are acquired by prior occupancy of highways must be recognized.

The committee's work during the past year has been primarily the establishing of an engineering department at the association headquarters and a policy of active participation in the situation. A basis has now been laid for co-operation with the telephone companies in the study of inductive interference and its mitigation.

A feature of the inductive interference session was the presence of several representatives of the American Telephone & Telegraph Company. If telephone men could know the corresponding men in the light and power industry with whom they must deal, Bancroft Gherardi asserted, the conflict between the two interests would be far on the road to solution. The two industries must find a fair basis on which to give the two services that the public needs without imposing costs or sacrificing the service of either.

It was announced by R. F. Pack that a committee to classify points of agreement and disagreement had been organized for active work under the joint leadership of Mr. Gherardi and himself. National engineering bodies cannot settle the inductive interference situation alone, said H. L. Wills of Atlanta. Unless there is mutual confidence and help is secured from everybody the move for co-operation must crumble.

Sympathy for the small power companies that are required to face a large telephone organization with every facility at its command was expressed by Donald Henry of the Illinois Public Utilities Commission, who made a plea for a definition of "Substantial Interference."

H. B. Hayden of the Wisconsin Railroad Commission emphasized the difficulties of commissions due to lack of funds and forces to carry on research necessary in telephone interference cases. The speakers just named and A. B. Campbell of the Iowa Commission, A. E. Knowlton of Connecticut and E. H. Morse of North Dakota made pleas for co-operation. The real problem in bringing about co-operation, declared Peter Junkersfeld, is one of educating the men of both industries. W. J. Canada warned against hasty decisions and ill-balanced action.

TRIBUTE TO THE LATE DR. E. B. ROSA

Out of respect to the memory of the late Dr. E. P. Rosa, chief physicist of the National Bureau of Standards, who gave such earnest and conscientious support to the furtherance of safety measures in this country, the committee on safety rules submitted its report by title only and presented the following resolution, which was accepted unanimously:

Whereas the executive committee of the Technical National Section of the National Electric Light Association has learned with profound regret of the death of Dr. Edward Bennett Rosa, chief physicist of the United States Bureau of Standards and long closely associated with the development of the National Electrical Safety Code; and

Whereas this committee desires to place on record its high appreciation of the public service of this distinguished physicist and research engineer, who brought to his work and to public relations the highest ideals of personal devotion, public duty and loyalty to principle, attaining unusual success; and

Whereas in the discharge of every duty and responsibility Dr. Rosa's steadfast qualities of mind and character won the respect and esteem of all with whom he came in contact, and at the time of his death he was meeting increasing appreciation of his accomplishments, it is, therefore,

Resolved, that the committee express its acknowledgment of the disinterested work done for the industry by Dr. Rosa, and that this resolution be spread in full on the minutes of the committee and be transmitted by the secretary to the family of Dr. Rosa and to the director of the Bureau of Standards.

R. F. Schuchardt, W. J. Canada and W. C. L. Eglin testified to their appreciation of Dr. Rosa's work. Mr. Eglin expressed the highest personal regard for Dr. Rosa's integrity, high sense of honor and keen sense of duty. Mr. Canada said that it had been his great pleasure to work with Dr. Rosa and that he could testify to the earnest aims, deep thought and constant search for truth that characterized Dr. Rosa's efforts. The co-operation which existed between the Bureau of Standards and those affected by its work must be continued, he said.



Program

TUESDAY, MAY 31

Address of section chairman M S Sedman, Jr
Report of Bureau of Advertising and Publicity Service, L. D. Gibbs
Report of committee on education, Fred R. Jenkins.
Report of committee on "Electrical Salesman's Handbook," George H. Stickney.

PARALLEL SESSION

Report of Power Sales Bureau, H H Holding
Report of division on economics of the use of centralization electric power J W Meyer
Report of division on industrial electric heating, N. T. Wilcox.
Report of division on electric arc steel furnaces, Joseph McKinley.
Report of division on general power, George H. Jones.

WEDNESDAY, JUNE 1

Report of Merchandise Sales Bureau, Dorsey R. Smith.
Report of division on electrical merchandise, C. E. Greenwood.
Report of division on electric shop management, Thomas Berger.
Report of division on standardizing and testing, R. S. Hale.
Report of electric range division, C. O. Dunten.

Program

PARALLEL SESSION

Report of Electric Vehicle Bureau, E. S. Mansfield.
Paper, "Selling Electric Power as a Service Through the Medium of Material Handling Equipment," O. W. Stiles.
Report of committee on compensation of salesmen, L. R. Wallis
Address, "Capitalizing an Opportunity" William L. Goodwin
Report of committee on commercial service and relations with customers, L. A. Coleman

THURSDAY, JUNE 2

Report of Lighting Sales Bureau, Oliver R Hogue
Report of committee on educational exhibits, Clarence L. Law
Report of division on residence lighting, M. Luckiesh.
Report of division on street and highway lighting, W. D'A. Ryan
Report of division on industrial lighting, G. Bertram Regar.
Report of division on lighting of large buildings, F. A. Gallagher.
Report of division on commercial aspects of lamp equipment, Earl A. Anderson.
Report of division on sign, display and billboard lighting, H. I. Markham.
Report of division on store lighting, James J. Kirk.

Commercial Sessions

CONSTRUCTIVE discussion of commercial and merchandising problems marked the commercial sessions of the convention this year. The advertising and publicity as conducted during the past will be continued with a broadening aspect, as it was felt that this service has fully proved its value to the industry. General conditions in the merchandising field, while passing through the inevitable period of readjustment, are gradually improving and a distinct note of optimism was prevalent.

Tremendous future loads will be built from industrial heating. The electrical vehicle, pumping and electrolytic processes, new developments and increased activity in industrial lighting offer a profitable field for additional revenue.

Merchandising

Four divisions make up the report of the Merchandise Sales Bureau, Dorsey R. Smith chairman—electrical merchandising, electric ranges, electric shop management, and standardization and testing.

Pointing out that the merchandising departments of central-station companies can be made an invaluable help to the utilities as a connecting link between the company and the public, the bureau stated that every effort should be made to develop central-station merchandising business. The electric light and power companies should be the leaders in this field and at the same time should keep in close touch with the large number of electric specialty shops coming into existence in order to maintain a high standard of service and to protect customers from inferior appliances.

Outlining the principal subjects for consideration in operating the merchandising department, the electrical merchandising division, C. E. Greenwood chairman, said that the success of an electric shop is dependent chiefly on the choice of merchandise, and it is of primary importance that the "service" in an appliance be the basis of the selection.

It was the belief of the division that the central-station shop should sell portable lamps, if not fixtures. With regard to the sale of "side lines" of merchandise the committee felt that if an electric shop could not do a profitable business on electrical merchandise only, the trade is laboring under a serious handicap; however, if profit or loss depends on kindred merchandise, it ought to be sold.

An adequate system for determining the cost of doing a merchandising business is essential to success, and the division strongly advocated the adoption of an accounting system which would give the true selling costs and recommended the classification prepared by the Accounting Section last year.

Growth of the electric range load during the last four years has been quite rapid, but not so rapid as the lucrativeness of the business warrants, and the report of the electric range division, C. O. Dunten chairman, was devoted mainly to collecting authentic information as to new investment required, increases in operating expenses, income and other data. The field for electric ranges, in the opinion of the division, is especially attractive to the electric light and power company, but has not received the attention that it deserves as many companies have erroneous ideas of this branch of the business. To facilitate analyzing the conditions affecting the electric range business the division has prepared and included in its report a comprehensive formula for determining the profitableness of the electric range load to the central station.

The present electric water-heating devices have been

developed to the highest state of efficiency and apparently very little more can be done. The question of the cost of heating water electrically depends primarily upon the rate for electricity which is in effect. In general, where the rate is 3 cents per kilowatt-hour hot water may be supplied for the average family of four people at a cost varying from $5 to $8 per month.

In the opinion of the electric shop management division, Thomas W. Berger chairman, too much stress has been laid upon clerical routine work before the business was secured, and too much study has been given to the details in connection with the handling of the business and not enough to the production of the business itself.

The work of the standardizing and testing bureau, R. S. Hale chairman, has been confined for the most part to the testing of flatirons and heater cords. A preliminary report of the results of these tests, which were very exacting and thorough, is given in an appendix to the division's report. The division will continue these tests and is planning next to take up toasters and heating pads. It is working on the question of what tests should be applied to these.

Discussion of electrical merchandising by central-station companies centered around present practices and the future outlook. J. F. Killeen spoke optimistically of prospective business and pointed out that lower prices depend upon increased production on the part of the manufacturers in order that present overhead cost may be spread over a larger output. Co-operation with the central-station companies, price maintenance and the sale of standard devices were advocated by Sidney Blumenthal, who also believes that sales cannot be materially increased by price-cutting competition.

That central-station men are not the best of merchandisers was the opinion of F. J. Allen, who suggested that all members of electric light and power companies should give a trial to every electrical device which the company has for sale in order that he may be properly informed upon the merits of the appliance. Carrying of more than one make of any particular appliance should be discouraged, according to T. J. Casey, on the ground that no salesman can do justice to two competitive appliances on the same floor. H. H. Newman differed from this view, believing that customers should have choice of more than one appliance.

Electrical merchandising, said Walter Fagan, should be conducted along the fundamental principles of general merchandising, and technical atmosphere should be eliminated from the electric shops and stores wherever possible. Growth of income from the sale of merchandise by central-station companies is best shown, H. N. McConnell asserted, by an instance of one company whose income from this source is equal to the gross income from the sale of energy to its residential consumers. He deplored the fact that the salesrooms of many companies lack the equipment conducive to the best results and recommended a careful study of department-store methods.

It is not the purpose of the standardizing and testing division, according to R. S. Hale, to stand as judge and jury on what appliances a company should purchase. It has been the aim of this division to determine which are good and which are poor appliances and then leave the buyer to decide for himself in the light of the knowledge thus elicited. With the services of this division now available, it will be possible for a company purchasing appliances merely to ask a manufacturer of such devices for the results of the tests in order to determine their desirability.

J. F. Farquhar pointed out that the Washington Water Power Company has 3,000 electric ranges on its lines. The proportion in the suburbs (22 per cent of the number of accounts is relatively higher than in the city. There are 2,400 water heaters so connected that simultaneous use of heater and range cannot occur. The net revenue per kilowatt-year of demand for this load is $66. This allows for interest on capital charges (at 15 per cent), maintenance and operation and construction cost making a gross revenue of $84.50 per kilowatt-year on demand. The demand is figured at one-seventh the connected load of each range, and one heater has a connected load of about 7 kw. Therefore the foregoing figures will apply to one such set as well as to 1 kw. of demand, and one set will net about $66 per year.

Lighting

A change in the activities of the Lighting Sales Bureau during the past year in order to make its aims and scope more specific was dwelt on in the report of the bureau, Oliver R. Hogue chairman. Its work was planned with the following objectives in mind: To promote appreciation of the value of lighting to the electrical industry, to collect, analyze and disseminate information concerning lighting practice and to promote lighting sales. The bureau operated in seven divisions as follows: (1) Commercial aspects of lamp equipment; (2) industrial lighting; (3) lighting of large buildings; (4) residence lighting; (5) sign display and billboard lighting; (6) store lighting; (7) street and highway lighting.

Attention was called by the lamp equipment committee, Earl A. Anderson chairman, to the movement toward higher standards of lighting both as to intensity and quality and the redesigning of fixtures in the direction of less glare, ease of maintenance and cleaning and better general appearance. The report covers the trend of development in equipment design, which has important influence on lighting practice. Sections of the report were devoted to commercial and industrial equipment, color equipment for show-window lighting, residence lighting equipment, motion-picture lamp equipment and street and outdoor lighting.

Special emphasis was given by the large buildings division, of which F. A. Gallagher, Jr., was chairman, to the duty of the central-station company to work for good lighting in large buildings.

The advantage of good lighting to the employer and the employee was emphasized in the report of the division on industrial lighting, G. Bertram Regar chairman. Included were curves showing the increased cost of living contrasted with the decreased cost of electric lighting, "before and after" pictures of lighting installations, accident curves and production curves.

This year's report of the residence lighting division, M. Luckiesh chairman, included data pertinent to and showed the possibilities inherent in residence lighting. Wiring specifications for an adequately wired residence were also included. Suggestions were made as to the methods of interesting the householders in the importance of better lighting. Attention was called to the necessity of a campaign to show the physical aspect of lighting and the necessity for redesigning the lighting

fixture for the high-efficiency gas-filled lamps. The division emphasized the opportunity that the central-station company has to see that model homes of house-furnishing and department stores use properly designed lighting equipment.

In the report of the division on sign, display and billboard lighting, H. I. Markham chairman, attention was called to the large revenue that this type of business will produce. A section on billboard and outdoor advertising was included, and allusion was made to a notable development in the increasing use of higher-wattage and gas-filled lamps for electric sign service.

W. D'A. Ryan, in the report of the street and highway lighting division, called attention to the strides that high-intensity street lighting has taken in the past year —the development of a 2,500-c.p. series tungsten lamp for "super-whiteway" lighting and the improvements in electrodes for luminous-arc lamps.

A forceful presentation of the present deplorable conditions of commercial lighting was given in the report of the store lighting division, of which James J. Kirk was chairman.

The report of the education exhibit committee of the lighting department, which was newly created this year for the express purpose of promoting industrial lighting exhibits, embodied a résumé of the demonstrations conducted. There are now eight exhibits in full operation, three are under construction, and four cities are about to put on exhibits. In addition to his report of the activities in the establishment of permanent lighting demonstrations, Field Director Ward Harrison included as an appendix a lecture on industrial lighting.

Electric Vehicles

In view of the fact that the Post Office Department has authorized an expenditure of $50,000 to conduct an investigation into the use of electric trucks for that branch of the federal government, the Electric Vehicle Bureau's comparative data committee, F. M. Feiker chairman, decided to postpone for the present its work of getting together statistics on the cost of operation of electric vehicles as compared with the cost of operation of other forms of trucking and recommended that the actual work of starting the investigation be delayed until after the issuance of the postal report.

The activities of the electric vehicle exhibition com-



L. D. GIBBS
Superintendent Advertising Dept
Edison Electric Illuminating Company



H. H. HOLDING
General Power Representative
Public Service Electric Company



D. R. SMITH
Manager Merchandise and Domestic Sales
Consolidated Gas, Electric Light & Power Company



E. S. MANSFIELD
Supt Field Statistics
Edison Electric Illuminating Company



O. R. HOGUE
Head Lighting Agent
Commonwealth Edison Company



L. A. COLEMAN
Treasurer United Electric Light & Power Company



L. R. WALLIS
Superintendent Sales Dept.
Edison Electric Illuminating Company



C. L. LAW
Manager of Bureau of Illuminating Engineering
New York Edison Company

Chairmen of commercial committees who presented reports at the Chicago convention: Mr. Gibbs, Bureau Advertising and Publicity Service; Mr. Holding, Power Sales Bureau; Mr. Smith, Merchandise Sales Bureau; Mr. Mansfield, Electric Vehicle Bureau; Mr. Hogue, Lighting Sales Bureau; Mr. Coleman, committee on commercial service and relations with customers; Mr. Wallis, committee on compensation of salesmen; Mr. Law, committee on educational exhibits, which are effective in improving lighting.

mittee, of which Charles R. Skinner was chairman, has resulted in two successful exhibitions of electric vehicles since Jan. 1 of this year. One was held in the showroom of the New York Edison Company and the other was held by the Public Service Corporation of New Jersey at its Newark showroom, where all the vehicle manufacturers were represented. The committee reported that twenty-two exhibitors had signified their intention of exhibiting at the electric automobile show in the electric shop of the Commonwealth Edison Company from May 26 to June 4 at the time of the N. E. L. A. convention. Exhibitions are under consideration in Boston and other large cities.

A report is now in process of compilation by the committee which will set forth in detail figures concerning the cost of these garages, and the belief was expressed that there is no reason why capital should not enter the electric garage field.

No laws adverse to the electric vehicle were passed during the year 1920-21, according to Day Baker, chairman of the legislation committee. However, a number of motor-vehicle bills were before committees of various legislatures. Details of the action taken will be reported later by the committee.

Progress in the use of electric trucks has been gradual, indicating that its application is being made on a firm and sound basis of merit and of advantage to the user. The transportation engineering committee, F. M. Feiker chairman, reports that during the past year more electric trucks were sold in New York City than ever before. This is taken as an indication of renewed interest on the part of users in the inherent economy of the electric truck as a method of local delivery.

C. R. Skinner, rates sub-committee, announced that rates on battery charging are being collected and that attempts will be made to obtain preferential rates for such business.

In a paper on "Selling Electric Power as a Service Through the Medium of Material-Handling Equipment," O. W. Stiles, manager industrial transportation of the Lakewood Engineering Company, presented a number of interesting examples of the savings effected in industrial plants by the installation of material-handling machinery.

Compensation of Salesmen

To ascertain the conditions obtaining during the year the committee on compensation of salesmen, L. R. Wallis chairman, sent a questionnaire to ninety-nine company members serving populations of 100,000 or more. Of the thirty-eight companies from which answers were received, fifty-two pay weekly or monthly salaries with no commission for salesmen selling service. Seventeen companies, however, favor paying on a salary and commission basis, and fifteen oppose paying any commissions. Twenty-six of the companies reporting pay salary for salesmen selling appliances, and one pays commission only on such sales. Payment of commissions based on the gross amount of appliance sales in addition to the regular salary was favored by twenty-two companies, while five opposed such commission, favoring straight salaries only. Commissions paid to appliance salesmen were found to vary from 1 per cent to 20 per cent on gross sales, one company paying on a basis of 50 per cent of the gross profit.

M. S. Seelman, chairman of the Commercial Section, called attention to the tendencies of central-station companies to pay their salesmen a commission for business that is particularly profitable.

O. R. Hogue, Commonwealth Edison Company, gave some very interesting experiences of his company in compensating salesmen. He pointed out that the central-station salesmen function in two capacities, namely, first as stimulators of public good will and second as salesmen. Therefore salesmen should be compensated primarily for maintaining good will. During the war, owing to the lack of generating capacity, central stations had to stimulate business which would fill the valleys of their load curves. As a result they had to set values on different kinds of business. Now they believe that salesmen should be paid on the basis of what income the business brings per kilowatt-hour.

It was urged by Frank D. Fagan, Edison Storage Battery Company, that members advise the committee of all legislation accomplished or contemplated in different localities which will affect the status of electric vehicles.

Publicity

The problem today is not so much one of organization and sales promotion as to find ways and means of meeting capital requirements, said William L. Goodwin, assistant to the president of the Society for Electrical Development, in his address. The big work of the future is to eliminate waste and work. It is estimated that the human effort wasted in convention and association activities, chiefly through duplication of efforts, would amount to from $10,000,000 to $15,000,000 annually if it could be reduced to a monetary basis. Besides duplication there is also the danger, as the associations grow larger, that some bodies will work against the interests of others or of the whole industry.

Another object will be to "sell" the electrical industry to the men associated with it. Although the number of electrical men who have investments in the industry is increasing, it is still a small percentage of the total number in the industry.

Another suggestion along financial lines was the formation of a body to handle the time payments of the installment business of the industry. This may amount to three, four or even ten billion dollars annually. Another need which will be cared for is the insufficiency of trained men for the merchandising end of the industry. The society will attempt to induce colleges to establish courses to train such men and will conduct a correspondence school for the same purpose. Regional, national and local committees will be established, as well as specialized committees, to lay out plans as to how best to further the interests of the industry.

Relations with Customers

During the past year members of the committee on commercial service and relations with customers, L. A. Coleman chairman, have tried to bring before executives and employees various phases of this work through articles in the *N. E. L. A. Bulletin.* A series of pictorial pamphlets showing how customers are affected by good and by bad service are planned, and the first set, the report states, wil be ready in a few weeks. These pamphlets are to be followed with suggestions in connection with billing, collecting methods, handling complaints, etc.

"The employee should be so educated," the committee

said, "that he will feel the responsibility which is his when dealing with the customers, and the executives should be shown that red tape, antiquated systems of application routine, drastic and imperious collection methods, inaccurate billing and inattention and lack of courtesy in handling complaints are the chief causes of disagreement."

The national good-will campaign conducted from headquarters has had, according to the report of the Advertising and Publicity Service Bureau of the Commercial Section, L. D. Gibbs chairman, the hearty support of every advertiisng man in its field. The work has included the handling of pamphlets prepared by Director of Publicity Oxley and helping to conduct the national co-operative advertising campaign. The bureau's various divisions reported separately.

The division on adequate outlets and co-ordinate advertising, P. L. Thomson chairman, reported that during the year it had continued to draw the manufacturers' attention to cases in their advertising where electric outlets in the wall were overlooked and connections to appliances represented as if made from lighting sockets. Four manufacturing companies have published booklets on the completely electrified home. The calendar assigning special commodity sales to each month in the year as adopted in former years was indorsed without change.

The division of illuminating engineering (non-technical lighting applications), P. B. Zimmerman chairman, which represents primarily the advertising specialists of manufacturers and central station companies particularly interested in promoting better lighting and extending its field, reported that it had endeavored successfully to arouse interest in the N. E. L. A. industrial lighting exhibits and spoke of the popularity of some of its informative publications.

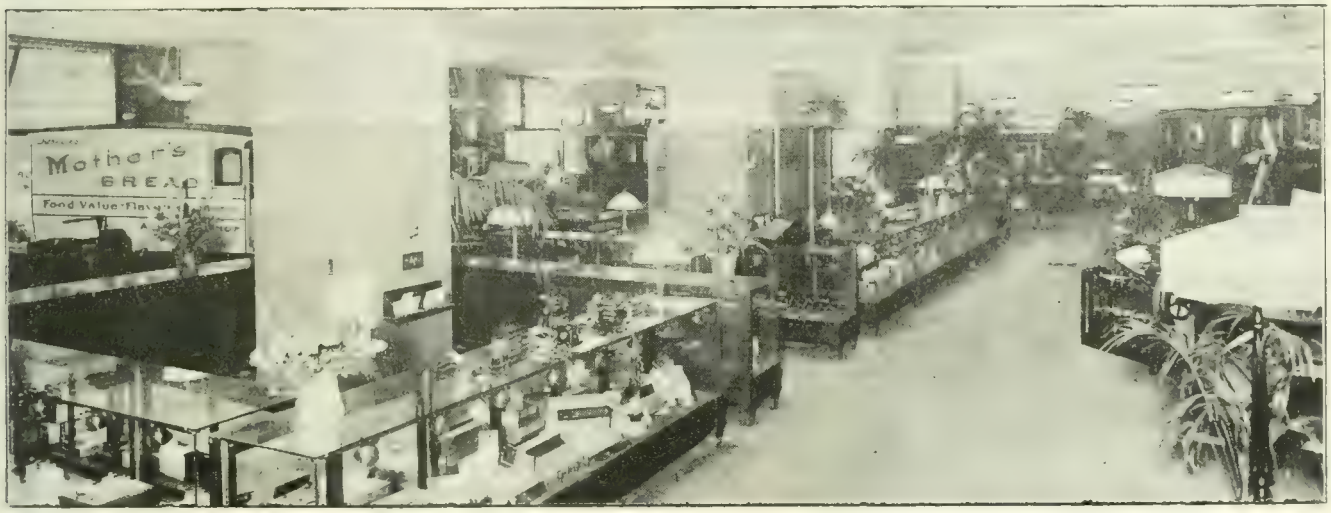
The division on newspaper advertising campaigns, Norman Maul chairman, devoted its efforts principally to finding a way to increase the use of electrical page newspaper advertising. It felt that the fact that electrical pages are not more extensively used was due to the indifference of the electrical interests involved and not to any shortcomings in the idea itself.

The division on news syndicate and magazine writers, Frank B. Rae, Jr., chairman, confined its efforts mainly to organizing a photographic bureau to which writers may apply for acceptable pictures to illustrate their articles and to continuing the experiment of supplying syndicate material to electrical pages of newspapers.

The publication division, Cyril Nast chairman, reported against getting out any considerable new printed matter until that now on hand shall be disposed of. Owing to the business depression last year's publications did not sell so well as had been hoped, and more than half the booklets and folders printed were still on hand on May 7.

In a short address at the opening of the meeting J. F. Madison, president of the American Association of Advertising Agencies, quoted some interesting data on results of recent surveys of the business done by different electrical dealers. According to Mr. Madison, a comparison of fifteen advertising dealers with fifteen non-advertising dealers showed that the advertising dealers did more than six times the amount of business done by the non-advertisers and their sales per thousand population were in virtually the same ratio.

William L. Goodwin, in offering the services and co-operation of the Society for Electrical Development on matters pertaining to advertising and publicity, made a plea for a uniform adoption in advertising of elementary terms which can be easily understood by the householder and layman.



VIEW OF COMMONWEALTH EDISON COMPANY'S ELECTRIC SHOP, WHERE THE ELECTRIC VEHICLE SHOW WAS HELD DURING THE N. E. A. L. CONVENTION

EDUCATION

Two courses, one in commercial engineering and the other in practical electricity, the former started in November, 1915, and the latter in January, 1917, have been continued by the education committee, of which Fred R. Jenkins is chairman. Considerable publicity has been given to these courses during the year. Both courses have continued to be self-supporting, with sufficient surplus to allow for future reprinting, revising and constructing of courses. The committee recommends that next year an additional course be started which would be a combination of the subjects covered by the present courses with desired additional matter so as more generally to cover the requirements of all classes of members.

This year the "Electrical Salesman's Handbook" committee, G. H. Stickney chairman, planned to resume publication of the handbook, and material is therefore being collected under the following sections: "Power," "Industrial Heating," "Lighting," "Electric Vehicles," "Domestic Heating and Appliances," "Wiring" and

"The Salesman and His Work." Two books, one "Industrial Lighting" and the other "Lamp Equipment for Commercial and Industrial Lighting," are now on sale and will be considered a test of the efficiency of the plan adopted for selling the handbook.

Industrial Load

Manufacturers are tending to consider the element of power cost from the viewpoint of cost per unit of product rather than cost per unit of power. With this in mind, the Power Sales Bureau, H. H. Holding chairman, has given particular consideration this year to electric heating, steel furnaces, economies in the use of central-station power and the general diversification of load. Special attention has also been given by the sub-committee on the economics of the use of central-station electric power, J. W. Meyer chairman, to the cost committee on the economies of the use of central-station service and to methods of increasing loads.

Glass annealing, normalizing of castings and wire, oil tempering, automatic arc welding, non-ferrous metal melting, bread baking and the electrically heated steam boiler are some of the most interesting developments of the past year, according to the sub-committee on new developments in industrial electric heating, N. T. Wilcox chairman. The outlook for increasingly large and profitable power loads from such applications is most encouraging, the committee held, and should be carefully studied by all live sales organizations.

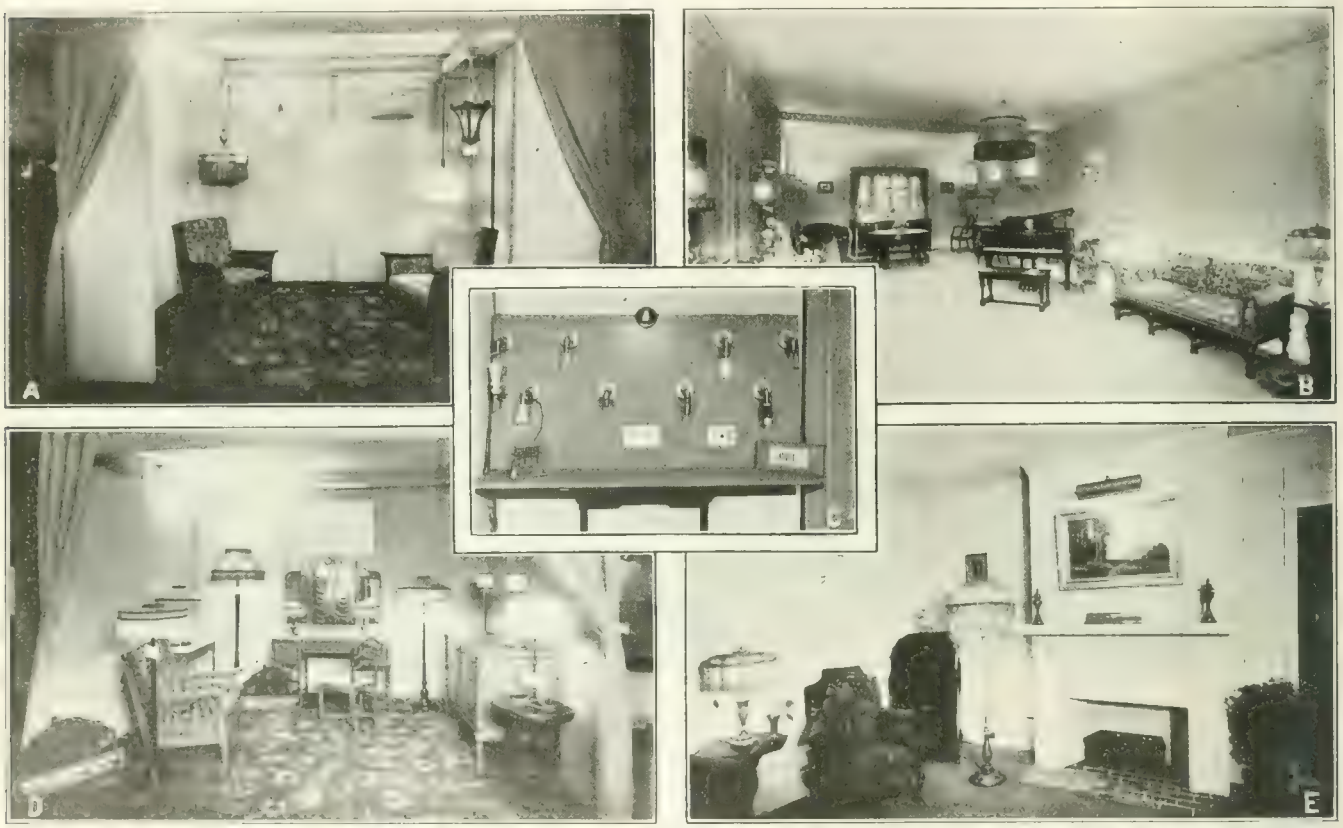
In steel making, excellence of product is the only factor controlling the use of electrical energy, the sub-committee on electric arc steel furnaces, J. McKinley chairman, asserted.

Electric water pumping as an auxiliary to existing pumping plants was shown to be practicable on a very large scale by the sub-committee on general power, G. H. Jones chairman. Because of the diversity factor electrochemical processes offer a good field for power development.

Alex Dow, president Detroit Edison Company, in commenting on the acquisition of new business, pointed out that at the present time the cost of capital necessary for plant extension is the controlling factor. He warned against a central station investing too much capital to supply only one industry which might later suffer serious depression. In speaking of special rates (off-peak rates, etc.) he advised that they should be as nearly as possible consistent with the regular rates. That the rates for power should be removed from the jurisdiction of public service commissions was advocated by Morse Dell Plain, Northern Indiana Gas & Electric Company, Hammond, Ind. He contended that energy for power is a competitive product and that rates should be determined in the same way as the cost of other commodities.

G. E. Miller, Cleveland Electric Illuminating Company, objected to the off-peak rate schedule shown by Mr. Meyer, contending that it gives a consumer a rate even at the times of peak load which is less than the standard rate to regular customers.

Speaking of industrial heating, V. M. F. Tallman of Charles H. Tenney & Company, Boston, told of the good results which had been secured from an educational course conducted by the New England Division.



RESIDENCE LIGHTING DEMONSTRATION AT CONVENTION

A—Typical room of custom design. B—Lighting for living room. C—Special socket and convenient plug devices and lamps. D—Specially designed portables for houses. E—Mantel, indirect portable and double bracket lighting, which allows variety.

Accounting Sessions

Reports of Committees Recommend a More Intensive Study of Accounting and Financial Problems

PROBLEMS that are most vital to the existence of central stations were taken up by the Accounting National Section in its three afternoon sessions. Subjects such as credits, collections, bonus systems, classification of accounts and other equally important features brought forth thorough discussion. It was suggested that committees to be appointed give careful study to the question of income-tax procedure and to the comparative costs of mechanical and hand billing. Both subjects provoked lengthy discussion and a considerable divergence of opinion.

Program

TUESDAY, MAY 31

Address of section chairman, J. C. Van Duyne.

Report of committee on accounting education, Fred R. Jenkins.

Report of committee on classification of accounts, reports to commissions and relations with other associations, W. J. Meyers.

Report of committee on purchasing and storeroom accounting, W. F. Stevens.

WEDNESDAY, JUNE 1

Report of committee on federal income-tax procedure, F. B. Odlum.

Paper, "Accounting for Coal," H. M. Edwards.

Report of committee on customers' records and billing methods, J. D. Jacobus.

Report of committee on credits and collections, David Darlington.

THURSDAY, JUNE 2

Report of committee on bonus systems, A. H. S. Cantlin.

Report of committee on security holders' records, William S. Kline.

Report of committee on investment budget control, Harry A. Snow.

Uniform Classification

Under the present high cost of capital the necessity for a comprehensive budget system has been realized by central-station companies, according to the report of the committee on investment budget control, Harry A. Snow chairman. Budget systems may be divided into three classes, (1) Construction, which should provide for future needs of a company over a given period and which should also include an analysis of the problems in such form as can be laid before executives; (2) operation, which should embrace a forecast of interest and dividend payments to be met, fuel requirements, increased load, probable profits and the estimated cost of departmental operations; (3) material and supplies, which should tend to make it impossible to run up an excessive investment in stock, thus tying up capital.

Large companies, said H. M. Edwards of the New York Edison Company, have reached the point where it is impossible to operate without a system of budget control, especially for new construction. He stated that a certain degree of elasticity could be provided in a budget by classifying proposed construction as imperative, urgent or desirable.

H. C. Joy of the Midwest Utilities Company said that the keeping of a diary by the engineering department covering extraordinary conditions under which construction work had been done had been found extremely useful in substantiating costs in valuation proceedings before the Public Utilities Commission.

A short statement was made by the committee on classification of accounts, reports to commissions and relations with other associations, W. J. Meyers chairman, to the effect that: co-operated with the American Gas Association and the National Association of Railway and Utility Commissioners in the development of a standard classification of accounts recommended by the latter association at its annual meeting last November.

Differences in company conditions, said H. M. Edwards, New York, do not justify diversities of practice in accounting. He characterized the new classification as "sound, safe and sane," and said that no regulatory matter should be incorporated in a classification *per se*. John W. Lieb, New York, also commended the work. In the discussion it was brought out that better provision for retirement at first cost of property is made through the reserve account in the new classification, renewals being met out of capital account. It was pointed out that as a rule commissions do not exercise as close control over surplus as over charges to operating account. H. W. Brundage, American Gas Association, also commended the new classification.

Fred R. Jenkins, chairman, then presented the report of the committee on accounting education.

A short statement was made by the committee on federal income tax procedure, F. B. Odlum chairman, in which the duties of the committee are outlined and recommendations made. The committee considers that the subject of federal taxation is of the highest degree of importance at this time and will continue to be for some years to come.

Discussion led to the unanimous conclusion that federal income taxes should be chargeable to operating expenses and not to surplus earnings.

Purchasing

Business conditions call for greater care in controlling the investment tied up in storeroom material and supplies, according to the report of the purchasing and storeroom accounting committee, of which W. F. Stevens is chairman. The falling market, uncertainty of expansion plans and the tendency of manufacturers to reduce stocks call for greater care in stocking the storeroom. Good results are reported where stock control has been put in the hands of a competent committee.

Commenting on the report, C. E. Olwine, Newark, N. J., emphasized the desirability of adjusting claims through the auditor in cases where a large number of storerooms are located over an extended area.

Customers' Records

This year's report of the committee on customers' records and billing methods, J. D. Jacobus chairman, the activities of which extend over a period of five years, covered methods in use by various companies in reading meters, prevention of curbstone readings, reading of skip meters and methods used to insure billing of all meters in service. In the opinion of the committee a close study should be made to insure member companies having a system whereby all meters in service will be billed as it is an easy matter for a customer's record to become lost if not properly safeguarded.

The report of the committee on credits and collections, David Darlington chairman, was originally scheduled to be presented at this session, but was postponed.

The discussion brought out much divergence of opinion on the question of requiring a deposit from residence and small-power customers.

Use of the addressograph machine in preparing dividend checks to effect a saving in clerical work and the signing of checks by the cashier or assistant cashier only, instead of the earlier practice of having two of the higher officers sign, were practices suggested by W. S. Kline, chairman of the committee on security holders' records.

Miscellaneous

The investigation of the use of bonus systems by the bonus system committee, A. H. S. Cantlin chairman, covered 141 companies, serving all cities with a population in excess of 50,000. The returns received indicated that the use of such systems is stationary, if not on the decrease. The committee report gave a brief description of the plan adopted by the solitary member company which has whole-heartedly adopted a bonus plan of payment as an essential feature of its relations with its employees. Letters from the chief executives of some of the large member companies are included in the appendage and bear out the belief of the committee that straight daily and monthly wages will continue in general use by the electric light and power industry.

A method for keeping purchasing department, auditor and station or storage coal records was described in detail and illustrated with record forms by H. M. Edwards, auditor New York Edison Company, in a paper entitled "Accounting for Coal." By means of the system described, the author holds, it is possible to keep an accurate record of all coal from the time it is purchased to the time it is put into the company's bins.

Two courses, one an elementary course and the other an advanced course, have been developed and printed by the accounting education committee, Fred R. Jenkins chairman, and the report this year was a brief statement of the subscriptions so far and the expense of the course and income therefrom. Some notes on the publicity that has been given to the courses and an outline of each of the courses were included.

Criticism of the practice of allowing inadequately prepared employees to take the advanced course was voiced by several speakers.

E. J. Fowler, Chicago, was elected chairman of the Accounting National Section.



DAVID DARLINGTON
Assistant Treasurer
New York Edison Co.



W. S. KLINE
Assistant Secretary
Commonwealth Edison Co.



H. A. SNOW
Statistician
Detroit Edison Co.



A. H. S. CANTLIN
Division Manager
Pennsylvania Power & Light Co.



W. J. MEYERS
Secretary
The United Electric Light & Power Co.



W. F. STEVENS
Supt. Supply Dept.
Edison Electric Illuminating Co. of Boston



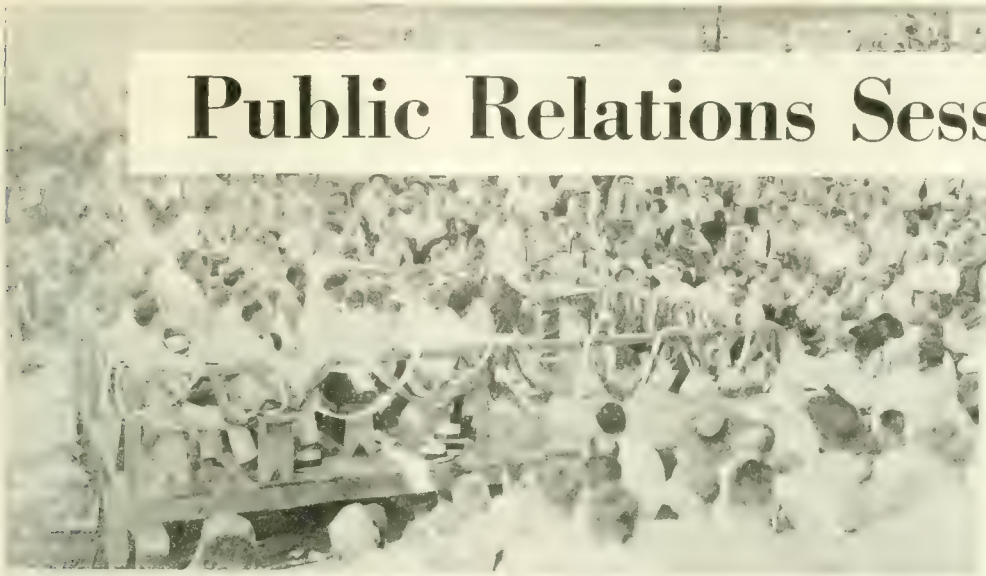
F. B. ODLUM
Attorney
Electric Bond and Share Co.



J. D. JACOBUS
Chief Clerk Customers' Accts.
Detroit Edison Co.

Chairmen of accounting committees who presented reports at Chicago convention: Mr. Darlington, committee on credits and collections; Mr. Kline, committee on security holders' records; Mr. Snow, committee on investment budget control; Mr. Cantlin, accounting section, committee on bonus systems; Mr. Meyers, committee on classification of accounts, reports to commissions and relations with other associations; Mr. Stevens, committee on purchasing and storeroom accounting; Mr. Odlum, committee on federal income-tax procedure; Mr. Jacobus, committee on customers' records and billing methods.

Public Relations Sessions



A Demonstration of Public Interest in Electrical Affairs When They Are Conducted on a Partnership Basis. Photo at Official Opening of a Large Western Water-Power Plant

Program

WEDNESDAY, JUNE 1

Address of chairman, J. E. Davidson.
Report of committee on manufacturers' advertising, P. L. Thomson.
Report of committee on public utility information, John F. Gilchrist.
Report of committee on public utility taxation and uniformity of regulatory laws, W. W. Freeman.
Address, "Do We Know Our Customers?" Edward N. Hurley.
Report of committee on relations with bankers, M. S. Sloan.
Report of committee on relations with regulatory bodies, R. H. Ballard.
Report of committee on upbuilding the industry, F. R. Coates.

THURSDAY, JUNE 2
(With music)

Report of public policy committee, Sidney Z. Mitchell.

STEADY improvement in public relations was emphasized at the session devoted to this important subject and presided over by Chairman J. E. Davidson, the open-door policy of the utilities being held in large measure responsible. The meeting was virtually a symposium on the best methods of winning friends with the public, and it came to a climax in the address of Edward N. Hurley, former chairman of the United States Shipping Board, on "Do We Know Our Customers?"

Opening the session, Chairman Davidson reviewed the public information committee work which has now been developed in ten states and is in prospect for the six New England states and others. He advocated more vigorous efforts to acquaint residence lighting customers with the modern equipment now available and recommended that a week be set aside during which central-station men the country over shall address local organizations of business men upon public utility affairs.

Publicity

The work of the public utility information committee warrants the attention of the best minds in the industry, said J. F. Gilchrist, chairman of the committee. The work of the past year in Illinois was described, emphasis being laid upon the value of the weekly news bulletins sent out from the local headquarters. Much editorial comment has been voluntarily published in local papers as a result of this campaign.

Among the speakers were J. J. Canavan, Chicago; J. C. Carter, Buffalo, and Executive Manager Aylesworth. The last-named said that the association stands directly back of these state campaigns to disseminate public utility information. Horace Davis, Lincoln, Neb., warned against expecting quick results from campaigns.

The manufacturers' advertising committee, P. L. Thomson chairman, reported on its efforts to second the work of the association's public relations committee. The plan adopted was for each manufacturer to devote a certain part of his scheduled space in trade papers, popular magazines and newspapers to telling in his own way the story of the indispensability of a solvent and prosperous electric light and power company in every progressive community. "This we have been doing," the committee declares, "and this we propose to continue to do." Forty-seven manufacturers have been carrying on this work or have pledged space, and the number of mediums already used and scheduled reaches seventy-two, with an aggregate circulation in excess of 9,440,000.

The report of the public policy committee, presented by Chairman S. Z. Mitchell, comprehensively discussed conditions in the industry during the past year, pointing out that the deflation process is still far from complete. Slowness of recovery is due primarily to frozen credits and the enormous demand for money. As the old high prices in inventories are liquidated the amount of money required to do business at the new price is greatly decreased.

The buyers' strike has materially reduced demands for power service in many of the industrial districts and is giving impetus to the deflation of labor and commodity prices. Member companies during the past few years have been forced radically to revise their rates, which have in large measure been changed to give them a larger fixed or minimum charge. This, together with some increases in lighting and small power business and with some rate increases, has enabled the companies to pass successfully the crisis of high operating costs. Coal costs and labor costs for plants have been reduced but little, and freight on fuel has been largely increased. The past year has been marked generally by a more favorable attitude of the public toward the light and power industry. The decisions of the public utility commissioners have, generally speaking, been fair and in the interest of both the company and the public. The greatest drawback to the public regulation is that the commissions have so much work piled up on them and in many cases have had so little appropriation for help that it has been absolutely impossible for them to give

decisions in rate adjustments quickly enough to protect either the public or the companies.

As a result of the co-operative work of this association, the National Association of Railway and Utility Commissioners and the American Gas Association, the industry will soon have before it for the first time an acceptance accounting system which will apply throughout the United States.

Regulation and Finance

The value of frankness in setting forth the inside conditions and the problems of public utilities in dealing with the commissions was emphasized by R. H. Ballard, chairman of the committee on relations with regulatory bodies. Well-managed companies following this policy reap their reward before such tribunals.

High tribute was paid to the cordial co-operation between the N. E. L. A. and the Investment Bankers' Association by M. S. Sloan, chairman committee on relations with bankers. The latter has prepared much publicity material emphasizing the value of public utilities to all investors.

R. H. Ballard, Los Angeles, suggested the establishment of cross-memberships to interlock sessions of the investment bankers and the N. E. L. A. Frank W. Smith, New York, commended visits of bond salesmen to utility plants.

The cultivation of public good will as a goal was strongly emphasized in the report of the committee on upbuilding the industry, by F. R. Coates, chairman. The committee advocated an unflinching stand on behalf of adequate rates and throwing overboard timorous policies and apologetic attitudes in dealing with the public. The confidence of a million and a half American citizens holding utility securities and of several millions more indirectly interested through banks and insurance companies must not be destroyed or shaken. Any country is safe with its citizens saving more than they spend, the committee said, but it is the duty of every utility management not only to fight for its rights, but to protect the army of its stockholders. The strategical value of customer ownership was strongly emphasized. Utilities should cultivate the natural pride resulting from home-owned institutions.

An informal report was presented by W. W. Freeman, chairman of the committee on public utility taxation and uniformity of regulatory laws, showing that the committee has confined its attention to preliminary work.

Martin Insull, Chicago, was elected chairman of the Public Relations Section for the ensuing year.



F. R. COATES
President and General Manager
Toledo Railways & Light Co



S. Z. MITCHELL
President
Electric Bond and Share Co.



W. W. FREEMAN
President
The Union Gas & Electric Co



M. S. SLOAN
President
Brooklyn Edison Co.



R. H. BALLARD
Vice-pres. and Gen. Mgr.
Southern California Edison Co.



J. F. GILCHRIST
Vice-president
Commonwealth Edison Co.



F. R. JENKINS
Mgr. Central Station Institute
Commonwealth Edison Co.



P. L. THOMSON
Advertising Manager
Western Electric Co.

Chairmen of public relations committees who presented reports at Chicago: Mr. Coates, committee on upbuilding the industry; Mr. Mitchell, committee on public policy; Mr. Freeman, committee on public utility taxation and uniformity of regulatory laws; Mr. Sloan, committee on relations with bankers; Mr. Ballard, committee on relations with regulatory bodies; Mr. Gilchrist, committee on utility information; Mr. Jenkins, committee on accounting education; Mr. Thomson, committee on manufacturers' advertising

Practices and Tendencies in Steam Generating Plants

Upper Temperature Limit Temporarily Reached According to N. E. L. A. Committee, but Further Economy in Raising Steam Pressures Appears Promising —House Turbine with Heater Condenser or Straight Electric Drive with Bleeder-Type Prime Mover Favored for Heat Balance



BOILER ROOM CONVERTED TO OIL BURNING, SHOWING AUTOMATIC CONTROL USED WITH MECHANICAL BURNERS, FALL RIVER ELECTRIC LIGHT COMPANY

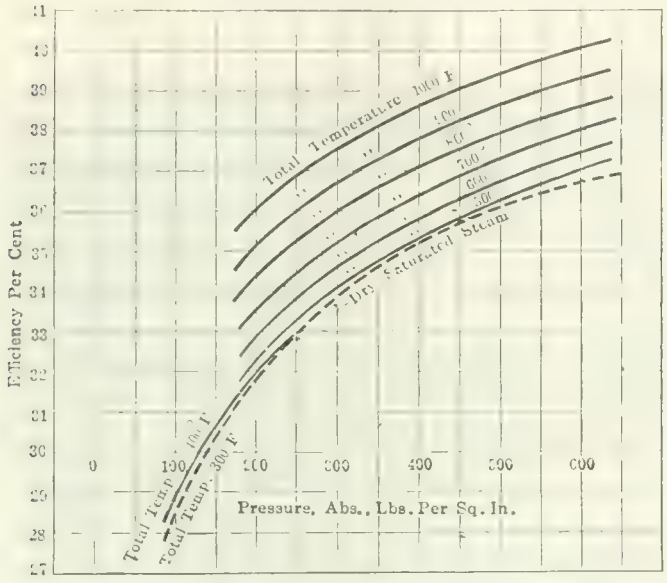
A TENDENCY to increase turbine speeds and to improve turbine economy by raising steam pressure is indicated in the report made to the National Electric Light Association by its prime mover committee, of which N. A. Carle is chairman. However, present knowledge of materials does not justify raising steam temperatures appreciably beyond the existing maximum limit of 700 deg. Fahr. (370 deg. C.). Single-cylinder turbines seem to be still limited to 45,000 kw. For maintaining a heat balance, sentiment among the operating companies appears to be crystallizing in favor of the house turbine in combination with a heater condenser or straight electric drive with bleeding of the main units for feed-water heating. One of the most important activities of the prime mover committee has been the formulation of an operating code the object of which is to recommend the most suitable methods of operating and maintaining generating stations to insure continuity of service and efficiency. Regarding the burning of lignite coal, it is said that good progress has been made abroad, but in this country there does not appear to be sufficient knowledge of how to utilize this fuel efficiently. For the benefit of small-size companies an excellent analysis of the relative economy of various prime movers has been compiled.

During the past year turbine manufacturers have directed their efforts toward improvement of details affecting reliability and operating efficiency. A number of them are working on the development of a closed system of generator ventilation in which the same air is constantly recirculated. The idea is to obtain cleaner air and to reduce first hazard to a minimum. The wide variation in characteristics of turbine lubricants has led the committee to formulate a tentative set of general specifications, which are given in the report. In addition attention is called to an interesting development in turbine foundation design known as the three-point flexible suspension and intended to guard against destructive effects of vibration.

Because of the seasonal variation in cooling-water temperature, both utilities and manufacturers are giving more attention to regulation of circulating water than usual. This scheme, if practicable, will reduce the power required for driving circulating pumps and will avoid lowering the condensate to a temperature below that corresponding to the vacuum. Leakage from condensers should be guarded against, the committee warns, particularly if it is at all serious, because the expense of feed-water treatment will be very materially increased. Methods of avoiding leakage are suggested.

A new record as regards boiler sizes was established for the United States during the past year by the

installation at the Ford Motor Company plant of four boilers each rated at 2,647 hp. Pressures and superheats are said to be gradually rising, although 300 lb. to 350 lb. (21 kg. to 24.5 kg. per sq.cm.) and total temperatures of about 650 deg. Fahr. (343 deg. C.) seem to be as high as boiler designers are willing to go at the present time. The high cost of economizers has led to the development of boilers with a higher tube bank, which will give at least part of the saving that could be



MAXIMUM GAIN IN EFFICIENCY OF STEAM TURBINES DUE TO INCREASING PRESSURE AT CONSTANT TEMPERATURE. GAINS WOULD BE SOMEWHAT OFFSET BY LEAKAGE AND WINDAGE

realized with an economizer. Two important developments by the manufacturing companies are reported, one being soot-blowing equipment which is designed to blow tubes automatically at a predetermined time. Superheaters are also being developed for separate firing which are intended to eliminate superheat fluctuations.

Satisfactory progress is reported by the American Uniform Boiler Law Society during the past year.

Although the cost of economizers is considered high, excessive fuel cost has partially offset this consideration so that some development is reported by manufacturers of steel-tube economizers. In operating them corrosion, both internal and external, is considered the most serious problem. Internal corrosion, which is generally due to the presence of excessive amounts of oxygen and CO_2 in the feed water, may be prevented by freeing the air from dissolved gases. The combination of moisture condensing on the outside surface of tubes with the sulphur compounds in flue gases is held to be chiefly responsible for external corrosion, and the remedy that is prescribed is to raise the temperature of the inlet water to the point where condensation does not take place.

Of the two methods devised for maintaining heat balance in the larger stations the house turbine and condenser heating method is considered the more desirable in plants without economizers. This method has the advantage of providing an immediate method of eliminating oxygen without the addition of de-aërating equipment.

Bleeding of prime movers seems particularly desirable in plants having economizers, owing to the limited amount of exhaust steam required at light loads and the possibility of but slight increase in prime-mover water rate at the heavier loads. One company favors house turbines and electric auxiliaries in order to limit the cost of auxiliary switching and to reduce short-circuit currents obtainable on auxiliary circuits.

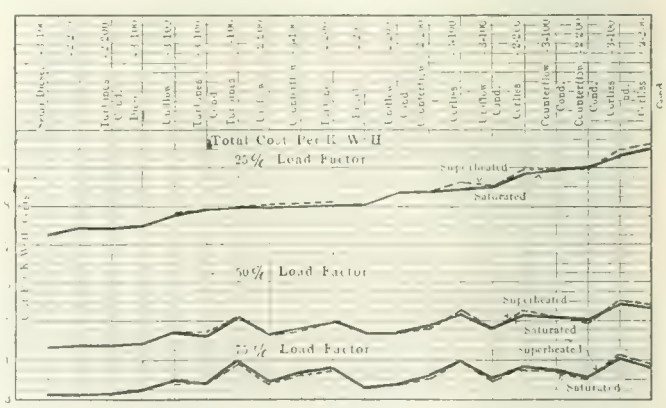
Comparative Analysis of Small Prime-Mover Performance

Regarding small prime movers, the activity of the committee was directed chiefly to a study of design features and operating costs of a 200-kw. central station with various classes of prime movers installed. The following prime movers were considered: (1) Uniflow engines; (2) counterflow engines, including piston-valve, slide-valve and four-valve types; (3) turbines, both direct-connected and geared; (4) slow-speed belted Corliss engines; (5) Diesel engines, and (6) semi-Diesel engines. In calculating the operating costs coal having 13,500 B.t.u. per pound was assumed to cost $7 per ton delivered and oil containing 18,500 B.t.u. per pound was considered to cost $3 per barrel delivered.

Under the conditions assumed and with present prices of equipment, there is no very wide variation in costs whatever the type of apparatus used. The lowest total cost per kilowatt-hour is realized by the semi-Diesel engine and the condensing turbine, the former having a slight advantage. However, the difference in total cost per kilowatt-hour between the two classes of prime movers is so small, the committee concluded, that the turbine plant would probably be more desirable on account of its lower first cost. Contrary to general belief, the lower steam rate which obtains with superheated steam is in virtually all cases offset by higher fixed charges and fuel costs, and except in the case of turbines no net gain is realized by operating the plants condensing.

Burning Low-Grade Fuel

Rather complete information regarding the burning of "hogged fuel" by the Northwestern Electric Company at Portland, Ore., is included in the report. This fuel shows a loss of from 30 to 40 per cent in B.t.u. content



TYPICAL GENERATING COSTS IN SMALL STATIONS FOR VARIOUS TYPES AND COMBINATIONS OF PRIME MOVERS

after being in storage a year, and it apparently makes little difference whether the storage is indoor or outdoor. Some fires have been experienced in storage piles, but it is said that if care is taken to remove the fine dust which gradually collects about a plant trouble from this source may be almost eliminated.

Contrary to expectations, the use of lignite did not receive any great impetus as a result of the acute

demand for fuel during the war period in the United States. This is attributed to a lack of knowledge of how to get efficient results from fuel of this type as well as to the storage difficulties, which are usually serious. However, very complete tests of lignite have been carried on both in the Bitterfeld station in Germany and at the Melbourne plant in Australia, so that the properties of this fuel under various operating conditions, as well as the design features to be embodied in stokers and furnaces, have been clearly defined.

Continued interest has been manifested in the pulverized-fuel method of burning coal. Aside from the restrictions imposed by the layout of old stations in changing over from grates or stokers to pulverized-fuel equipment, the question of high boiler ratings does not seem at all serious. High ratings are said to be obtained in new plants where boilers have ample combustion space and are designed expressly for burning pulverized fuel. The Lakeside plant in Milwaukee, designed for burning pulverized fuel, has recently been put in operation and will have an ultimate capacity of 200,000 kw.

Processes for the recovery of by-products from raw coal have been developed further in England and Germany than in this country. It is reported, however, that more development of by-product recovery processes in this country is anticipated.

The development of new types of boiler-room and turbine-room instruments during the year has been very encouraging, although no complete data are at hand covering the performance of the new types under conditions of actual operation. Among the new instruments are: (1) Recording pyrometers for indicating boiler furnace temperatures, (2) combined CO_2 and CO recorders, (3) multiple-type draft gages, (4) flow meters for indicating small rates of flow of liquids under pressure, such as bearing oil or jacket water, and (5) meters based on the principle of the alternating-current potentiometer for detecting condenser leakage.

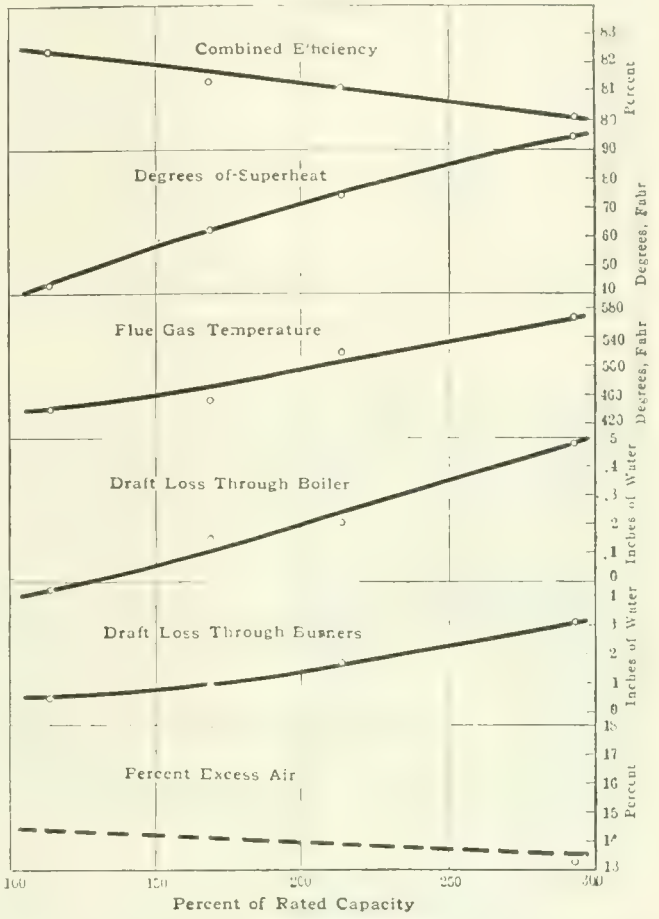
Present practice in the installation of fuel-oil storage tanks favors the steel tank with steel roof or the concrete tank. The heating of oil to insure its ready flow through piping systems makes it necessary to have the best materials and workmanship, because leakage of hot oil is dangerous and expensive. There is no more important item of equipment in an oil-fuel installation than the oil heater, the committee declared.

Promising Progress in Burning Liquid Fuel Efficiently

Successful burning of oil requires that boiler designs take into account other factors than the question of sufficient furnace volume. The type and location of baffles, location of burners, thickness and kind of refractories and a number of other equally important considerations have a marked effect on operating results. While steam atomizing burners have been in use for a number of years in stationary plants, it is only recently that mechanical burners have been employed to any extent. It is claimed by some manufacturers that the mechanical burners use very much less auxiliary steam than a steam-atomizing burner. This claim seems well founded according to the committee's report, and is substantiated by the experiences of a New England plant, which show that only two-thirds of 1 per cent of the total steam was used by the mechanical burners.

It is further claimed that a boiler equipped with mechanical burners will have a very much better efficiency at high rating and that for this reason outputs of about 210 per cent of rating are had for weeks at a time without destructive effect on brickwork or tubes.

A number of important manufacturers have added oil engines to their list of products, thus indicating their



EXCELLENT RESULTS HAVE ATTENDED PROGRESS IN LIQUID FUEL BURNING AS SHOWN BY TEST RESULTS OF THE SAVANNAH ELECTRIC COMPANY

belief in the future of this type of engine for stationary service. The future of oil engines for stationary plants depends largely upon the ability of manufacturers to develop engines which will successfully burn residues and heavy asphalt-base oils, because the growing demand for gasoline and lubricating oil will result in extensive cracking of crude petroleum.

As contrasted with the extremely conservative and even pessimistic views which have been expressed concerning the future of the oil supply, the committee calls attention to the very encouraging estimates of geologists concerning the reserve supply of oil which can be extracted from the enormous oil-shale deposits in the United States.

A questionnaire sent to operating companies using evaporators for feed-water purification indicates that evaporator equipment, while a comparatively recent development, is successful in central-station plants, provides pure water at a reasonable cost and justifies the installation and operating expense. It is reported that the internal use of any substances in boilers, whether for the purpose of reacting chemically or aiding mechanically in the elimination of boiler water impurities, seems to be coming into general disfavor. Except in a very few cases, it is more satisfactory to treat the water in separate treating apparatus. An excellent

indication of the importance of clean water is evidenced from the number of companies which are employing chemists to make periodic tests of feed-water composition. Even where it is not practicable to employ a chemist, excellent results are said to be obtained for certain purposes from the use of portable testing outfits which can be operated satisfactorily by inexperienced men after a very little instruction.

Marked activity toward adapting present stoker designs to low-grade coals has been manifested, evidently due to the excessive cost of high-grade coal. The successful application of forced draft to the chain-grate and conveyor-type of stokers is also reported. Packing of coal and irregularity of feed can be virtually eliminated, it is said, by the use of power-operated agitators installed at the base of the hopper. An interesting development which has not been in service very long is an attempt to control stoker speeds and speeds of fans and other auxiliaries automatically by changes in steam velocities.

Almost no trouble has been experienced from spontaneous combustion in coal piles during the past year, owing chiefly to the fact that coal stocks have been low. Furthermore, the use of heated sheds or tunnels has not been adopted by large companies for thawing out frozen coal on account of the large investment cost. Car dumpers and pneumatic chisels appear to offer an effective means of unloading at a very much lower cost.

Some companies have expressed the feeling that coal crushers of large capacity have been developed at a sacrifice of uniformity of the crushed product. A decrease in the peripheral speed of the rolls is suggested as a probable remedy. Since some difficulty has been experienced with automatic coal samplers owing to their failure to extract representative samples. Care should be exercised in the selection of such equipment.

A few years ago line welds were considered advisable to reduce the number of flanged joints, the report said, but experience of operating companies gained since that time has indicated that they may be dangerously weak unless very carefully made. Nearly all stations using steam above 200 lb. (14 kg. per sq.cm.) have standardized on steel-body gate valves with complete monel-metal trim. Both hydraulically and electrically operated valves are being extensively used, a preference being shown for the electrically operated valve. Some type of valve is in demand which will shut off steam to the turbine room in case of accidents to turbines or their steam piping, but arrangements that will serve this purpose have not yet been devised. A great variety of color schemes are in use by the member companies for indicating different classes of piping, and the committee expresses the hope that a standard color scheme can be agreed upon. Attention is called to the fact that the American Society of Mechanical Engineers is revising piping standards for pressures higher than 250 lb. (17.5 kg. per sq.cm.), acting as the sponsor body designated by the American Engineering Standards Committee with a view to adopting an American standard for such pressures. A member of the prime movers committee has been appointed to represent the users of pipe and fittings on the sectional committee.

Practice in Use of Electrical Apparatus

Closed-Circuit System of Ventilating Turbo Generators Coming Into Favor—Tendency Toward Greater Use of Electrically Driven Auxiliaries—Data on Oil-Circuit-Breaker Performance

CLOSED-CIRCUIT generator ventilation, a distinctly new type of switch-house design,* the electric drive of auxiliaries, oil-switch performance and transformer-oil standardization are subjects of special interest in this year's report of the N. E. L. A. electrical apparatus committee, of which R. F. Schuchardt is chairman. As in former years, the work of the committee was divided among sub-committees dealing respectively with generating stations, oil circuit breakers and switchboard equipment, transformers, substations, motors, service voltage and special fields. Among subjects considered by these sub-committees aside from those mentioned were generator-fire fighting and relay protection, direct-current test sets, shunting of reactors, and transformer polarity standardization. Progress in automatic substations, adoption of motor rules, use of alternating-current motors for elevators, action on 40-deg. versus 50-deg. motors, service voltage standardization and application of electrical apparatus in special fields were also discussed.

In the closed-circuit system of generator ventilation air is circulated through a closed system of ducts and cooled by passage through water-spray or radiator-type coolers. According to the report, this arrangement minimizes fire hazard by failing to sustain combustion and besides provides cleaner air and hence lower operating temperatures and longer life of insulation. In the Narragansett Electric Lighting Company's plant the heat from the generator cooling air is utilized to raise the boiler feed-water temperature. The closed-circuit system will be used in the new station of the Hartford Electric Light Company and the Calumet station of the Commonwealth Edison Company.

Motor Drive for Station Auxiliaries

One of the most interesting points brought up by the committee was the very definite trend toward the greater use of electrically driven auxiliaries. One of the large stations now under construction will have all auxiliaries electrically driven, with the exception of two or three steam reserves such as emergency boiler-feed pump. All of these auxiliary motors are to be alternating current and motors above 25 hp. will be rated at 2,300 volts.

In the application of alternating-current motors to auxiliary drive one of the chief problems has been to obtain the desired adjustment of speed: One method of overcoming these difficulties has been to use constant-speed motors with some form of mechanical speed-changing device or the multi-speed pole-changing motors with or without mechanical speed-changing device.

*See Electrical World, April 1, 1921.

Slip-ring motors with external resistance have also been used and recently the brush-shifting commutator type of motor has been made available. This motor is more efficient for such service than the slip-ring type, according to the committee, particularly when the average running speed is much lower than the maximum. Its cost, however, is considerably higher than that of the slip-ring type, and it has the disadvantage of having a commutator. Moreover, it is not readily adaptable to differential-relay protection. Such motors were installed for boiler-fan drive in the Springdale plant of the West Penn Power Company, recently placed in operation, and a similar installation is planned in another large station now under construction.

Starting of constant-speed alternating-current motors has, in the past, generally involved the use of individual-starting compensators installed at the motor. However, it is possible to start motors from a common starting bus supplied by auto-transformers or from the taps of the power transformers. The Colfax station of the Duquesne Light Company, recently placed in operation, uses auto-transformers, while in the Calumet station of the Commonwealth Edison Company, now under construction, taps on the power transformers are to be employed. Protection of auxiliary motors is being developed along the lines of the differential-relay schemes of protection which have come into extensive use for generators, transformers and cable protection and more recently for motor work.

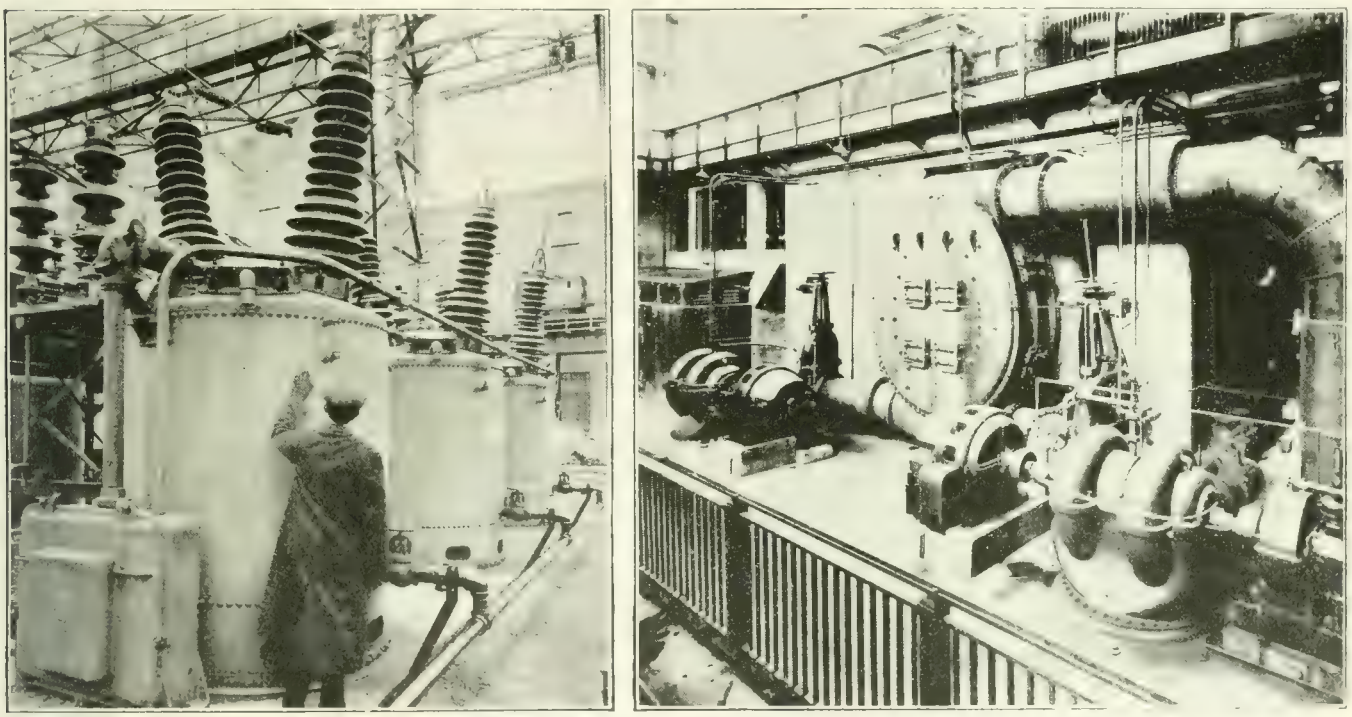
Differential protection of generators and fire-extinguishing equipment are considered very important. In one case of generator failure in which the unit was protected with differential relays the generator was so promptly disconnected that the damage was slight. In another case where the relay protection was lacking but fire-extinguishing equipment was provided the fire which started was readily extinguished by the application of steam.

From the investigation which the committee made of oil circuit breakers it is evident that the present specified duty cycle, which is to open twice and then to be closed and carry the rated current until it is practicable to inspect the breaker and make any adjustments which may be found necessary, does not permit as large a number of times of openings or as short an interval between openings as is required for distribution service. On the other hand, for high-tension cable circuits, this present duty cycle provides for one more opening and for a shorter interval than is usually required in practice. For overhead high-tension transmission the manufacturers' duty cycle is in general agreement as to the number of times the breaker is closed, but does not give a sufficiently short time interval to agree with operating practice.

In answer to the question whether oil circuit breakers should be rated at their ultimate interrupting capacity or in some percentage of that value, thirty-one companies favored an ultimate rating while eighteen favored a factor of safety of two. Five companies thought the question immaterial.

Oil breakers are inspected yearly by twenty-three companies, while eleven companies follow a schedule inspection of every six months. Other companies have schedules calling for inspection at intervals of three months, one to one and one-half months or every two years, and a few companies have no definite time for inspection. It is almost universal practice, however, to inspect an oil breaker at once if it shows signs of severe stress, and a number of companies make more frequent inspection of breakers used for hard service than for other equipment. The nature of the periodic inspections is generaly to remove the oil, test it and filter, if necessary, to examine, adjust and repair all contacts and operating mechanisms, and to examine the condition of bushings, tanks, etc.

Changing the speed of mechanical operation of oil



OIL-CIRCUIT BREAKER OPERATING PROBLEMS AND ELECTRIFICATION OF STATION AUXILIARIES WERE TWO IMPORTANT STUDIES MADE BY THE ELECTRICAL APPARATUS COMMITTEE

breakers to give a faster parting of contacts has been reported on favorably by nine companies. The operation was considerably improved when the speed of opening was increased, since the life of the contact was prolonged, oil throwing reduced and distortion of tanks prevented. The increase in speed was put as high as 100 per cent in two cases.

It was stated by the representatives of the Power Club present at the January meeting of the electrical apparatus committee that the benefits to be derived from speeding up oil breakers would be found beneficial only to old breakers or to those on which the normal operation had been slowed down by long operating rods, many bell cranks or stiff operating mechanism. The representatives claimed that modern breakers are so designed and constructed that little increase of interrupting capacity is to be expected by an increase in speed of contact separation.

It seems to be the general practice to test the oil and filter or change it, if necessary, when the breakers are regularly inspected or when they have opened short circuits and it is suspected that the oil has been damaged. A number of companies make a practice of testing the oil at more frequent intervals than those at which periodic inspections are made and then filtering or changing if found necessary. Of the companies replying to this question, six have such a periodic inspection yearly, while nine companies inspect every six months, eighteen comapnies have no routine inspection and a few other companies vary the inspection from one to four months.

Several other points were investigated, such as troubles due to operating breakers outdoors in cold climates. Temperatures were reported as low as 50 deg. Fahr. below zero, and where low-freezing oil was used no trouble has been experienced. About thirty companies reported that oil from different manufacturers was used interchangeably in breakers. In all cases where oil was so used no trouble had been reported because of the substitution. Only a few companies reported trouble from heating of oil circuit breakers under normal operating conditions, although several cases of trouble were reported when breakers had been installed in poorly ventilated compartments.

In an investigation of oil-circuit-breaker failures it became evident that electrical storms are responsible for more failures than any other cause. Another cause for failure has been that the system outgrew the interrupted capacity of the breakers. In this connection the committee recommended that careful study of existing conditions be made in order that steps may be taken to eliminate hazardous equipment.

Question of Rating Important

From the investigation which the committee made it is evident that no rating based on one particular duty cycle, such as opening twice with a two-minute interval, gives sufficient information to the operating engineer, who may desire to use the breaker for several different classes of service, thereby necessitating his resorting to the manufacturer for information as to the rating on some duty cycle other than the standard. It is also clear that the ideal way of showing the interrupted capacity capabilities of a breaker would be to have curves or tables which would give the current the breaker would interrupt for various numbers of openings and for various time intervals between openings.

Manufacturers, however, hesitate to adopt the foregoing method because of the difficulty and expense involved in determining so many ratings for each type, size and voltage of breaker. On the largest breakers the determination of the actual limitations would depend largely upon the assistance of operating companies in permitting the use of their generating equipment for tests and in reporting the results of breaker operation under abnormal conditions. The expense involved in determining the above rating would no doubt be reflected in the cost of the breakers.

Steps were taken, however, to make a series of tests in conjunction with the Power Club which would determine, first, the current which a breaker would interrupt once; second, the current which the breaker would interrupt twice with a two-minute interval; third, the current which the breaker would interrupt four times with intervals of one-half minute; fourth, the current which the breaker would interrupt 300 times at intervals of not less than fifteen minutes. At the present time these data have not been completed, but it is hoped that their preparation will furnish the preliminary step toward the development by manufacturers of curves of interrupted capacity rating for breakers of other types, sizes and voltages.

Alternating-Current Motors Growing in Favor for Elevator Service

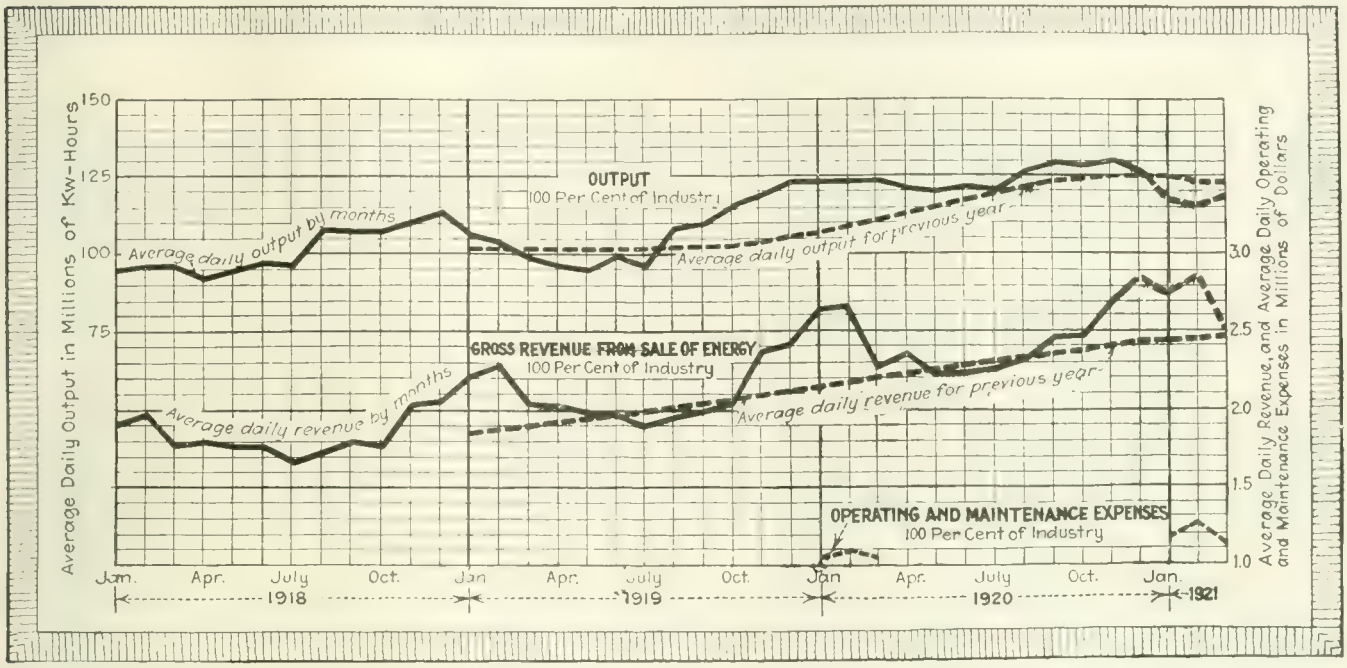
One of the interesting features pointed out by the sub-committee on motors was the growing interest in the use of alternating-current motors for high-speed passenger-elevator service. Of twenty-one manufacturers communicated with fourteen are making passenger elevators and are prepared to furnish alternating-current machines in speeds varying from 200 ft. to 450 ft. (60 m. to 137 m.) per minute. Several companies are experimenting with car speeds of 50 ft. to 550 ft. (15 m. to 167 m.) per minute. Contrasted with the general opinion that direct-current elevators predominate is the statement by the Otis Elevator Company that for the year 1920 the alternating-current elevators bought from it for use in this country were 57 per cent of the total number, and that of the remaining 43 per cent gearless-traction type were 9 per cent.

Service voltage standardization has been very carefully considered by a sub-committee appointed for this purpose, and data from the lamp committee of the N. E. L. A. and from the lamp manufacturers have been summarized. It is shown, for instance, that 51 per cent of the operating companies are using 110-volt lamps, while 21 per cent are using 115-volt lamps and 6.9 per cent 120-volt lamps. Lamps are in use, however, ranging from 100 volts to 130 volts in 1-volt steps and operators can be found using some one voltage in this range.

A tentative recommendation was drawn up by the committee favoring the standardization of 115 volts for lamps and electric household appliances having a voltage range from 110 to 120. Motors are recommended for a voltage of 110.

The sub-committee on apparatus for special fields presented an illustrated account of the development of electrical applications in the fields of woodworking, pulp and paper making, electric furnaces, textile mills, motion-picture production and projection, coal mining, surface excavating, car dumping, and in connection with byproducts coke ovens. In each of these fields present-day practice has been outlined.

Central-Station Operations Reflect Greater Industrial Activity During March



RETURNS of central-station operations received by the ELECTRICAL WORLD for March clearly indicate a material resumption of industrial activity in every section of the country. In spite of the rapidly advancing season and the correspondingly decreased lighting requirements, the average daily output was 100,000 kw.-hr. in excess of that reported in January and 2,200,000 kw.-hr. in excess of the February output. The estimated total output during March of 3,648,000,000 kw.-hr. was, however, 8 per cent below that of March, 1920; but it must be remembered that spring last year saw some of the most intense industrial activity in the history of the nation.

Electric light and power companies, representing over 53 per cent of the industry, are now reporting monthly operating and maintenance expenses to the ELECTRICAL WORLD. The returns for March indicate that while the average daily output was about 2 per cent above that of February, the operating and maintenance expenses were more than 9 per cent under those reported for February. In two sections of the country this comparison between output and expenses was even more pronounced. The North Central States reported an increased daily output of 2.3 per cent and a 13.1 per cent decrease in operating and maintenance expenses, while the Mountain and Pacific States reported an increased daily output of 8 per cent and a 13.5 per cent decrease in operating and maintenance expenses. There are a number of causes contributing to this downward swing in cost of generating energy, among the more important being lower wages, lower cost of fuel, lower cost of supplies and the shutting down of a number of steam auxiliary plants owing to bountiful rains.

The general textile situation in New England showed a marked improvement over February, when many plants were shut down. The boot and shoe industry of that section, which accounts for over 50 per cent of the shoe production of the United States, increased operations slightly over February, but was still operating at only about 50 to 75 per cent capacity. These and other increases in the industrial load of this section resulted in an increased daily energy output over February of 280,000 kw.-hr.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Ratings Represented	Kw.-Hr. Output (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase	Percentage of Installed Ratings Represented	Revenue from the Sale of Energy (Companies Reporting) 1920 Thousands	1919 Thousands	Per Cent Increase
April	70	2,603,692	2,098,559	24 1	65	$45,547	$36,541	24.5
May	70	2,631,560	2,179,916	21 2	65	43,888	35,512	23.4
June	71	2,630,831	2,175,645	20 2	66	44,434	35,528	24 5
July	71	2,677,131	2,234,215	20 0	66	46,608	36,265	28 5
Aug.	71	2,769,175	2,303,099	20.1	66	47,410	36,713	29 1
Sept.	71	2,734,179	2,327,460	17 4	66	49,224	38,209	28 5
Oct.	71	2,797,625	2,499,488	11.9	66	51,370	41,055	25 1
Nov.	71	2,741,705	2,503,402	9 6	66	54,620	44,711	22 0
Dec.	71	2,792,554	2,648,746	5 4	66	57,697	48,580	18.6
		1921	1920			1921	1920	
Jan.	76*	2,765,632	2,943,349	−6 0	70*	58,855	50,861	15 8
Feb.	76†	2,456,553	2,711,251	−9.4	70†	55,778	48,624	14 8
Mar.	77‡	2,812,493	3,179,943	−11.6	72‡	55,706	49,014	13 7

	Percentage of Installed Ratings Represented	Operating and Maintenance Expenses (Companies reporting) 1921 Thousands of Dollars	1920 Thousands of Dollars	Per Cent Increase	OPERATING RATIO Steam Plants 1921	1920	Hydro Plants 1921	1920	Combined Systems of Steam and Hydro 1921	1920
Jan.	40	14,562	13,085	11.3	56.1	55 3	26 8	27.0	38 1	45 6
Feb.	43	15,085	13,640	10.5	55.6	54.5	22.9	26 0	44 1	47 3
Mar.	53	18,544	17,125	8.4	56.1	57.7	23 4	19.6	40.3	44 8

* Includes estimates for twenty-three companies, representing 3.6 per cent of the total installed rating of all central stations.

† Includes estimates for thirty-five companies, representing 4.4 per cent of the total installed rating of all central stations.

‡ Includes estimates for six y-nine companies, representing 10.8 per cent of the total installed rating of all central stations.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States: Percentage of Installed Ratings Represented	New England States: 1920 Thousands	New England States: 1919 Thousands	New England States: Per Cent Increase	Atlantic States: Percentage of Installed Ratings Represented	Atlantic States: 1920 Thousands	Atlantic States: 1919 Thousands	Atlantic States: Per Cent Increase	North Central States: Percentage of Installed Ratings Represented	North Central States: 1920 Thousands	North Central States: 1919 Thousands	North Central States: Per Cent Increase	South Central States: Percentage of Installed Ratings Represented	South Central States: 1920 Thousands	South Central States: 1919 Thousands	South Central States: Per Cent Increase	Pacific and Mountain States: Percentage of Installed Ratings Represented	Pacific and Mountain States: 1920 Thousands	Pacific and Mountain States: 1919 Thousands	Pacific and Mountain States: Per Cent Increase
KW.-HR. OUTPUT	April....	82	187,174	144,922	29.1	65	883,264	701,778	25.9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May....	82	188,566	148,186	27.5	65	854,631	711,276	20.0	74	862,127	700,095	23.5	56	137,779	98,815	39.2	79	588,457	521,544	12.6
	June....	82	189,934	149,607	26.5	66	865,714	721,688	19.9	74	855,013	681,780	25.5	56	132,733	99,660	33.2	79	587,437	522,901	12.2
	July....	82	190,668	159,000	20.0	66	881,241	714,485	23.5	74	841,351	702,302	19.7	56	138,937	106,460	30.1	79	614,934	551,959	13.4
	Aug....	82	194,028	171,002	13.5	66	905,170	728,097	24.2	74	891,712	750,787	18.6	56	147,082	111,573	32.0	79	631,183	541,640	16.5
	Sept....	82	194,730	170,593	14.1	66	905,872	758,737	19.5	74	878,237	758,017	15.9	56	147,524	113,649	30.0	79	607,816	526,464	15.5
	Oct....	82	196,310	191,132	2.7	66	964,739	841,694	14.5	74	896,241	817,757	9.5	56	157,267	126,769	24.1	79	583,068	522,136	11.7
	Nov....	82	193,231	183,624	5.4	66	953,436	825,011	15.5	74	895,229	861,352	10.5	56	144,889	125,438	15.0	79	554,920	507,977	9.2
	Dec....	82	210,494	227,403	-7.4	66	969,909	917,945	5.7	74	903,628	852,264	5.9	56	140,485	133,419	5.3	79	568,038	517,715	9.6
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan..	81	200,269	247,800	-19.2	77	1,003,223	1,043,650	-3.9	73	860,643	956,078	-10.0	62	144,936	145,336	-0.3	81	556,561	550,685	1.1
	Feb....	81	178,694	216,890	-17.6	77	901,942	969,318	-7.0	73	790,935	883,545	-10.5	63	131,654	132,537	-0.7	81	453,928	508,961	-10.8
	Mar....	81	204,952	230,125	-10.9	79	1,028,624	1,117,441	-8.0	73	895,900	943,470	-5.0	63	139,650	136,971	1.9	81	543,367	751,936	-27.2
REVENUE			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	April.	82	$5,087	$3,943	29.0	64	$17,700	$14,383	23.5	57	$12,690	$10,042	26.9	54	$2,952	$2,181	35.2	79	$7,118	$5,992	19.2
	May....	82	4,897	3,741	30.1	64	16,624	13,631	21.9	57	12,471	9,853	26.8	54	2,829	2,140	32.0	79	7,067	6,147	15.1
	June....	82	4,948	3,778	30.5	65	16,525	13,449	22.1	57	12,412	9,776	26.9	54	2,849	2,127	33.9	79	7,700	6,398	20.5
	July....	82	5,009	3,802	28.5	65	16,899	13,438	25.5	57	12,822	9,793	30.9	54	2,747	2,194	35.0	79	9,131	6,948	31.5
	Aug....	82	5,075	4,093	24.0	65	17,210	13,731	25.9	57	13,497	10,151	32.9	54	3,168	2,281	38.1	79	8,460	6,457	31.1
	Sept....	82	5,409	4,296	25.9	65	18,081	14,456	24.5	57	13,834	10,522	31.5	54	3,262	2,386	36.5	79	8,638	6,549	32.0
	Oct....	82	5,675	4,623	22.7	65	19,201	15,722	22.0	57	14,458	11,667	23.9	54	3,504	2,551	37.3	79	8,532	6,492	31.5
	Nov....	82	5,898	5,017	17.5	65	20,938	17,119	22.2	57	15,158	12,561	20.8	54	3,853	2,910	32.4	79	8,775	7,104	23.5
	Dec....	82	6,548	5,744	14.0	65	22,332	19,149	16.7	57	16,004	13,142	21.8	54	3,722	3,113	19.8	79	9,091	7,432	22.3
			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan....	81	6,379	6,170	3.5	74	22,180	19,225	15.3	59	16,818	14,436	17.3	62	4,155	3,484	19.3	81	9,323	7,546	23.6
	Feb....	81	5,925	5,728	3.4	74	21,489	18,317	17.4	59	15,981	14,071	13.7	62	3,915	3,329	17.6	81	8,468	7,179	18.0
	Mar....	81	5,788	5,566	3.8	76	21,761	18,870	15.4	59	15,945	14,108	12.5	63	3,869	3,246	19.2	81	8,489	7,224	17.5
OPERATING EXPENSES:			1921	1920			1921	1920			1921	1920			1921	1920			1921	1920	
	Jan....	34	$1,098	$1,288	-14.7	48	$6,373	$5,411	17.8	28	$3,941	$3,451	14.2	37	$1,015	$905	12.2	54	$2,135	$2,030	5.2
	Feb....	35	1,069	1,242	-13.9	53	6,799	5,937	14.5	29	3,958	3,445	14.8	44	1,217	1,053	15.5	55	2,042	1,963	3.9
	Mar....	46	1,560	1,642	-5.0	59	7,874	7,274	8.2	35	4,597	4,191	9.8	53	1,704	1,453	17.3	79	2,809	2,565	9.4

The Atlantic States presented two conflicting tendencies. In the Middle Atlantic States there was a materially increased activity among the industries closely allied with the automobile interests, but on the other hand the iron and steel industry and other metal products experienced a decidedly greater slump during the month, and the coal-mining districts, such as those of West Virginia, were operating at only about 25 per cent capacity. In the South Atlantic States conditions were reported as fast approaching normal in the textile and lumber industries, these two industries consuming over 46 per cent of the electrical energy generated in the Southern States. The increased power requirements of the South and of a few industries of the Middle Atlantic States were sufficient to overcome the curtailments of the steel and coal-mining industries, this resulting in an increased daily output in the Atlantic States of 3,600,000 kw.-hr. over that reported in February.

Similar conflicting tendencies were also experienced in the North Central States. The greatly decreased power requirements by the iron and steel industry were more than offset by the greatly increased energy requirements of the automobile and related industries, operations in which increased more than 63 per cent over those of February. But after accounting for the decreased lighting requirements the resulting energy output of this section was only slightly more than that reported for February.

Activity in all the copper, lead and coal mining centers of the Mountain States was considerably curtailed during March, and general industrial activity in this section was at a low ebb. Generally speaking, conditions throughout the Pacific States were slightly improved, and the daily central-station output of the Mountain-Pacific States was 8 per cent greater than that reported in February.

TABLE III—AGGREGATE OPERATING RATIO OF COMPANIES REPORTING DATA MONTHLY TO THE "ELECTRICAL WORLD"

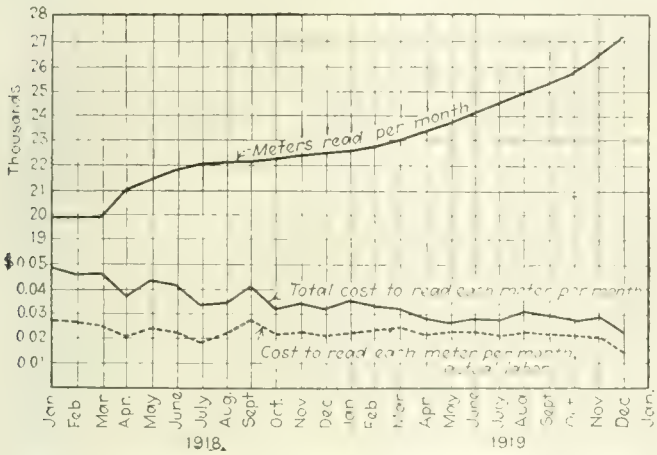
Type of Generating Plant and Month	New England States: Average for Year		Atlantic States: Average for Year		North Central States: Average for Year		South Central States: Average for Year		Mountain and Pacific States: Average for Year	
	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920
Steam Plants:										
January..	54.0	60.8	53.5	50.9	61.2	61.8	53.1	53.7	69.0	60.5
February.	54.3	59.5	52.3	53.0	63.0	57.9	59.1	51.2	60.2	60.3
March...	64.0	70.0	54.5	56.7	58.4	59.7	53.3	50.9	68.4	62.5
Hydro Plants:										
January...	26.5	35.2	21.2	21.2	25.0	20.8	26.4	20.1	27.5	27.3
February..	30.1	46.5	20.1	20.6	24.1	20.6	28.6	21.4	23.9	27.9
March...	29.9	30.0	21.0	20.6	23.0	20.6	30.4	23.2	24.9	19.0
Combined Systems of Steam and Hydro Plants:										
January.....	45.3	53.5	43.5	45.8	39.5	38.6	38.6	46.6	35.2	45.6
February....	44.3	60.0	41.8	41.9	42.6	43.8	41.7	39.6	39.6	43.8
March.....	49.7	53.8	39.7	47.3	42.0	45.3	41.5	46.0	36.4	39.7
	1921	1920	1921	1920	1921	1920	1921	1920	1921	1920
	54.0	60.8	53.5	50.9	61.2	61.8	53.1	53.7	69.0	60.5
	54.3	59.5	52.3	53.0	63.0	57.9	59.1	51.2	60.2	60.3
	64.0	70.0	54.5	56.7	58.4	59.7	53.3	50.9	68.4	62.5
	26.5	35.2	21.2	21.2	25.0	20.8	26.4	20.1	27.5	27.3
	30.1	46.5	20.1	20.6	24.1	20.6	28.6	21.4	23.9	27.9
	29.9	30.0	21.0	20.6	23.0	20.6	30.4	23.2	24.9	19.0
	45.3	53.5	43.5	45.8	39.5	38.6	38.6	46.6	35.2	45.6
	44.3	60.0	41.8	41.9	42.6	43.8	41.7	39.6	39.6	43.8
	49.7	53.8	39.7	47.3	42.0	45.3	41.5	46.0	36.4	39.7
							40.5	42.0		
							40.2	41.2		
							38.6	39.2		
									36.9	43.0

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Graphic Representation of Cost of Meter Reading

GRAPHIC charts aid the management of the Worcester (Mass.) Electric Light Company in visualizing the cost of reading meters. The chart, which is like that reproduced herewith, is made up from the monthly payrolls, which show the total cost of meter reading, the labor cost and the number of meters read



COST OF METER READING SHOWN CLEARLY ON THIS CHART

per month. It may be noticed from observing this curve that as the number of meters read per month has increased the cost of the reading has decreased.

Curves similar to this are used by the distribution department of the company for improving operation along other lines. Some of these have already been published in the ELECTRICAL WORLD and others will follow in later issues.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Maintaining Station Transformers

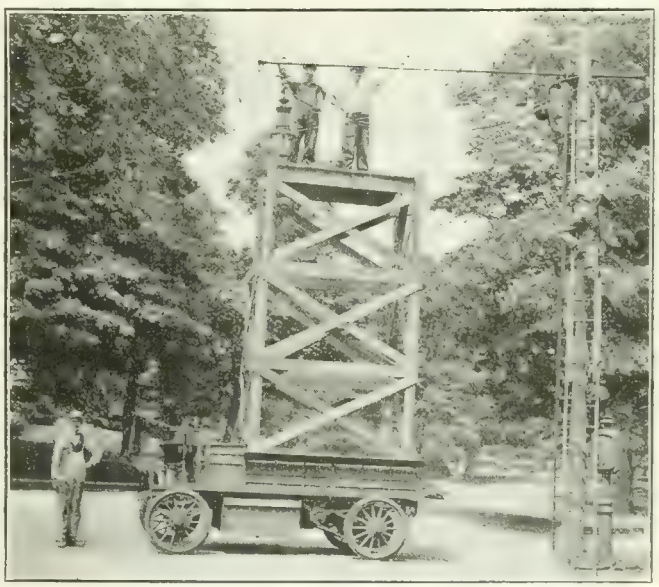
A SYSTEMATIC maintenance schedule for station transformers should call for oil breakdown tests every two to six months, depending upon the size and importance of the installation, and a thorough inspection, including filtering of oil regardless of its dielectric strength, lifting of core, tightening of nuts, checking for connections, etc., at least every three years. Water in transit oil detected at the time oil samples are taken can usually be removed and the leaks stopped without any serious loss, if the matter receives early attention.

Thorough overhauling will disclose a number of defects which might not be noticed in oil sampling or by inspection of the exterior. For instance, some 60-kv. transformers serving a cement plant were, after five years' operation, found with oil ducts clogged and all interior parts coated with a $\frac{1}{2}$-in. deposit of sludge. After the cores and cases had been washed clean the operating temperature was lowered 7 deg. Oil samples taken from these transformers at three-month intervals had satisfactorily passed breakdown tests. The sludge, due to oxidation of the oil and breathing of cement dust, only came to attention at the overhaul period. During this period many imperfections or results of carelessness may be found, such as leads burned inside the case because of arcing, mechanical strain or too much slack on leads to bushings, tools accidentally left inside the tanks—cores and coils out of position—bushing assemblies distorted, and the wooden coil supports at bottom of transformers burned or carbonized, showing that there has been leakage of energy which would no doubt eventually cause failures.

G. W. SCHMAUDER,
Assistant General Manager.
Texas Power & Light Company,
Dallas, Tex.

Tower on Truck Makes Work of Painting Mast Arms of Street Lamps Easier

FOR painting the mast arms of street lamps the Worcester (Mass.) Electric Light Company has built the tower shown in the accompanying photograph. This is made of 2-in. x 4-in. boards and is mounted upon a 1-ton electric truck. The top platform can be raised and lowered by a pulley, and it clears the trolley wires when it is down. A man standing upon this tower can paint, sandpaper and oil the arms much faster than



PAINTING IS DONE MORE QUICKLY FROM THIS TOWER THAN FROM LADDERS

when standing upon a ladder. Moreover, it is not necessary to get down and shift the ladder from one position to another, thus wasting time. Another advantage is that the danger of accidents from falling ladders has been eliminated. FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

Bettering Efficiency of Hydro-Electric Plants

SUGGESTIONS toward the improvement of efficiency in utilizing water power are included in the latest report of the New Hampshire Public Service Commission on water conservation and water power in sections contributed by Prof. C. M. Allen, Worcester (Mass.) Polytechnic Institute, and C. H. Pierce, district engineer United States Geological Survey, Water Resources Branch, Boston. Professor Allen points out that the determination of present operating efficiency in hydro-electric plants has too often been sadly neglected. Experience has shown that, although some waterwheels thirty or forty years old are still doing good work, yet a much larger number should be scrapped and replaced with modern high-efficiency wheels.

One of the principal causes of low operating efficiency is improper wheel setting. It is impossible to make a poor wheel efficient, even by placing it in a good setting; but an efficient wheel can be tremendously crippled by placing it in a poor setting. With the exception of a few cases, the installation of larger wheels in the original settings has proved to be bad practice as regards efficiency, and in many cases little if any more power has been obtained. A considerable increase in power and efficiency can be obtained at little or no additional expense by simply taking as good care of the water-power installation as is ordinarily given to the steam-power plant. Thus waterwheels should be inspected every month or two to make sure that the shafts are lined up and the runners have proper clearance and are free from debris. Too many plant operators never give the waterwheels much thought until something happens. Breakdowns can often be avoided and a much higher operating efficiency obtained by systematic inspection. Trash racks should be kept free, as a considerable loss in head may otherwise result. A loss in head becomes a greater loss in power because if a wheel is properly chosen for the normal head, any drop from this head causes the wheel to operate at the wrong speed for best efficiency, especially at part-gate loads. The loss of head at racks in low-head plants may cause a serious loss in power.

If old-style vertical wheels stand idle during low-water periods, the buckets very often become covered with tubercles. These, unless removed, decrease the efficiency, sometimes from 10 to 15 per cent, and the power from 20 to 30 per cent, depending somewhat on the size of the wheel. Obstructions in the tailrace and draft-tube cause the water to back up and reduce the head. This trouble is all too common. Headgates not fully opened, owing to a poor rig or laziness on the part of the operators, are a frequent cause of reduced head and are inexcusable. If headgates are used frequently —and they should be in most plants—power-operated gates of some sort should be installed. They would pay for themselves in a short time, not only in the saving of labor but in the increased efficiency of the plant, owing to more frequent inspections. If wheels are shut down any considerable length of time on account of low water, the headgates should be closed and cindered to prevent leaks, the wheel gates not usually being tight enough for this purpose.

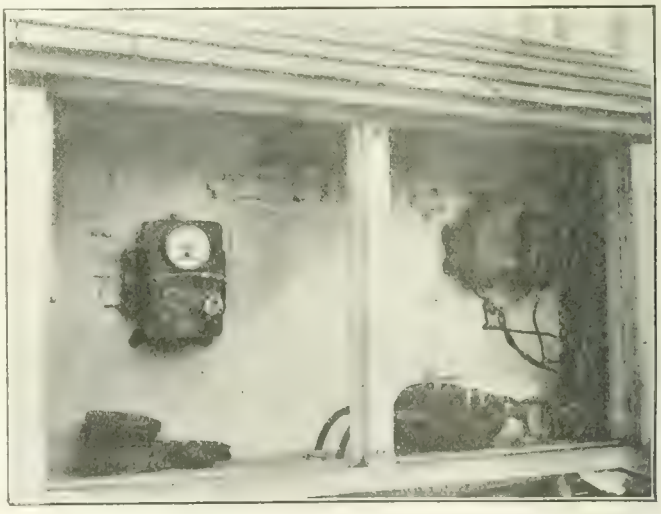
In some plants tests have shown that the wheels are often operated at the wrong speeds for maximum power and efficiency. Curves should be kept on hand showing the proper speeds to operate the wheels in order to obtain maximum horsepower for different heads and gate openings. These charts, combined with the use of a tachometer on the wheel shaft, will provide all the data necessary to get maximum output from the units.

Mr. Pierce points out that many old wheels use enormous quantities of water for the power developed and should be replaced, in many cases an entirely new plant arrangement being justified. More information at each plant in regard to the quantity of water used in producing a definite amount of power would be a great help toward reducing waste. Measured by recent improvements in water-power development, most of the small water-power plants built fifteen or twenty years age are very inefficient. Twenty to thirty per cent more power can frequently be obtained by redevelopment, using the same amount of water. At one redevelopment in Massachusetts, where the old and new plants were carefully tested, the increased power which was from the same quantity of water amounted to about 50 per cent of the old plant.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Meter Box for Outdoor Substations

CONVENIENCE in reading, testing and inspecting and ample space for additional meters are afforded by the outdoor meter box used by the Trinidad (Col.) Electric Transmission Railway & Gas Company. The box is of wood with shingled roof and has two glass doors to permit ready inspection of the interior. These doors may be locked to prevent tampering with the meter or wiring. The box is 3 ft. high, 4½ ft. wide and 1 ft. deep inside. The inside back wall is of transite, and on this are mounted the meter, meter wiring and potential transformers. The current transformers are mounted on the floor of the box. The 2,300-volt leads pass through porcelain insulators in the bottom of the box to the current transformers. Three 10-watt lamps mounted on the back wall are connected in star to the potential transformer secondaries. If any one of these lamps is not burning, it is an indication that something is wrong with the potential transformer connections. As the box is only 4 ft. from the ground, inspection and working on the meter and wiring is easy. FIELD EDITOR ELECTRICAL WORLD.



GOOD ARRANGEMENT OF METERS AND TRANSFORMERS IN OUTDOOR METERING INSTALLATION

San Francisco, Cal.

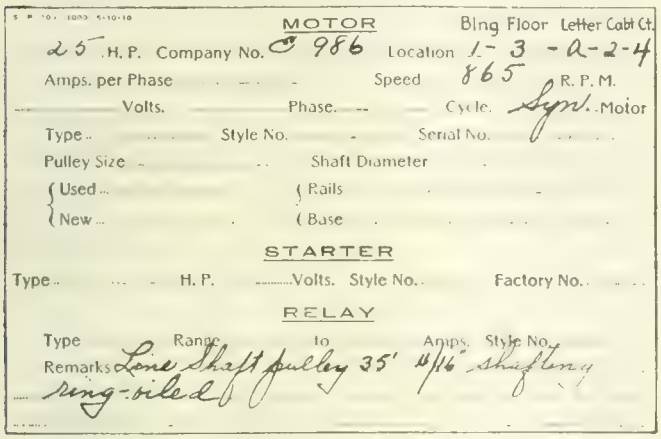
Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Convenient Motor-Record Card

A COMPACT index card for motor records was used at the East Springfield (Mass.) works of the Westinghouse Electric & Manufacturing Company during the period of munitions manufacture.

It is 4 in. x 5 in. in size and in addition to the usual motor nameplate data carries spaces for recording pul-



CARD FOR KEEPING A RECORD OF MOTOR FEATURES AND PULLEY, STARTER AND RELAYS

ley and shafting details, starter and relay information. The notation at the upper right-hand corner specifies the building, floor, section, cabinet and circuit number. On the reverse side is space for a sketch of the driving arrangement adopted. R. P. King is plant engineer.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Changing 60-Cycle Motor for 40-Cycle Operation

A DEMAND for a 40-cycle motor for quick delivery was taken care of some time ago by the writer by changing over a 60-cycle machine to operate at the lower frequency. The requirements called for a 20-hp. motor of the slip-ring type to operate at 220 volts, 600 r.p.m., three phases and 40 cycles. The operation was to be at a variable speed with 50 per cent reduction in full-load speed over a part of the cycle of duty. After considering a number of 60-cycle machines one was found that could be connected readily to fulfill these requirements.

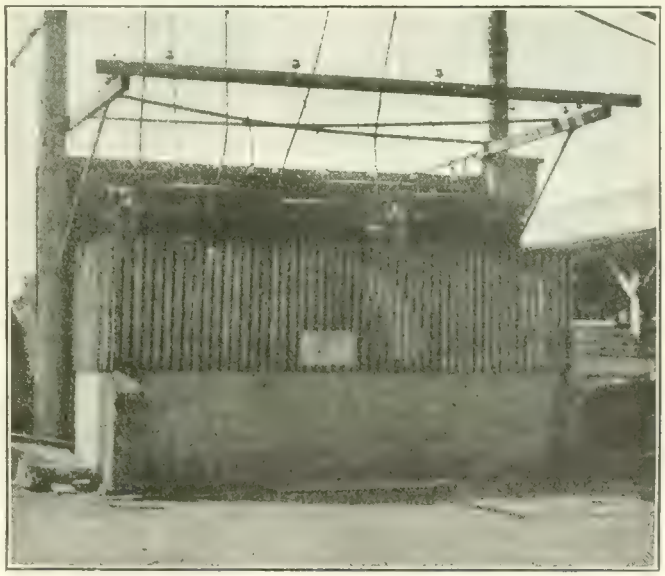
In the first place, to operate at 600 r.p.m. on 40 cycles the machine would have to operate at 900 r.p.m. on 60 cycles. A reduction in speed results in a corresponding proportional reduction in voltage that may be applied and in power. Therefore the motor would have to be rated originally for about 30 hp. A 35-hp. motor for 440 volts, three phases, 60 cycles, rated for a 40-deg. C. rise in temperature, was found. This machine was connected series-delta, and a two-circuit star connection gave a voltage of 380. This was for 60-cycle operation, but on a 40-cycle circuit the voltage applied to the two-circuit star winding should be only 254 volts. The line voltage, however, was 220. With a 35-hp. motor operated at 254 volts, the power delivered at 40 cycles would be $(35 \times 2)/3$. However, the motor was to operate on a 220-volt line instead of a 254-volt line. Therefore the horsepower would be still further reduced. Since the power varies as the square of the voltage, the resultant power on a 220-volt circuit would be as 220^2 to 254^2, or 79 per cent of the 254-volt rating. The final horsepower, therefore, would be $(35 \times 2 \times 0.79)/3 = 18.4$ hp. on a 40-deg. C. rise basis. As the motor was to carry a load of 20 hp. only at intervals, it was judged to be suitable for the work.

Accordingly the machine was reconnected and put into service and the necessary secondary resistance for starting and speed variations was found with little difficulty by trial. When last heard of the machine was carrying its load in a very satisfactory manner after eight or nine months of service. WILLIAM THOMSON.

New York City.

Oil-Filled Transformers Near Inflammable Material Set in Concrete Vat

WHERE oil-insulated transformers are installed on wooden structures or within 25 ft. of buildings some provision should be made to prevent the escape of oil in case of fire. To make such installations comply with the Underwriters' requirements, the Portland



CONCRETE WALL AROUND TRANSFORMERS INSTALLED NEAR SAWMILL

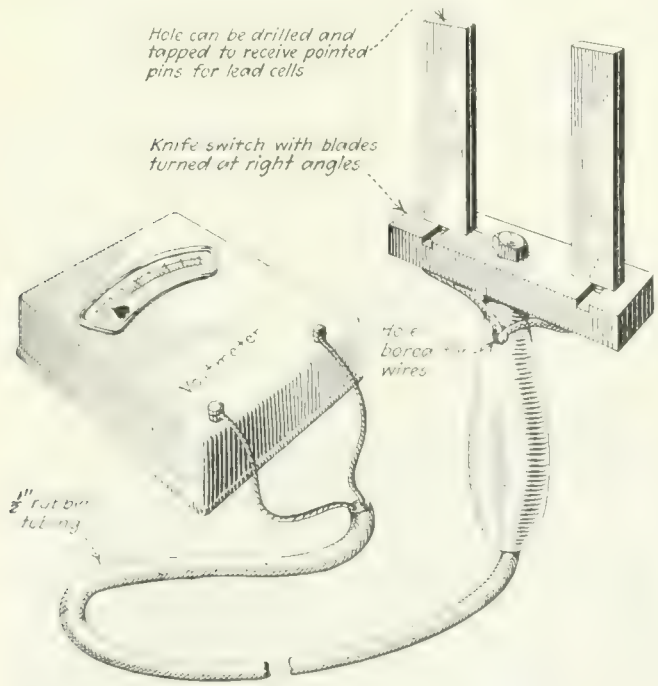
(Ore.) Railway, Light & Power Company sets the transformers in a concrete vat or tub of sufficient size to hold all of the oil contained by the transformers. The vat is provided with a sewer drain to carry away any overflow

of oil that might occur. This arrangement has the further advantage that water may be sprayed on the transformers to keep them cool in case they are overloaded and become too hot. The accompanying photograph shows such an installation of three 500-kva., 11,000/440-volt transformers supplying power to the electrified sawmill of the Inman Poulsen Lumber Company at Portland, Ore.

W. C. Heston,
Industrial Power Engineer.
Portland Railway, Light & Power Company,
Portland, Ore.

Cell Tester for Taking Voltage Readings with One Hand

In taking the voltage on cells of a storage battery it is desirable to have one hand free for writing down the reading. In order to accomplish this purpose a two-bladed cell tester has been made by the writer which can be manipulated by one hand. This tester is made of a two-pole switch handle with the blades cut off to a suitable length and turned at right angles to the original position. Connection to the voltmeter is made through two lamp cords which are attached under the screws which hold the blade to the handle. The lamp cords are led through a hole drilled in the handle of the switch, and from this point they pass in ½-in. rubber tubing to the voltmeter, as shown in the accompanying illustration. The tester shown is made for use



ONLY ONE HAND IS REQUIRED TO TAKE VOLTAGE READINGS ON BATTERIES WHEN USING THIS TESTER

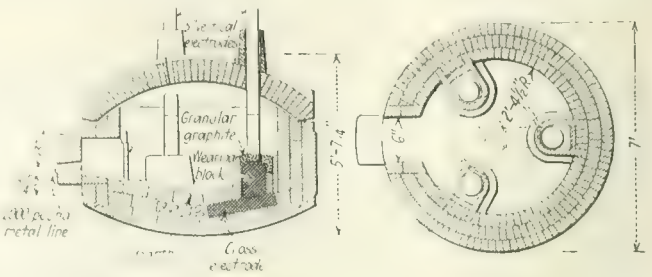
on Edison cells. However, if it be desired, a hole may be drilled and tapped in the end of each blade for holding a steel point which may be used on lead batteries.

This tester allows quicker work than may be done with the two-pointed handles or prods commonly used for taking voltage readings.

Fred A. Reibert,
Foreman Battery-Repair Department.
American Railway Express Company,
New York, N. Y.

Electric Brass Furnace Shows Small Metal Loss

A metal loss for yellow brass of less than 1.5 per cent and for red of less than 0.75 per cent brass was shown on tests of two new types of muffled-arc electric furnaces developed by the General Electric Company. These tests were made by this company in its own plant.



MUFFLED-ARC FURNACE WHICH HAS SHOWN VERY LOW METAL LOSS

In one test in which more than forty heats of approximately 70-30 brass were melted the total metal loss by weight, including spillage, dirt and grease in the charge, was only 1.014 per cent.

These furnaces are designed in two sizes, a 1,500-lb. unit and a 50-lb. unit, for melting virtually any nonferrous metal requiring a pouring temperature not above 1,500 deg. C. (2,372 deg. Fahr.). The test showed that the larger furnace melts yellow brass, pouring at 1,100 deg. C., with a power consumption not exceeding 270 kw.-hr. per ton operating twenty-four hours a day with one heat every hour. The smaller furnace melts yellow brass at 1,100 deg. C. at the rate of 100 lb. to 125 lb. per hour with a consumption of 35 kw.-hr. to 40 kw.-hr. per 100 lb., provided that the furnace is heated at the beginning of the run. The power factor for both furnaces is 0.95 or better. The larger furnace takes three-phase energy and the smaller furnace is single-phase.

The 1,500-lb. furnace is equipped with electrode regulators to maintain automatically the desired power input. The whole top of the furnace may be lifted for inspection or repair of the lining without disturbing the electrodes. The diagram shows the interior arrangement of the three D-shaped muffles, wearing blocks, cross electrodes and vertical electrodes which compose the heating elements. The space between the inside wall of each muffle and the electrode and wearing block is filled with crushed graphite to smother the arc. The triangular space where the cross electrodes meet in the middle is filled with a mixture of graphite and tar to insure a good electrical connection.

The 50-lb. furnace is constructed on much the same principle except that in this case the hearth is flat, it being designed to receive standard graphite crucibles. There is also some difference in the electrode and block arrangement, since the furnace is for single-phase operation. A horizontal carbon block, embedded in crushed graphite, extends across the bottom, carrying a wearing block on each end. Between these wearing blocks are four carborundum bricks which form the hearth. Two graphite electrodes extend through the roof to the wearing blocks, the arcs being smothered in the graphite surrounding the blocks. The electrode regulation is entirely manual and is accomplished by adjusting the wheels on the electrode holders. In operation the cruci-

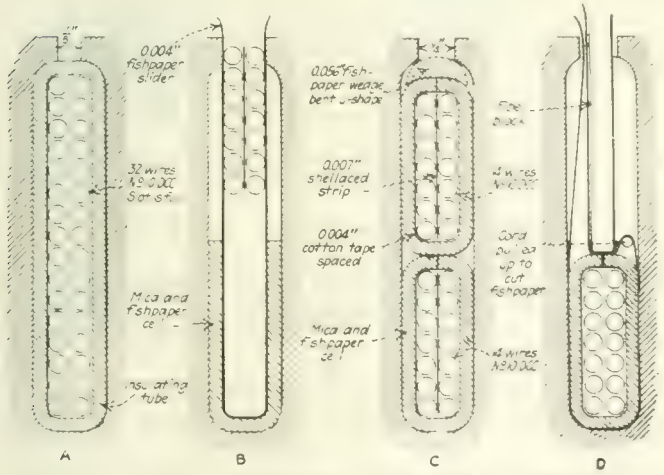
ble containing the metal to be melted is set on the carborundum bricks forming the hearth.

The metal is heated by the same action in both furnaces. The current flows from the vertical electrodes through arcs to the crushed graphite and the wearing blocks. These arcs are smothered by the graphite in the muffles, and the whole mass becomes heated, forming a heat source of large area and uniform temperature. The heat is radiated to the metal from all directions as well as absorbed from the muffles and the hearth. As a result uniform temperature distribution free from hot spots and an atmosphere free from oxidizing gases or other agencies which would contaminate the metal is said to be obtained.

Threaded-in Chain Winding Replaced by Formed Coils

IN A RECENT rewinding job done in a large repair shop an old concentric-chain winding was replaced by formed coils. Although this caused some unusual difficulties, it was decided upon as the easiest method of rewinding. The machine was a 200-hp., three-phase, 60-cycle, 4,400-volt, twelve-pole, 585-r.p.m. old-style squirrel-cage induction motor which had burned out. The stator had 180 slots and 90 coils, one coil per slot, arranged in two ranges, in concentric chain, and connected two-parallel star. The opening in the top of the slot was $\frac{1}{8}$ in. wide. There were thirty-two turns of one No. 10 double-cotton-covered wire per coil. The slots were sixteen wires high by two wires wide. There were five coils connected in series per group. This winding had been wound in place by hand. To rewind the stator with the same type of winding was out of the question on account of the time required, so it was decided to change the winding into the two-layer diamond-shape pulled-coil type.

The first difficulty was that the opening in the top



HOW THREADED-IN WINDING WAS REPLACED BY MOUND COIL

A—Old threaded-in winding. B—Slot opening enlarged to $\frac{1}{4}$ in. and coil slipped in with aid of fishpaper slider. C—Coils in place, 28 wires in slot instead of 32. D—Scheme for cutting off fish paper

of the slot was very narrow, $\frac{1}{8}$ in. The old winding had been pushed through an insulating tube, as shown at *A* in the drawing, one wire at a time. The slot opening was large enough to pass one No. 10 wire and the wires of the new coils could be threaded in, but this would mean bending wires at the ends of coils and would take much time. There would also be possibilities of crossed wires in the slots. Therefore the threaded-in coil was discarded, and it was decided to grind the slot opening large enough to pass a coil, wound in layers, two wires wide. This coil would have to be held rigid by means of a 0.007-in. shellacked fullerboard strip and 0.004-in. cotton tape spaced and dipped twice in plastic varnish. A 0.004-in. fishpaper slider also was required in the slot to protect the coil while being inserted. This meant that the slot opening had to be the width of two No. 10 double-cotton-covered wires (0.224 in.) + 0.007 in. (shellacked strip) + 0.008 in. (tape) + 0.012 (varnish) + 0.008 (fishpaper), which equals 0.259 in. or about $\frac{1}{4}$ in. Accordingly the slot was ground with a wheel to this width.

The next problem was to decide type of connection, pitch, turns per coil, etc. The old winding consisted of ninety coils, thirty-two turns per slot, therefore a two-layer winding would require 180 coils, sixteen turns per coil. There being two coils per slot would make thirty-two turns per slot as before. But the two-layer winding requires insulation between top and bottom coils, because the full difference of potential exists between these points in some parts of the winding. As the old winding and insulation fitted the slot tightly, the only remedy was to drop off two turns per coil or four turns per slot, which would give 0.224 in. for a retaining wedge and for insulation between top and bottom coils.

Dropping two turns per coil of sixteen turns would mean a reduction of $12\frac{1}{2}$ per cent, which would decrease the required applied voltage $12\frac{1}{2}$ per cent. As this voltage is too low for satisfactory operation, the motor could not be connected as it was before (in two-parallel star).

A series-delta connection with fourteen turns would, however, make the correct voltage possible. With a two-parallel star connection the voltage was 4,400. Changing this to series star, the voltage would be 8,800. A change from series star to series delta would give 8,800 ÷ 1.73 = 5,080 volts. Decreasing the turns to fourteen instead of sixteen would give 4,445 volts. This is about 1 per cent high and would be perfectly satisfactory. However, the chord pitch might be reduced without materially affecting the voltage. Consequently, in order to save copper and to make a neater job, the pitch was made one-and-fourteen instead of one-and-sixteen, which was the original pitch. A pitch of one-and-fourteen gives a chord factor of 0.978, which decreases the voltage to 4,445 × 0.978 = 4,347 volts. This is sufficiently close to 4,400 volts (about 1.2 per cent less). As the voltages between turns in the new coil would be virtually the same as in the original winding, no extra insulation was necessary.

Accordingly 180 coils were wound on a shuttle with fourteen turns of one No. 10 double-cotton-covered wire, two wide by seven deep, with cross-overs taped. A 0.007-in. strip of shellacked fullerboard was placed between the two halves, as shown in *B*, and the coils were pressed and pulled into shape. The sides were taped with one layer of 0.004-in. x $\frac{3}{4}$-in. cotton tape spaced. This was extended onto the diamond ends about 2 in. The coils were dipped twice in plaster varnish and baked after dips. Then the coil ends were taped with four half-lapped layers of 0.008-in. x $\frac{3}{4}$-in. black bias-cut treated cloth tape, sterling varnish being brushed on between layers. The layers were put on so that the thickness of insulation tapered to one thickness which extended 1 in. onto the slot section.

One layer of 0.007-in. x $\frac{3}{4}$-in. cotton tape half lapped

was put on over the treated tape. The bottom slot section of the coil was made long enough to project 1¼ in. beyond the iron on each side, while the top projected 1½ in. The phase coils had six layers of treated cloth (two extra), and red cotton tape was used on the lead ends to distinguish them from the plain coils. The coils ends were then dipped twice in "Sterling" varnish, care being taken that the varnish did not run onto the slot sections.

The slot insulation consisted of two cells, one for the bottom half of the coil and one for the top, as shown in *C*. Each cell was built up with five thicknesses of 0.015-in. mica and fishpaper. These were cut the full length of the straight part of the slot section and just wide enough to turn over on top of the coil and meet, as shown in *C*. A 0.004-in. fishpaper slider was used, as in *B*, to allow the coil to slide into the mica cell without catching on the edges. When the bottom half of coil was in place, the 0.004-in. fishpaper was cut off flush with the mica cell, the two were bent over on top of the coil and the top mica cell was put in (*C*). A 0.004-in. slider was used in the top as in the bottom. When the top coil was in place the slider was cut off. The mica cell fishpaper was bent over, and a 0.056-in. fishpaper wedge.

Some difficulty was experienced in cutting off the fishpaper sliders even with the top of cells. The slots were too long and narrow to use the regular insulation trimmers and the coils could not be lifted to the top of the slot, because when it was attempted they could not be pushed down again into the cell. Therefore a piece of strong hemp cord ⅜ in. in diameter was used as shown at *D*. A loop at one end was passed over the bolts which hold on the end bells and the string was laid inside the cell on top of the coil from one end of the slot to the other. Then a piece of ⅛-in. hard fiber 8 in. x 4 in. in size was placed with its edge on the outside of the fishpaper. This block was pressed down on top of the paper and the string was pulled up at one side of the block, thus cutting the paper. The block was moved along the slot until the full length of the cell was cut. The secret of this operation is to have a block of such thickness that there is just room between the side of the slot and the block for the string to pass.

The coils were taped one by one as they were put in, from the iron to the diamond ends, that is, around the corners of the cells, with two layers of 0.007-in. x ¾-in. cotton tape half lapped. This was done to seal the mica and fishpaper cells that extended outside the slot.

The motor was rewound for $1,100 less than the cost of a new motor and the delivery date for a new motor was bettered by two months. The new winding was connected series-delta, pitch one-and-fourteen with 180-coils of fourteen turns of one No. 10 double-cotton-covered, five-coils-per-group, top-to-top connection.

Bronx, New York City. C. A. Johnson.

Pigtails and Large Number of Brushes Aid in Dissipating Heat

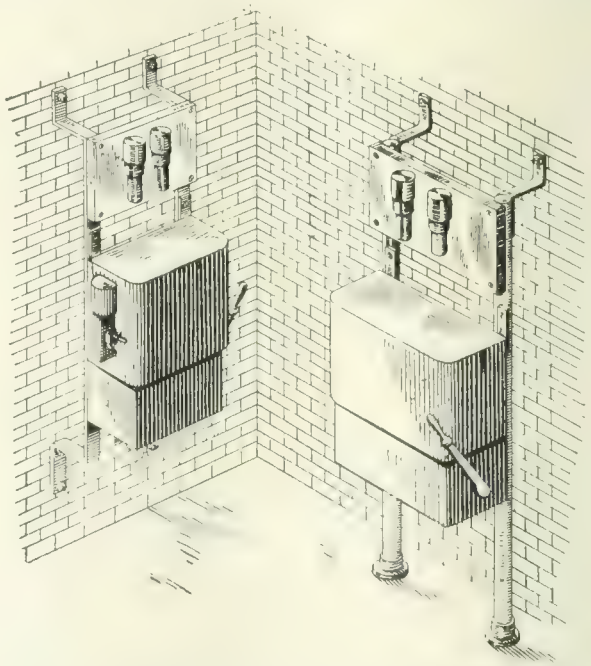
With the latest designs in electrical machines of high speed and high current ratings the dissipation of heat losses on the commutator is an important item. A large number of small brushes have a much greater radiating area than a small number of large brushes, and in addition to this a small brush has less inertia than a large one; hence the small brush is more capable of maintaining contact with commutator surface.

Pigtails are a very good path for the dissipation of heat, and brushes should be equipped with more than one pigtail when all possible heat dissipation is required. Under these conditions the omission of any type of pigtail insulation is advisable. Another item often overlooked but relatively important is to be sure that the terminal on the pigtail has sufficient conducting area both on its shank and its contact with the conductor to which it is fastened.

These remarks were made at a recent meeting of the Iron and Steel Electrical Engineers.

Neat Starter Brackets of Strap Iron or Pipe

Starting compensators mounted on iron brackets are far better looking than those on wooden blocks and there is more room to work behind them. To hold a starter of ordinary size, say up to 50 hp., brackets should be made of flat iron bar ½ in. thick, 1½ in. to 2 in. wide, and in one full length with both ends bent



BRACKETS FOR HOLDING AUTO-STARTERS

At left, bracket for starters up to 50 hp. in size, using ½-in. x 1½-in. strap iron. At right, bracket of 1½-in. pipe for larger starters.

for about 2 in. offset from the wall. The upper and lower ends should be fastened to the wall by lag screws at least ½ in. in diameter and 4 in. long, fitted into expansion shields. If the shields fit the hole drilled for them rather loosely, wedge them in with enough nails to make the lag screws fit tightly. One good feature of this type of bracket is that if all brackets are drilled alike any starter is easily replaced by another in an emergency, using the same bolts and holes. A standard plan can be drawn up and brackets made and kept on hand for any motor job.

For quite heavy starters stands should be built up from the floor and braced out from the wall. Such stands should be made of at least 1½-in. pipe screwed into floor flanges. H. S. Rich.

East Berlin, Conn.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Helping to Locate Street Lamps to Popular Satisfaction

TO FACILITATE expression of opinion by the public as to the proper location of new street lamps the Greenfield (Mass.) Electric Light & Power Company marks on the curbing in yellow paint tentative sites of lamps, and on public ways where no sidewalk exists yellow stakes are put in place. By this means the company's representative is able to ascertain the consensus of opinion in the neighborhood affected and new lights are installed so as to satisfy the majority.

What Constitutes a Desirable Power Customer

HOW a user of central-station power may become an undesirable customer when the cost of serving him becomes excessive was discussed by E. C. Stone of the Duquesne Light Company at the recent meeting of the Pennsylvania Electric Association in Pittsburgh. If a technical analysis be made of the cost of furnishing service under various conditions, a base form will be found, said Mr. Stone, in which form power can be delivered at a minimum cost, and any variations from this form will involve an increase in cost. In the following table he presented the base form indicating the principal variations:

Base Form of Power	*Variations*
Alternating current.	Direct current.
Generated frequency.	Frequencies other than that generated.
Three-phase.	Other than three phases.
Primary voltage.	Other than primary voltage.
Steady.	Unsteady with more or less rapid fluctuations.
Balanced.	Unbalanced.
Unity power factor.	Leading or lagging power factors less than unity.
Ordinary regulation.	Close regulation.
Delivery to point on existing transmission or distribution system.	Delivery to point requiring line extension.
High diversity factor—use of power throughout the year and high load factor.	Low diversity factor—seasonal use of power and low-load factor.
Ordinary continuity of service.	High continuity of service.

Explaining the base form and variations, Mr. Stone continued:

Electric power in the base form described above can be supplied at a minimum cost. Variation from this form involves an increase in cost, the magnitude of which depends upon the nature and degree of the variations.

To furnish direct current or alternating current of frequency other than the system standard ordinarily requires the installation of rotating machinery. The investment, operating losses and operating attention on this machinery add a distinct element of cost to such service. In the rate schedule of one company 30 per cent is added to the energy charge to cover the cost of conversion to direct current. Transformation from standard three-phase to other polyphase systems is simpler and less costly, but it nevertheless involves some additional cost, since such transformers are special and special switching equipment may also be required. If the consumer can use the primary or transmission voltage, the cost of an installation of step-down transformers is saved.

In the basic form there is a steady flow of energy as indicated by constant voltage, current and power factor in the circuit. In general, however, the equipment which utilizes electric power takes a more or less unsteady flow of energy, causing fluctuations of load on the lines and power plant. The tendency of such fluctuation is toward causing trouble in two ways:

(a) On the installation causing the fluctuation, by pulling the voltage down so low that the service becomes unsatisfactory, leading to failure of motors to start and other inconveniences.

(b) On other connected installations, by causing such voltage or frequency disturbances as will render the service unsatisfactory to users in general.

In one case which came to the writer's attention a certain hydro-electric plant was serving a number of textile mills very satisfactorily. The textile mill load being steady, the frequency and voltage of the power system were also steady, giving almost ideal conditions for the operation of the textile machinery. Later on, however, the same system took on a heavy steel mill installation involving rolling mill motors of high capacity. The swinging loads on these motors were so heavy and their magnitude compared to the capacity of the power system was so great that the speed regulation was immediately broken and the service to the textile mills rendered very unsatisfactory.

Fluctuating loads are so numerous and produced by so many types of equipment that no attempt can be made to catalog them here. The important point is that to take care of them involves an additional cost of service in every case where the fluctuations are equal to any considerable percentage of the system capacity.

Balanced load, by which is meant load that is equal on all phases of the primary polyphase system, is a characteristic of the base form of power. The most common form of unbalanced load on a three-phase system is single-phase load, such as lighting units, small furnaces, etc. If the load on a three-phase system is balanced, the capacity of the system is at its highest. Any unbalancing of the phases increases the operating losses and heating.

Effect of Unbalanced Load

Unbalanced load on a polyphase system therefore requires additional investment in substations, lines and generating plant to take care of the greater heating and may require improvement in voltage regulation. There is, therefore, a perfectly real increase in cost in supplying single-phase or other unbalanced loads.

That the capacity of the system is maximum when the power factor of the load is unity is so thoroughly understood as not to require discussion at the present time. It is only necessary to mention the fact that power factors of less than unity involve an additional cost in generators, lines and transformers or in corrective equipment such as static and synchronous condensers. Low power factors may be largely prevented, however, by proper design of power installation and use of the most suitable motors.

In discussing this general subject, the necessity of good voltage regulation on all central-station systems should be emphasized. The apparatus utilizing electric power is extending over a constantly widening field and is becoming more and more exacting in its requirements. Higher

voltage, voltage-regulating equipment and power-factor-raising equipment are the best methods of obtaining better regulation. In general, the addition of copper to the circuit is the most costly method.

These things being the case, the normal regulation of the system will be such as properly to take care of normal service. Where excessively close regulation is required additional equipment must be installed as indicated above, and such additional equipment will involve an additional cost.

It sometimes happens that a consumer who has at one time been taken on a system in an irregular manner because power was available later becomes an excessive-cost consumer because of changes in the system. For example, a number of cases have come to the writer's attention where power consumers were taken on to a 500-volt railway system which afterward became overloaded and thus made it impracticable to take care of other than railway power. This is a situation which should be carefully watched, and the central-station company should not obligate itself to furnish power under these conditions except with suitable limitations. The central-station system aims to furnish a supply of power which is sufficiently continuous to take care satisfactorily of the needs of its average consumers and which is as near being absolutely continuous as such average consumers are willing to pay for. To render service which is subject to less interruption than this requirement indicates involves an additional cost such as the installation of special emergency lines and substation equipment or even storage batteries in certain cases. For many users this excess cost is not warranted. Special provisions for continuous service required by users having special conditions should be paid for by those users.

The object of the foregoing discussion has been to show that electrical energy in some standard form can be supplied at a minimum cost, and that when variations from such standard form are required additional costs are developed. Standard central-station power service is analogous to the standard product of a factory. The cost of the standard product is much lower, but the special product can be furnished if the user is willing to pay the price. If, then, the rate schedule is based on supplying the standard form of energy, the most desirable consumer is the one who takes his energy in that form nearest the standard and the most undesirable consumer is the one who requires energy farthest from the standard form and who, therefore, involves an unduly high cost to serve without yielding a corresponding increase in revenue.

EXCESSIVE COST OF SPECIAL SERVICE

At the present time the excess costs of some types of special service have been provided for in a more or less haphazard way in the various rate schedules of the power companies, but no comprehensive plan has been developed for systematically taking care of the entire situation. The result is that in many cases no incentive is offered to use power in the standard form and many petty disputes arise due to restrictions of various kinds which may be placed about the customer.

The points to "put across" to the consumer are that the supply of power in special forms such as those enumerated actually costs more to furnish than standard power, that it is not fair to make those who use power in standard form bear a share of this excess cost of special power, that power in special forms can be furnished if necessary, provided the excess cost is met by the user, but in many cases it is inherently more economical for the user to modify his installation so as to take power in the standard form than for the central-station company to furnish it in a special form.

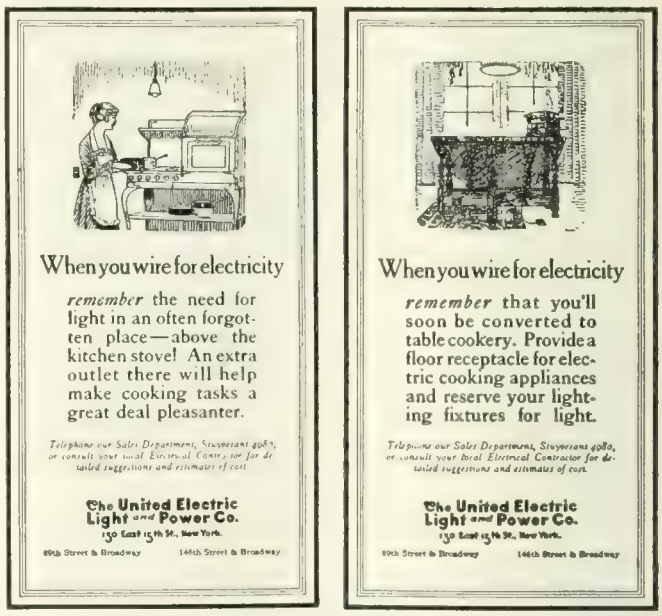
It seems desirable, therefore, to develop a rate schedule which will take care of the various special forms in which electric power must occasionally be supplied and which will provide a rate for these various forms commensurate with the cost of serving them.

Such a schedule should be founded upon a base rate covering power furnished in the standard form. To this base rate for standard power a series of corrective factors would be applied for the various special forms of power as outlined above. The corrective factors would be so designed that they would increase the base rate by a sufficient amount to take care of all additional operating costs and to earn the normal return on the additional investment involved in the special service. Such a schedule would put the rate for the various forms of service on a standardized basis, on which the consumer could operate as he desired if he was willing to pay the price. From the technical standpoint there would then be no undesirable customers, since each would pay adequately for the service rendered him and a definite incentive in a lower rate would be provided for all users to make their service conform as closely as possible to the standard. If the rate were properly designed, the result would be such a combination of equipment in customers' installations and on the central-station system as would supply the service required at the lowest possible cost.

This lower power cost would lead, in turn, to additional use of power and open up new fields for its utilization, thereby furthering the prosperity and development of the community and at the same time increasing the business of the central-station company.

New York Company's Advertisements Stimulate House-Wiring Business

TO STIMULATE house-wiring business and at the same time emphasize the desirability of installing an adequate number of convenience outlets the United Electric Light & Power Company of New York is running a series of twenty-five advertisements in the daily



TYPICAL ADVERTISEMENTS OF THE UNITED ELECTRIC LIGHT & POWER COMPANY'S HOUSE-WIRING SERIES

morning newspapers. Two advertisements which are representative of the series are shown here.

Commenting on their purpose Ralph Neumuller, advertising manager of the company, said:

"Apart from the direct benefits to the local electrical contractors and ourselves, we hope that the influence of the campaign will be more far reaching and create a greater demand upon the industry generally for wire, sockets, fixtures, appliances and other materials.

"As a follow-up and tie-in with the newspaper copy we are sending individual copies of some of the advertisements to our house-wiring prospect lists. This has already proved of considerable benefit and is expected to result in a considerable house-wiring business throughout our territory."

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Comparative Study of Vector Diagrams for Polyphase Asynchronous Motors.—J. MONNIER.—Many tests on the above subject proved that the well-known and much-used Heyland circle diagram is not quite accurate. A similar method arrived at by Grob comes somewhat nearer to actual test results. A corrected diagrammatic vector method, called a polar-diagram, has been devised which gives results that check tests very satisfactorily. This new diagram is really the well-known Kapp transformer diagram, with some changes to make it applicable for motors.—*Revue Générale de l'Electricité*, April 2, 1921.

Three-Phase Induction Motor Drive for Mine Hoists.—P. ESCANDE.—Mines in northern France which were partly destroyed during the war are being reconstructed now on a large scale. Virtually all of these hoists were steam-driven, but they are now rebuilt for electric drive. The question of the proper system was carefully analyzed, and it was found that for medium hauls the wound-rotor, three-phase induction motor was best suited. The different variations of the Ward Leonard system might seem to be more advantageous, but with the development of a special control system all the disadvantages of the induction-motor system are claimed to have been successfully overcome. The article describes in detail the control apparatus built for twenty 430-hp., three-phase induction-motor hoists. A centrifugal regulator prevents a runaway speed of the motor. For rope inspection as slow a speed as 5 in. (13 cm.) per second may be safely maintained by cutting additional resistance into the rotor. Regenerative braking may be used with greater than synchronous speed. Final setting and emergency braking is operated electro-pneumatically.—*Revue Générale de l'Electricité*, March 19, 1921.

Lamps and Lighting

Henri Pieron on the Physiological Principles Underlying the Study of Light.—LEONARD T. TROLAND.—A discussion of an article by Henri Pieron in which he is said to offer a very conclusive and well-ordered summary of modern determinations of the relations between visual sensation and conditions of retinal stimulation.—*Transactions of Illuminating Engineering Society*, April 30, 1921.

Generation, Transmission and Distribution

Graphic Method for the Calculation of High-Voltage Lines.—W. KOCH and W. MAURER.—The authors have developed a very simple and, up to about 200 miles (320 km.), surprisingly accurate graphic method for the determination of the voltage drop, efficiency and power factor of high-voltage lines. The principle of the method is the substitution of an imaginary line, with its capacity concentrated in the middle and half of its resistance and half of its inductance concentrated in each half of the line. A number of concrete examples are calculated with the aid of a great many graphs, and the same examples are also calculated mathematically to show up to which line length the two methods give the same results. Up to 200 miles the results are identical; up to about 500 miles (800 km.) the deviations from the exact values are negligible.—*Elektrotechnische Zeitschrift*, April 14, 1921.

The Economy of Impregnating Wooden Poles.—F. MOLL.—Of the four million wooden poles used annually in America, 90 per cent are white cedar and chestnut, which have, *untreated*, a useful life of about twelve years. In Germany and in most of Europe spruce and pine poles are used almost exclusively, with an untreated useful life of only five years. Impregnation is therefore of utmost importance. The author has investigated its economy and come to the following conclusions: (1) The increase of preserving chemicals improves the over-all economy but slightly, but their decrease causes rapid deterioration; (2) the yearly maintenance cost may be reduced to one-third by proper impregnation; (3) preserving chemicals recommended are: (a) 60 kg. of tar oil per cubic meter wood, (b) 3 kg. to 4 kg. of a mixture of fluor-natrium and phenol per cubic meter wood, applied under pressure, (c) impregnation with 0.66 per cent corrosive mercury (Kyan process), (d) impregnation with 0.66 per cent corrosive mercury and 1 per cent fluor-natrium (improved Kyan process).—*Elektrische Kraftbetriebe und Bahnen*, March 24, 1921.

Unusual Boiler-Tube Corrosion by Carbon Dioxide.—BARZILLAI G. WORTH.—A steam boiler corroded rapidly and resisted all attempts to protect it electrolytically. Finally the trouble was traced to soluble iron bicarbonate in the water used, which gave off large quantities of carbonic-acid gas when heated in the boiler. The water was then treated by being kept at the boiling point eight hours in a preheater, where the carbonic-acid gas was liberated and a sludge of ferric hydroxide precipitated. The trouble then ceased.—From paper presented before American Electrochemical Society, April 21, 1921.

Installations, Systems and Appliances

Electrically Heated Steam Boilers.—REVEL SYSTEM.—Steam is generated by passing the current through the water, using two, three or more axially arranged electrodes. The steam pressure is maintained constant automatically by raising or lowering the water level, thus immersing the electrodes more or less. To avoid electrolytic action alternating current is used. The steam generator discharges its steam into a steam accumulator. Tests on a boiler of 0.18 cu.m. water content consuming 200 kw. gave 1.256 kg. of steam per kilowatt-hour at a feed-water temperature of 10 deg. C. The evaporation efficiency was determined to 95.3 per cent, the thermal efficiency to 95.7 per cent. An average pressure of 6.42 atmospheres was maintained. The boilers can be used on voltages of 200 to 3,600.—*L'Industrie Electrique*, April 10, 1921.

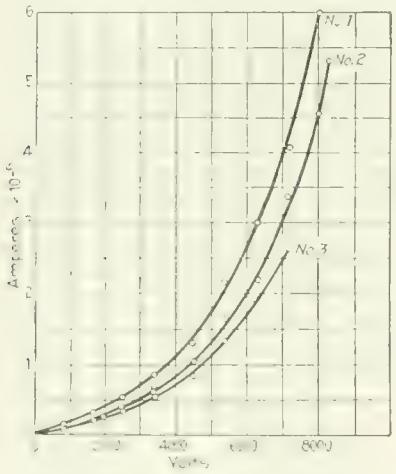
Magnetos for Ignition Purposes in Internal-Combustion Engines.—E. A. Watson.—The design of magnetos for ignition purposes is discussed and the trend of development indicated.—London *Electrician,* April 22, 1921.

Electrophysics and Magnetism

Piezo-Electric and Allied Phenomena in Rochelle Salt.—J. Valasek.—Some recent work on the piezo-electric and allied properties of Rochelle salt is described which has brought to light a number of peculiarities in the electrical reactions of this substance to applied forces and electric fields.—*Physical Review,* April, 1921.

Damped Electric Oscillations.—R. B. Abbott.—A summary of previous work on logarithmic and linear damping in electric circuits is given. The mathematical treatment of four types of oscillations is then carried out, namely, (1) simple harmonic, (2) logarithmically damped, (3) linearly damped, (4) combined logarithmically and linearly damped.—*Physical Review,* April, 1921.

Conductivity of Insulating Materials Near the Breakdown Voltage.—J. E. Shrader.—Insulating materials were found whose conductivity (1) obeys Ohm's law throughout, (2) obeys Ohm's law up to near breakdown and then increases at an accelerated rate, and (3) increases over the whole range of voltage at an accelerated rate to breakdown. In general, materials in class 3 have the greatest dielectric strength and those in class 1 the least. Results are given for untreated cement paper, paraffined fish paper and black treated cloth, which were selected as representative, respectively, of the three classes.—*Physical Review,* April, 1921.



CONDUCTIVITY CHARACTERISTIC OF TREATED BLACK CLOTH 0.011 IN. (0.28 MM.) THICK

The Electrical Properties of Glass.—J. R. Clarke.—A discussion of the insulation resistance, the dielectric constant or specific inductive capacity and the dielectric strength of glass. The qualities which should be characteristic of glass for various special purposes are outlined in the article.—*Beama* (British Electrical and Allied Manufacturers' Association) March, 1921.

Electrochemistry and Batteries

Recent Progress in High-Frequency Inductive Heating.—E. F. Northrup.—A description of the present status of high-frequency oscillating-current furnaces for experimental, laboratory and commercial work. Also of the high-frequency converter sets made for use with them. Furnaces of seven types are described in detail and the actual performances given, showing them to run at 30 to 40 per cent of electrothermal efficiency. The largest furnace described takes 60 kw. and can melt 600 lb. (275 kg.) of silver.—From paper presented before American Electrochemical Society, April 21, 1921.

Symposium on Corrosion of Metals and Alloys.—The various corrosion studies discussed are (1) corrosion of metal roofing—atmospheric corrosion, (2) corrosion of pipes, rods and wires embedded in moist soil, (3) corrosion of boiler tubes and hot-water pipes, (4) corrosion of metals submerged in sea water or acid liquors, and (5) corrosion of metallic anodes. The corrosion of buried lead cables is also discussed.—*Chemical and Metallurgical Engineering,* May 11, 1921.

Units, Measurements and Instruments

High-Voltage Fuse with Current-Limiting Resistance for the Protection of Instrument Transformers.—F. Patzelt.—In plants of high capacity ordinary fuses fail to protect safely instrument transformers, owing to the large surge of current into the faulty apparatus. For voltages up to 50 kv. it has been found that a fine-wire fuse will open safely if the energy is limited to about 1,500 kva. Siemens-Schuckert build such fuses, therefore, using a fine wire embedded in a fireproof powder and inclosed in a glass tube. It is in series with a current-limiting resistance consisting of a wire spiral, wound upon a porcelain cylinder and protected by a coat of enamel. Such fuses have been in successful operation for years in several large power plants.—*Elektrotechnische Zeitschrift,* April 7, 1921.

Telegraphy, Telephony and Signals

Wireless Rapid Telegraphy.—J. Brun.—To utilize to better capacity wireless stations, especially those in the tropics, where there are numerous disturbances during the day, the author recommends the use of automatic sending and receiving. The messages are first transcribed in perforations on a paper strip and are sent out at a speed of about 200 words per minute, which is ten times faster than by the ordinary key transmission. The reception is made by a photographic registering instrument, similar to an oscillograph, which develops, fixes, washes and dries the message within five minutes. Other apparatus suitable for rapid transmission are the Wheatstone, Creed and Baudot systems. With certain modifications all these may be operated by radio. The article gives a detailed description of the different methods and necessary modifications, including the construction of the perforating machines.—*Radio-Electricité,* March, 1921.

Small Ear Telephone.—L. Weber.—Primarily for the use of people who are hard of hearing, a radically new telephone construction has been put on the market by Siemens & Halske. The customary standard receiver, which is held to the ear by a steel strap, not only causes painful pressure upon the head but attracts unnecessary attention to the impediment of the bearer. This new telephone might be called rightly the smallest ever built. It measures only about an inch in length, and its open end is to be inserted into the ear, being held there by proper shaping of the end piece. Being of such small dimensions, it was not possible to use an iron membrane for the sound generator. A fine piece of specially treated skin with a tiny piece of iron fastened to its middle serves as a membrane. The voice reproduction is claimed to be excellent, and it is adjustable for maximum clearness; it is called "Phonophor."—*Elektrotechnische Zeitschrift,* March 10, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Appropriations Committee Approves Items in Aid of Exports

QUITE contrary to the usual practice, the committee on appropriations of the House of Representatives has acceded to the request of the Secretary of Commerce and allowed the full $250,000 requested principally to assist the twelve chief export industries of the United States, including heavy machinery and electrical goods. In addition the committee approved the full amounts which Secretary Hoover asked for the Bureau of Standards, as follows: Testing structural materials, $50,000; industrial research, including elimination of waste, $100,000; standardization of equipment, $100,000.

Patent Amendment Proposed

IN THE interest of the national defense and to prevent unwarranted advantages to foreign inventors, Senator Stanley of Kentucky has proposed an amendment to the Revised Statutes providing that any patents issued to foreigners must be put in operation and that production in reasonable quantities must be begun within the continental limits of the United States within two years. Failure to comply with that provision entitles the United States to issue a license which will permit use of the patent.

New England Division Convention Set for New London in Early September

THE New England Geographic Division of the National Electric Light Association will hold its fall convention at the Hotel Griswold, Eastern Point, New London, Conn., from Sept. 6 to 9. Business sessions will begin on the morning of Sept. 7.

New England Power Company to Build Million-Dollar Hydro-Electric Plant

HENRY I. HARRIMAN, president of the New England Power Company, Boston, has announced to the Massachusetts Department of Public Utilities that it is the company's intention to begin preliminary work this year upon a new hydro-electric development in the Deerfield River valley of southern Vermont which will produce from 24,000,000 kw.-hr. to 25,000,000 kw.-hr. annually. This will be chiefly primary power, the plant being built below the Somerset Reservoir near Searsburg. Water will be diverted by a dam, and a 21,000-ft. wooden-stave pipe line will serve the station, where a 4,500-kw. installation operating under 245-ft. head will be made. Transmission lines operated at 66,000 volts will be built from the new plant to the Vernon and No. 5 stations of the company. Later the company plans to build a storage reservoir of 4,000,000,000 cu.ft. capacity above Davis Bridge, which is south of the proposed Searsburg plant location, and this will add 80,000,000 kw.-hr. yearly to the system generating capacity. The estimated cost of the Searsburg development is $1,137,000, and that of the associated transmission line and high-tension construction is $277,021.

Ground Broken for Niagara Hydraulic Power Canal

WORK on the new fifteen-million-dollar power project of the Niagara Falls Power Company at Niagara Falls, N. Y., was started recently when Paul A. Schoellkopf, president of the company, turned the first spade of earth for the hydraulic power canal. Among those who witnessed the ceremony were Lieut.-Col. William Kelley, engineer of the Federal Power Commission, and Col. James G. Warren, engineer in charge of the Great Lakes division. Building of the tunnel is only part of the project. When the improvements are complete the Niagara Falls Power Company will generate 450,000 electrical horsepower under one roof.

California Electrical Rates Reduced by Another 4 per Cent

DECISIONS in the surcharge cases of the Pacific Gas & Electric Company and the Great Western Power Company announced by the California Railroad Commission on May 27 make a further reduction of 4 per cent in the electric rates of both companies in addition to the 5 per cent reduction already provided in the temporary order of April 10. This total reduction of 9 per cent leaves in effect only 6 per cent of the original 15 per cent surcharge. The decision is retroactive to April 10, the date when the original surcharge expired and the temporary reduction to 10 per cent was made. That 10 per cent was then ordered impounded and 4 per cent of it will now be returned to consumers.

The decision, written by Commissioner Chester H. Rowell, points out that the electric rates now provided are only 22 per cent in excess of those in the same territory in 1916, though oil prices have in the meantime risen 150 per cent and the costs of other commodities used in the operations of the companies are in general 50 per cent above pre-war prices. Commissioner Rowell points out that these companies were held down strictly to the fair return basis even during the period when other industries were generally making greatly increased profits, and they should therefore not be pressed below that level at this time. A careful analysis of the estimated revenues and expenses of the companies shows that a complete removal of the surcharge would deprive the companies of a fair return, but that with efficient management they can make such a return with

a 6 per cent surtax. Proceedings are now pending for a complete valuation of the properties and business of both companies and a determination of more permanent rates based on that valuation. The old rate plus the reduced surcharge will apply until the determination of the main cases.

The Pacific Gas & Electric Company's statement of operating expenses for 1920 showed an actual net revenue of $9,181,860 available for return and depreciation. Had the 15 per cent surcharge been retained during 1921 the net revenue would have been $10,328,353. The new order shows that the commission estimates that the basic rates of the company plus the 6 per cent surcharge will produce a gross revenue of $23,028,000 and a net of $9,979,190, of which $1,594,055 is for depreciation.

Farm Bureau Urges Completion of Muscle Shoals Dam

AN INVESTIGATION of the whole Muscle Shoals project has been made by a special committee of the American Farm Bureau Federation, and its recommendation that the Wilson Dam at Muscle Shoals be completed by the government without continued delay and that the air-fixation nitrate plants be placed under the direction of a governmentally owned corporation which may in its discretion operate the plants or maintain them ready for operation, but with strict regulations relative to prices to be obtained for commodities in which the products of these plants are used, has been approved unanimously by the executive committee.

Representative Graham, who is against the Muscle Shoals project, has introduced a bill authorizing the Secretary of War to lease the dam and nitrate plant No. 2 for a period not to exceed twenty years to any co-operative agricultural association or corporation. The lease is to include the steam power plant and may be extended so as to empower the lessee to complete the dam.

The Chief of Engineers has been instructed by the Secretary of War to ascertain if any power companies would be interested in entering into a contract with the government to take over power which would be generated at Muscle Shoals in case the dam were completed.

Activities for Engineers Indorsed by A. A. E.

MEMBERS of the American Association of Engineers went on record at the annual meeting at Buffalo, N. Y., recently, as indorsing the following stands in matters affecting the activities of engineers: Favoring an engineer on the International Boundary Commission; favoring a national board of classification for engineering schools; against laws permitting corporations to practice as engineers; favoring a census of highway traffic; favoring a continuance of federal aid to highways; favoring Phipps bill increasing federal aid allotment in public land states; favoring national financing of reclamation work; favoring sanitary engineers on public boards of health; favoring a minimum of two weeks' notice by both parties in case of separations in employment, and providing for a committee to plan employment service and payment therefor.

It was directed that advance copies of annual convention reports be prepared. The officers elected for the ensuing year were: President, H. O. Garmon, chief engineer and consulting engineer with the Indiana Public Utilities Commission; first vice-president, A. N. Johnson, dean of engineering at Maryland State College; second vice-president, A. S. Morris, auditor, capital expenditures, Chicago & Northwestern Railroad; directors, E. F. Ayres, Webster L. Benham, Garrison Babcock, Morris Bien, G. M. Butler and W. R. McKeen.

Dr. George Otis Smith Urges Ample Coal Reserves for Utilities

"CLEARLY the public utility operator has everything to gain and nothing to lose by continuing to maintain his reserves. It is increasingly plain that the condition of consumers' stocks has a very profound bearing on the coal market. When a man has a large stock he can wait for favorable terms. When his stock is small he has to buy. If something happens to interrupt the orderly flow of coal from mine to place of use he has to buy emergency coal. Now, when stocks are generally low a sudden interruption to supply—a blizzard, a switchmen's strike, a traffic jam—finds many consumers unprepared and drives them to enter the spot market. That is the time when a well-stocked coal bin pays for itself. That plant is equipped to withstand a siege."

In these words Dr. George Otis Smith of the United States Geological Survey, replying to a request from John W. Lieb, vice-president of the New York Edison Company for an expression of opinion as to whether public utility companies should conclude contracts for coal at present, expresses his views on the importance of such companies keeping their bins stocked. To Mr. Lieb's question as it stands Dr. Smith does not return a categorical answer, but as bearing directly on the subject he gives statistical data from the Geological Survey's weekly coal report concerning the stocks of coal carried by electrical utility plants on April 1. These data show that the public utilities were then in probably the strongest position of all coal consumers.

Expressing the view that a coal stock above ground of from 30,000,000 tons to 40,000,000 tons constitutes the "critical level" above which there is a buyers' and below which there is a sellers' market, Dr. Smith proceeds:

"Now, what is the present level of stocks? The Geological Survey's inventory showed that on Jan. 1, 1921, it was not more than 48,000,000 tons and not less than 42,000,000 tons—say about 45,000,000 tons. By April 1 stocks had dropped to somewhere near 37,000,000 tons, and since then they have doubtless decreased further. In other words, while we can tell from the tone of the market that the critical level has not yet been touched, it is plain that stocks are fast approaching it, and that it would be unwise from the consumers' point of view to let them sink much lower."

Danger of a congestion of coal transportation under heavy peak loads occasioned by a revival of business is not a thing of the past and forms another argument for abundant storage. "With adequate stocks," Dr. Smith concludes, "the public utility is and will be in a strong position to buy, whatever the level of costs and whatever the market position of other consumers. The public utility cannot shut down, and the public must pay for the coal the public utility buys; hence from the public standpoint the double function of large stocks—to keep up service and to keep down prices."

Mechanical Engineers Discuss Middle West Power Development

ENGINEERS can accomplish more by concentrating on the power problem in their own locality than by devoting time to the general problem of super-power projects. This was the opinion expressed by Samuel Insull as chairman of the power session at the convention of the American Society of Mechanical Engineers in Chicago on Thursday, May 26. Much of the criticism and hostility to the development of huge power systems has been due, the speaker held, to the lack of understanding of the fundamental economic foundation on which electric power generation and distribution is built and to the feeling that such systems are only another type of big business combinations. The prejudices of the mechanical engineer, due to pride in his own work of plant construction and in some measure to pure personal interest, were said by Mr. Insull to be hindrances that have retarded development of larger systems. It took the war movement in Great Britain, which based its reasons for combining power sources and systems on American figures and practices, to convince Washington that concentration is necessary. The location of steam plants at the mine mouth was questioned as an economic measure because of the danger in tying up to a single fuel source subject to complete domination by labor organizations and because of the lack of adequate and proper water supplies at such locations. Mr. Insull stated that there are only two or three such locations having water available in the State of Illinois.

W. L. Abbott outlined the location of the principal central power distribution sources in the Middle West, calling attention to the comparatively small amount of high-tension transmission between Pittsburgh and the territory lying east of the Missouri River. The high-tension transmission, except around Pittsburgh, is principally in the southern peninsula of Michigan, around Minneapolis and St. Paul in both Minnesota and Wisconsin, in southern Wisconsin and between Keokuk and St. Louis, with a small amount in Ohio. The largest part of the territory, Mr. Abbott said, has warranted only the lower range of transmission voltages, but in time these systems will merge into large systems that will cover entire states and become interstate in character.

C. W. Place in discussing future power development in the Middle West showed that the fact that only 15 per cent of the oil production of the United States was from that section precluded the possibility of oil cutting a large figure in power production there. With coal as a fuel steam-electric generating plants will form the main source of power.

Serious consideration of the progressive development of streams on a low-head basis, with automatically controlled plants, to make the best possible use of hydro-electric power to supplement steam generation was proposed. Hydro-electric power was indicated as largely a peak-load resource because of the limitations imposed on storage by the cost of overflow lands on the river bottoms.

In the discussion the utilization of coal to obtain its by-products before its use in producing steam was suggested for serious study. Mr. Insull closed the discussion by showing that interconnection in the Middle West is proceeding along economic lines. The necessary lines are being constructed as there is real reason for them. On such a foundation alone can interconnection be a success. Mr. Insull also asserted that no one should be allowed to produce energy when it could be purchased more cheaply and that in place of depriving commissions of the power to regulate they should receive more drastic powers in order to prevent economic blunders.

On Tuesday a session devoted to fuel discussed the capacity, efficiency and limitations of mechanical stokers in the utilization of Middle West coals. H. B. Reynolds discussed efficiency tests of a 30,000-kw. steam turbine at the Fifty-ninth Street power station of the Interborough Rapid Transit Company in New York. On Wednesday W. M. White of the Allis-Chalmers Company presented a full discussion of the hydraucone regainer and its development.

Testimonial Dinner to J. M. Wakeman

A DINNER in honor of James M. Wakeman, the retiring general manager of the Society for Electrical Development, was given on the evening of May 26 at the McAlpin Hotel, New York, by present and former members of the staff. Formalities were barred, but, led by Harry Alexander, former director of publicity for the society, those present united in expressing their sense of the value of the experience gained under Mr. Wakeman's leadership, which had been a source of inspiration to them, and in extending to him their heartfelt good wishes. It was felt that, though he has severed his active connection with the society, he will always remain a potent factor in its work and that the ideals he set in the formative period of the society constitute a solid foundation upon which the organization can rest and expand.

At the conclusion of the dinner Theodore Dwight, on behalf of the staff, presented to Mr. Wakeman a loving cup inscribed: "To 'J. M.'—An Appreciation from Associates in the S. E. D."

Federal Power Commission Approves Amended Regulations

THE Federal Power Commission, meeting in special session May 27, approved the amendments to the regulations promulgated for the administration of the water-power act, with the exception of the proposed multiple in the specified rate of return and the regulation dealing with the allocation of earnings. The commission affirmed the multiple 1.5 and approved a revised form of the existing regulation on allocation which allows permittees or licensees to propose a basis of allocation before the issuance of a permit of license but subjects such a basis to review at not less than five-year intervals.

The commission also gave approval to an additional paragraph to Regulation 20, which requires licensees to file copies with the Federal Power Commission of annual reports made to the state commissions or to their stockholders.

The application of the Arkansas Hydro-Electric Company was denied because the Chief of Engineers reported that the Little Red River is navigable at and above the site at which it is proposed to build the dam. Another reason for denial of the application was that public lands are involved.

North Central Geographic Division Arranges Its June Program

THE general relations between telephone and electric companies in the matter of construction and operation of lines will be discussed during the annual convention of the North Central Geographic Division of the N. E. L. A., to be held June 21, 22 and 23 at Duluth, Minn. Addresses on the subject will be given on June 22 by A. A. Gantt, chief engineer of the Northwestern Bell Telephone Company, Omaha, Neb., and by a representative of the Tristate Telephone & Telegraph Company of St. Paul.

At the business sessions on June 23 F. R. Winders of the Railroad Commission of Wisconsin will read a paper on "Rural Electric Lines," and W. T. Delihant, Jr., fuel agent of H. M. Byllesby & Company, Chicago, will address the convention on the subject of "The Fuel Situation." A paper on "Coal Economy in Small Steam Plants," by J. J. Brennan, engineer of tests for the Northern States Power Company, Minneapolis, will follow. There will also be addresses by officers of the National Electric Light Association. A large number of entertainment features have their place on the program.

Southwestern Men Discuss Power Factor and Electrical Merchandising

THE poor power factor of customers' loads was characterized as the fault of the central station by E. B. Speer of Dallas in a paper on "Power-Factor Meters and Measurements" presented before the Southwestern Electrical and Gas Association, which met at Galveston, Tex., May 18-21. Mr. Speer called attention to the importance of seeing that customers buy motors of the size actually needed rather than for future developments. He favored applying charges for power factor to the energy portion rather than the maximum-demand portion of the rate. In the discussion that followed considerable preference for measuring the power factor of a customer's load by two single-phase wattmeters was expressed.

That the central station that does not carry on a merchandise business is going backward was the opinion expressed by K. E. Mason of Terrell, Tex., in discussing the subject of electrical merchandising. With attractive salesrooms and a carefully worked-out sales policy such merchandising was believed by Mr. Mason to be a business builder for the central station. Vance Porter of Bay City, Tex., advocated the use of electrical merchandising as a means of raising the kilowatt-hour revenue of the average consumer, citing the success of the Texas Public Service Company in raising residence lighting revenues from $2 per month to $4 and $5 by the sale and use of electrical appliances. J. C. Kennedy of the American Public Service Company, Dallas, told of the possibilities of keeping appliances in service by following up consumers and ascertaining whether appliances owned were in proper repair.

Ex-chairman Busby of the Missouri Public Service Commission declared that the causes for public hostility to the utilities are past. Criticism of state utility commissions had been largely caused by the courage of commissions in adjusting rates upward under war conditions.

Judge M. H. Gossett, president of the federal land bank, Houston, in discussing the utility problem from a banker's viewpoint, asserted that the pecuniary interest of voters in the settlement makes any determination of utility matters by popular vote a travesty. The consumer has grown to accept service as a matter of course and must be educated to understand what is involved in labor costs and financial expenditure. The speaker favored the establishment of a commission for Texas. The establishment of such a commission was also advocated by W. B. Head, vice-president of the Texas Power & Light Company, who favored a form of joint control of utilities by the municipalities and a state board.

Officers for the coming year were elected as follows: President, C. E. Calder; first vice-president, Alba H. Warren; second vice-president, S. R. Bertron, Jr.; third vice-president, John W. Carpenter.

Illinois Utility Bill Passes House

THE utilities bill now before the Illinois Legislature passed the House last week by a vote of 100 to 23. It had been expected that the measure would be beaten in the House, but it was jammed through as an administration measure. The bill, which has been heralded as carrying out Governor Small's pledge to abolish the present utilities commission, was outlined briefly on page 1123 of the May 14 issue of the ELECTRICAL WORLD. Although it reduces the salaries of the individual commissioners, it increases their number and adds assistants until the total salary list is about doubled. A hot fight against the bill is looked for in the Senate, and a public hearing before committee is expected to be granted by that body.

Western Society of Engineers Protests Against Illinois Commission Bill

PROTEST has been made to the Governor and the General Assembly of Illinois by the Western Society of Engineers against the pending bill changing the organization and functions of the Public Utilities Commission of the state. The board of direction of this society asserts its belief that the proposed act would be a very harmful piece of legislation. It would result, the board holds, in endless confusion, including conflicting jurisdictions and, in some cases, no regulation at all. It would abolish all safeguards over civil service and give the commissioners much less to do, while at the same time more than doubling the total salaries of the commission. An analysis of the bill made by the public affairs committee of the society concludes:

"It is misleading in its provisions. It is a return to the unsatisfactory former utility regulation, or lack of regulation, and practice. It places in the hands of the administration a large appointive power without civil service restrictions. The change in name would permit the wholesale discharge of the present technical staff of the commission, under the guise of abolishing the office, and the substitution therefor of untrained, inexperienced employees for political purposes. It would disrupt any standard of service or rate and would render of little value the investments of thousands of citizens in the present utility corporations. In place of safeguarding these investments and increasing the state-wide regulation, it would permit it to disintegrate into uneven and chaotic conditions. The pretense of abolishing the utility commission is not borne out by the proposed law."

Safety Men Find that Electrical Hazards Are Reduced by Proper Design

ELECTRICAL hazards in generating stations and substations will be greatly reduced by proper consideration of safety features at the time the equipment layout is made, according to M. M. Samuels of the J. G. White Engineering Corporation, speaking at the May 27 meeting of the American Society of Safety Engineers in New York, at which electrical hazards were discussed. The plentiful use of signal lamps at each piece of apparatus to indicate whether the equipment is alive or dead was recommended by Mr. Samuels. Furthermore, he believed that hook-type disconnecting switches should be eliminated and mechanically operated switches used. It has also been found advisable to have push-button switches, in series with the control circuit, mounted on oil switches so that a repairman working on an oil switch can open the control circuit.

C. O. von Dannenberg, also of the J. G. White Company, pointed out that on distribution lines plenty of climbing space should be allowed, back arms should be placed to allow clear working spaces and pole steps should be used on all poles where climbing is frequently necessary. In discussing transmission lines he stated that lines should be positively grounded with some form of clamp and by the use of flexible leads rather than with the old chain method. Here also the use of hook-type disconnecting switches was discouraged.

Motor applications are rapidly developing along lines that reduce electrical hazard to the operator, stated L. E. Smith of the General Electric Company.

Chicago's Licensing Ordinance Is Redrafted

A NUMBER of changes have been incorporated in the latest draft of the proposed municipal ordinance to license and regulate the sale and installation of electrical appliances in Chicago, which was noted some time ago in the ELECTRICAL WORLD. The changes were made in response to requests of various electrical interests in the city, but the opposition aroused by the original draft of the ordinance has not entirely died down. A hearing before a joint sub-committee of the committee on gas, oil and electricity and the committee on revenue was arranged for June 2, at which the city and the electrical interests were to endeavor to come to an agreement.

Among the most vital of the changes made is one which specifies that the Commissioner of Gas and Electricity will accept the tests of certain recognized testing bodies as to the safety of any appliance. In the first draft this matter was left entirely to the discretion of the commissioner. The new ordinance also limits licensing and regulation to retail business, whereas the original one could have been construed to control any local business house engaged in selling electrical appliances. The license fee has been increased from a flat fee of $50 to one of $50 where fewer than six clerks are employed and $5 for each clerk above that number. The preliminary testing fee has been cut from $5 to $1, but the person or company applying for test will still pay all expenses of having the test made. The new draft also provides for a fine of 20 per cent of the amount realized by the sale of any appliance which on account of changes in construction should have been resubmitted to the commissioner for test. That section of the first draft providing for re-examination once a year of all appliances has been stricken out.

Electric Light and Power Company Issues for May Break All Records

SINCE the beginning of the year there has been a decidedly marked general upward trend in the amount of financing of electric light and power utilities. May, 1921, has been, however, the banner month and has set a new record with its flotation of $55,375,475. This unprecedented total almost doubles that of last month as well as that of a year ago. It exceeds the total for January, 1921, which was also a record month, by $14,791,475, and makes the issue of October, 1920, $38,295,300—the highest of last year—seem small in comparison.

The average yield, 7.71, is slightly less than that of last month. Long terms and large single issues predominate, the periods ranging from not less than five to as long as thirty years. The largest single flotation is that of the Duquesne Light Company, which offers $10,000,000 in fifteen-year convertible gold debentures at 98.5, to yield 7.85.

Name of Company	Amount of Issue	Period	Class of Security	Purpose of Issue	Rate of Interest	Per Cent Yield	Offered at
Connecticut Light & Power Co.	$6,500,000	30-year	First and refunding mortgage sinking fund gold bonds, series A	Retire floating debt—future construction	7	7.40	95
Milwaukee Electric Railway & Light Co.	5,000,000	20-year	Refunding and first mortgage gold bonds, series A	Reduction of floating debt	7.5	8	95
American Power & Light Co.	3,500,000	20-year	Secured gold bonds	Refunding	8	8.15	98.5
Portland Railway, Light & Power Co.	4,500,000	25-year	First lien and refunding mortgage gold bonds, series A	Acquisition of property—current working capital	7.5	7.85	96
Duquesne Light Co. (Pittsburgh)	10,000,000	15-year	Convertible gold debentures	Acquisition and extension of properties	7.5	7.65	98.5
Niagara Falls Power Co.	6,000,000	30-year	First and consolidation mortgage gold bonds, series A A	Refunding and new construction	6	7	88
San Diego Consolidated Gas & Electric Co.	2,750,000	18 year	First and refunding mortgage gold bonds	Future construction	6	7.30	87
Durham (N. C.) Public Service Co.	500,000	15-year	General mortgage sinking fund gold bonds series A		8	8.25	98
Little Falls Water Power Co.	157,000	12-year	First refunding mortgage serial gold bonds of 1916	Refunding	6	7.75	90
Cumberland County Power & Light Co.	600,000	5-year	Collateral trust bonds	Retirement of outstanding notes	8	8	Par
Kansas City Power & Light Co.	6,000,000		First preferred stock		8	8	Par
Philadelphia Electric Co	5,000,000		Cumulative preferred stock	Reduction of floating debt	8	8	Par
Monongahela Power & Railway Co.	4,580,275		Cumulative convertible preferred stock		6	7.90	19 (par 25)
Washington-Idaho Water, Light & Power Co.	200,000	5-year	First mortgage gold notes		8	8	Par
American Public Service Co.	88,200		Preferred stock		7	8	87.50
Total	$55,375,475						

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

One Central Station to Serve a Whole Province.—If a bill now before the local Legislature becomes law all of Prince Edward Island, the smallest of the Canadian provinces, will receive electric service from one central plant to be owned by the Prince Edward Island Light, Heat & Power Company, which seeks incorporation with a capital of $2,000,000. Prince Edward Island has a population less than 100,000 and an area of 2,184 square miles. It is now served by three small electric light and power companies.

Summer Engineering Course at University of Illinois.—A large registration is indicated for the intensive short course to be given from June 13 to June 18 by the department of electrical engineering of the University of Illinois at Urbana, co-operating with the Illinois State Electrical Association. This course will be attended largely by employees of various public utility companies of the state, and in addition to the university faculty meter experts from some of the larger utility companies will be present to give lectures and demonstrations to the summer students in attendance.

Engineering Students in Germany.—According to the London journal *Engineering*, the technical high schools of Germany are overcrowded, the aggregate number of students for the winter term of 1920-21 having been 19,891, as compared with 12,200 before the war and about 5,000 thirty years ago. Electrotechnical students number 3,229, against 1,300 at the beginning of the war, civil engineering students 3,111 as against 2,767, mechanical engineers 6,540 as against 3,100. Mining engineers have shown a comparatively small increase. The largest attendance at any one school was credited to the Charlottenburg institution—3,209.

Thirtieth Anniversary of Kansas School of Engineering.—The thirtieth anniversary of the organization of the School of Engineering at the University of Kansas was recently celebrated by a "conference on engineering activities in Kansas" by visiting engineers and an elaborate "Engineers' Day" program by the students. The conference turned largely into discussion of electrically driven trucks and highway maintenance. This school was built up under the direction of the late Dean F. O. Marvin. It has graduated almost a thousand students. At present the enrollment is 635 in the departments of civil, electrical, mechanical, mining, chemical and architectural engineering.

Electrical League of Cleveland Compiles Directory.—A directory containing the names of 773 companies in the Cleveland district engaged in manufacturing has been compiled by the Electrical League of Cleveland. The directory contains the following information: Main office address, location of factory, office telephone number, names of factory executives and articles manufactured by each of the companies listed.

Construction Begins on Arkansas Power Plant.—Under present conditions electric power will be available from the first plant of the Arkansas Hydro-Electric Development Company, on the Little Red River near Judsonia, before the first of the new year. The first dam, now under course of construction, will, a dispatch to the *Manufacturers' Record* says, cost approximately $1,500,000. It will be 80 ft. high, 450 ft. long, with a thickness of 58 ft. at the base tapered to 8 ft. at the top. It will create a lake with sufficient power to develop 15,000 kw. an hour. Ultimately it is planned to erect other dams and establish plants on streams available for the purpose throughout the state.

Hydro-Electricity in Norway.—In Norway, which has always had prominent rank among European nations utilizing water power, many new power stations have been built in the last few years, writes a European correspondent of the ELECTRICAL WORLD. The production of nitrogen alone requires 400,000 hp. In 1920 the paper mills used ten times more water than steam power. In 1922 the electrification of the most important railway of the country, the Christiania-Drammen line, will be completed. In the neighborhood of Christiania alone the following hydraulic power stations are under construction: Tunhövel, 75,000 hp.; Mörkfossen, 15,000 hp.; Hakovik, 15,000 hp., and Nore Falls, 100,000 hp.

Financial Statement of Ontario Hydro-Electric Power System.—According to a financial statement just prepared, the Niagara system of Ontario hydro-power municipalities has accumulated reserves amounting to $13,874,799, which is less than a million dollars short of the $14,745,499 total advanced by the Ontario government to the municipalities in order to carry through the project. In the statement of assets and liabilities it is shown that the commission's own plant is valued at $14,745,499, municipal plant systems and others are valued at $30,766,611, and the Ontario Power Company's plant and other assets at $28,306,583—a total of $73,826,694. Liabilities are: Advances by the Ontario government to municipalities, $14,745,499; municipalities' debenture debt and other liabilities in respect to local systems, $18,640,645; Ontario Power Company's debentures, $26,567,750—a total of $59,953,895. Reserves are thus apportioned: Sinking fund, plant renewal and other reserves, $11,075,476; surplus, $2,799,323; total, $13,784,799.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

American Society for Testing Materials.—This society will convene at Asbury Park, N. J., on Monday to Friday, June 20-24.

New York Electrical Society.—The annual meeting of this society for the election of officers was held last night (June 3), when these nominations were made by the nominating committee: For president, C. G. Young; for vice-presidents, F. B. Colt, Ernst Woltmann, O. A. Kenyon; for secretary, George H. Guy; for treasurer, T. F. Honahan.

June Meetings of N. E. L. A. Divisions.—Following the national convention at Chicago, four geographic divisions of the National Electric Light Association are scheduled to hold their annual conventions in June—the Pacific Coast Division at Del Monte, Cal., on June 7-9; the North Central Division at Duluth, Minn., on June 14-16; the Northwest Division at Portland, Ore., on June 15-18, and the Canadian Electrical Association at Quebec on June 15-17. The Iowa Section will meet at Lake Okoboji, Iowa, on June 22-24. Thus, with the annual convention of the A. I. E. E. at Salt Lake City and the A. M. E. S. at New London, Conn., June will be a busy month in electrical circles.

Coming Meetings of Electrical and Other Technical Societies

N. E. L. A., Pacific Coast Division—Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

N. E. L. A., North Central Division—Duluth, Minn., June 14-16.

National Fire Protection Association—San Francisco, June 14-16.

N. E. L. A., Northwest Division—Portland, Ore., June 15-18. (For program see issue of May 21, page 1180.)

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17. (For program see issue of May 28, page 1265.)

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

American Society for Testing Materials—Asbury Park, N. J., June 20-24.

A. I. E. E. Annual Convention—Salt Lake City, June 20-23. (For program see issue of April 30, page 1009.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Ohio Electric Light Association—Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Implied Obligations of Public Service Corporations.—When a public service corporation obtains the privilege of occupying and using the streets for a particular public service beneficial to the people of the city, and there is no express contract defining its duties and obligations, the Court of Appeals of Kentucky has recently declared, in Humphreys vs. Central Kentucky Natural Gas Company, the law will raise an implied and enforceable contract to take the place of the omitted express contract, and impose on the company the obligation to render the service that was reasonably within the contemplation of the parties when the contract was made. (229 S. W. 117.)*

Duty of Public Utility Company to Trespassing Child. — A verdict for the defendant company was, the Supreme Judicial Court of Massachusetts has determined, rightly ordered in Adamowicz vs. Newburyport Gas & Electric Company, where the father of a child who died from burns caused by the dumping of hot ashes upon his bare feet in a lot owned by the company sued for damages. The child, as the plaintiff's counsel admitted, was a trespasser, and the court held that there was no evidence of the "gross and wanton negligence" that in such a case would alone permit recovery, inasmuch as it had not been proved that the driver of the truck from which the ashes were dumped had willfully injured the child or had realized that he would not keep out of the way. (130 N. E. 388.)

Liability of Company for Death by Drowning Due to Opening of Its Dam Gates.—In Prondecka vs. Turners Falls Power & Electric Company damages were accorded in the trial court to relatives of two boys who were drowned because of the opening of the gates of a dam owned by the company while the boys were fishing or bathing in the Connecticut River just below the dam. The Supreme Judicial Court of Massachusetts has sustained exceptions filed by the defendant to the charge of the judge in the lower court, holding that he should have directed a verdict in the company's favor on the charge of "wanton and reckless" conduct and that, upon the counts as submitted, the plaintiffs could not recover except upon proof of such neglect as would entitle a trespasser, or at best a licensee, to prevail. (130 N. E. 386.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Remedies Before Public Service Commission Must Be Exhausted Prior to Appeal to Courts.—In vacating an injunction granted by a Supreme Court justice to the city of New York in an action to prevent the New York Edison Company and the United Light & Power Company from increasing their rates in accordance with an adjustment based on the price of coal, the Appellate Division held that the city was without right to bring action in the courts until it had exhausted its remedies before the Public Service Commission. The municipality, the decision held, though it had no interest as a consumer, the schedules complained of not being applicable to it, had the undoubted right to be the complainant in the general interest of the public. However, the plaintiff had an adequate remedy at law expressly provided for it of which it had not availed itself. "There is no reason to suppose," the Appellate Division remarked, "nor is any suggested, that the Public Service Commission would not do its duty when called upon according to law. It is not the province of the court to interfere with the regulatory and administrative work of the Public Service Commission. The court should only act when the commission itself has acted or omitted to act contrary to law." (See ELECTRICAL WORLD for May 7, 1921, page 1063.)

Refusal of Service Where Amount Due Is in Dispute.—In Carpenter Steel Company vs. Metropolitan Edison Company the defendant had threatened discontinuance of service because of plaintiff's refusal to pay the bills rendered unless the supply company continued to furnish bonds to refund any surplus payment which might be found to have been made when rates in dispute and superseding prior contract should finally come to be fixed by the Pennsylvania Public Service Commission. The powers of the commission in the matter were not questioned, but only the equity of the situation as between the parties to the suit. The United States Court for the Eastern District of Pennsylvania condemned the defendant for refusing to submit the justness of its claim to judicial decision and resorting instead to a "strong-hand extrajudicial remedy" which, the plaintiff claimed, abrogated an agreement not to shut off power. The court found no merit in the contention that the published rules and regulations nullified this agreement. "The amount of the debt could have been determined," it said, "by a simple expedient in this very proceeding. All that was necessary was that the defendant file an answer by way of a cross-bill, averring what the sum due was and praying for this to be decreed. As the sum due would thus be found, the court would not restrain the defendant from the collection of a debt thus found to be due and payable. The same finding of what was due could be made in an action brought in any court having jurisdiction." A decision in accordance with this opinion was rendered. (270 Fed. 255.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Extension of Service to Unprofitable Locality. — The Pennsylvania Public Service Commission has refused to order extension of service into sparsely settled localities where such extension would produce a return so low as to unduly burden other consumers.

Utilities Entitled to Fair Return Even in Periods of Depression.—In granting higher rates to the Illinois Bell Telephone Company the Public Service Commission of Indiana made the following interesting pronouncement on the right of a public utility to earn a fair rate of return in bad times as well as good: "Although the commission hesitates to increase rates at a time when business generally is depressed and prices show a tendency to decrease, it cannot deny an increase in rates to a utility which has not earned a reasonable return in recent years; which furnished service throughout the war period at less than cost, while unregulated private corporations were making large profits; whose reasonable requirements for an estimated year are $215,660 in excess of its estimated revenues under present rates, and which is efficiently and economically managed, since the utility must continue to give service, extend its lines and improve its equipment, and the only source of revenue and credit is from the subscribers and patrons who pay the rates. It is contended that in times of business depression a public utility should be required to forego its profits and take its losses like any private corporation. This might be all right if during hard times a public utility were permitted to close its doors and suspend operation until business conditions became promising. It might be still more logical if a utility were permitted during boom times to enjoy large earnings and pay out its profits in dividends. Regardless of the state of business generally, a utility must continue to operate at maximum speed. It must continue to give service, for its service has become one of the necessaries of life. It must constantly extend its lines and add to and improve its equipment in order to keep up with the growth of its community and the developments of the art. The public demands these things. Their cost is great and will probably never again be at the pre-war level. As time passes and improvements are developed the service demands become more complex and insistent. There is but one source of revenue and credit, and that is from the subscriber and patrons who pay the rates."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Harrison Williams, who has been a director of the North American Company since June, 1920, has been elected chairman of the board as well as of the executive committee. As chairman of the board he is acting president of the company.

Harley W. Brundige of the California State Railroad Commission has been elected its president, succeeding Frank R. Devlin, former president, who resigned on May 1. Mr. Brundige has been a member of the commission since January, 1919, when he was appointed for a term of six years. He was formerly an assistant to the publisher of the Los Angeles *Daily Express.*

Alex Dow, president of the Detroit Edison Company, has accepted an appointment to the board of directors of the Detroit United Railway, where he will bring his experience and administrative ability to bear in an effort to straighten out long-standing complications affecting the local street-railway service. Mr. Dow has long been recognized as a leader in the electric light and power industry. He has been president of the Detroit Edison Company since 1913.

Dr. A. E. Kennelly, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology, will sail next Thursday, June 9, on the steamship France to take up his work as exchange professor in French universities. His selection for this important duty was announced in the ELECTRICAL WORLD for May 14, page 1125. Dr. Kennelly has obtained a year's leave of absence from Harvard and the Institute of Technology, which he will spend in France. He will attend the meetings of the International Electrotechnical Commission to be held in Paris this month.

Raymond D. Sherman has been appointed assistant electrical engineer for the Philadelphia Electric Company, with headquarters in Pittsburgh. Mr. Sherman is a graduate of Union University and completed a two years' apprentice course of testing and construction with the General Electric Company. He then secured a position with the Schenectady Power Company and worked up to be chief operator. This company is now the Adirondack Light & Power Company, Schaghticoke, N. Y. Later he was advanced to be electrical superintendent of that company, which position he left to become superintendent of the Deerfield River Power Company, Readsboro, Vt. One year later he was made superintendent of the Connecticut River Power Company at Vernon, Vt.

David Sarnoff, commercial manager of the Radio Corporation of America since its organization, has been appointed general manager. Mr. Sarnoff will supervise and control the operation of the corporation's plant and the conduct of its business subject to the direction and approval of the board of directors, the executive committee or the chairman of the board, through the president. In general he will have charge of the corporation's high-power, low-power and ship stations and their operation, as well as be responsible for their upkeep and the maintenance of



DAVID SARNOFF

their service. He will also be charged with the corporation's transoceanic communication system, the selling and rental of apparatus and the solicitation and negotiation of contracts. Mr. Sarnoff is now rounding out fifteen years of service with the Radio Corporation and its predecessor, the Marconi Wireless Telegraph Company of America, covering virtually every branch of the radio communication art.

F. B. Lewis was appointed assistant manager of operations for the Southern California Edison Company at the time of the reorganization recently, when the old organization of two operating divisions was abolished and the entire operation placed under the supervision of B. F. Pearson, manager of operations. Mr. Lewis was graduated from the Rose Polytechnic Institute at Terre Haute Ind., with the 1905 class of electrical engineering. Immediately thereafter he became employed by the Southern California Edison Company in the testing department. In 1906 he was promoted to the position of engineer of the underground department and later assumed the duties of illumination and power engineer in addition to his other duties. In 1912 he became superintendent of the Los Angeles district and had charge of all the city overhead and underground distribution and substations. Last year he was promoted to the position of power administrator and had charge of the system load operation and of the interconnections with other companies. In April, 1921, he was promoted to his present position.

James R. Lowe has been appointed general sales manager of the Harrisburg (Pa.) Foundry & Machine Works. Mr. Lowe was formerly sales engineer with the Midwest Engine Company, Anderson, Ind.

George W. Curtiss, sales manager of the Electric Railway & Manufacturers' Supply Company, recently left San Francisco for a seven weeks' business trip in the East. He acted as a delegate for the Pacific Division of the Electrical Supply Jobbers' Association at its annual convention at Hot Springs, Va., and attended the Westinghouse jobbers' convention at the same place.

James Dixon, who for the last year has been production manager of the Reliance Electric & Engineering Company of Cleveland, Ohio, has been appointed works manager. Mr. Dixon is a graduate of Columbia University and a member of the A. I. E. E. Prior to his association with the Reliance company he was connected with the Crocker-Wheeler Company as superintendent of construction, assistant chief engineer and works manager of the small-motor department. He has been a frequent contributor to the pages of the ELECTRICAL WORLD, chiefly along the lines of industrial applications. During the world war he was a junior lieutenant in the United States Naval Reserve.

Obituary

Edgar M. Graham, consulting engineer in Muskogee, Okla., since 1910, was killed May 14 in an automobile accident. For more than ten years Mr. Graham was chief engineer of the Muskogee (Okla.) Electric Traction Company. He built during this time about 10 miles of the Webbers Falls Railway Company. In 1900 he became assistant to Guthrie & Diehl, consulting engineers, Buffalo, N. Y. The following year he became connected with the New York Central Railroad and then was with the Lackawanna Steel Company for two years. In 1905 he became chief draftsman for the Buffalo & Susquehanna Railway Company and in 1907 was made assistant chief engineer. He entered private practice in Buffalo in 1908. Mr. Graham was forty years old and active in engineering society affairs. He was a member of the A. S. C. E. and president of the Muskogee chapter of the American Association of Engineers.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Report of Delinquent Accounts in N. E. C. A.

A GOOD idea of the general conditions of collections throughout the electrical industry is presented in the summary of Secretary Frederic P. Vose, National Electrical Credit Association, which met in annual convention at Richmond, Va., May 19 and 20. The total number of tardy and delinquent customers reported to the five associations was 192,088. Of the delinquent accounts reported, there was an average increase throughout the five associations of 67 per cent in number and 49 per cent to 242 per cent increase in the amount involved. The percentages reflect the general depression in the industry and the multiplying of unsatisfactory accounts.

Total of 202,000,000 Large Lamps Sold During Year 1920

TOTAL sales of lamps, excluding miniature, in the United States during the year 1920 amounted to 202,000,000 tungsten-filament lamps, according to the report of the lamp committee submitted before the National Electric Light Association in convetion at Chicago this week. This is an increase of 32,000,000 lamps, or 19 per cent over sales for the year 1919. In the ELECTRICAL WORLD of Jan. 1, 1921, it was estimated that 215,000,000 large tungsten lamps were produced in 1920.

In numbers the percentage of tungsten-filament lamps has shown a decided increase each year since their introduction until in the year 1920 they comprised 95.7 per cent of the total large lamps sold. On the other hand, the sale of carbon lamps has fallen off each year until in 1920 the percentage stood at 4.3 of the total sales. Their sales in 1920 amounted to 9,000,000 lamps, a decrease of 4,000,000 over 1919. Relative percentages of large-lamp sales from 1907 to 1920 are shown in the following table:

Year	Tungsten (Including Tantalum)	Carbon (Including "Gem")	Year	Tungsten (Including Tantalum)	Carbon (Including "Gem")
1907	0 8	99 2	1914	70 5	29 5
1908	7 3	92 7	1915	78 9	21 1
1909	15 9	84 1	1916	83 7	16 3
1910	22 0	78 0	1917	87 0	13 0
1911	28 1	71 9	1918	89 0	11 0
1912	41 0	59 0	1919	93 0	7 0
1913	56.7	43 3	1920	95 7	4 3

As stated in the committee's report for the previous year, there has been recorded each year an increase in the average candlepower of lamps sold. This increase is due in part to the utilization of gas-filled tungsten lamps in service formerly performed by other types of lamps. The figures for average candlepower, watts and efficiency for the past three years show a favorable increase which is interesting in indicating the upward trend in lamp manufacture and sales.

Each year the report has recorded the average candlepower, watts and efficiency of lamps sold. These figures for the past three years have been as follows:

	1918	1919	1920
Average candlepower (horizontal)	51 5	53 2	55 8
Average watts	52.7	51.5	53 3
Average lumens per watt	10 3	10.5	10.6
Average lumens	515	532	558

The tendency toward standardization of the different types and voltages of tungsten lamps is noticeable from the table that is given below. The gas-filled type is steadily increasing in sales, while the vacuum type is falling off. Still, of the 202,000,000 large lamps sold in 1920, 41,000,000 were of the gas-filled type and 161,000,000 of the vacuum type.

At the same time, while the gas-filled lamps comprised only 20.3 per cent in number, they aggregated 46 per cent in wattage and 56 per cent in candlepower. The 40-watt vacuum lamp still remains the most popular size, although the percentage has been decreasing steadily. The 50-watt size shows the greatest gain of all, the 1920 demand being 24,000,000 as compared with 16,500,000 in 1919. Lamps of the 100-watt vacuum type have fallen off in the last few years, while that size in the gas-filled type has steadily come up.

DISTRIBUTION OF TUNGSTEN FILAMENT LAMPS BY SIZES AND TYPES

Size:	Per Cent of Total Tungsten Filament Lamps 1918	1919	1920
Vacuum type:			
Sign lamps	4 9	4 3	5 8
15 watts	5 5	4.1	5 5
25 watts	22 4	21.0	18 8
40 watts	24 3	21.6	20 1
50 watts	8 4	9 7	11 9
60 watts	13 3	13.0	12 3
100 watts	2 0	1 3	1.0
Street railway	3 8	3 3	3 2
Others	1 7	2 7	1.1
Total vacuum type	86 3	81 0	79 7
Gas-Filled Type:			
50 watts		1 9	1 8
75 watts	4 1	5 5	5 9
100 watts	4 7	5 5	6.3
200 watts	1 9	2 2	2 3
300-1,000 watts	1 3	1 0	1 2
Street series	1 3	1 4	1 3
Others	0 4	1 5	1 5
Total gas-filled type	13 7	19 0	20 3

Gradual Resumption of Washing Machine Demand

DISCUSSION of prevailing business conditions by Secretary Seitz occupied the greater part of the opening session of the spring meeting of the American Washing Machine Manufacturers' Association, held May 18 and 19 at the Hotel Sherman, Chicago. A sudden revival of demand, he said, was not to be expected, but business in most lines was showing a fair increase for each month to date. He submitted the April report on production of washing machines, gathered through his office, as evidence of the gradual resumption of demand, showing that April production had increased over March. March, he added, had shown a large increase over preceding months.

At the afternoon session a committee was instructed to draw up a resolution opposing the passage of the Chicago ordinance which proposes to license all dealers in electrical applinces and to require tests of all electrical appliances sold in Chicago, and to co-operate with any other body fighting the bill.

Following this several examples of misleading advertising of washing machines were brought before the meeting, and it was decided that the matter was so vital to the welfare of the industry that it should be brought to the attention of the Associated Advertising Clubs at once and also that

members should use their influence with the publications concerned to have the practice discontinued. Members complained that advertising of washing machines at extremely low prices misled the public and the dealers to expect impossible cuts on legitimate products.

An educational program was proposed to acquaint dealers with the need of a proper spread between list and factory price, but no action was taken on it at that session.

Some Business Aspects in the Intermountain Region

LIGHT money is still the bane of business and industry in the Intermountain West, and loans are next to impossible to get even for the most urgent enterprises. Sheep men and cattle growers are reported in a quandary to know how to tide over the crisis. Warehouses are packed full of Western-grown fleeces, and some growers have as many as three seasons' clippings now on hand and can scarcely get money to meet current expenses. Most of them have reduced their employee force by upward of 50 per cent. Banks, it seems, come to the rescue only in extreme cases, and then often to protect their loans. At the same time the spring season, with its prolonged siege of cold and wet, has been unfavorable to lambing. The one hopeful sign of relief is the tariff bill that was just signed by the President, which excludes foreign wool.

Farmers are also hard put to it to finance the spring cultivation and planting. With beet growers seed is a big item of expense and sugar companies are giving relief here. They are also interceding for their growers with the banks in an effort to obtain for them loans to pay for the labor of cultivating and thinning. A late season has seriously retarded the sowing of crops. Despite the low market price on general farm products farmers are holding up to their acreage averages. Everything points to bounteous yields.

The copper industry is virtually nil as a market for electrical and other merchandise. The plants are only buying such supplies as are necessary to keep the physical equipment intact until operations are resumed.

Buying of Brushes by Central-Station Companies Close to Normal

MANUFACTURERS of carbon brushes quite uniformly report a quiet market for their product this spring. With industrial operation at its present low point in so many lines of activity throughout the country fewer motors are being run and fewer brushes are being bought. On the other hand, in certain lines, such as the steel industry, opportunity is being taken of slack production to overhaul electrical equipment, and there the demand for replacement brushes holds up fairly well. Electric railways are not endeavoring to carry surplus stocks, and their buying is of the hand-to-mouth order. Central-station companies at the present time are buying most nearly to their normal requirements.

There are signs of better business ahead, however; in fact, in certain quarters it is stated that the carbon-brush business this month represents an improvement over the previous three months. This is especially noted in the automobile branch of the industry, as brushes for starting and lighting sets had probably been hit hardest of all types when the automobile business slumped so severely. Producers as a rule are proceeding cautiously, nevertheless, on the supposition that the next few months may be lean ones. Production is down to 50 to 75 per cent of capacity and inventories have been reduced accordingly.

Stocks of the semi-finished products are in ample shape to take care of customers, however, for shipments at present are very prompt. Prices are still at their peak except with one producer who is selling brushes at their present replacement cost, and this, it is stated, figures about a 10 per cent reduction. Other manufacturers are quoting on a price basis which has remained constant since the latter part of 1918.

Interest in Trade Acceptances Continues to Grow

REPORTS coming in to the National Association of Credit Men show that certain companies consider the trade acceptance the most valuable of all collection instruments, especially in times like the present when there is a strong tendency on the part of retailers to let their obligations run and to use all sorts of excuses to delay payment. This form of payment is coming more and more into use, not only as a method of affecting collections but also as a sound type of commercial paper.

At the same time there has been found throughout certain sections of the country a reluctance on the part of banks to accept trade acceptances—particularly when these are in small denominations. One of the larger electrical supply jobbers has overcome this difficulty by taking trade acceptances on his monthly statement, thereby decreasing the number of his pieces of paper but considerably increasing the value of each one. Some banks that discounted this paper would have been unwilling to have discounted smaller amounts.

The number of acceptances is increasing in the electrical jobbing industry, although the denominations are smaller in amount. At the same time more jobbers are coming to realize that this two-name paper increases their turnover of capital, lessens their losses and makes for a better credit condition of both buyer and seller.

Many cutomers formerly on open account were frequently seen on the "past-due" list; but under the trade acceptance method of credit these names as a rule are missing from this list.

The Metal Market Situation

THE copper market shows a slight weakness in line with current weakness of demand. Domestic consumers remain out of the market, and foreign orders, which have been received in such encouraging volume of late, have fallen off. A decided break in foreign exchange rates last week was perhaps in part accountable for this, as it meant a corresponding lowering of the equivalent price per pound of spot copper at London. Copper for prompt and June shipment can be purchased at 13.25 cents per pound delivered, though the asking price of some producers ranges up to 13.50 cents. June and July copper is held at 13.50 cents, but it is thought this could be shaded. The full third quarter is quoted at 13.75 cents.

To stimulate the market, trading in standard copper was begun on the New York Metal Exchange on June 1 under a new and broad contract.

Demand for lead continues light, and with the drop in sterling exchange noted above foreign lead prices are approaching a figure where they will enter into competition. Zinc quotations are a trifle easier and the market as a whole is quiet. There is little pressure to sell tin, though prices are off slightly under the influence of lower London quotations and the break in the price of sterling; but on the other hand consumers are showing no more buying interest. The position of the scrap metals market is unchanged.

NEW YORK METAL MARKET PRICE

	May 24, 1921	May 31, 1921
Copper	£ s d	£ s d
London, standard spot	74 0 0	72 10 0
	Cents per Pound	Cents per Pound
Prime Lake	13.25	13.25
Electrolytic	13.12½—13.50	13.25–13.50
Casting	12.62	12.50
Wire bars	14.75–15.00	15.00—15.25
Lead, trust price	5.00	5.00
Antimony	5.25	5.25
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.25	5.20
Tin	32.25	31.62½
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.50—10.75	10.50—10.75
Brass, heavy	5.25— 5.50	5.25— 5.50
Brass, light	4.00— 4.25	4.00— 4.25
Lead, heavy	4.25— 4.40	4.25— 4.40
Zinc, old scrap	2.50— 2.75	2.50— 2.75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

WHILE little of a hopeful nature is reported on business conditions in the electrical trade in the New York region and in the city of Chicago, other centers do show a little more life. Building permits in Boston increased well last week, the wiring supplies trade is quite good, and while prices are holding well for materials in small quantities, still on large lots there is some cutting. Trade outside of Chicago is increasing somewhat, and washing-machine makers have had a constantly increasing production this year. St. Louis industrials are inquiring for new property for expansion purposes, and the Standard Underground, it is reported, has purchased a large tract.

Residential construction is bettering in the Southeast and meters are moving well to municipalities and small central stations. Jobber business is getting better in number of orders and in size. Things are quiet in the Intermountain region because of poor stock sales and consequent credit restraints. The Northwest, too, is quiet, although broken somewhat by activity in residence building. Industrials are not expanding. New York contractors are doing quite a bit of estimating, but that is about as far as it goes for the present. Pipe and armored conductor prices are soft there. Fans are moving well in St. Louis and but little in New York.

NEW YORK

There does not seem to be any improvement in the electrical trade worthy of note in this section. Occasionally temporary spurts in business occur, and here and there jobbers report an upward tendency in sales, but the general situation is on a level with that which has prevailed for many weeks. From present indications little relief from the quiet market is promised before next fall.

Contractors are doing considerable estimating on building work, and there are plenty of plans in the air, but the results are still far in the future. With industrials generally operating at low capacity, that outlet for goods is now limited; shipyards are seeking longer credit terms and contractors are stocking nothing at all. On the other hand, this policy of non-stocking is providing an every-day source of bread-and-butter buying that helps to keep things going.

No new prices are reported this week, though conduit and armored-cable prices are soft with jobbers. Buying is from hand to mouth, and conservatism in stocking rules in all lines of goods, even in seasonable articles such as fans and flashlights, which have not started to move yet. Jobbers disagree on collections, but the situation with those whose collections have all along been good remains favorable, while with those whose collections have been tight no improvement is shown.

Lamp Cord.—In lots of 1,000 ft. No. 18 twisted cotton sells for $14 to $17.70 and No. 18 cotton parallel for $16.50 to $17.75. Demand is quiet and stocks are only fair except where jobbers act as agents, and there stocks are large.

Fans.—For the most part supplies have not started to move, there having been little good fan weather thus far. Stocks are good, but compared with other seasons the number carried is extremely conservative. The 16-in. oscillating fan, which jobbers are selling in lots of twelve for from $26 to $32.40, according to make, bids fair to maintain its popularity.

Flashlights.—The usual vacation run of sales in this line has not started, jobbers report, and renewal business is only fair. Stocks are spotty, and, in representative instances the discount allowed on standard packages is 40 and 10 per cent; in unit packages of ten, 40 per cent, and less than unit packages, 33⅓ per cent.

Conduit.—Stocks are spotty with not very much material moving. In 2,500-ft. lots prices quoted this week on ½-in. black range from $60 to $68 per 1,000 ft.; ½-in. galvanized, $65.70 to $73.40; 1-in. black, $116 to $127; and 1-in. galvanized, $125.60 to $137.90. The lower range is nearer the actual market, and even these prices are shaded.

Non-metallic Flexible Conduit.—In 1,000-ft. lots ⅜-in. brings from $22 to $24.75 and ½-in. from $23 to $27. Very little is being sold, though stocks are fair.

Knife Switches.—Demand is spotty, and so are stocks, though there is no scarcity of material. A standard single-throw, two-pole, 30-amp. fused switch jobbers sell for about 90 to 95 cents each in lots of a dozen.

Flexible Armored Conductor.—No. 14, two-wire, double-strip in 1,000-ft. lots is nominally selling for from $55 to $58 per 1,000 ft., but these prices are cut drastically under prevailing competition. Demand quiet; stocks fairly good.

Rubber-Covered Wire.—A few jobbers report a fair demand, but the general situation is weak. Some houses have large stocks, others are down to fair quantities. The market has settled to a price of $6.75 to $7 per 1,000 ft. for 10,000 ft. of No. 14 single-braid.

CHICAGO

Business from the country is better but is not of sufficient volume to bring the aggregate up to a fair volume. Local industrial conditions are disquieting. The construction labor controversy remains open and the shutdown is approaching the absolute.

Non-employment is on the increase in the Detroit district, with many large plants reducing forces and some of the big auto builders considering shutting down. In the steel plants along the south of Lake Michigan forces are being gradually reduced as the volume of "orders on book" continues to shrink. It is freely predicted that the present slump in the steel trade will persist until fall and that further cuts both in prices and in wages must come before any upward slant is found. In short, the general opinion is that, while the low point in trade may have already been touched, it will be some time before any better tendency is felt.

As regards collections no improvement is noted. Average collections with the large houses continue to range around ninety days. Contractors, fearful of a long-drawn-out controversy in the present labor troubles, are not stocking any materials and contractor-dealers are following the same procedure. Retailers find their stock moves slowly, as lack of employment is reducing the amount of money in circulation. No price changes of moment have occurred.

Line Material.—No price fluctuations in wire or other outside material have been noted. Demand is limited to out-of-town customers. Bare copper wire stands at 16½ cents per pound for No. 8 in 1,000-lb. lots and No. 6 weatherproof, triple-braided, is 17 cents per pound in similar quantities.

Inside Wiring Material.—Business is a little better in this line than any other as numerous rewire and repair jobs are under way. Prices are unchanged with rubber-covered No. 14 offered at $7 per 1,000 ft. in 1,000-ft. lots. Flexible armored conductor is finding slow sale at $57.50 per 1,000 ft. for the No. 14, two-wire.

Black Conduit.—The new quotation noted last week of $59 per 1,000 ft. in 5,000-lb. lots is not causing any appreciable increase in trade. Contractors and dealers alike are refusing to take any chance by stocking up.

Washing Machines.—Increased production is the story with washing machines. A steady recovery all through the year has occurred since last winter, and the industry as a whole is now making and selling more machines than at any time since last fall. Washers are recognized as a necessity and the liberal extended payment terms being offered are permitting a wide distribution. It is estimated that factories are now running on approximately 60 per cent capacity.

BOSTON

Trade is well sustained in wiring-supply lines, and while the demand for appliances fell off during the week-end holiday, considerable activity is apparent. House-wiring campaigns are proceeding well. Building and engineering contracts placed in New England during the week ended May 24 totaled $5,230,100, a gain of $1,433,500 over the preceding week. Labor troubles are still handicapping the resumption of normal building, however. In some engineering offices a better feeling is apparent and jobbers generally point to improved business in May against April of this year. Collections still have to be watched closely. Shortages in supplies are virtually unknown. Prices are holding firm in the main for small-quantity purchases, but on large sales, notably in wire, considerable cutting is apparently taking place. The New England Power Company has decided to go ahead with a 6,000-hp. development on the Deerfield River at Searsburg, Vt., hoping to complete a layout costing about $1,500,000 in 1922.

Meters.—Although the market is quiet, some orders hitherto held back from shipment are now being called for by the purchasers. Back orders are also keeping manufacturing facilities moderately busy.

Lamps.—Lamp sales hold up better than most other supplies. Stocks are excellent. Sign lighting is developing well.

Motors.—A quiet market continues, with some "pick-up" sales and a fair volume of scattered, small business. Nothing like the available productive facilities can be utilized in motor manufacture at present. Some distributors are moving their stocks slowly by offering less than factory prices. The market for second-hand motors is extremely quiet, owing to the supply of new motors available.

Wire.—A fair demand is reported. In 5,000-ft. lots No. 14 rubber-covered sells for $7 per 1,000 ft., and in 1,000-ft. lots at $10. Weatherproof wire sells as follows per 100 lb. in the triple-braid selection: Reels or large coils, solid No. 4/0 to No. 8, 100-lb. to 200-lb. lots, $21.50. No. 8 in 25-lb. coils, solid, in 100-lb to 200-lb. lots, sells for $22.50. Additions for stranding range from $0.005 per pound in No. 0 and larger to $0.04 per pound for No. 8.

Flexible Armored Conductor.—Sales are somewhat improved. One house is disposing of 10,000 ft. to 20,000 ft. per week—a subnormal volume, but encouraging nevertheless. No. 14 double-strip is moving at $60 per 1,000 ft. in 1,000-ft. lots, the market being open above this quantity. Plenty of this material can be had locally.

Plugs and Receptacles.—Some of these are moving into the contractors' hands following recent price concessions. A well-known line sells as follows: Plugs, less than cartons, 30 cents net; cartons, 27 cents net, standard packages, 24 cents net. Another number of plug, in lots of 1,000, sells at 15 cents net.

Lamp Guards.—Prices quoted on a leading make range from 50 per cent off double list on less than one-fifth of a standard package to 70 per cent off double list on five standard packages. Trade is moderate with good stocks as related to present demand.

Industrial Electric Trucks.—While the market is dull considerable interest is apparent in marine circles, and some competitive try-outs are reported under way along the Boston waterfront.

Electric Ranges.—Demand is quiet, with sales spotty. A leading manufacturer announced a price reduction approximating 7½ per cent effective June 1, owing to decreased factory costs. Deliveries are being made from stock.

ATLANTA

It is encouraging to note a slight improvement in business in general. Electrical jobbers report that their business for the past two weeks shows considerable increase over prior periods as regards not only the number of orders being received but also the volume of the individual orders, which is increasing. The increase in the number of inquiries is evidence of a decision on the part of the industrial plants to take up improvements and expansions which were allowed to be dropped in the early fall. The textile mills seem to be entering upon a more active market. Three of the largest mills in Georgia, which have been shut down for some time, were permanently reopened last week. Private concerns estimate the 1921 cotton crop at 8,000,000 bales, the smallest yield in many years. This should lend a firmer tone to the cotton market despite the carry-over of last year's crop of 13,000,000 bales. It should also go far to stimulate activities in the rural districts. Construction, particularly of the small residence and the commercial house, is getting well under way, as is evidenced by building permits in the eight principal Southern cities for April which totaled $2,960,000. This movement should be further stimulated by the reduction in building cost, a bulletin of the Association of Contractors and Builders showing that construction is costing approximately 70 per cent what it cost a year ago.

Fans.—Despite the recent warm spell, the movement in this line is not up to jobbers' expectations, though they still hold a most optimistic outlook for the season.

Rigid Conduit.—The market continues quite dull, and nearly all jobbers have accumulated heavy holdings. There is little movement of the larger sizes, though ½-in. and ¾-in. sizes of black are moving quite well in the large centers.

Flexible Armored Conductor.—This continues quite active, especially on the smaller jobs. The price is steady at $70 per 1,000 ft. for No. 14, two-wire, single-strip.

Industrial Lighting Fixtures.—Advertising campaigns are serving to hold up sales in this line, the 100-watt and 150-watt sizes being reported as the most popular. Local stocks are in good shape with shipments at two weeks. A price advance amounting to approximately 20 per cent was announced May 15.

Pole-Line Material.—Cross-arm braces and through bolts are reported quite active, while other lines of hardware are dull. Cross-arms, pins, insulators and poles are all reported slow, purchases being for current demand only. Stocks of all items are plentiful with no recent change in price noted.

Meters.—The purchase of meters by municipalities and small central stations continues to hold up well, the 5-amp. and 10-amp., two-wire type leading in volume. Stocks are in good condition.

Schedule Material.—This line continues slow with purchases still on the hand-to-mouth basis. Stocks of the entire line are in good condition, except for a shortage here and there in certain types of switch plates and cut-outs. Snap switches and key sockets are reported the most active, with rosettes the slowest.

Lamps.—The sale of the larger size lamps is keeping pace with the activity in the industrial lighting fixtures. Orders for 75-watt, type C, lamps are above the average.

ST. LOUIS

The best news from the industrials this week was the announcement on the part of the Standard Underground Cable Company of Pittsburgh of its purchase of a 12-acre tract upon which a wire factory will be built in the near future. Other concerns are making inquiries for real estate and the indications are for a good volume of industrial construction work, though it is problematical as to when it will begin. Wages have not been reduced at all in the building lines, and until some concession is made a vast amount of work will be held off the market.

Unseasonably warm weather has added impetus to fan sales, both retail and wholesale. No appreciable increase in sales of other summer appliances has as yet resulted. In fact, except for the increase in fan sales, business on the part of electrical jobbers shows almost no change.

Stocks are in general in good shape though some jobbers report an oversupply of schedule material. The demand for electrical materials is apparently composed of a large number of small orders, representing a healthy condition. As stocks in hands of contractors and retailers are being maintained at a minimum, it is believed that business for the jobbers will show improvement just as rapidly as business confidence is restored.

Knobs and Tubes.—A cut in the price of "Nail-it" knobs is announced, the new price being about $19 per 1,000, with

the maximum at $20.80. Local stocks are not considered too heavy, and yet the demand is quite low. The price on tubes is unchanged.

Fans.—Heavy buying by consumer and retailer was found last week as a result of the unseasonablly warm weather. Jobbers report that the largest call is for ceiling fans because they are not stocked by the retailers. They expect the demand for the popular styles to be heavier in a month or so as the stocks in the hands of retailers become exhausted. Stocks in hands of jobbers are considered to be on a conservative basis.

Flatirons.—Only a slight improvement in demand is reported except in the case of one or two lines on which special campaigns are being conducted. Local stocks are on a reasonable basis.

Poles and Cross-Arms.—The expected large business in these items has so far failed to develop. One reason advanced is that the inquiries which were received in such attractive amounts were based on transmission extensions for industrial business which is slow to materialize. One large jobber reports an actual decrease in business for the week. Stocks are in fairly good shape.

Wire.—Demand and supply remain unchanged, and though the prices are as low as they are expected to go, no one shows any appreciable tendency to stock. No. 14 rubber-covered, in 5,000-ft. lots, is selling at about $6.75. In 100,000-ft. lots sales are being made at $6.35 to $6.50, the variation being largely due to the quality of the wire. The base price quoted on bare and weatherproof varies from 15 cents to 16 cents.

Schedule Materials.—The demand is found to be very quiet with stocks somewhat heavy. There is a tendency to cut prices on the part of those jobbers with heavy stocks, and there is an underlying feeling that a general price reduction is about due.

SAN FRANCISCO

The outstanding event of the past week was the spread of the building trades strike to the electrical contracting industry, with the result that not only are all the San Francisco and Oakland contractors shut down but that other localities also have become affected, with a prospect of the strike becoming state-wide. So tight is the situation that practically no shipments are being made by jobbers to the affected area because no orders are being received, and all city salesmen of San Francisco and Oakland jobbers have been asked to take their vacations the first two weeks of June.

Household Material.—Naturally the labor situation has not improved the morale of the buying public, and very desultory sales of appliances are reported. There are virtually no sales crews working for dealers, and those dealers who specialize on appliances are finding the services of the crew captain to be sufficient. However, should the strike last it is probable that there will be increased appliance efforts made by dealers to offset their contracting loss.

Conduit.—Prices have recently been amended to eliminate the less-than-500-lb. quantity which was formerly 20 per cent higher in price than the 500-lb. to 10,000-lb. quantity. The 10,000-lb. assorted is now the minimum quantity for all finishes.

Conduit Fittings.—Condulets have dropped in price from 20 to 25 per cent. Like all roughing-in lines, they are now very slow save in the southern part of the state.

Wire.—Although the more sanguine expected that rubber-covered had finally touched bottom, a new low mark of $7.20 per 1,000 ft. for 5,000-ft. lots of No. 14 single-braid solid is recorded. Weatherproof wire has just taken a drop of 50 cents per 100 lb., making a new base of 19 cents per pound for triple-braid base sizes.

Lamps.—Jobbers are circularizing the trade regarding their requirements for Christmas tree outfits. From present indications there will be little change over last year's styles and prices. A determined effort is being made to reduce the value of consigned lamps on the dealers' shelves, it being found that in many cases their value totals more than the value of the same stocks at the first of the year.

SALT LAKE CITY—DENVER

It is the feeling of contractors that there will be a substantial building boom once the prices of materials come down to a point that will make it practicable, and many large projects are awaiting this. This period of relative inactivity is conducive to a general accumulation of stocks in the warehouses of jobbers and on the shelves of dealers.

Vacuum Cleaners.—The movement is satisfactory. Dealers report a good demand, especially since the advent of housecleaning time. With one or two exceptions there has been no trouble in getting quick shipments from the factories and in unlimited quantities.

Motors.—A field of almost unlimited possibility is afforded by the growing use of motors to provide flow for private irrigation systems. Farmers and fruit growers are coming to use them extensively to supplement the water that reaches them by gravity flow. Central stations are leading the way in this development, and dealers in motors are competing vigorously for installation contracts.

Farm Lighting and Power Plants.—Sales at present are few. Farmers are hesitant about investments at a season when crop yields are uncertain. Jobbers, however, are perceiving the possibility ahead and sparing no effort in the work of educating the farmer to the need of electric service on the farm.

SEATTLE—PORTLAND

Conditions in the electrical business in the Northwest generally and the Puget Sound district specifically show but little change from week to week. Buying is of the hand-to-mouth variety, and from present indications this condition will probably obtain until well into the summer and possibly later. The buying which will materialize from logging camps, lumber mills, fish and fruit canneries and other industrials has not, and undoubtedly will not, approach the volume expected, neither will sales of domestic appliances, movement of which is very light. At present washing machines, ranges and cacuum cleaners are showing a fair movement, but sales are away below the mark set for this season of the year. The movement of percolators, chafing dishes, flatirons, etc., is expected to register satisfactory increases during June, but jobbers and dealers are well prepared to handle normal demands.

Schedule material, owing to the constantly increasing building program, of both residence and business structures, is moving in a fair way, and the demand for this merchandise is expected to continue showing improvement until late in the fall. Improvement in building is noted throughout the entire Northwest, and Seattle, Tacoma, Everett and Bellingham report favorable indications of a continuance of this condition. Prices are fluctuating downward, but the decrease is gradual. Certain lines, it is believed, are near rock bottom, while others will continue dropping until fall. The last observation applies particularly to domestic appliances. Manufacturers in the Portland district report no material change in general business or collections, but jobbers state that collections are slightly better. Improved collections, however, are partly due to greater activity of collection departments.

Considerable activity is reported in the construction of new transmission lines in various counties throughout Oregon. Contractors generally report quiet business so far as large contracts are concerned, but small contracting work continues about the same, there being an increasing amount of residence work. The marine strike continues and will undoubtedly result in the closing down of a number of lumber mills and other industries because of lack of an outlet. In the Portland district it is freely predicted that there will be very little change in business in general before the fall movement of crops, which will provide a new supply of money and relieve the situation resulting from lack of movement of last year's crops.

Flashlamps.—With the coming of the camping season dealers report an increasing demand. Stocks are ample and prices are steady.

Meters.—Northwest jobbers in considerable numbers report an increasing demand occasioned by increased residential construction and some transmission extensions.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Standard Underground Cable to Erect St. Louis Factory

Announcement is made on the part of the Standard Underground Cable Company of its purchase of a 12-acre tract in St. Louis on which in the near future a large plant is to be erected for the manufacture of cable and other forms of insulated wire, supplementing its four other factories. A million-dollar addition is now being made to its plant in Pittsburgh.

Lighting Fixture Manufacturers to Meet in July

The midsummer meeting of the National Council Lighting Fixture Manufacturers will be held at West Baden, Ind., July 6, 7 and 8. Capacity attendance is requested by the secretary as matters of importance to the lighting-fixture industry will be discussed.

Armstrong Radio Patent Upheld for Westinghouse

As a result of litigation extending over a period of years, the Armstrong radio "feedback" patent, controlled by the Westinghouse Electric & Manufacturing Company, has been held valid by Judge Mayer in the United States District Court, Southern District of New York. The De Forest Radio Telephone & Telegraph Company was the defendant which, it was ruled, infringed all the claims presented. The employment of the "feedback" arrangement, it is held, greatly increases both the loudness and the definition of sounds heard in the receiver, improving long-distance radio communication.

Educational Program by Washing Machine Manufacturers

The report of Miss Mary E. Keown, head of the educational bureau of the American Washing Machine Manufacturers' Association, was presented before the spring meeting of that organization, held in Chicago, May 18-19, and showed that the efforts of the association to educate the public in the proper use of the washing machine were bearing fruit. Accordingly the work of the bureau will be continued more extensively, it was announced.

Several months ago bulletins were printed on the subject of "Laundering at home." Although it was not attempted to give extremely widespread publicity to this fact, there were calls for 59,000 bulletins in five weeks. Each request averaged twenty-five copies so that the calls came from about 2,200 sources. Arrangements have been completed for lectures to be given by Miss Keown on the subject of "Laundering at Home" before the Southern Home Economics Bureau and the National Bureau of Home Economics.

N. E. C. A. to Consider Sales Terms and Cash Discounts

Resolutions were presented at the convention of the National Electrical Credit Association, held at Richmond, Va., May 19 and 20, according to the summary of Secretary Vose, declaring it to be the sense of those present that the variety of sales terms and numerous cash discounts prevailing were distinctly detrimental to the electrical industry and uneconomical to manufacturers and jobbers alike. It was proposed that a committee be formed, composed of representatives from the Electrical Supply Jobbers' Association and Associated Manufacturers of Electrical Supplies, to act in conjunction with the N. E. C. A. and to give consideration to standardizing sales terms and cash discounts.

Arrow Electric Company Upheld in Trade-Mark Suit

Judge Killits recently handed down an opinion in the federal court in Ohio establishing the exclusive right of the Arrow Electric Company to the trade marks "Arrow" and the symbol of an arrow for electrical wiring devices and the like, and in addition holding that the use of the name "Arrow Manufacturing Company" in a similar line of business was on the facts proved a case of unfair competition. The action was to restrain the use by defendant (now, by changed corporate name, Airway Electric Appliance Corporation) of the figure of an arrow on its goods and the use of the word "Arrow" to designate its manufactures.

Manhattan Electrical's Business Shown in 1920 Report

For the year ended Dec. 31, 1920, the Manhattan Electrical Supply Company, 17 Park Place, New York City, reports net profits after expenses and taxes of $153,041, as compared with $702,910 for the preceding year. Net sales in 1920 amounted to $7,286,446, an increase over the preceding year of more than $300,000, but the cost of sales in 1920 was $5,608,475, or $550,000 more than in 1919. Expenses and taxes in 1920 increased so much that the resulting net was comparatively low.

Accounts receivable amounted to $754,249, a decrease of about $160,000 from this item for 1919. Inventories have been rated at $2,767,375.

Machen Company Reports Larger Demand for Specialties

The Machen Electric Manufacturing Company, Bridesburg, Philadelphia, manufacturer of push-button switches, receptacles and ground clamps, states that, although it is a new company and has only been shipping its products since last December, its sales have steadily increased. The company is bringing out a Duplex receptacle similar to the standard receptacle, which will be ready for delivery by July 1. The company is represented by Hermans-Griffith Company, San Francisco; A. W. Marshall Company, Detroit; W. A. Hendrickson, Boston; George H. Maire, Seattle; Metropolitan Distributing Company, New York City; Sperry & Bittner, Pittsburgh; E. F. Reinhardt & Company, St. Louis; E. M. Scribner, Chicago; Southern Jobbers' Supply, New Orleans, and Samuel Toole, Indianapolis.

New Store and Warehouse for Electrical Supply Company

The N. Hirschfeld Electrical Supply Company, formerly at 147 Bowery, New York City, announces that it has removed its main store and warehouse to 78 Warren Street, where it has much better facilities and will carry much larger stock. This location was chosen because of greater convenience for transportation and for traveling in and around the city. With an increased selling force and service department the company plans to improve its service to the trade both in and out of the city.

Edison Industrial Lighting Exhibit Returns Home

Completing a tour of approximately seventy cities in twenty states since the first of the year, during which the idea of better industrial and commercial lighting has been demonstrated to between 10,000 and 11,000 factory executives, business men, architects and others, the industrial lighting exhibit sent out by the Edison Lamp Works of the General Electric Company has finished its schedule. Plans are now under way for sending it out again next fall and for introducing new features in connection with it.

Approximately the same percentage of attendance was recorded throughout as that noted in these columns on March 19, when returns were sent in after the first third of the trip.

While the exhibit was designed to promote the idea of industrial lighting on a scientific basis, it had none the less a direct and immediate effect in increasing sales.

The Armature Coil Equipment Company, Cleveland, has awarded contract for the erection of a factory to cost about $40,000.

The C. H. Wheeler Manufacturing Company, Lehigh and Sedgley Avenues, Philadelphia, manufacturer of condensers, pumps, etc., announces that it has established a new branch office in Boston at 53 State Street.

The American Engineering Company, Philadelphia, has appointed Isaac Hardeman as sales agent to represent the Taylor stoker in North Carolina, South Carolina and Georgia. His office is 816 Realty Bulding, Charlotte.

The Ohio Ice Machine Company, 1579 Columbus Road, Cleveland, manufacturer of ice-making machinery, has awarded contract for construction of a new one-story and two-story plant, 50 ft. x 100 ft., to cost about $25,000.

The Rome Wire Company, Rome, N. Y., and Buffalo, N. Y., has opened district sales offices at 50 Church Street, New York City. H. S. Hammond, who has represented the company in the Eastern territory during the past twenty years, will be in charge.

Pass & Seymour, Inc., Syracuse, N. Y., announces the appointment of L. L. Parkinson as Chicago district sales manager to succeed William Hall, Jr.

The General Electric Company, Schenectady, N. Y., has been authorized to increase its capital stock from $175,000,000 to $185,000,000 as the spread between authorized and issued stock, it was felt, had become too small.

The Champion Engineering Company, Kenton, Ohio, manufacturer of Champion electric cranes, has established an engineering, service and sales headquarters at 326-327 Ferris Building, Columbus, Ohio. R. W. Valls, vice-president of the company, is in charge of the Columbus office.

The Luthy Company, Inc., Oakland, Cal., recently organized, has acquired a factory at Hayward, Cal., which it will equip for the manufacture of storage batteries. The plans provide for an initial output of 400 batteries per day. J. P. Schiller, manager of the Luthy Battery Company, San Francisco, a branch of the parent organization, is in charge.

Foreign Trade Notes

GERMAN WIRE-ROLLING MANUFACTURERS TO DISSOLVE.—At a session of the German wire-rolling-mill manufacturers it has been decided to dissolve the wire syndicate on July 1. This decision is due to the fact that some of the largest manufacturers had already withdrawn from the association.

ELECTRICAL APPLIANCES DUTY FREE IN LETTLAND.—On April 21, the Lettland government passed a law according to which machinery, tools and electrical appliances will be admitted duty-free into the country. Several large electric plants are at present under construction and several railroad lines are soon to be electrified.

AUSTRIAN DISTRICT TO ELECTRIFY. —The little Alpine country of Vorarlberg in Austria will soon build a powerful electric station and a transmission system to be extended all over the country. The first sum of 50,000,000 crowns has already been appropriated for this purpose, and work is to be started in the near future. The whole enterprise will be operated by the state.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An inquiry has been received from Spain (No. 34,922) for machinery for modern slaughtering and meat-preparing establishments, equipped with all the latest machinery, such as chopping machines with electric motors adapted to 110 volts.

An engineer in France (No. 34,925) who proposes to equip a large number of plants for the preparation of materials for the reconstruction of the devastated regions of that country desires to be placed in touch with American firms which can supply pneumatic or electrically operated machinery for tamping cement, etc.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT FOR JAMAICA. Plans are under consideration for the construction of a hydro-electric plant in Jamaica, to cost about £614,740. The present plans provide for a 6,000-kw. development, to include the erection of three power stations equipped with a water turbine directly connected to a three-phase alternating-current generator. Transmission will be both by underground cable in one section and by overhead lines to a main line along the railway. The project also includes the electrification of the railways on the island.

COMMERCE REPORTS NEW TELEPHONE SYSTEM IN ASUNCION, PARAGUAY.—As soon as the commission of engineers chosen by the President of the Republic of Paraguay decides upon the system of telephones to be used in Asuncion, the President will call for bids for installation of same in accordance with Law No. 454, approved Dec. 18, 1920.

New Apparatus and Publications

OIL CIRCUIT BREAKER.—The Condit Electrical Manufacturing Company, South Boston 27, Mass., has placed on the market its type D-17 oil circuit breaker with resiliently suspended tanks in single units up to 1,200 amp. at 15,000 volts and up to 800 amp. at 25,000 volts.

MOTORS.—The Electric Specialty Company, Stamford, Conn., has issued bulletin No. 234, covering its "Esco" polishing, buffing and grinding motors.

THERMOMETERS.—Bulletin No. 16 published by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J., describes its "Ideal" pyrometric outfit for temperature measurement work with thermocouples.

SYNCHRONOUS MOTOR CONTROL. — The General Electric Company, Schenectady, has issued bulletin No. 48,032, entitled "Synchronous Motor Control Apparatus and Exciters," supplementing bulletin No. 41,-309.

DRY BATTERY.—The Manhattan Electrical Supply Company, Inc., 17 Park Place, New York City, has added another unit to its "Red Seal" dry battery line. This new device is known as the "Red Seal" utility battery.

STEAM PUMPS.—The National Transit, Pump & Machine Company, Oil City, Pa., is distributing bulletins Nos. 102-A and 105-A, covering its Transit duplex piston steam pumps, Klein type, and its Transit duplex direct acting, slush and valve pot type steam pumps respectively. The company has also issued bulletin No. 5-C describing its tools for pipe line construction.

PIPING.—"Power Plant Piping" is the title of a 130-page catalog giving tables and illustrations, distributed by the M. W. Kellogg Company, 90 West Street, New York City.

FLEXIBLE COUPLING — The Kay Manufacturing Company, South Norwalk, Conn., is distributing a folder covering its new free-floating shaft coupling.

BELL-RINGING TRANSFORMER.—The Amrevo Electric Company, 2309 Archer Avenue, Chicago, has put on the market a direct-current bell-ringing transformer under the trade name "Signalrite Type B," which is designed to furnish alternating current at 10 volts and 20 volts on 110-volt and 220-volt circuits.

EXCAVATOR. — Pamphlet SX, recently published by the Pawling & Harnischfeger Company, Milwaukee, describes the new P. & H. shovel attachment for use with standard P. & H. types 205 and 206 excavator cranes.

BRONZE PRODUCTS. — The American Brass Company, Waterbury, Conn., is distributing a sixty-four-page booklet covering its copper products, etc., including price lists.

TOBIN BRONZE.—The American Brass Company, Ansonia Branch, Ansonia, Conn., has issued a fifty-eight-page booklet describing its "Tobin bronze" and its uses, etc., with price lists.

WIRE.—The Copper Clad Steel Company, Braddock P. O., Rankin, Pa., is distributing a leaflet showing loading tables and characteristics of its Aristos "Copperweld" wire.

New Companies

THE ELECTROL MANUFACTURING COMPANY, New York, N. Y., has been incorporated by A. L. Wyman, J. Behrens and W. O. Bacon. The company is capitalized at $200,000 and proposes to manufacture electrical and mechanical specialties. C. A. Levy, 34 Nassau Street, heads the company.

THE HOWLAND BATTERY COMPANY, Detroit, Mich., has been incorporated with a capital stock of $25,000 to manufacture electric storage batteries and battery accessories. The incorporators are George A. Howland, James Romas and Joseph I. Cox, 6536 Sixteenth Street, Detroit.

THE PITTSBURGH FIRE ALARM COMPANY, Pittsburgh, Pa., has been incorporated with a capital stock of $50,000 to manufacture electric alarms and other electrical equipment. J. H. Forrest, 1421 Bristol Street, is treasurer.

HARTT & LANE, INC., New York, N. Y., has been incorporated with a capital stock of $52,500 to manufacture electrical appliances. The incorporators are N. Lane, Jr., J. J. Hartt and F. H. Field, 29 Liberty Street.

THE ANCHOR BRONZE COMPANY, New York, N. Y., has been incorporated by R. J. Kupferrman, M. Lovitch and J. Schaefer, 1703 Washington Avenue. The company is capitalized at $10,000 and proposes to manufacture electric fixtures.

THE LIBERTY LAMP WORKS, 117 Grand Avenue, Harrison, N. J., have filed notice of organization to manufacture electric lamps. M. H. Rosenberg, 231 First Street, West Newark, N. J., is interested in the company.

THE MULTIPLE STORAGE BATTERY COMPANY, New York, N. Y., has been incorporated wth a capital stock of $1,000,-000 to manufacture batteries and other electrical specialties. The company is represented by Arthur W. Britton, 65 Cedar Street.

THE PINE CREEK ELECTRIC LIGHT COMPANY, Lock Haven, Pa., has been incorporated with a capital stock of $5,000 to install and operate an electric light and power system in this section. W. S. Harris is treasurer.

THE DEAL ELECTRIC COMPANY, New York City, has been incorporated with a capital stock of $25,000 to manufacture electrical products. The incorporators are J. H. Tuttle, R. Eckstein and B. Mintz. The company is represented by Barnett & Mintz, 44 Court Street, Brooklyn, N. Y.

THE NORTH AMERICAN ILLUMINATING & ENGINEERING COMPANY, New York City, has been incorporated by A. N. Bernard, S. Stein and M. Berstein, 167 East Broadway. The company is capitalized at $5,000 and proposes to manufacture electric lamps, etc.

THE JERSEY STATE ELECTRIC COMPANY, Elizabeth, N. J., has been incorporated by Joseph M. Waldo, 1182 Elizabeth Avenue; Samuel Gelber and Louis Solins. The company is capitalized at $10,000 and proposes to manufacture and deal in electrical products.

(Issued May 3, 1921)

1,376,681. PROCESS OF PRODUCING PHOTO-ELECTRIC CELLS; Theodore W. Case, Scipio, N. Y. App. filed Aug. 27, 1920. Permanent in activity.

1,376,682. PHOTO-ELECTRIC CELL; Theodore W. Case, Scipio, N. Y. App. filed Aug. 27, 1920. Constant and uniform in reaction.

1,376,696. PHOTO-ELECTRIC CELL; Theodore W. Case, Scipio, N. Y. App. filed Aug. 27, 1920. Permanent in activity.

1,376,610. METHOD OF EXTRACTING BROMINE AND APPARATUS FOR USE THEREIN; Herbert H. Dow, Midland, Mich. App. filed June 7, 1916. From natural brine.

1,376,615. NON-METALLIC FLEXIBLE CONDUIT; Hans Hansen, Maspeth, N. Y. App. filed July 1, 1919. Circular loom.

1,376,627. TERMINAL CONNECTION; Homer W. Jones, Lakewood, Ohio. App. filed Oct. 10, 1919. For carbon electrode of dry cells.

1,376,633. RELAY; John A. Obermaier, Chicago, Ill. App. filed April 5, 1920. Secondary action controlled by varying primary action.

1,376,657. RESISTANCE WELDING MACHINE; Sigurd Thronsen, Chicago, Ill. App. filed Oct. 30, 1919. Work fed along under reciprocating electrode.

1,376,679. RADIO RECEIVING SYSTEM; Austen M. Curtis, Brooklyn, N. Y. App. filed Oct. 10, 1917. Reduction of static interference.

1,376,688. TROLLEY HARP AND TROLLEY HEAD THEREFOR; Charles T. Gillenwater and John L. Pedigo, Bluffield, W. Va. App. filed April 7, 1920. For maintaining wheel in accurate alignment.

1,376,712. WALL SOCKET; Ernest G. Liebold, Detroit, Mich. App. filed Oct. 11, 1918. Hospital call system.

1,376,713. PROCESS FOR PRODUCING MOTOR FUEL; John R. McCabe, Wichita, Kan. App. filed Oct. 27, 1919. Hydrocarbon oils and gases treated to produce liquid.

1,376,719. WHISPER PHONE; William Molloy, Chicago, Ill. App. filed March 18, 1920. Attachment for telephone.

1,376,722. TROLLEY-WHEEL GUARD; John A. Murray and Robert S. Buchanan, Patton, Pa. App. filed Nov. 9, 1918. For preventing jumping.

1,376,729. HIGH-SPEED REVOLVING FIELD MAGNET; Reinhold Rudenberg, Charlottenburg, near Berlin, Germany. App. filed Sept. 30, 1915. Slot construction.

1,376,735. CONTACT PIN FOR CONNECTING PLUGS AND PROCESS FOR THE MANUFACTURE THEREOF; Otto Stalhane and Olof O. Kring, Djursholm, Sweden. App. filed July 8, 1919.

1,376,758. OPERATING MECHANISM FOR ELECTRIC FURNACES; James H. Gray, New York, N. Y. App. filed April 12, 1919. Electrodes held in fixed position with reference to tilting furnace.

1,376,811. MEASURED-SERVICE TELEPHONE SYSTEM; Emil Jacobsen, New York, N. Y. App. filed Feb. 12, 1919. Few mechanisms for several phones.

1,376,829. ELECTRIC STOVE; Sebring I. Phelps, Wilmette, Ill. App. filed May 10, 1919. Heating elements movable.

1,376,841. LIGHT REGULATOR; Allen A. Tirrill, Pittsburgh, Pa. App. filed May 14, 1919. For vehicle lights.

1,376,842. ELECTRIC WARMER; John W. Tufts, Milwaukee, Wis. App. filed Oct. 20, 1919. Heating pad.

1,376,848. AUTOMATIC TELEPHONE SYSTEM; Bernard D. Willi, Oak Park, Ill. App. filed March 29, 1920. To eliminate click.

1,376,890. CHRONOGRAPH; Alfred L. Loomis, U. S. A. App. filed Nov. 5, 1919. For measuring speed of projectile.

1,376,936. TELEPHONE SWITCHING APPARATUS; James L. McQuarrie, Montclair, N. J. App. filed May 13, 1918. Automatic.

1,376,905. SEAL FOR BATTERIES; Norman D. Sturges, Bellerose, N. Y. App. filed April 24, 1918. Seal between cover and terminal post.

1,376,920. PLATE FOR STORAGE BATTERIES AND METHOD OF MAKING SAME; Rufus N. Chamberlain, Chicago, Ill. App. filed Aug. 11, 1919. Planté type.

1,376,923. NON-SPILLABLE BATTERY JAR OR CONTAINER; Herbert Dean, Clifton Junction, near Manchester, England. App. filed Oct. 24, 1918. To ventilate battery and prevent spilling.

1,376,927. RETAINER OR SEPARATOR FOR SECONDARY OR STORAGE BATTERIES; Bruce Ford, Philadelphia, Pa. App. filed Feb. 8, 1918. Slit wall having a permanent open set imparted to slits.

Record of Electrical Patents

Notes on United States Patents

1,376,928. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed April 12, 1916. Flexible intercell connections of few parts.

1,376,929. STORAGE-BATTERY PLATE; Bruce Ford, Philadelphia, Pa. App. filed Jan. 23, 1920. Large portion of frame embedded in active material.

1,376,932. STORAGE BATTERY; Charles D. Galloway, Philadelphia, Pa. App. filed Dec. 5, 1919. Seal between jar cover and post.

1,376,963. PROCESS OF UNITING ALLOY STEEL TO CARBON STEEL; Oscar L. Mills, Easton, Pa. App. filed Oct. 10, 1919. Electrode coating.

1,376,971. VACUUM-CLEANER ATTACHMENT; George Qualman, Toledo, Ohio. App. filed March 11, 1920. Hair drier.

1,376,976. FLASHLIGHT DEVICE; Paul C. Smalley, Newark, N. J. App. filed Jan. 13, 1920. Battery will not break lamp when dropped.

1,376,978. REGULATOR FOR ALTERNATING CURRENTS; Erwin R. Stoekle, Milwaukee, Wis. App. filed Nov. 24, 1917. Electromagnetic.

1,376,987. PROCESS OF MAKING ELECTRIC HEATERS; Charles Wirt, Philadelphia, Pa. App. filed Dec. 2, 1918. Flexible pad.

1,377,000. SYNCHRONIZING CLOCK SYSTEM; James W. Bryce, Binghamton, N. Y. App. filed May 13, 1920.

1,377,021. PROCESS OF CLARIFYING AND DECOLORIZING OILS; Russel W. Mumford, New York, N. Y. App. filed July 11, 1917. Bleaching fatty oils.

1,377,059. PRODUCTION OF ELECTRICAL CURRENT PULSES; Fulton Cutting, Tuxedo Park, N. Y. App. filed June 26, 1918. Radio.

1,377,060. RECHARGEABLE ELECTRIC BATTERY; Henry R. Dam, Brooklyn, N. Y. App. filed Dec. 12, 1918. Dry type.

1,377,061. ELECTRIC DOOR LOCK; Gustav Deeg, Newark, N. J. App. filed Feb. 27, 1920.

1,377,074. SELF-REGULATING DYNAMO-ELECTRIC MACHINE; William Holt, Birmingham, England. App. filed Jan. 5, 1920. For automobiles or railways.

1,377,092. COOKER OR LUNCH BOX; Toussaint Phaneuf, Newport News, Va. App. filed May 6, 1919. For cooking or keeping food warm.

1,377,126. BATTERY TERMINAL; Albert H. Haefele, Lakewood, Ohio. App. filed Jan. 23, 1914. Spring clip.

1,377,127. ELECTRODE TERMINAL; Albert H. Haeffele, Lakewood, Ohio. App. filed Jan. 23, 1914. For carbon electrodes of dry cells.

1,377,128. ELECTRODE TERMINAL; Albert H. Haefele, Lakewood, Ohio. App. filed Jan. 23, 1914. Spring clip for dry-cell carbon.

1,377,129. UNDERWATER WAVE TELEGRAPHY; Walter Hahnemann, Kiel, Germany. App. filed Jan. 2, 1915. Radio under water.

1,377,144. TRANSMITTER; Francis C. Breckenbridge, Providence, R. I. App. filed Dec. 6, 1919. Telephone.

1,377,148. STORAGE BATTERY; Samuel R. Guy, Los Angeles, Cal. App. filed Sept. 10, 1919. Improved separator.

1,377,155. ELECTROPLATING BARREL; Forest H. Hartzell, Dayton, Ohio. App. filed April 22, 1919. Removable contact bars.

(Issued May 10, 1921)

1,377,194. STORAGE BATTERY; Thomas A. Edison, West Orange, N. J. App. filed June 16, 1920. For starting system of automobiles.

1,377,217. PROCESS OF RECOVERING METALLIC CONSTITUENTS FROM A MIXTURE THEREOF; George W. Mullen, Elmhurst, N. Y. App. filed Jan. 14, 1920. Separating metallic constituents from white-metal mattes.

1,377,223. AUTOMATIC FARM LIGHTING AND POWER SET; Bernhard Schilling, Paterson, N. J. App. filed Feb. 9, 1920. Storage cells supply load current except while being charged.

1,377,225. SEMI-AUTOMATIC TELEPHONE SYSTEM; Arthur J. Seymour, St. Paul, Minn. App. filed March 19, 1919. Interconnection between manual and automatic exchange.

1,377,227. SECONDARY BATTERY; Thomas Spencer, Lakewood, Ohio. App. filed July 24, 1918. Tubes of lead hold active material.

1,377,229. DYNAMO-FIELD REGULATOR; Harry L. Tanner, Brooklyn, N. Y. App. filed July 25, 1917. To vary reluctance of path of field flux.

1,377,242. NETWORK-SELECTING CIRCUIT; Charles S. Demarest, Brooklyn, N. Y. App. filed Jan. 4, 1919. Repeater circuit.

1,377,246. RAIL BOND; Joseph A. Frauenheim and Harry Etheridge, Zelianople, Pa. App. filed May 31, 1919. Of soft iron.

1,377,274. CONTROL APPARATUS; Harry F. Porter, Trenton, N. J. App. filed June 3, 1919. For recording variations of any character.

1,377,282. APPARATUS FOR MEASURING THE VACUUM IN LARGE RECTIFIERS; Bela B. Schafer, Baden, Switzerland. App. filed July 14, 1920. By passing an electric current.

1,377,325. ELECTRIC MOTOR; Charles W. Durnford, West Ealing, England. App. filed Dec. 6, 1917. Runs submerged in water.

1,377,405. AUDION CIRCUIT; Lee de Forest, New York, N. Y. App. filed April 9, 1915. For wire or wireless.

1,377,410. CIRCUIT-EXTENDING PLUG; Harry A. Douglas, Bronson, Mich. App. filed July 23, 1917. "Ediswan" type.

1,377,435. ELECTRIC FOOT WARMER; Matthys C. Rasen, Denver, Col. App. filed March 1, 1920. Remains warm after current is off.

1,377,476. CURRENT-SAVING DEVICE; William J. Hahn, Philadelphia, Pa. App. filed Jan. 20, 1920. For electric cars and trains.

1,377,477. BATTERY HAND LAMP; Carl Hambuechen, Belleville, Ill. App. filed April 13, 1917. For rough service.

1,377,492. GUARD FOR ELECTRIC HEATERS; Richard G. Ledig, Philadelphia, Pa. App. filed Oct. 31, 1919. Radiant type.

1,377,521. SIGNALING APPARATUS; Serge Oulianine, Sydenham, London, England. App. filed July 20, 1920. Selective receiver.

1,377,554. PROCESS AND APPARATUS FOR THE ELECTRICAL UTILIZATION OF MOLTEN SLAGS; Jacob E. Bloom, Brooklyn, N. Y. App. filed May 3, 1920. Manufacture of fertilizers.

1,377,555. TELEPHONE SYSTEM; Clifford C. Bradbury, Rochester, N. Y. App. filed May 16, 1910. Convertible from "call-distributing" to full automatic.

1,377,562. ELECTRIC HAMMER; Frederick W. Davey, Brooklyn, N. Y. App. filed Sept. 19, 1919. Plunger reciprocated by solenoids.

1,377,573. CIRCUIT-INTERRUPTING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Oct. 6, 1916. Circuit breaker.

1,377,639. ELECTRIC SWITCH; Clarence C. Stirling, Hartford, Conn. App. filed Jan. 14, 1920. Pendant switch.

1,377,645. METHOD OF MIXING BATTERY MATERIAL; Joseph W. Weiss, Madison, Wis. App. filed Nov. 14, 1918. Unusually close contact.

1,377,646. FLASHLIGHT OF BATTERY HAND LAMP; Arthur W. Wellington, Waterbury, Conn. App. filed Aug. 26, 1919. Improved switch.

1,377,722. ELECTRIC ACCUMULATOR; Guglielmo Marconi, London, England. App. filed March 9, 1918. Chlorine as active element at positive pole and zinc at negative pole.

1,377,728. LAMP FOR PROJECTING APPARATUS; Nicholas Power, Brooklyn, N. Y. App. filed Jan. 10, 1917. Motion picture.

1,377,806. WATER HEATER; Ferdinand J. Clifford, Pateros, Wash. App. filed April 20, 1920. For vaporizing water.

1,377,808. WINDING MACHINE; Frederick W. Cotterman, Dayton, Ohio. App. filed Aug. 23, 1916. For winding high-tension coils.

1,3777,822. TREATMENT OF IRON ORES; Frederic A. Eustis, Milton, Mass. App. filed April 27, 1920. Electrolytic iron direct from ore, without sintering or smelting.

New England States

HAMPTON BEACH, N. H.—The Board of Trade is considering plans for replacing the incandescent lamps now in use with ornamental lighting system.

SEARSBURG, VT.—The New England Power Company, Worcester, Mass., it is reported, is considering the purchase of a 7,250 hp. turbine and generator for its local plant.

SOMERVILLE, MASS.—The Boston Elevated Railroad Company, Boston, has acquired land adjoining its electric generating plant. The site will be used for further extensions to the power station.

WEST NEWTON, MASS.—The Security Mills, Inc., contemplates the erection of an addition to its mills and a power plant. The buildings will cost about $75,000.

NORWICH, CONN.—Plans for the installation of an ornamental lighting system, consisting of fifty lamps, on Main Street and Broadway have been approved by the Chamber of Commerce. The cost is estimated at $12,000.

Middle Atlantic States

JAMESTOWN, N. Y.—Plans are being prepared by the Crescent Tool Company, 200 Harrison Street, for the construction of a new one-story power plant. Louis T. Klauder, Pennsylvania Building, Philadelphia, is engineer.

LAUREL HILL, N. Y.—H. Hoffman, Inc., Clinton Avenue, plans to build a power house in connection with its new local factory, to cost about $60,000.

ROCHESTER, N. Y.—The Rochester Gas & Electric Company contemplates an extensive construction program, including the erection of a duplicate electric transmission line from Rochester to Canandaigua, a distance of 30 miles, to cost about $240,000.

SILVER CREEK, N. Y. — The Public Service Commission has granted the Silver Creek Electric Company permission to erect an electric transmission line to Forestville and to supply electricity for lamps and motors in that town.

ALLOWAY, N. J.—Residents of Alloway have agreed to finance the erection of a transmission line from Quinton, a distance of 3 miles.

CAPE MAY, N. J.—The Board of Utility Commissioners has authorized the Cape May Light & Power Company to issue $61,000 in bonds, the proceeds to be used for improvements, etc.

PASSAIC, N. J.—Steps have been taken by the Board of Trade for the installation of an ornamental lighting system on Main Avenue.

PERTH AMBOY, N. J.—The Board of Alderman has received a report submitted by Jay B. Franke, city electrician, covering a proposed addition to the municipal electric power plant to furnish power for the city pumping station and for additional street lamps. The cost of the improvements is estimated at $50,000.

ALLENTOWN, PA. — The Pennsylvania Power & Light Company is planning to erect an electric transmission line from the Hauto power plant in the Panther Creek Valley to Frangville.

ELIZABETHTOWN, PA.—The board of directors of Elizabethtown College has had plans prepared for the construction of a new power house at the institution. Kast & Kolker, 222 Market Street, Harrisburg, are architects.

FARRELL, PA.—The Council is having plans revised for the installation of a street-lighting system to cost about $30,000. Bids received on former plans were rejected. H. Whitford Jones, 1845 Rosaline Avenue, Cleveland, Ohio, is engineer.

HARRISBURG, PA.—Arrangements have been made by the Harrisburg Railways Company for the installation of two 600-hp. boiler units and auxiliaries at its South Cameron Street power station.

CLAYMONT, DEL. — The Wilmington Sugar Company will require considerable electrical equipment in connection with its proposed local sugar refinery, to cost about $1,000,000. The plans provide for a number of buildings including a power plant.

RICHMOND, VA.—The finance committee of the Council recommended an appropriation of $10,000 for improvements to the street-lighting in Hull Street.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

STAUNTON, VA.—Petition has been presented to the Council requesting that the municipal light plant be enlarged to supply electricity for commercial purposes.

North Central States

YOUNGSTOWN, OHIO. — The Pennsylvania-Ohio Company has been instructed by the Council to prepare estimate of cost of the installation of an ornamental lighting system on four streets in the city.

BOWLING GREEN, KY.—The Kentucky Public Service Company is considering extending its lines to supply light and power to Auburn and Woodburn. The cost is estimated at about $30,000.

EAST CHICAGO, IND.—The Board of Works will receive bids until June 13 for furnishing and installing electric motors and centrifugal pumps rated at 75,000,000 gal. per day for a sewer pumping system. The total cost is estimated at $131,000.

STERLING, ILL.—The Russell, Birdsall & Ward Bolt & Nut Company is considering improvements and extensions at its plant to cost about $500,000. The proposed plans provide for the reconstruction of the present



EXTENSION OF THE CORNING GLASS WORKS UNDER CONSTRUCTION

plant, new wire mill and new power plant, including the installation of a large generator and electrical equipment. The plant will be equipped for electrical operation.

MARTINTOWN, WIS.—The Lena (Ill.) Light & Power Company is considering the construction of a hydro-electric plant on the Pecatonica River near Martintown, Wis., for which plans are being prepared. The cost is estimated at $70,000. Holland, Ackerman & Holland, 106 East Liberty Street, Ann Arbor, Mich., are engineers.

REDWOOD FALLS, MINN.—Bonds have been authorized for the installation of an ornamental lighting system to cost about $14,000.

ST. PAUL, MINN.—The installation of an ornamental lighting system on Summit Avenue, to cost about $7,000, is under consideration.

CHILHOWEE, MO.—The City Council is negotiating with the Green Light & Power Company, Pleasant Hill, for the sale of the municipal electric light and power plant. The company, it is reported, is considering connecting Blairstown, Chilhowee, Urich and Windsor.

JASPER, MO.—The City Council is considering calling an election to submit to the voters a proposal to issue $40,000 in bonds for the construction of an electric light plant and waterworks.

ST. LOUIS, MO.—The Excelsior Laundry Company, Grand and Bell Streets, contemplates the construction of a power plant to cost about $100,000, in connection with a new laundry, 100 ft. x 104 ft. B. T. Kearns is president.

MONTPELIER, N. D.—The erection of a municipal electric light plant in Montpelier is under consideration. G. W. Rulon is village clerk.

SIOUX FALLS, S. D. — The Northern States Power Company is considering erecting a transmission line from Baltic to Garretson to supply electricity in the latter town and in Sherman. It is also proposed to serve farmers along the route.

Southern States

SHELBY, N. C.—The Board of Aldermen is considering an issue of $50,000 of electric light and water extension bonds.

GREAT FALLS, S. C.—The Southern Power Company, Charlotte, N. C., it is reported, is considering plans for enlargement of its local power plant.

MILLVILLE, FLA.—Bonds to the amount of $27,000 have been authorized for the installation of electric lighting and water systems.

CHATTANOOGA, TENN. — Plans have been presented to the Commissioner of Public Utilities for the installation of an ornamental lighting system on Broad Street from Sixth to Ninth Street with a similar arrangement on connecting streets between Broad and Market Streets.

MARTIN, TENN.—Bids will be received until June 15 for improvements to the light and water plant, including the construction of a power house, installation of two alternating-current generators direct connected to non-condensing uniflow or non-releasing Corliss engines, two water-tube boilers, heater and feed pumps, switchboard, piping, chimney, elevated tank, motor-driven centrifugal pumps, resetting air compressor, street lighting material, transformers, etc. Frank L. Wilcox, Chemical Building, St. Louis, Mo., is consulting engineer.

MERIDIAN, MISS.—Bonds to the amount of $600,000 have been voted for the construction of a municipal electric light and power plant.

SAYRE, OKLA.—The town officials contemplate the construction of an electric distribution and power plant. V. V. Long & Company, 1300 Colcord Building, Oklahoma City, are engineers.

Pacific and Mountain States

SEATTLE, WASH.—The city officials are planning to issue additional bonds to the amount of $5,500,000 for the Skagit hydro-electric project. The proceeds are to be used to carry on the work at Gorge Creek, to acquire or construct substations and to make changes to the distribution system in the city which will be made necessary for the delivery of Skagit energy. C. B. Fitzgerald is chairman of the council finance committee.

PORTLAND, ORE.—Arrangements have been made by the Portland Railway, Light & Power Company for an issue of $4,500,000 in bonds, the proceeds to be used for extensions to its system and general expansion.

SALEM, ORE. — The California-Oregon Power Company, San Francisco, has applied to the state engineer for permission to appropriate 2,100 sec.ft. of water from the Klamath River for the development of 70,000 hp. near the California line in southern Klamath County.

HEMET, CAL. — Improvements to the street-lighting system are under consideration.

LOS ANGELES, CAL.—Petition has been filed with the Board of Supervisors of Los Angeles County for the establishment of a lighting district to be known as the South Gate Lighting District of Los Angeles County.

PALMDALE, CAL. — Citizens of Palmdale have petitioned the Board of Supervisors for the establishment of a lighting district which will provide for street lighting in the business and residence sections of the town.

SANTA PAULA, CAL.—Plans are under consideration by the Chamber of Commerce for improvements to the lighting system on Main Street.

Canada

GALT, ONT.—The Hydro-Electric Commission is having plans prepared for the construction of a two-story substation on Dickson Street, to cost about $50,000. A. B. Scott is manager.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 63 East Adams St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West 40th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University of Bethlehem, Pa.

AMERICAN ENGINEERING STANDARDS COMMITTEE. Secretary, P. G. Agnew, 29 W. 39th St., New York City

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual convention, Salt Lake City, Utah, June 20-25.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary-treasurer, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting, Asbury Park, N. J., June 20-24.

AMERICAN WELDING SOCIETY. Secretary, H. C. Forbes, 29 W. 39th St., New York City.

ARKANSAS UTILITIES ASSOCIATION. Secretary, S. E. Dillon, Hot Springs, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New London, June 27-30.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, Preston S. Millar, Electrical Testing Laboratories, New York.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES OF ONTARIO. Secretary, S. R. A. Clement, 190 University Ave., Toronto. Annual meeting, Niagara Falls, Ont., June 23-25.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Co., Montreal, Canada. Annual meeting, Quebec, June 15-17.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, M. B. W. Baker, Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 19 West 44th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, R. H. Tillman, Baltimore, Md.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRIC HOIST MANUFACTURERS' ASSOCIATION. Secretary-treasurer, E. Donald Tolles, 52 Broadway, New York City.

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Electrical World

New York, Saturday, June 11, 1921

The Unique Economic Position of the Electrical Industry

EVERY electrical man is a booster for his industry. He believes that it is the greatest industry in the whole wide economic world. He feels that his future as an electrical man promises opportunity unparalleled in any other science, profession or trade. And he is right. It is well, however, to consider the causes and conditions of these things. It helps us work with a better background and a better prospect.

There are several kinds of industries. First, there are those that furnish the basic staples of life—food, clothes and shelter. These are the great necessities. Their market never fails. But man does not live long by bread alone, and so balanced against them we have the great, varied industries that produce the assorted luxuries of life. And in the mass their market seldom fails either, for in the world is so much wealth spent by so many people. These two groups, with the other industries of service—like transportation—that contribute broadly to them both, make up the bulk of the industrial world. Each meets and measures its own conditions for and against prosperity.

The electrical industry, however, holds a unique position. It sails a course that cuts across them all. Our product is not a true necessity, for within our memory men lived long and happily without it; and yet electric service today plays a large part in the manufacturing of necessities. Neither is it in the true luxury class, though it helps produce the luxuries. Electricity, in all its applications, is in reality just a comfort, a convenience, an economy. Be it light, heat or power, in industrial, commercial or domestic service, this is what it is. It is a comfort. It is a convenience. It is an economy. It brings safety. It brings cleanliness. It brings time saving, labor saving and improved efficiency. And it has so established these comforts and economies in our lives that they have come to be necessities, and the influence of electric service is recognized as one of the greatest impulses for civic growth and betterment.

The electrical industry, therefore, stands in a wonderful position. It has economic stability. It has already, though young in years, gained a scope and volume that indicate a future staggering to the imagination. It is organized on a high intellectual plane to which the inventive mind, the scientific mind, the engineering mind and the financial mind have contributed the background and the machinery for progress. It has prestige. It has prosperity. It has strength and power. Therefore, know more of it, have more from it, be more in it and do more for it.



Edwin Sibley Webster

Whose constructive service and financial judgment in the organization and sound development of public utilities typifies the best traits of American business leadership

GREAT financial acumen, combined with a thorough engineering training and rich experience, has long since made Edwin S. Webster one of the outstanding national figures in public utility management. Inspired by a finely tempered enthusiasm, he realized the possibilities of centralized management early in the period when it began to be seen what the co-ordinated administration of electric railway, lighting and power properties could accomplish in contrast with the individual direction of company business. Mr. Webster has never lost this enthusiasm as the magnitude of his interests has increased, and his executive ability, grasp of economics and rare banking judgment have had an influence beyond measurement in the affairs of Stone & Webster, Inc., and in the many corporations.

Born at Boston, Mass., in 1866, Mr. Webster was graduated in electrical engineering from the Massachusetts Institute of Technology in 1888. After a year in the banking house of Kidder, Peabody & Company, Boston, he and Charles A. Stone established in that city the consulting engineering firm of Stone & Webster. At this time the electrical art was still in its infancy and it took no small amount of courage to believe in the future. Many electric light and power companies as well as other utilities because of haphazard financing and for other reasons did not prosper. Reorganization became necessary and the services of this firm were sought. Today this great organization occupies a world-wide field in finance, engineering, construction and utility management. The capitalization of public utilities under its management totals approximately three hundred millions of dollars.

Mr. Webster and his partner have never been contented to confine their engineering activities within any prescribed bounds. Examples of their skill may be found in almost every state of the Union as well as in Canada, Cuba, Porto Rico and other parts of the world. Hydro-electric and steam power plants, transmission systems, electric railways, large buildings, industrial plants—all fall within the scope of practice of this organization.

An associate says of Mr. Webster: "He thinks quickest and in the biggest figures of any man I know. He is never stampeded, never 'cries over spilled milk,' knows how to make prompt decisions and how to play. His spirit of team play, modesty and a 'bully' sense of humor have won for him the loyalty of his organization and the affection of his associates and co-workers."

Mr. Webster's devotion to his Alma Mater has enriched her counsels and her plant alike. He is a trustee and life member of the corporation of the Massachusetts Institute of Technology. In his life as an engineer and public-spirited man of affairs he typifies the best traits of American business leadership.

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Supply Jobbers Preparing for "Normalcy"

THE electrical supply jobbers naturally are experiencing the same decline in business as the manufacturers. Interchange of stocks, however, has enabled them to clear their shelves and keep down new purchases to a minimum, thus conserving credit. As a class the jobbers have agreed to let liquidation run its course, feeling that the sooner normal conditions are reached the better. The years of the world war were fat ones for the electrical supply jobbers, and were they not now handicapped by war-time organizations and high overhead expense the present would not be a lean year compared with pre-war standards. However, internal organization matters are now in process of adjustment. Jobbers who take a certain pride in their business are anxious that their methods and prices shall conform to normal standards. When, therefore, they are accused of holding up prices they naturally resent it. The manufacturers, they claim, have only reduced the prices of motors and heating appliances 10 per cent, and while the pig-iron base is at present $20 a ton, compared with $50 a ton during the war, rigid conduit has come down only 17 per cent. Manufacturers, however, have in the main written off inventories to present price levels, but with the exception of copper few of these have returned to normal. Certainly manufactured products may be expected to reflect reductions in prices of materials and labor promptly. The enlightened business sense shown by the electrical supply jobbers in the present emergency is worthy of commendation. The war has served to set their business on a firmer foundation, and if we judge the temper of the jobbers aright, they will do nothing to weaken it.

The Public's Interest in Utility Development

WHY should the citizens of the United States, of whom one in eighty is a direct investor in the securities of electric light and power companies and two billion dollars of whose money has gone by way of insurance companies and banks into these same securities, grudge to the companies a reasonable degree of prosperity—that is to say, a fair return under present-day conditions on the actual capital invested and to be invested? This is the question which James A. Perry, president of the National Association of Railway and Utility Commissioners, speaking before the Chicago N. E. L. A. convention, answered when he ascribed public hostility to lack of information. Misled by agitators who, if honest, are equally misinformed with those to whom their appeals are addressed, Mr. Perry finds that many citizens cherish an attitude of unreasoning opposition to the utilities resembling that which confronted the railroads before the war brought the enlightening experiment of government control. "We seldom hear of a municipality," he said, "making an investigation and ascertaining whether there is any merit in the claim of the utility company. Investigations are seldom made, little information is had, and seemingly none is desired." We hope that this attitude is not so widespread as Mr. Perry fears. There are certainly some communities where it does not prevail because the remedy has been applied and the citizens have come to realize that the electric light and power industry is a "wage-earning" and not a "speculative" business and that its wages, which is the true meaning of the return it receives, must be adequate if it is to give those it serves the ever-increasing supply of electrical energy that means so much to domestic comfort, industrial prosperity and community progress. "Audacity, again audacity, always audacity!" was the motto of a famous revolutionist. "Education, again education, always education!" might well be that of our industry.

Sam Robinson Ready to Be Convinced

A DIFFERENT point of view from that of Commissioner Perry, though not a contradictory one, was put before the N. E. L. A. convention last week in racy sentences by Harford Powel, Jr., the editor of *Collier's Weekly*. The two addresses will be found in part elsewhere in this issue and should be read together. Mr. Powel visualized the average citizen in his relation to the electric light and power industry as consumer, taxpayer, voter and investor. He waved out of existence the vague entity known as the public. Customers, he observed, were no more the public than the electric men to whom he was speaking were the public. Instead of a public safeguarding its rights against imaginary rapacious corporations, there is merely a nation of Sam Robinsons, all interested in electricity, all wanting to use it, all resenting company carelessness and condescension. These Robinsonian multitudes are willing to treat fairly those other Sam Robinsons whose business it is to make electricity and sell it, and they will with their billions of savings finance the industry, provided that—and here Mr. Powel's line of thought and Commissioner Perry's converge—the facts are brought home to them. Mr. Powel's argument, then, is one for continuous publicity. True, one form of publicity—the furnishing to newspapers of matter for gratuitous reproduction—may, as the editor-speaker graphically demonstrated, fail in large part unless quality rather than quantity is its distinguishing characteristic. None the less, advertising is indeed industry's breath of life and cannot be suspended or limited to stated seasons without inviting disaster.

N. E. L. A. Prime Movers Report Is a Noteworthy Work

THIS year the report of the N. E. L. A. prime movers committee, abstracted in the issue of June 4, rose to the proportions of a treatise of more than 350 pages. It is full of material of value to the engineer, but the most that we have done or can do is to direct attention to certain parts of it which seem of exceptional value. The chief emphasis must, of course, be laid on the progress in prime movers. There is a tendency toward higher working temperatures and higher speeds, which means working still further toward the limitations imposed by the various materials. How far bearing pressures can be raised without getting into trouble remains to be seen. Until new material for blades has been discovered it is not yet clear what peripheral speed can be endured. Another problem is that with rising temperature there comes increasing difficulty with lubrication.

An interesting development is to be found in the Ljungstrom turbines, in which the steam flows radially outward, expanding between two bladed rotors revolving in opposite directions, and having therefore a relative speed which is double the actual rotative speed. The principle involved has been repeatedly used for various purposes, sometimes without sufficient justification, but in the instance here considered the plan would seem to be amply justified for trial on a considerable scale. Especially is this true since the past few years have shown the great difficulties in properly proportioning and balancing rotors to stand the peripheral speed they have to endure in service, combined with temperatures near the danger point.

It seems to be the feeling of the committee that both higher pressures and higher temperatures are coming. Even now recent plants are working to final temperatures between 600 deg. and 700 deg. Fahr. How much beyond the latter figure one can go without passing the danger point for available materials is not certain, but the limit is sufficiently well in sight to encourage a tendency toward high steam pressure. The present limit of about 350 lb. per square inch is likely to be exceeded before long. In this connection comes an interesting possibility in the way of reheating between stages after the initial temperature has so fallen that the addition will not rise to an inconvenient degree. The principle is well worth trying out, and it is reported that one of the new European plants will be equipped with this in view.

Pulverized fuel has also had considerable attention from the committee. In particular the Milwaukee Electric Railway & Light Company has put in operation a new plant which will have an ultimate capacity of 200,000 kw. The experimental results obtained with this and other plants indicate that the boilers can be pushed to high efficiency and work uniformly and well. Something, of course, depends on the kind of fuel used, with reference to its preparation for burning. It seems to be clear that by the pulverizing process it is possible to deal with widely varying grades of fuel in the same furnace without some of the difficulties commonly found in burning them on ordinary grates. Certain grades of coal now not easily adaptable for firing can be successfully used as powder, and finally there is the additional possibility of working almost interchangeably in the same plant with fuel oil, powdered coal or even gas. As experience is gained with the use of pulverized fuel there is an excellent chance for working in low-grade bituminous coals and lignites on a considerable scale, and the process may prove particularly adapted to so-called mouth-of-mine operation. If the fuel can be pulverized at the breakers, its transportation over moderate distances is a comparatively simple matter involving less handling cost than is required by coal used as fuel in the ordinary way. One of the outstanding difficulties is the unpleasant tendency of ash to go up the stack in rather large quantities. This, however, is a detail which can doubtless be taken care of in due season.

Graphical Solutions for Alternating-Current Problems

THE theory of the general alternating-current transformer, of which the theory of the induction motor is a special case, has been treated for many years on two different lines. Both methods of treatment started with the same premises, using vector diagrams or polar diagrams for the representation of the electromotive forces, fluxes and currents. The analytical method then expresses these diagrams in the form of complex algebra and obtains values for the quantities involved by an evaluation of algebraic equations. The graphical method, starting with the same geometrical diagrams used in the analytical method, attempts to find geometrical loci for the electromotive forces, fluxes and currents, thus making it unnecessary to express in complex algebra the quantities represented in the vector diagrams.

The contributions which Dr. A. S. McAllister has made from time to time to the theory of alternating-current motors have always been marked by a degree of refreshing originality which has aroused interest in them and which has commended them to the attention of the student, the teacher and the engineer. The contribution from his pen published in this issue is no exception to this statement. He deals in a vigorous manner with a problem that many writers in the last twenty-five years have endeavored to solve and yet have failed to solve in so simple a manner as is here done by Dr. McAllister. The principle of the McAllister transformations is by no means new, as it is the transformation by means of inversion or "reciprocal radii" used for many years; but it is most strange that those who have used this method for years have failed to see that it is possible to find for each particular case of the transformation a "center of inversion," from which at a glance the diagram can be transformed into one taking account of such change in the arrangement of the circuits as has to be provided for to cover qualifying assumptions usually neglected in the general theory.

The McAllister transformations supply in a very simple and direct manner solutions for the following problems: (1) What is the effect of primary resistance placed in series with an induction motor, the potential being kept constant at the point where the resistance is connected to the line? (2) What is the effect of primary reactance placed in series with an induction motor, the potential being kept constant at the point where the resistance is connected to the line? (3) What is the effect of primary impedance placed in series with an induction motor, the potential being kept constant at the point where the resistance is connected to the line? (4) What is the effect of a shunt of either resistance, reactance or capacity placed in multiple with the

terminals of an induction motor with additional resistance, reactance or impedance in series with the motor? (5) What are the secondary voltages and secondary currents in a transformer or induction motor under different conditions of load under any or all the conditions mentioned above?

Dr. McAllister's paper appears to us to be a production of exceptional merit, all the more so because of its simplicity and of the fact that electrical literature, rich though it is in publications of a similar character, seems to us to have ignored this solution which is now for the first time presented to the engineers interested in alternating-current phenomena.

Engineering the Basis for Greater Lighting Sales

THE Commercial Section of the N. E. L. A. by no means confines itself to matters of salesmanship. We have learned to expect from it material contributions to the engineering problems daily faced by the central station. The engineering basis of good lighting is the foundation for lighting sales, and the report of the Lighting Sales Bureau at the Chicago convention makes this fact doubly evident. Two lines of advance in particular are marked out in this report, one the directly industrial phase of lighting and the other the lighting of the home. As regards the former matter, evidence is accumulating month by month, and rather rapidly at that, to the effect that improvement in lighting directly and definitely pays in production, not only in the quantity of things manufactured but also in their quality and in the better morale of the workers. Over and over again it has been found that the introduction of a new lighting system has meant definite improvement in output, but the facts have seldom been put more forcibly than in one of the cases cited in this report. An example was taken from a spinning room where the lighting initially was about on the basis which was common among economical engineers twenty years ago, to wit, 1.5 foot-candles. A new system was installed which pushed the intensity up to 9 foot-candles, and the immediate result was an increase of output of 18 per cent. The speed of the machines was not, and could not be, increased, so that this gain simply represented the added efficiency of the operator in rapid work when hand operations were required on the machine. This experience not only bears out the general principle of improved output but also shows directly that the effect was due to the improved time element in working produced by higher illumination. It is one thing to see the detail in a machine which requires attention; it is quite another to see it well enough and quickly enough to put things to rights in the shortest possible time. It is only recently that this time element of vision has been given attention, and the more it is studied the more plainly it will be demonstrated that illumination just sufficient for vision without eye strain is a very different thing from the illumination which produces that facile vision which tends to efficiency.

The second matter, that of house lighting, is treated briefly but in an exceptionally effective way by actually showing the methods to be adopted, the fixtures to be used and the outlets to be provided in a typical small house. There was a time in the fortunately distant past when it was the practice of many central-station operators to look on residence lighting with contempt and to read papers proving that it never had paid and never could pay except at enormously increased prices. That idea has subsided under the pressure of facts, and its exponents do not attempt any further propaganda, realizing that if residence lighting appears not to pay, it is simply because it is mishandled. The special feature of the typical lighting layout recommended by the committee is the large number of convenience outlets for use with appliances or extra lamps. Their number is almost a third of the total, and experience today indicates that such a proportion is not in the least overdoing the matter. An outlet of this sort may be unused for several years, but some day it is wanted and wanted badly. If not provided at the start, it is a troublesome and expensive matter to supply the need later.

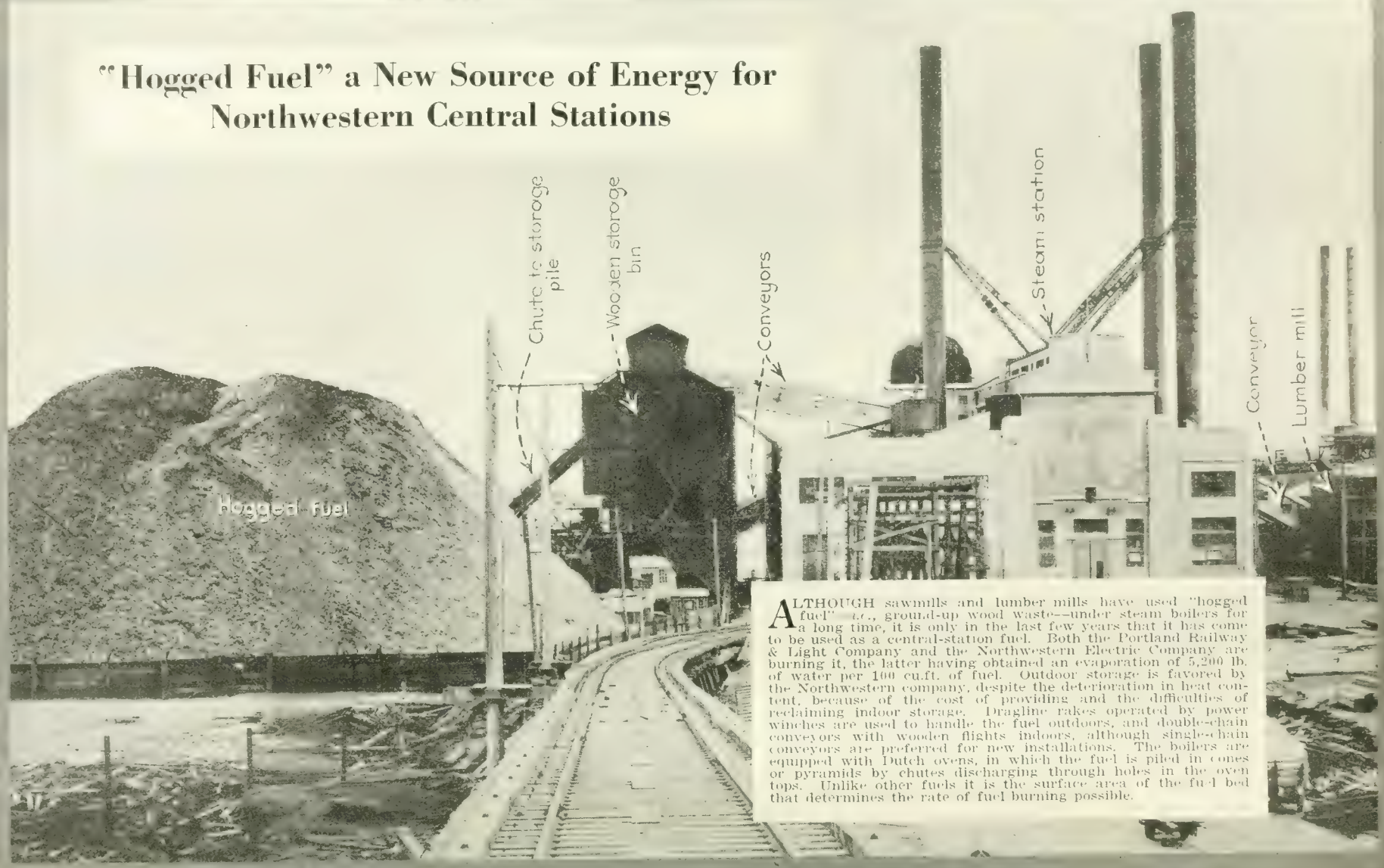
The great problem of putting electricity into the houses of the people at large turns on the introduction of easier and cheaper methods of wiring. We have been for some years tied up in this respect by propaganda and convention, and the result is disastrous in the older communities where one must go beyond the limits set by new building and find some means of wiring the dwellings already in existence at a reasonable price. We hope that the N. E. L. A. will take up actively this particular phase of increasing lighting sales and find means of relieving a trying and awkward situation.

Electric Energy Should Be Sold and Not Loaned

IT IS generally admitted on all sides that any customer who takes alternating-current power at a low power factor thereby injures the service of all his neighbors and should have to pay at a definite extra rate. Various plans have been suggested, or may already be in operation, aiming at an equitable surcharge for low power factors. One method is to have a basic rate on active energy and a surcharge rate on reactive energy, so that two meters are installed on the customer's premises, one for the total active energy consumed and the other for the total reactive energy. Another plan is to measure the power factor at a time of maximum load and make a surcharge upon this power factor if it falls below a certain percentage value. This week M. L. Sindeband describes a rate schedule based upon, say 85 per cent power factor as the normal. If the customer develops a lower average than this, the rate per kilowatt-hour of active energy consumed is increased in approximate inverse proportion, whereas if the average power factor of his installation increases, his energy rate is reduced. Moreover, automatic cut-out relays are installed on the premises, to disconnect the service if a steady overload occurs, either by reason of increased consumption or of reduced power factor, so that the customer's attention is speedily directed by this means to the source of trouble.

The proper business of an electric service company is to sell electrical energy and not to loan it. Lamps, heaters, etc., operating normally at 100 per cent power factor consume electrical energy outright. However, all motors require to be magnetized as well as to be fed with energy, and alternating magnetization calls for the loan of electric energy at each alternation of current. The loaning of energy represents power—*i.e.*, reactive power—being directed outward and inward in rapid succession. No electric service system should be expected to loan energy without charging for it, because the loaning business is a drain upon the conductors, the transformers, the generators and all the system.

"Hogged Fuel" a New Source of Energy for Northwestern Central Stations



ALTHOUGH sawmills and lumber mills have used "hogged fuel"—*i.e.*, ground-up wood waste—under steam boilers for a long time, it is only in the last few years that it has come to be used as a central-station fuel. Both the Portland Railway & Light Company and the Northwestern Electric Company are burning it, the latter having obtained an evaporation of 5,200 lb. of water per 100 cu.ft. of fuel. Outdoor storage is favored by the Northwestern company, despite the deterioration in heat content, because of the cost of providing and the difficulties of reclaiming indoor storage. Dragline rakes operated by power winches are used to handle the fuel outdoors, and double-chain conveyors with wooden flights indoors, although single-chain conveyors are preferred for new installations. The boilers are equipped with Dutch ovens, in which the fuel is piled in cones or pyramids by chutes discharging through holes in the oven tops. Unlike other fuels it is the surface area of the fuel bed that determines the rate of fuel burning possible.

The Public Viewpoint

An Analysis of the Average Man's Conception of the Electric Light and Power Industry, in Which He Is Interested Because He Is a Consumer, a Taxpayer, a Voter and an Investor

By HARFORD POWEL, Jr.
*Editor "Collier's Weekly"**

YOU are getting strongly interested in what people read. You want them to read your story. You want them to connect their houses with your factories. You want them to flood their houses with light. You want your average customer, Sam Robinson, to use all the various devices and appliances that make life easier and less laborious, that do for Mrs. Robinson today what it took a small army of servants to help her do in the past.

Well, gentlemen, yours is not a hard service to sell. But you want people to go farther still; you want them to support your industry with their investments. You want them to study the facts before they pay attention to the ill feeling that now and then springs up—not against you alone, but against every man and group of men who supply some service or commodity for money. So you are interested in what people read. You are beginning to speak to them through the printing press. You are not so silent as you were a few years ago.

You believe that the public should have the facts, and you believe that when the facts are before them you will receive in every city and village in America the squarest kind of a square deal.

And you will receive it. You will have more demands for your service. You now supply with electricity six million and a half of the twenty-one million homes in America. That's a fair beginning. Nobody in his senses thinks that is more than a beginning.

Fourteen Million Houses to Supply

You have more than fourteen million houses to supply—houses now standing. And before you finish that little job, there will be built a million and a half new homes to take care of the housing shortage, five thousand new schools, sixty thousand new apartment houses, fifteen thousand new theaters. But never mind the future. Right now there are five million unwired houses within reach of existing electrical supply stations. You have got about half way through your job of supplying light to the householders; and now you expect to finish the job.

To do it, gentlemen, every one knows you need money.

You need it in such large amounts that you are out of the class of the average business man who can borrow it from a banker or group of bankers.

You have to go direct to the only bottomless well of money that exists in the world—the little pools of people's savings—those little pools, million after million, through which trickles all the wealth there is in America. For that's where the big money is. It is the only place where it is. You won't get the four billion dollars you propose to spend before 1925 out of the vaults of banks and insurance companies alone. You must look for it in the family sock. You must coax it out of grandmother's purse. You must show the workingman cause when you ask him to take it out of his pay envelope and lend it to you. The four billion you need for expansion is partly in the merchant's cash drawer, partly in what mother has saved out of her housekeeping money, partly in what Sam Robinson and Pat Murphy and Ole Johnson have laid by for a rainy day.

That's what you are talking about the minute you start talking about billions of dollars. And there's no half-way measures about it. Either you'll get that necessary money or you won't get it. Either you'll move forward or you'll slip back—for in no business is there such a thing as standing still.

Advertising Must Be Continuous

Every one who reads newspapers and magazines knows that you are doing far more advertising than you have done and are making a serious and intelligent bid for public interest and public good will. It is not wise to think of that, or to speak of it, as an advertising campaign. There is no such thing. You can accomplish anything by advertising. You can accomplish nothing by an advertising campaign.

Either you advertise or you don't advertise. The word "campaign" is too limited to describe this thing. You might as well speak of a "breathing campaign" or an "eating campaign." You can stop breathing and let your lungs rest—but more of you will soon be at rest than your lungs.

Do not think of advertising as something to be done by fits and starts. Don't think that a campaign started and finished this year will produce a finished and final effect. If you have any such idea, take twenty deep breaths right now and then try to stop breathing till lunchtime. Some old minister went to Billy Sunday and day and said, "You're a fake. You get people all stirred up. They hit the trail. But your conversions don't last." "Well," said Sunday, "neither does a bath."

You are making conversions by your scraping our chins every morning and expect them to last. We have all been scraping our chins every morning for years—but the effect does not last. Advertising is like that. It is a matter of repetition. Of convincing a man once and convincing him again. Say it. Repeat it. Then repeat it again. The human mind wabbles. Keep it wabbling your way.

This has nothing to do with the amount of money you spend. It depends entirely on how you lay that money out. You have a great story to tell—the finest, I think, in the world. You have a great service to sell. You have a chance to make America happier, better educated, better knit together. The one great circuit you propose to build will have a lot to do with breaking down arbitrary lines of feeling between districts, states and cities. You are expanding the city limits every-

*Paper read before the National Electric Light Association Convention, held in Chicago last week.

where, so that the farmer feels he is part of the community and not merely a sort of Robinson Crusoe on an island cut off from civilization.

Of your advantages, every man in the room is better qualified to speak than I. People are well disposed to you. They are alive to the fact that after long silence you have at last started to speak to them. They know they need your service. Sam Robinson knows he needs it. People in his town who haven't got electric light envy Sam because he has got it. Your salesmanship this year will fall upon as fertile soil as ever it has fallen in the past.

You have not suffered from the ills that have recently beset most industries; you have few bad debts to write off and few inventories to write down; your business as manufacturers of electricity has not greatly decreased in volume, and you are now getting the benefit of declining costs.

Are there any handicaps at all in your way?

Indifference Loses Customers

You supply a great service and you know it. Be reluctant to feel that you are doing a customer a favor by supplying him with light or power. He is doing you just as big a favor by allowing you to supply him. He resents even a trace of indifference or of arrogance. Public utilities lose very few customers when they put their rates up. They lose many customers whenever they fail to furnish service and courtesy.

Your customer's income may be small. He may be shabby. He may be tired, cross, unreasonable. But he resents any coldness or carelessness on your part, just as you resent it from any merchant with whom you deal. You're a mighty industry, getting bigger and more prosperous all the time. He's just little Sam Robinson. But he's the fellow who in the long run breaks any industry, any government or any religion.

Don't think of Sam Robinson as "the public." You are just as much "the public" as he is. If we could get those two vague words "the public" out of our systems, we'd all take a giant step forward on the road to law and order and peace and prosperity.

Individual Counts Most

It's the little things that look largest to the individual. It's the individual who in the long run looms largest with you. Study Sam Robinson—don't worry about the public. Serve Sam Robinson—the public can take care of itself. Watch out for Sam Robinson when he first comes to see you. First impressions count. Have you enough help in your office so that Sam doesn't have to wait. He likes to wait just as much as you do.

It was Marshall Field who first impressed on his people this slogan, "The customer is always right." No store of that grade, big or little, will let even one customer get away unsatisfied. If she's honestly disappointed, she always gets her own way, even though she carries her complaint to the proprietor of the store. Sentimentality? Blarney? Waste of time? No. Simply common sense. For one injured man or woman, with a free swinging tongue, can hurt you more than a hundred satisfied customers may help.

Where do the agitations for lower rates—rates that are unfair to you and your employees and your bondholders—come from? Do they come from people who have analyzed their bills, and studied your annual statements, and inspected your methods of operation? Not a bit of it. Agitations are sometimes led by professional experts in that line, but the rank and file are people who want a chance to show some big corporation where it gets off and that they are as good as it is. We can forestall that feeling by making people realize that we know they are as good as we are. In our contact with them, we can avoid two deadly sins. One is carelessness. The other is condescension.

I don't know whether your scientists—and you have the best brains of American engineering among them—are at work on improving the meters you use. They are instruments of precision. They measure current to a hair. If they make any mistakes at all, it is in favor of the customer. Sam Robinson has an idea you could still improve this instrument.

I think that eventually—very gradually of course—those 1898 meters can be withdrawn from 1921 homes, and that the great electric supply houses will co-operate with you in making and installing something that will give the public more confidence in themselves and in you—something that will measure your "juice" just as openly and clearly in dollars and cents as the taximeter measures transportation or the cash register accounts for cash. Old stuff, I know.

Use of Publicity Matter

What I have here is an awful example of publicity gone wrong. This scrap basket was loaned to me by one of Chicago's evening newspapers It contains the daily grist of "publicity matter" that comes to that one paper. Those sheets, gentlemen, are the earnest work of press agents from coast to coast. Do you suppose the writers know how much of it there is? Today is Thursday. There was just as much yesterday. There will be just as much tomorrow. And every paper in Chicago—every paper in America—gets it every day. It's a full day's work for one man to read it through from end to end. This press material on the floor—all cheerfully labeled "for release June 1"—aggregates just over a thousand columns, or enough to fill solid all the four papers in this city tonight.

The time has come to give the newspapers only what they can use. What they want, of course, is news—and news that will interest as many people and as many different kinds of people as possible. They like variety, they like to get news the other papers have not been able to get. But I am not going to venture on any analysis of publicity of this kind.

Let me tell you why Sam Robinson is really interested in you. Let me tell you why he'll read your advertising and actually search the newspapers for news about you. Let me tell you why Sam thinks about you more than he thinks about other manufacturers. It's because Sam is interested in you in four ways:

He's interested in you as a consumer.

He's interested in you as a taxpayer.

He's interested in you as a voter.

He's interested in you as an investor.

There are the four ways Sam Robinson looks at you. There are your four roads to his heart. And let me tell you this, and I tell it to the everlasting honor of the American people—when Sam makes up his mind that a man is square and right, that a business is square and right—why, then Sam sticks with it through thick and through thin.

Treat Sam Robinson fairly, gentlemen, and he'll play fair forevermore with you. You know whom I've been referring to as Sam Robinson, of course. Lots of people call him Uncle Sam.

Substations for 110-Kv. Transmission Lines in France

Energy Delivered from Hydro-Electric Station in Switzerland Is Made Available for French Industry —Substation Apparatus Partly Out of Doors

BY M. A. HENRIOD
Electrical Engineer, Paris, France

THE principal features of the transmission-line design and construction adopted for the transfer of hydro-electric energy at 110 kv. from Goesgen, Switzerland, to substations at Delle and Pouxeux were discussed in the ELECTRICAL WORLD for April 30 in considerable detail. The discussion is completed in this issue by a brief treatment of these two principal substations on French soil.

Switch Racks.—In order to make inspection easy and to permit quick location of troubles, switch racks have been erected at Bavilliers, Plancher les Mines, Severance and Rupt, dividing the line in sections of about 13 miles (21 km.). These switch racks are provided with three aërial disconnecting switches which can be operated from a walking platform. Close to each switch rack a little house for the watchman and material storage was built.

Pouxeux Station.—At Pouxeux the line is connected to an electrolytic lightning arrester mounted out of doors, as shown herewith. Then the line enters the substation of the Compagnie Lorraine d'Electricité and is connected to the buses through a choke coil and a circuit breaker with remote control. Potential and current transformers are supplied for the control circuit and measuring apparatus.

Delle Station.—This station is the terminus of the line coming from Goesgen and is the connecting point between the Swiss line to the French line. The building was erected 1,600 ft. (490 m.) from the border and is so arranged as to permit an extension in the future. It is equipped with 110,000-volt devices, which allow the power stations of Goesgen and Vincey (the steam power station of the Compagnie Lorraine) to be run in parallel. It is also equipped to cut the circuit under load and to record the passing energy.

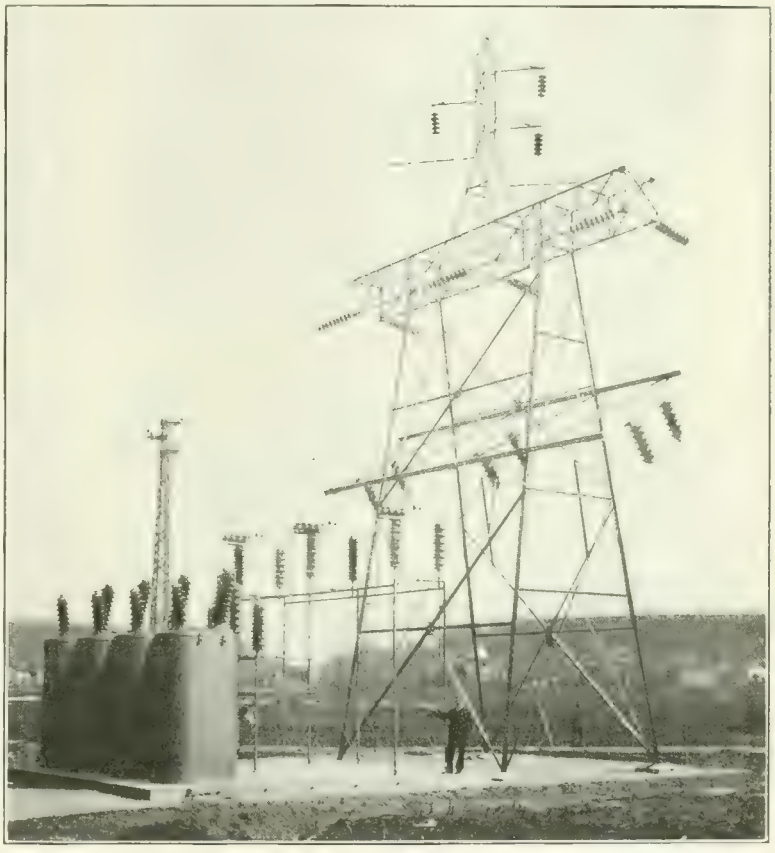
Before entering the station the lines are protected with choke-coils and have three horn-gap lightning arresters. A 10,000-ohm resistor made up of cylinders of "Koppat" is connected in series on the last string of insulators and used as a "bumper." All these devices are mounted out of doors on a steel structure which is the dead-end of the line. The conductors enter the station through special bushings secured at the center of a glass plate 5 ft. (1.5 m.) square and protected by a reinforced-concrete shed.

The top floor is reserved for the choke coils, disconnecting switches and the fuses of the measuring transformers and does not have any apparatus involving oil. The grounding resistors (Brown-Boveri), which are also used as potential transformers, are installed on the main floor with the current transformers and circuit breakers.

The connections in copper tubing are carried, as are the disconnecting switches and fuses, on insulating columns of "Bituba" 3 ft. (1 m.) high. No walls have been provided between phases, but precautions have been taken for fire protection. The circuit breakers are in closed rooms which the wires enter through wall bushings. Furthermore, under each apparatus in an oil bath a drain is provided.

The closing of the circuit breakers is operated by a direct-current motor. The tripping is operated by relays directly connected on the high-tension side, but the mechanism can be operated by hand in case of emergency. The control circuit is provided with lead-covered cables laid in the floor and connected to the main board carrying switches, operating devices, measuring and synchronizing apparatus. A similar arrangement is provided for the auxiliary service with the switchboard in a room directly beside the operator's apartment. There is a small storage battery with its charging devices on the second floor.

A private telephone line connects the Delle substation with the Pouxeux substation and touches each switch rack. The telephone communications with Goesgen in Switzerland are made in Delle by the government telephone administration.



ELECTROLYTIC LIGHTNING ARRESTER INSTALLED OUT OF DOORS

It should be mentioned also that the parallel operation of the power station of Vincey with the hydro-electric power station of Goesgen causes no difficulty at all, although these power stations are 140 miles (225 km.) apart.

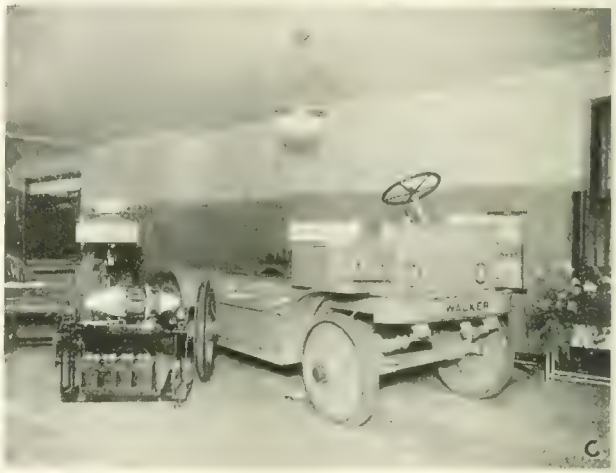
As the transmission line route on French territory passed through the war area, the design was made in accordance with the orders of the War Office, which offered the help of the military personnel in the work of erection. The Swiss section was built by the Société Motor, helped by the water-power department of the French War Office in obtaining the material.

Chicago Holds Successful Vehicle Show

At the Electric Shop of the Commonwealth Edison Company last week the public as well as the executives attending the N. E. L. A. convention had an opportunity to see the progress that has been made in battery transportation. In A are shown charging panels; batteries and road trucks in B and C; pleasure cars in D; industrial tractors in E, and accessories in F and G.

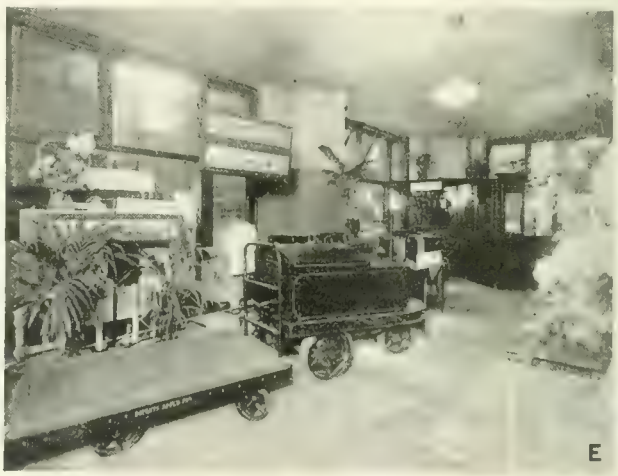

A


B



C


D


E


F


G

New Era Dawns for Electric Vehicle

Appreciation of Service Achievements and Possibilities Reflected in National Thought and Action—Leaders of the Industry Indorse Economic Battery Transportation

A NEW day has dawned for the electric vehicle after a period of sub-normal appreciation of its economic capabilities. Lukewarm interest and indifference have been challenged by progress. Faith in the superiority of battery transportation within its proper field and perseverance in demonstrating the inability of gasoline and animal transportation to dominate short-haul urban service have been rewarded. The line of new installations is rapidly lengthening, and many of the foremost men in the industry are standing up to be counted as believers in the electric vehicle opportunity. Actual service achievements are convincing the business world that electric road and industrial trucks and passenger cars must be reckoned with as tried and successful transportation agencies within a broad and profitable field of usefulness. Manufacturers are keenly alive to service needs, and central-station companies are awakening to the extraordinary value of the battery-charging load.

New Enthusiasm Aroused

At the Chicago convention of the National Electric Light Association last week the electric vehicle went "over the top" and carried the first-line trenches of that ever-present enemy of progress—uninformed indifference. Men like Samuel Insull, John F. Gilchrist, Milan R. Bump, E. W. Lloyd, Joseph B. McCall, W. H. Atkins, Arthur Williams, W. W. Freeman, John W. Lieb, F. W. Smith, W. H. Blood, James H. McGraw and E. S. Mansfield do not align themselves with losing causes or champion hopeless ventures. These and three hundred other supporters of electric transportation were in the front line of attack in what was well declared "the greatest electric vehicle meeting in history," and the impetus given at Chicago to electric vehicle progress through the convention, the fine show at the Electric Shop of the Commonwealth Edison Company and the working exhibit of service trucks and cars on the streets and in the industrial plants of the city will not soon subside.

Henceforth the advance of the electric vehicle is to be based upon a higher grade of application engineering than has often been displayed in the past. By the intelligent selection of improved equipment better installations will be made. The "electric" of today, as Arthur Williams pointed out in his able paper before the Commercial Section at Chicago, is not the car of ten or twenty years ago. In every feature of construction and equipment, from battery to motor through to each part, including steering gear and frame, there have been many decided improvements. The manufacturers are becoming increasingly united for far-sighted, co-ordinated field work. They are undertaking a careful study of transportation conditions, and it is desirable that central station and industrial engineers work with them. As a part of this effort they are planning to sell their product on a scientific basis, and a committee was recently appointed, having a membership of some of the ablest men connected with the industry, to prepare an electric vehicle sales manual. In this will be pointed out the best field of application and the best selling arguments. Other questions looking to a larger public development will also be considered.

The Chicago show, which extended from May 26 to June 4, was the first purely electric-vehicle display ever held in that city. Thirty-one exhibitors occupied about one-sixth of an acre set apart in the great Electric Shop of the Commonwealth Edison Company, and not a few others sought space too late. Road trucks, pleasure cars, charging apparatus, batteries, motors, industrial trucks, tractors, trailers and accessories were advantageously displayed under the direction of L. T. Carpenter of the Commonwealth company. As a result of the shows held in New York, Chicago, and Newark, N. J., fifteen or more shows are likely to be held next year.

A significant movement is in progress at Chicago under the auspices of the Board of Education's public continuation school to provide training in the fundamental principles and practical operation of storage batteries and electric vehicles. The course consists of sixteen lessons given by R. Macrae, electric vehicle engineer of the Commonwealth company, two three-hour sessions a week being held.

Edison's Message of Optimism

One of the features of the N. E. L. A. convention was the reading by Samuel Insull at the electric vehicle meeting referred to of a letter by Mr. Edison which said: "I am pleased to hear that the electric vehicle for city traffic is receiving more attention lately from the electric lighting companies. Any merchant who keeps accurate costs will buy electrics." This latest indorsement by the great inventor, who has long been interested in the advance of this branch of the industry, was welcomed as an expression of encouragement and opportunity.

More than 4,000 electric vehicles are now in service in Chicago, 90 per cent of the trucks being on Commonwealth Edison lines and yielding a revenue of above $400,000 a year to this central-station company. The American Railway Express Company now operates 1,284 electric trucks, representing 52 per cent of the fleet owned by this organization. More than 50 per cent of the electric trucks in the United States are operating in the New York district, and the sales of electric trucks in New York in 1920 represent a 300 per cent increase over 1919. In the last six months of 1920 Chicago sales of electric road trucks increased 15 per cent and of industrials 25 per cent. It is estimated that electric vehicles now in service consume 200,000,000 kw.-hr. annually, representing, at 5 cents per kilowatt-hour, $10,000,000.

Figures like the above emphasize the economy and reliability the service electric vehicles are yielding. It is interesting to note that electric equipments are

long-lived under reasonable care. Not long ago, says Arthur Williams, a maker of gasoline trucks advertised very extensively that forty-eight of his first fifty vehicles were still in service after eight years. Such a record is one to boast of in considering the life of a gasoline truck, but it is young indeed in comparison with the vital statistics of "electrics." On Jan. 1, 1921, of the 4,362 electric trucks used in New York City one year or more the age classification was:

Number	Age in Years, Each	Number	Age in Years, Each
[illegible]	[illegible]	221	12
[illegible]	20	980	10
[illegible]	18	1,180	8
[illegible]	17	2,118	6
166	15	2,899	4

In the electric vehicle the central-station company has an opportunity for the development of an exceedingly profitable business. No additional investment to handle 75 to 90 per cent of this service is required in generating equipment, transmission lines, feeders or secondary distribution apparatus. The greater portion of the energy sold for electric vehicle operation is produced off-peak. As garages for this class of service are usually near the business district, existing distributing systems are generally adequate.

Does Work at Less Cost per Unit

F. J. Bridges of the Hydrox Company, Chicago, said recently that his experience showed the electric vehicle to be the best transportation agency for 30-mile to 35-mile service, operating costs being as low as by horses and the service better. The congressional commission report on mail handling declared in February, 1921 (Senate Document 416), that the use of electric trucks in New York will save annually over $200,000. A comparable service test by the Westcott Express Company, New York, under the direction of C. C. Lambert, general manager, showed that a 3-ton electric truck eight and one-half years old handled 3,294 pieces of baggage at an operating cost of $107.88, while a 3.5-ton gasoline truck six and one-half years old handled 3,296 pieces at a cost of $226.57. Drivers' wages were not included, as these would have been practically the same in each case; and depreciation, which would have been lower with the electric, was also omitted.

John W. Lieb, vice-president New York Edison Company, pointed out not long since that the electric vehicle should function effectively in reducing the wide gap now existing between the cost of wholesale production in the factory and the retail selling price. Business has effected improvements lately in internal transportation but is far behind on external delivery economies. The cost of delivery from trunk-line terminals to the consumer is generally a much greater expense than the whole freight cost from the factory to the trunk-line terminal. Vast improvements can be made in city haulage. Duplication of routes can be avoided and better schedules worked out in which the electric truck should play an important part. John F. Gilchrist of the Commonwealth Edison Company, Chicago, is another believer in the economic value of the electric vehicle within its field of useful service.

Brighter Skies Ahead

E. S. Mansfield of the Boston Edison company, chairman of the Electric Vehicle Bureau of the N. E. L. A. and long a hard worker in the cause of transportation by vehicles charged with central-station energy, stated to an Electrical World representative that the outlook is excellent today for a sane and consistent development. In the past there has been a tendency to expand the use of both passenger and commercial electrics into fields and to an extent for which they were not designed or are not adapted. Many of the apparent failures are due to this cause. The "electric" has a limited sphere of action and should be confined to its own field, he said, but within this field its usefulness is practically unlimited and the possibilities are great.

Mr. Mansfield believes that a closer working understanding between the manufacturers and the central-station companies must be accomplished. The manufacturer must realize that the central-station companies' transportation service requirements are not fundamentally electric, and he should not try to force electric vehicles upon them. The manufacturer has a right to expect, however, that the central-station company will assist in selling electric transportation to such of its customers as can benefit thereby. In time the experience of such customers will in turn tend to create in the central-station company a desire to use "electrics" in the latter's transportation system under favorable conditions.

"Every central-station company," said Mr. Mansfield, "should have some one in its organization sufficiently informed in electric transportation to be able to advise its customers impartially on such questions as they arise. The manufacturers' agents, on the other hand, should work in sympathy with the utility power salesman for the building up of the power load. Garages and service stations should be established in all centers where individual installations may be cared for until plants of sufficient size have been secured to permit of the establishment of private garages. The garage and rate committee of the bureau has plans under way to provide building plans, details and costs of equipment and operation, rates and revenue to be obtained, based on actual experience for a model garage, so that a central-station company, manufacturer or private investor may know in advance the probable result of such an investment.

To Have More Exhibits

"Electric vehicle exhibits are of great value in stimulating interest among ourselves and, by educating the public, in creating a larger market for the electric. A committee has been appointed and is actively at work in an attempt to increase the number of electric vehicle shows, several of which have already been held with marked success.

"One of our greatest needs is impartial, reliable data based on actual experience of the advantages and financial profit enjoyed by those who are operating 'electrics' in their transportation system, and a comparative data committee is already at work gathering together such information in a manner and to an extent which will be of tremendous advantage to the business. Other suggestions might be added, but if those already touched upon could be realized within the coming year, others would be brought forward as a natural development.

"Energy, co-operation and a courage born of conviction are most needed, and if instead of looking backward over the failures of the past we shall awaken to the opportunities which the future holds in store, those who have cast their lot with the transportation side of the great electrical industry will realize that they have not labored in vain."

Graphical Calculation of Interconnected A. C. Circuits

By Combining Two Well-Known Methods in a New Way an Accurate Graphical Solution Is Developed for Problems Relating to Interconnected Circuits — Applications Are Made to the Conventional Equivalent Circuits of Polyphase and Single-Phase Induction Motors

By A. S. McALLISTER
Consulting Engineer, New York City

ON ACCOUNT of the very large number of articles, papers and books that in recent years have been written relating thereto, it is safe to assume that methods of constructing graphically the exact current locus of interconnected circuits such as those usually assigned to the induction motor have been of widespread interest. In view of the very numerous partial solutions of the complete problem and complete solutions of parts of the problem, it is believed that a simple solution of this and allied problems relating to interconnected alternating-current circuits, complete in every detail, without involving any approximation, will be welcome at this time.

The solution described herewith, although a self-evident one, seemingly has not previously been developed in spite of the fact that many authors, including the present writer, have frequently utilized all of the fundamental relations essential to its development. In fact, a careful examination of the entire available French, German and English literature seems not to reveal an anticipation of the method about to be described.

Use is made of the "reciprocal-vector" method of transforming from one assumed constant condition in electric circuits to another assumed constant condition—a method similar to the one utilized by both Bedell and Behrend more than twenty-five years ago. Use is also made in each case of the "electric circuit" method of representing alternating-current relations, and for the purpose of giving emphasis to the most familiar case, the "equivalent electric circuits" chosen as the initial example are those of the polyphase induction motor treated as the general alternating-current transformer, such as are employed by Steinmetz in his first book on "Alternating-Current Phenomena." In combining these two familiar methods, the transformation by the "reciprocal vectors" is made, not in the more usual way from an assumed constant current to actual constant voltage, but by determining what would be the primary current and what would be the total primary impressed voltage required if constant voltage were impressed initially across merely the "shunted portions" of the "equivalent electric circuits" and finally across all of the circuits as in actual practice. In this way there are determined initially two separate circular loci, one representing voltage and the other current. The arbitrary voltage and current scales are selected in such relation to each other that the two circles, as plotted, have equal diameters, and on this account the two final "reduced circles" of voltage and current, obtained as a result of the "reciprocal vector" transformation, are of equal diameter. Moreover, that circle which represents the primary current becomes identical with the circle representing simultaneously the voltage consumed in the primary impedance and the delivered secondary voltage when a proper shift is made in the origin or co-ordinates of the voltage and current vectors.

In order first definitely to establish the accuracy of the method employed and to permit one most readily to follow each step in the development, there will be shown both the initial primary current locus and the initial primary voltage locus derived therefrom, together with the corresponding "reduced" separate loci of the primary current and secondary voltage. There will then be developed the equally accurate (absolutely exact) combined primary-impedance-voltage, secondary-circuit-voltage and primary-current circular locus, which is drawn immediately from the known "constants" of the motor without necessitating the introduction of the intermediate steps initially established.

Application to the Polyphase Induction Motor

Referring now to Fig. 1, there are presented the well-known "equivalent electric circuits" of the polyphase induction motor, which are here accepted as representing correctly the interrelations of the several "constants" of the machine—the "constants" being treated as absolutely constant, as is always done with both graphical and analytical methods. It must be understood that in actual operation the "constants" of the motor vary somewhat. However, the method here described gives absolutely exact results for the "constants" assumed, and these results do not depart appreciably from practical accuracy by reason of the variation in the "constants."

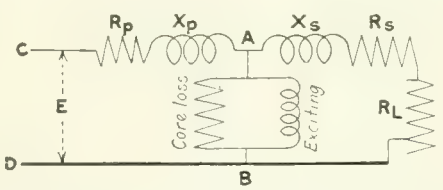


FIG. 1 — EQUIVALENT ELECTRIC CIRCUITS FOR THE INDUCTION MOTOR UPON WHICH SOLUTIONS IN FIGS. 2 TO 6 ARE BASED

The voltage is assumed constant across the shunted circuits (at *A B*), resulting in the two large circular loci of the primary voltage and primary current. Finally the voltage is treated as constant across the primary (at *C D*), resulting in the reciprocal circular locus of the voltage across *A B* and the reduced circular locus of the primary current.

Briefly stated, the problem of determining the exact locus of the primary current vector with constant emf. impressed between *C* and *D* is solved immediately by ascertaining the locus of the voltage consumed in the primary impedance between points *A* and *C*. This voltage becomes at once the primary current locus by

reason of the fact that the ratio between the scales for plotting voltages and currents has been set to equal the primary impedance, and a shift equal to the "primary impedance angle" has been made between the vectors of reference for the time-phase angles of the voltage locus and the current locus respectively.

In the same manner and simultaneously, the exact locus of the "shunted-circuit" current (combined core loss and exciting current) is determined from the locus of the vector representing the voltage between the points *A* and *B*, which voltage locus becomes at once the "shunted-current" locus, when plotted to the "shunted-circuit-impedance scale" and shifted by the "shunted-circuit-impedance angle." The vector difference between the primary current and the "shunted-circuit" current is the secondary current of the machine—reduced to primary terms and plotted to the proper scale.

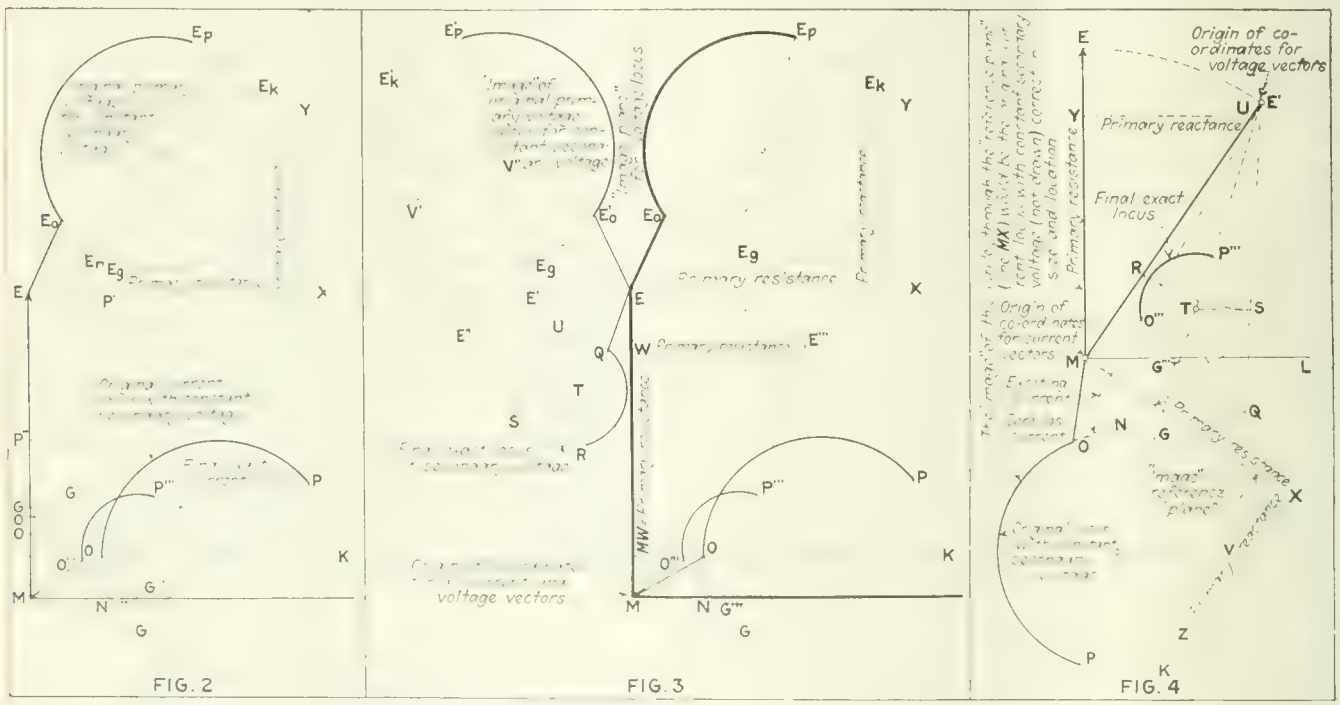
For the purpose of establishing the combined locus of the primary impedance voltage, secondary circuit voltage and primary current, there are located first the combined secondary and "shunted-circuit" current locus when the voltage impressed between points *A* and *B* (Fig. 1) is held constant and the simultaneous locus of the voltage between *C* and *D* in order to hold the voltage between *A* and *B* at a constant value under the conditions assumed.

In Fig. 2 *MN* represents the constant "exciting current," *NO* the constant "core-loss current," and the circle *OPK* is the locus of the extremity of the vector (measured from *M*) representing the combined exciting, core-loss and load currents. The assumed constant voltage across *AB* is the vector *ME* plotted vertically to the "ampere scale," with a value equal (in amperes) to $E \div Z_p$ where *E* is the constant emf. (in volts) and Z_p is the primary circuit impedance (in ohms).

The angle *YEX* being plotted equal to the "primary impedance angle," and the circle $E_oE_pE_k$ being drawn as an exact duplicate of circle *OPK*, it becomes at once the locus of the extremity of the vector (measured from point *E*) representing the voltage consumed in the primary impedance (between points *A* and *C* of Fig. 1) when the voltage is held constant across *AB*. It will be appreciated that the vectors to the voltage circle of Fig. 2, when measured from point *M*, represent the emf. that must be impressed between *C* and *D* (in Fig. 1) in order to hold the voltage constant across *AB*.

By the "point-by-point" method one can readily determine from Fig. 2 the locus of the primary current when the emf. across *CD* (of Fig. 1) rather than that across *AB* is kept constant. For any chosen current point (such as *O*, at "synchronous no-load") the primary current vector has the value and time-phase position *MO* (of Fig. 2) when the impressed voltage has the value and time-phase position ME_o. When the impressed voltage is changed in value and time-phase position with reference to *ME*, the "synchronous no-load current" assumes a new value *MO'''* such that the angle *OMO'''* is equal to the angle E_oME, and $MO'''/MO = ME/ME_o$. The method of locating the point *O'''* graphically is self-evident. In exactly the same manner are located the "reduced-current" points *G'''* and *P'''* corresponding to the original current points *G* and *P*. The "reduced-current" locus passes through the three points *G'''*, *O'''* and *P'''* and being a circle (as will be shown later) can now be drawn at once in its entirety.

The Unique Undistorted Diameters.—It will be noted that the points *P* and *G* have been so selected that the corresponding points E_p and E_g in the "primary impedance voltage circle" lie on a diameter which when extended passes through the point *M*, the origin of co-ordinates of the voltage vectors. The points *P* and *G* are, therefore, diametrically opposite in the original



FIGS. 2, 3 AND 4—METHODS FOR DETERMINING THE EXACT CURRENT AND VOLTAGE LOCI FOR THE POLYPHASE INDUCTION MOTOR

Fig. 2—Point-by-point method of determining the final "reduced-current locus" from the proportionality of the secondary to the primary voltage vectors with proper (identical) shift in phase. Fig. 3—Reciprocal vector method of determining the locus of the secondary voltage, which becomes the final exact current locus when shifted through the proper time-phase angle and given a new origin of co-ordinates. Fig. 4—Short-cut method of determining the exact circular current locus and simultaneously the primary and secondary voltage locus, all facts being fully accounted for.

current circle. Moreover, the points P''' and G''' in the "reduced-current circle" *lie on a diameter*, so that the last-named circle is fully located when these two points have been determined, since its center lies midway between them.

As will be appreciated fully from a study of the illustrations presented, the diameter selected is unique in that it is the only diameter of the original circle connecting points which when "carried over" to the "reduced-current" circle remain on a diameter. As compared in location with the "unique diameter" of the original circle, the "unique diameter" of the "reduced-current" circle is in general displaced by a certain angle (shown in Fig. 2 by the angle between P''', G''' and PG), which varies through a wide range and may be zero (for zero core loss and zero primary resistance) or even become negative—with zero primary resistance but normal values for all other circuit constants.

Method for Finding Reduced Voltage Locus

Referring now to Fig. 3, the original current locus and the original primary voltage locus have been plotted exactly as before and to the identical "ampere scale." The problem immediately at hand is to determine the locus of the vector representing the voltage across AB (Fig. 1) when the voltage across CD is kept constant. By the well-known reciprocal-vector method this locus is found to be the circle SRQ. The center and radius of this circle can conveniently be located by means of the "image circle" $E_gE_oE_p$ (reflection of the original voltage circle through the vertical plane), since its center lies on the line joining the origin of co-ordinates M to the center of the "image circle," and its tangent vector MS is determined from the relation $MS/ME = ME/MV'$, MV' being tangent to the "image circle." Point S is located graphically as the intersection with the tangent line MV' of a line $E'S$ drawn parallel to the line $V''E''$. The radius of the "reduced voltage circle" is ST and its center is T.

Since any point (such as Q) on the circle $SRQU$ shows the extremity of the vector of the voltage across AB (in Fig. 1) when measured from M as the origin of co-ordinates, and since ME (of Fig. 3) is the vector of the constant voltage across CD (in Fig. 1), it follows that the vector difference between these two vectors (EQ in Fig. 3) is the vector representing the voltage consumed in the primary impedance—CD of Fig. 1.

Since the voltage vectors have been plotted to the "ampere scale" (with the primary impedance as the constant of conversion) it follows that the circle $SRQU$ (of Fig. 3) would become the locus of the extremity of the vectors representing the *value* of the primary current (equal to the voltage consumed in the primary impedance) if the point E were used as the origin of co-ordinates. Moreover, the correct *time-phase* relations (as well as numerical values) between the primary current vectors and the impressed primary (constant) voltage vector would be given immediately by shifting the reference voltage vector through an angle equal to the "primary impedance angle."

The above-mentioned time-phase and primary current value relations are correctly represented in Fig. 3 by the circle $P'''O'''G'''$ which is identical in size and significance with circle RQU inverted and shifted so that the initial origins of co-ordinates M and E are located at points E''' and M, the angle EME''' being the "primary impedance angle."

A comparison of Fig. 3 with Fig. 2 will show that the circle $P'''O'''G'''$ is identical in size, location and significance with circle $P'''O'''G'''$ of Fig. 2. Moreover, the exact physical and graphical significance of certain relations touched upon in connection with the development of Fig. 2 become self-evident from an examination of Fig. 3.

A most advantageous feature of the similarities here established resides in the fact that one can construct graphically with the minimum of labor the "reduced voltage circle" and, by giving this circle the correct time-phase position with reference to the constant primary voltage vector, can utilize it at once as the "reduced primary current circle." This feature is brought out more forcibly, and given greater emphasis, in connection with Fig. 4.

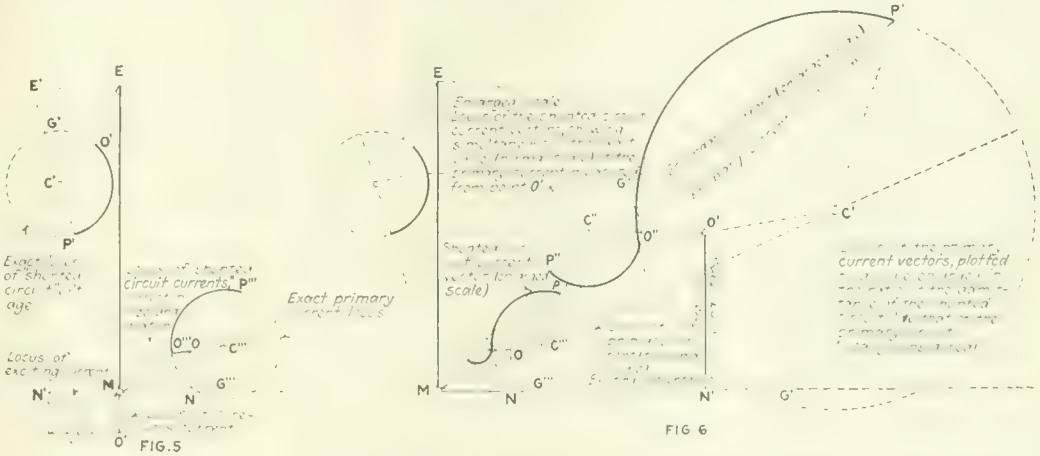


FIG. 5—VECTOR RELATIONS BETWEEN THE SHUNTED-CIRCUIT VOLTAGE AND CURRENTS, THE PRIMARY CURRENT AND THE SECONDARY CURRENT, PLOTTED TO NORMAL SCALE. FIG. 6—SIMPLE GRAPHICAL METHOD OF DETERMINING THE EXACT RELATIONS VECTORIALLY BETWEEN THE PRIMARY, SECONDARY AND SHUNTED-CIRCUIT CURRENTS, PLOTTED TO ENLARGED SCALE

Diagram for Combined Reduced-Current and Reduced-Voltage Locus

In constructing Fig. 4 the line ME' is drawn equal to the vertical line ME (which is plotted in "amperes" to equal $E \div Z_p$) and displaced from this line by the "primary impedance angle," as shown. The line MX is laid off perpendicular to ME', and the line ZM is drawn displaced therefrom by the "primary impedance angle." Along the line MZ the distance MN is laid off to equal the exciting current (if full voltage E were impressed across AB in Fig. 1), and the line NO is laid off to equal the core-loss current under the same assumed conditions. The circle OPK is then drawn with its center on the line passing through the point O and parallel to ZN, and having a diameter $OK = E \div X_s$, all values being plotted to the "ampere scale."

The circle OPK is the locus of the extremity of the vector (measured from M as the origin of co-ordinates),

representing the primary current when the voltage is kept constant across AB in Fig. 1. This circle is simultaneously the locus of the extremity of the vector (measured from E' as the origin of co-ordinates), representing the voltage across CD (in Fig. 1) under the same conditions. Hence the circle OPK of Fig. 4 and the points M and E' of the same illustration are identical in size, significance and relative positions with the circle $E_0E_pE_k$ and the points E and M of Fig. 3.

The method of constructing the "reduced-voltage" circle in Fig. 4 is identical with that used with Fig. 3, resulting immediately in the construction of the "reduced-current" circle proper in both size and location. For any point on the original current locus (such as O) there is a corresponding point on the reduced-current locus (such as O''') found at the intersection of the reduced-current circle by a line from the point chosen to the origin of co-ordinates E'. Similarly the point S on the reduced locus corresponds to the point V on the original locus, and the points P''' and G''' correspond to the points P and G on the original circle.

In case one desires to determine the location of the original circle as the locus of the extremity of the current vectors plotted in the proper time-phase relation with respect to the voltage vector ME of Fig. 4, he can draw the "image" of the original circle of Fig. 4 reflected through the plane shown at MX, thereby obtaining a circle identical in size and location with the original current locus shown in Fig. 2.

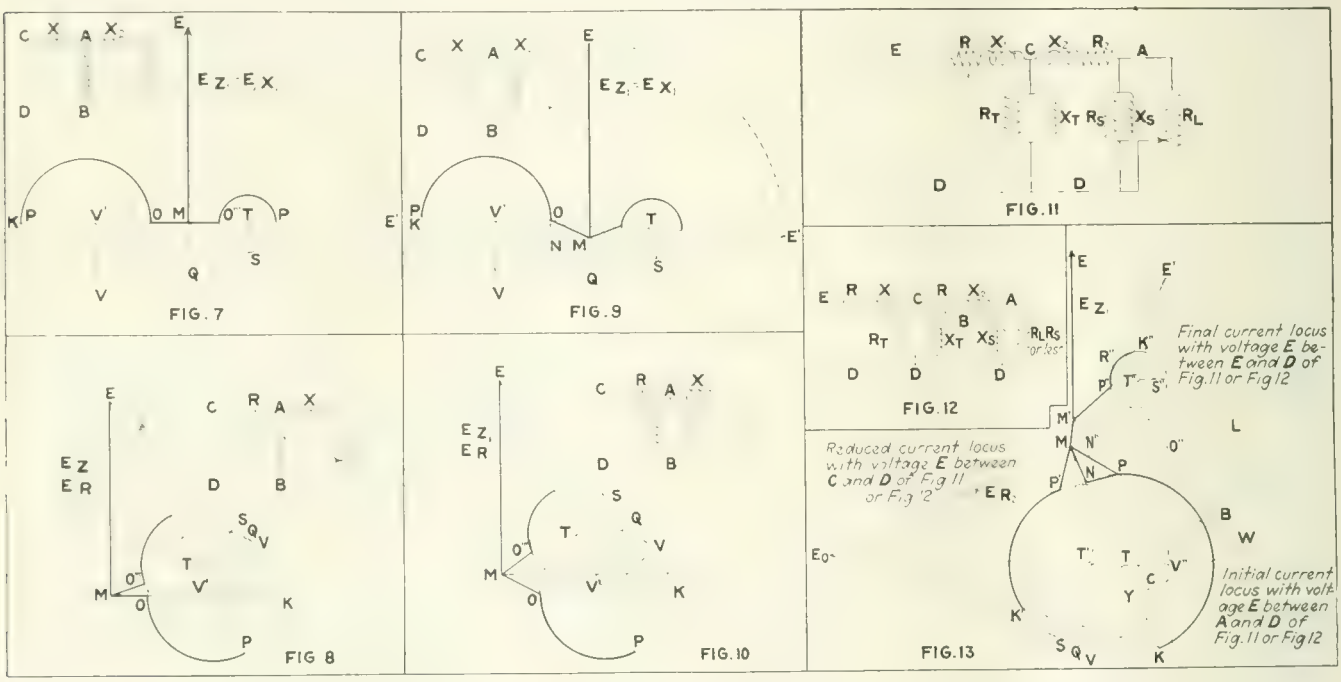
Shunted-Circuit Current and Voltage Locus Is Readily Found

As mentioned above, one can determine the locus of the "shunted-circuit current" (combined core loss and exciting current) from the locus of the voltage between A and B (of Fig. 1) when the voltage across CD is kept constant. In Fig. 5 the locus of the "shunted-circuit voltage" (across AB of Fig. 1) is shown as the circle $P'O'G'$. The locus of the exciting current and that of the core-loss current are constructed therefrom in the well-known manner, MN' being laid off to equal in value the constant voltage, E, divided by the exciting-circuit reactance (multiplied by the exciting susceptance), and MO' being made to the constant voltage, E, divided by the core-loss resistance (multiplied by the core-loss conductance). The vector addition of those two loci is the resultant "shunted-circuit" current locus, which is (as is self-evident) a replica of the locus of the shunted-circuit voltage drawn to a scale altered in the ratio of MO to ME (where MO is the shunted-circuit current at full voltage, E, across the shunted circuits and hence equals the admittance of the shunted circuits combined) and displaced therefrom by an angle OME, which is the "shunted-circuit admittance angle."

Deriving the Secondary-Current Vectors

Evidently it is possible to utilize the locus of the "shunted-circuit voltage" as the locus of the "shunted-circuit current" itself by shifting its time-phase position through the "shunted-circuit admittance angle" and selecting a proper scale for the current values, as was done before with the primary voltage and current loci. This plan is carried out in Fig. 6, where the "shunted-circuit admittance angle" is $EMO' = EMO$. In Figs. 5 and 6 the exact locus of the primary current (reduced) plotted to the original ampere scale is shown as the circle $P'''O'''G'''$. In Fig. 6 this same locus drawn to the enlarged scale (which is much more convenient for actual use) is shown as the circle $P'O''G'$. For every point (such as P') on the enlarged locus of the primary current there is a corresponding point (such as P'') similarly located on the enlarged shunted-circuit current circle. The vector MP' is the corresponding primary current; the vector MP'' is the corresponding shunted-circuit current, and the vector $P'P''$ is the corresponding secondary current (reduced to primary terms) correct in both value and time-phase position.

Having established its accuracy and discussed its



FIGS. 7, 8, 9 AND 10—FOUR COMBINATIONS OF SERIES AND SHUNT RESISTANCES AND REACTANCES, WITH THE CORRESPONDING GRAPHICAL DETERMINATIONS OF THE CURRENT LOCI RELATING THERETO. FIG. 11—ELECTRIC CIRCUITS OF WHICH FIG. 13 SHOWS THE CURRENT LOCI. FIG. 12—CIRCUITS OF FIG. 11 REPLOTTED BUT NOT MODIFIED. FIG. 13—GRAPHICAL CONSTRUCTION OF CURRENT LOCI CORRESPONDING TO THE CIRCUIT, FIGS. 11 AND 12

more important details by means of its application to a specific problem relating to the well-known equivalent electric circuits of the polyphase induction motor, it seems appropriate to show briefly the manner in which the general method herein developed can be utilized in the solution of numerous other electric problems, especially those of extreme values in circuit constants, together with the results obtained thereby.

SOLUTION OF CIRCUITS WITH EXTREME VALUES OF CONSTANTS

In Figs. 7 to 10 are shown certain extreme cases of circuit constants and the graphical solutions to the problems relating thereto, the method employed being identical in every respect with that used with the circuits shown by Fig. 1 and the solution thereto shown in Figs. 2, 3 and 4. To one acquainted with the well-known method of "inversion" for taking into account the effect of primary resistance on the current locus of the induction motor, Figs. 8 and 10 herewith will seem very familiar. The fact of the matter is that the graphical method herein developed is a general one unlimited in its application to alternating-current circuit problems, and the method already in use can be considered as a specific application of the general method to a limited portion of the complete problem. The method herein described is not limited to resistance in series but can be applied at once to resistance in series (or in parallel) or to impedance having any relation whatsoever of its resistance and reactance (either inductive or condensive) components in either series or parallel.

As showing the application of the general method to circuit problems in general, there is presented in Fig. 13 the graphical solution of the problems relating to the interconnected circuits illustrated in Fig. 11, which for convenience in explanation of the solution has been replotted without modification in its essential interconnections in Fig. 12. In solving the problems the circuit voltage is assumed to be impressed successively between A and D, between C and D and between E and D of Fig. 12 (which is identical with Fig. 11). In actually constructing Fig. 13 the angle $EM'E' = LM'B = BM'C$ is laid off as the "primary impedance angle." YMW is laid off equal to the "impedance angle" of the combined circuits R_s and X_s of Fig. 11, and $MM'N'$ is laid off equal to the "impedance angle" of the combined circuits R_t and X_t of Fig. 11.

With R_1 having an infinite value, MP represents the current through R_s and X_s with voltage E across A and D; with the voltage across C and D this current reduces to MP' with the current MM' through the circuits R_t and X_t; when voltage E is impressed across E and D in Fig. 11 this current reduces to $M'P''$, which is represented in Fig. 13 correct both in value and time-phase position with reference to the impressed voltage E, represented by the vertical line $M'E$. The method of locating other points on the several current loci is self-evident and need not here be carried out in detail.

In view of the ease with which the general method can be applied to any specific problem related to interconnected alternating-current circuits, it is believed that it will prove of value to all persons interested in interconnected alternating-current circuits and especially to those interested in graphical methods of solving such problems.

Eternal Vigilance in Maintenance Work Important

Periodic Inspections Are Made by Patrolmen Who Have No Connection with Maintenance Work—Record Forms that Are Useful

BY F. H. BATES
Assistant Manager Ohio Service Company, Coshocton, Ohio

NOTHING is more effective in reducing avoidable interruptions on high-tension systems having moderate voltages than eternal vigilance combined with common sense. There should be a definite time set for the periodical inspection of every piece of apparatus connected with the high-tension system, and that schedule should be adhered to rigidly. Changes in the schedule should be made whenever experience proves that inspections are not frequent enough. By supplementing a good inspection schedule with an automatic system for following up repairs interruptions will be reduced to a minimum.

Experience on a medium-sized system operating over three counties and serving twenty-two towns has demonstrated the value of such methods. The main trunk lines operate at 33,000 volts, while the feeders radiating from the trunk lines operate at both 33,000 volts and 13,200 volts. The load supplied is mainly power.

Too much stress cannot be laid upon the importance of patrolling the lines regularly and inspecting all other high-tension apparatus periodically. The plan of having the sections patrolled by linemen from the various districts has been tried out and found unsatisfactory. The press of work in the district often caused the patrol to be postponed and sometimes neglected altogether. Linemen were prone to take chances; that is, small defects which appeared to be of minor importance were sometimes not reported, and later these defects would become a source of trouble. It was not always practical to send the same man out each time to make the inspection, and there was always the tendency to pass by a fault and let some one else report it. Thus the division of responsibility crept in, and it was felt that the thing to do was to add to the organization a man whose sole duty was to inspect the lines.

PATROLMEN SPECIALLY TRAINED

It was decided to try out a man who had no experience in line work. The idea was that if such a man were properly coached and impressed with the importance of the work good results would be obtained. An experienced lineman on patrol duty is sometimes inclined to rely on his own judgment as to the necessity of certain repairs, and if his judgment is faulty, an interruption probably follows. With the plan as it is working at present, however, if the patrolman sees a defect, he reports it at once, and it is then up to the district superintendent to see that the repair is made. The fact that the patrolman does not have to help make the repairs is another very good reason why he does not hesitate to report everything that comes to his attention.

It is good practice for the district superintendent occasionally to inspect his own section, and the men who are responsible for the operation of the system as a whole should also walk the lines every few months.

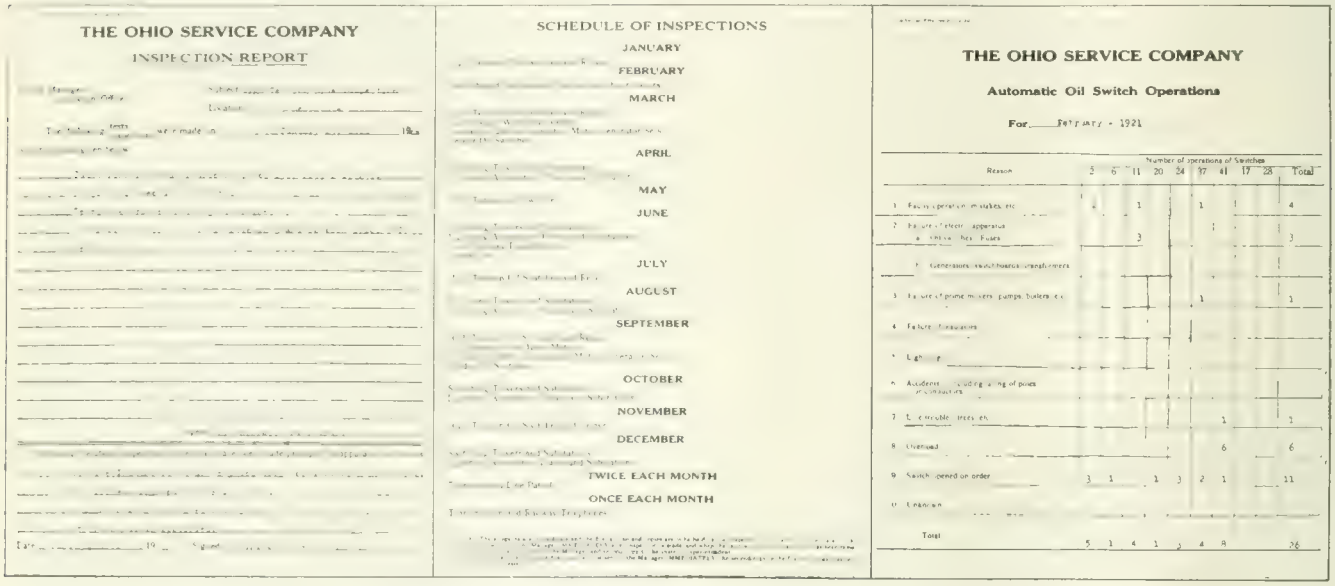
It has been found that keeping underbrush cut down

in the right-of-way is good practice. If the right-of-way is clear, the patrolman has no reason for skipping any portion of the line.

All high-tension systems must contend more or less with the insulator failures caused by hunters using the insulators as targets. It has been found that this can be prevented to some extent by posting signs at frequent intervals along the lines offering a reward for information leading to the arrest and conviction of the offender. If any such interruptions do occur, newspaper publicity of the right sort will help educate the public against the practice. It is also well to get acquainted with the farmers along the line and explain to them how much trouble can be caused by shooting at an insulator. The farmer living close to the line can be made a sort of an amateur patrolman. If he is told what to look for, he will often discover defects; official should then check up immediately to see what has delayed the work and endeavor so to arrange matters that there will be no further delay. Without a good follow-up system some work would be forgotten or neglected, with disastrous results.

Assuming that repairs are always made with the lines dead, arrangements should be made to kill the section where defects are discovered as soon as possible after they are reported. Sunday is the one day when repairs can almost always be made, but it is not always good practice to wait until Sunday. Interruptions can often be made late at night without inconvenience to consumers, and with the aid of powerful battery searchlights night repair work is practicable.

Any suspicious noise on the telephone system should at once be investigated, since it is often an indication of a fault on the transmission line. By sectionalizing



PERMANENT RECORDS OF INSPECTIONS AND TROUBLES AID IN IMPROVING SERVICE
On the right is a record of the oil-switch operations for a month; on the left is shown the inspection report, while on the back of this report (center) is the schedule of inspections.

and if he is paid a nominal sum, say $5 for each interruption prevented, he will be sure that the company is notified immediately in case he sees anything unusual on the line.

The transmission-line telephone is the lifeblood of the system. It must be kept in the best of repair at all times. The patrolman should be instructed to watch for defects on the telephone line as carefully as he watches the transmission line.

The method of reporting defects and following up the repairs is as important as the inspection itself. Every inspection should be scheduled for a certain time, and it should be the duty of some one in the organization to watch the schedule and if an inspection is not made on time, to find out the reason. It has been found good practice to have all reports made out in triplicate—two copies going to the man responsible for the repair work and the third copy being kept in the general office. The repairs having been completed, one copy of the report is mailed to the general office, signed by the man in charge of the work, the other copy being retained in his files. The triplicate copy can then be destroyed. If at the end of a certain period of time the signed inspection report is not received in the general office, the triplicate copy should automatically come to the attention of the proper official. This

the telephone in such cases it can be determined on what section the noise originates, and a patrol of that section should then be made. Sectionalizing switches are invaluable when trouble comes, but they must be inspected and tested often or they may develop trouble within themselves or fail to operate when needed. Relays, lightning arresters and all other substation equipment must be watched closely. The settings of the relays are highly important and should be readjusted whenever conditions on the system warrant a change. The man responsible for the relay settings should be at all times in touch with general operating conditions over the system.

The load dispatchers should make occasional trips over the system so as to be acquainted with conditions at the various substations. Then when emergencies arise they can readily visualize the situation and decide what should be done to resume service in the shortest possible time. If line foremen from various districts are acquainted, they will work together better when an extreme emergency in one district makes it necessary to send in men from other districts.

Such interruptions as do occur should be carefully analyzed and monthly reports made up showing the reason for every switch operation. Much can be learned from a record of this kind.

Simplicity in Outdoor Substation Layout

Extremely Flexible Switching Has Been Attained with a Simple Layout in the Outdoor Substations of the San Joaquin Light & Power Company—Towers Used for the Purpose of Cooling Transformer Circulating Water

By L. J. MOORE
Electrical Engineer San Joaquin Light & Power Company

SIMPLICITY carried to the furthest point that does not cause attendant loss of flexibility should be the keynote of design in laying out high-voltage outdoor substations. With this requirement in mind a study of the outdoor substations which were laid out as a part of the Kerckhoff power project by the San Joaquin Light & Power Company may be of interest. Some of the features of these substations are the use of oil switches with a pantograph break, cooling towers for transformer circulating water, auto-transformer windings for 110-kv. to 66-kv. transformation, switches to ground the lines substantially, and transformers having a special winding to eliminate harmonics and inductive interference.

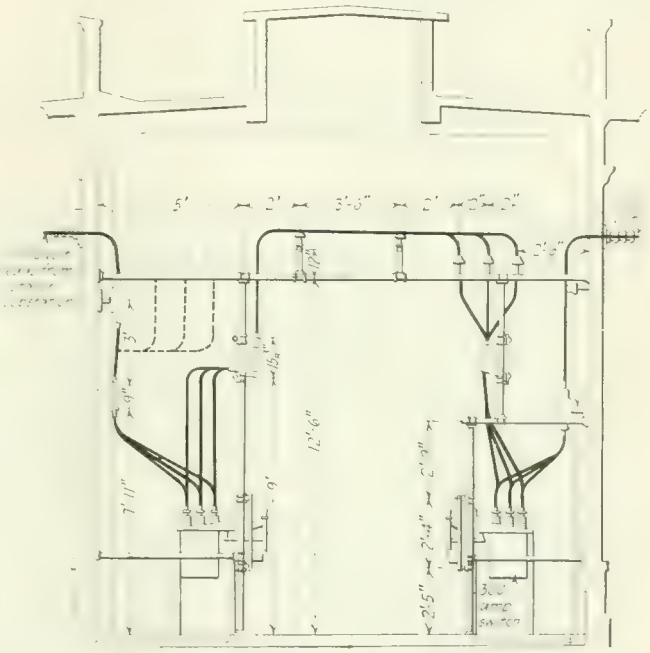
Construction of three new substations, at Merced, Sanger and Corcoran, Cal., has been completed. A fourth, of the same design, has been built at Semitropic to take the output of the new gas-burning steam plant which the company is erecting at Button Willow.

Inasmuch as the transmission voltage from the Kerckhoff* power house was fixed at 110,000, and since the original transmission system of the company was at 66,000 volts, it was decided to step down the voltage at each substation from 110,000 to 66,000 volts. In order to provide for local distribution from each station, the transformers were equipped with 11,000-volt windings, the rating of which is a small part of the total capacity. Thus the original system of 66,000-volt transmission has been preserved as a sort of secondary transmission system and the 110,000-volt line superimposed upon it as a large-capacity bus. As additional generating capacity and load are added to the system it is planned to construct a second 110,000-volt line along almost the same route as the first in order to provide a duplicate bus and allow the use of balanced relays in the sections between substations, thus insuring the best possible service.

ALL SUBSTATIONS BUILT ON SAME GENERAL PLAN

All of the substations are built on substantially the same plan, therefore a description of one will apply to all. The Sanger substation will become the most important one on the system as time passes because it is so located that all the transmission lines from Kings River plants can be brought into it. The Kings River project furnishes the company's most important prospective power sites. All lines from these plants will probably enter Sanger, and a number of radiating 110-kv. lines will be carried out from that station in addition to the duplicate line arrangement already mentioned. The drawings accompanying this article refer to the Sanger installation primarily, although some of the photographs are from the Corcoran substation.

Although the substations are of the outdoor type, all high-tension buses, switches and transformers being installed out of doors, a small reinforced-concrete building has been provided to house the 11-kv. feeder switches, all metering and relay equipment and the storage battery for tripping the high-tension switches. From the ground plan it will be seen that the 110,000-volt and 66,000-volt buses parallel each other on opposite sides of the high-tension yard. Sufficient space is left between them to allow the step-down transformers, with their necessary switches, to be installed between.



ELEVATION OF BUILDING, SHOWING 11,000-VOLT SWITCHING

The first units of the two buses and switches have been installed at one end of the yard, and all further extensions will be made in units toward the opposite end of the property. In this way the step-down transformers will be installed in a continuous row, and the transformer track will enable one single-phase spare transformer to afford protection for all banks. At the present time a single bus only has been provided on each of the 110-kv. and the 66-kv. lines. However, ample space for future needs has been left, and as the number of incoming lines increases a transfer bus of either voltage or of both voltages may be installed to provide for the by-passing of the station, inspection of switches and similar requirements. At stations from which it is not apparent that any 110-kv. lines will be run, except the two main buses already mentioned, it is planned to build the 110-kv. station bus in two sections with two switches per section, as shown on the drawings, with, say, one line from the north and one from the south connected to each section. A disconnecting air-break switch will then be installed

*See ELECTRICAL WORLD, Feb. 26, 1921, page 471, and March 19, page 641.





Typical Outdoor Substation Construction on System of San Joaquin Light & Power Corporation

A—Operator's cottage at the Corcoran substation, showing the tank house, cooling tower and garage in background.

B—Outdoor transfer structure for the 11,000-volt feeders at the Sanger substation.

C—Transformers are rated at 5,000 kva. and step down the voltage from 110 kv. to 66 kv. and 11 kv.

D—Four substations of this general type have been built by the San Joaquin Light & Power Company. The station shown is at Sanger, Cal.

E—Oil-switch and disconnecting-switch structure for the 110-kv. line at the Sanger substation.

F—Corcoran substation, showing building and outdoor structures.









between the sections of the bus. When the switch is opened two 110-kv. lines will pass through the stations, but they will be separated from each other. This arrangement was considered to provide enough flexibility for the small substations.

Oil Switches Are Pantograph-Break Type

The high-tension oil switches for both voltages are the outdoor type and have a pantograph break, permitting high speed of operation. The tanks are large and deep, so that the break is made under a high head of oil, and the blades are thin and are inserted at right angles to the direction of motion, so that small disturbance occurs in the oil when the switch opens. The 110-kv. switches are of much greater capacity than the 66-kv. switches and have two pantographs per pole, thus having a total of four breaks per phase. At the present time the switches are all hand-operated, but as the station grows it is expected to change them all to electric operation. The tripping on overloads is now done by a 32-volt storage battery, and for that reason alternating-current instead of direct-current solenoids may be installed because the present battery has insufficient capacity to close the switches. Hand operation would still be possible should there be no source of alternating current available for a short interval of time. The oil switches were manufactured by the Kelman Electric Company of Los Angeles.

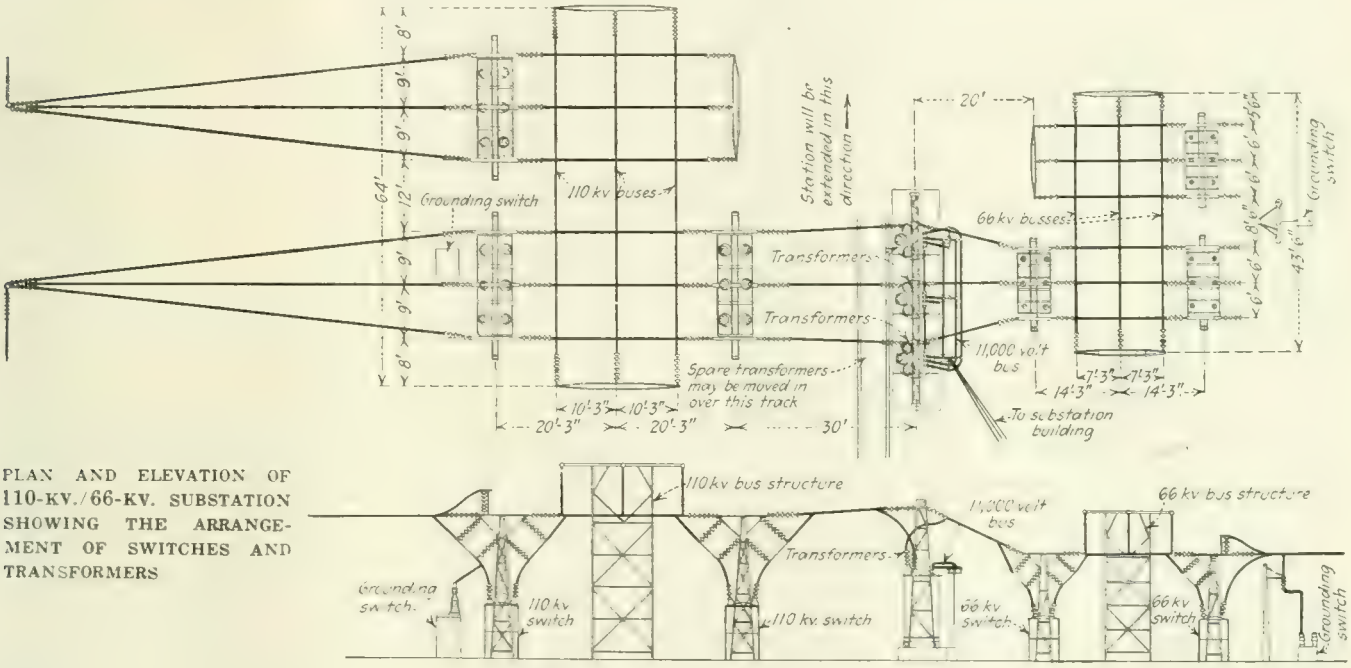
A portable synchroscope has been provided so that the operator can synchronize with the hand-operated switches. Single-phase potential transformers have been installed on the lines and at the low-tension side of the station transformers. Potential leads are brought into the building, the usual synchronizing and voltmeter receptacles being placed on a panel on which are also mounted the mimic bus and indicating lamps showing the position of the oil switches. Bright-light synchronizing has been provided, and the synchronous buses are carried out of the building to receptacles at each of the high-tension oil switches. These receptacles, however, simply provide a means for plugging the portable synchroscope on to the synchronizing bus. The synchroscope is then hung up on the bracket on the switch and the operator is able to synchronize incoming lines.

To synchronize, the operator plugs in between two potential transformers on opposite sides of the open switch on the mimic bus panel inside the station building. He then takes his portable synchroscope and goes out to the open switch, plugs his synchroscope into the receptacle and synchronizes. Bright-light synchronizing was adopted because in case of the failure of the lighting supply of the station the operator would have light at the instant the synchronizing pointer showed synchronism, thus making it possible for him to synchronize even though his station were in darkness.

Switches Provided for Grounding Line

The high-tension disconnecting switches, as will be noted from the photographs, are hung on towers installed over the oil switches. These disconnecting switches are of single-pole, single-throw type and are all provided with locks. On each of the outgoing lines a three-pole, single-throw grounding switch is installed which provides for grounding the lines when they are open for repairs. It is planned to install by-passing air switches on top of the switch towers at some of the stations to provide for the inspection and repair of switches which cannot otherwise be taken out of service. It will be noted that disconnecting switches are not installed on both sides of the oil switches. The omission is not intentional, but was merely because the delivery of post-type insulators was so slow that the job was not completed when the photograph was taken.

The station transformers are of the single-phase, 5,000-kva. outdoor type. The transformation from 110,000 to 66,000 volts is effected by means of an auto-transformer winding, the ratio being 63,510 to 40,100 and the three single-phase transformers being connected in star. Neutral connection to ground is made through a disconnecting switch, and thus either isolated neutral or grounded neutral operation may be had. A 6,600-volt winding has been provided of 20 per cent of the main transformer capacity and 20 per cent impedance, based on full load in the main transformer



PLAN AND ELEVATION OF 110-KV./66-KV. SUBSTATION SHOWING THE ARRANGEMENT OF SWITCHES AND TRANSFORMERS

winding. These windings will be connected in delta to provide a path for the triple harmonics in the transformer wave. Thus the triple harmonics will be kept off the line and inductive interference with telephone circuits reduced. A third winding rated at 1,650 kva. per transformer and voltage of 6,600 has been provided for grounding Y-connections to 11,000-volt circuits. This winding will care for the local distribution from each station. Leads from it pass into the substation building, where the 11-kv. feeder switches and meters are installed.

Transformer Circulating Water Cooled with Tower

It was decided to use oil-insulated, water-cooled-type transformers, and because all four of these substations are installed in country districts where no water supply is available, a complete water-cooling system was installed at each station. This system consists of a well and an elevated supply tank, a cooling tower and two duplicate pumps. The piping system is so arranged that either pump may pump from the well into the supply tank or from the well through the transformers or simply circulate the cooling water from the pond underneath the cooling tower through the transformers and back over the tower. In this way very reliable operation should be obtained. A float switch in the elevated supply tank operates the motor which is pumping from the well to the tank so as to keep a practically constant level in the supply tank at all times. The other pump will be used in the ordinary operation to circulate water from the cooling tower through the transformers and over the tower as has already been indicated.

An automatic float valve in the pond beneath the tower provides for the admission of water through this pond from the supply tank, thus always keeping a sufficient supply of water in the circulating system. Flow meters are being installed on the transformers to make sure that each transformer shall get its necessary supply of cooling water. The ordinary funnel type of flow meter usually applied to station transformers is not applicable because of the fact that a slight head is maintained on the transformer coils in order to force the discharge over the cooling tower. Irrigation water for the operator's garden may be supplied by pumping from the well directly to the transformers, either discharging at that point into an irrigating ditch or carrying the water on over the cooling tower and discharging from the pond into the irrigating ditch.

Added Investment for Water-Cooled Transformers Found to Pay

The pumps and cooling tower installed will take care of four 15,000-kva. banks, or a total of 60,000 kva. in transformer capacity. The complete equipment for the circulating water, exclusive of what would ordinarily be necessary for supplying water for domestic use at the operator's cottage, costs approximately $2,700. The annual charges on this investment, interest at 9 per cent, depreciation at 4 per cent and maintenance at 2 per cent, make a total of $405 per year. Assuming that 4 hp. is necessary to circulate the water for all banks of transformers, and figuring this continuously throughout the year, the actual cost of generating power is shown to be $165.50 per year. The total annual cost, then, is $570.50. On a capitalization basis of 15 per cent these figures indicate $3,770 as the additional first cost of transformers had they been air-cooled instead of water-cooled. This amounts to about 5.13 cents per kva. of the 60,000 kva. total rating. As this is much less than the manufacturer's difference in price per kva. between these types of transformers a considerable saving was effected by this cooling method.

Complete relay protection has been installed at all these stations. All of the high-tension oil switches are provided with bushing-type current transformers for relay operation. Reverse power relays are installed on all lines and will be set to operate for outgoing power from each substation bus only. In this way transmission-line trouble on any line passing out from a substation will trip the switch on that line only. The main 110-kv. lines which pass through the stations will have balanced protection when the second line is built. At the present time, however, only one contact of the double-contact relays for that purpose will be utilized and the relay will be so connected that outgoing power only will close the contact. The 66-kv. lines will operate on the same sort of protection. The station transformers are protected by overload relays differentially connected across the current transformers on the two transformer switches. These relays will be set high enough to prevent the ordinary load on the 11-kv. feeders from operating the high-tension oil switch on the transformers. All 11-kv. feeders are protected with transformer trip coils on the switches. The switch between the transformers and the 11-kv. bus operates on current-transformer tripping, with circuit-opening plunger-type relays.

The 11,000-Volt Feeder Supply Independent of Substation

The 11-kv. feeder switches inside the substation building are all mounted on pipe framework as shown in the drawing. An outdoor transfer bus is provided on 11-kv. feeders, thus allowing any two circuits to be carried off one feeder switch while the other feeder switch is inspected or repaired. This transfer bus is installed outdoors in order to provide for the cleaning of insulators, bushings and other equipment. The station power tank of transformers for feeding the circulating pumps and the station lights is equipped with double-throw switches between the indoor and outdoor 11-kv. buses. In this way it will be possible in case of a complete shutdown of the 11,000-volt part of the substation to feed the water-supply system from another substation over one of the interconnecting 11-kv. lines. This lighting and power transformer bank is mounted on a pole alongside the pump house. The power transformers are rated at 6,600 volts primary and are connected in star for 11,000 volts. The lighting transformer is single-phase, 11,000 volts.

This method of mounting combination lighting and power transformers is the same as that adopted for rural distribution and is a standard with the company for all service where transformers are not more than 10 kw.

These substations were designed by the writer and constructed by the operating department of the San Joaquin Light & Power Corporation under the supervision of the writer and E. A. Quinn, general superintendent.

The main transformers are Allis-Chalmers, while the 11-kv. switching equipment is General Electric Company and the main relay equipment is divided between the General Electric and Westinghouse Companies.

Power-Factor Rate that Works Both Ways

Consumer Credited for Power Factor Above Base and Penalized If Below—Capacity Charge Based on Kilovolt-Ampere Demand

BY M. L. SINDEBAND
Electrical Engineer American Gas & Electric Company

IN THE past the structure of the power rates was such that it imposed a considerable burden on public utilities, the reason being that the rate was based entirely on an energy charge. Today, however, the structure of the rate for power is being considered in a new light. This rate consists of two elements, namely, a capacity charge and an energy charge, the capacity being figured in terms of kilovolt-amperes instead of kilowatts, thereby taking into consideration the power factor of the consumer's installation. It may be very readily seen that not only does the power factor affect the capacity, but also has a great deal of influence on the losses, so that the public utility should be compensated for power factor in the energy charge as well.

A rate that is founded on a base power factor should benefit the consumer where the power factor is better than the base. This is particularly true in that part of the rate dealing with the effect of power factor on the energy charge. In such a case the consumer should be credited with the saving due to a higher transmission efficiency.

In taking into account the power factor the question comes up whether the average power factor for the month or the power factor at the time of maximum demand should be considered. As a rule, the power factor at the time of maximum demand is always a maximum, and it appears to me that the average power factor should be considered as basis instead of the maximum, because, after all, it is the average condition that counts.

In taking care of the energy charge one method that has worked out satisfactorily is embodied in the following considerations:

1. Assumption as to efficiency of transmission.
2. Assumption of a power factor which shall be used as a base value and up to which the public utility expects the consumer to work.
3. Determination of proper factors whereby a consumer will be penalized when his average power factor for the month is below the selected base value and credited when his average power factor is above the prescribed value, the penalties and credits being in the form of percentage of kilowatt-hours consumed.

In the development of a formula for these factors let P_1 = power delivered, P_2 = power input, and Q = per cent power loss based on delivered power. Then per cent efficiency of transmission = $100\ P_1/P_2$. Then P_2 may be reduced to terms of P_1 and substituted, giving:

$$P_2 = P_1(100 + Q)/100 \qquad (1)$$

Substituting, per cent efficiency of transmission = $(P_1 \times 100) \div P_2(100 + Q)/100 =$

$$10{,}000/(100 + Q) \qquad (2)$$

For penalty adjustment assume 85 per cent as a base line for power factor and an efficiency of transmission equal to 85 per cent at that power factor.

Substituting the assumed value of 85 for efficiency of transmission in equation (2), $85 = 10{,}000/(100 + Q)$. Therefore: $8{,}500 + 85Q = 10{,}000$. Solving, $Q =$ 17.65 per cent.

The above solution implies that with an efficiency of transmission of 85 per cent the per cent loss based on delivered power is 17.65 at a power factor of 85 per cent. To find the value of Q at any other power factor, 17.65 per cent would have to be multiplied by a factor equal to $0.7225/(\text{power factor})^2$.

With this arrangement if the average power factor is better than 85 per cent, the consumer is credited with the decrease in power loss. On the other hand, if the average power is less than 85 per cent, he is penalized with the increase in power loss. This is done by multiplying the kilowatt-hours consumed for the month by a factor given below:

For power factors above 85 per cent, the factor = $1 - [0.1765 - (0.1275/\text{power factor}^2)]$

For power factors below 85 per cent, the factor = $1 + [(0.1275/\text{power factor}^2) - 0.1765]$

In both of the foregoing formulas the power factor should be expressed as a decimal.

Power factor having been taken care of in the energy charge, the next point to consider is the capacity charge. Under this rate a consumer contracts for a certain number of kilovolt-amperes and by means of relays and switching equipment is held to this total, allowing for reasonable overload conditions. If he overdraws on the kilovolt-amperes for which he has contracted, his power supply will be interrupted. After several of these interruptions it is likely that he will go to the power company for an explanation where he can be told that he contracted for a certain number of kilovolt-amperes and that, owing to the bad power factor he has allowed, the total kva. for the required horsepower has increased. It can be explained that he can correct this condition in two ways—first, by installing corrective apparatus to compensate for the bad power factor, thereby reducing current; second, by contracting for more kilovolt-amperes, which, of course, means additional charges.

Rate schedules based on this principle are used in most of the territory that is served by the American Gas & Electric Company. In order to avoid the penalties imposed due to bad power factor the consumers have installed a very large number of synchronous and static condensers which have not only benefited them, both in regulation and lower rates, but have also relieved the generators, line and transformer equipment of a considerable amount of wattless current.

Data for Tilting of Circle Diagram

THE tilting of the circle diagram of the induction motor due to the effects of primary impedance was dealt with by R. G. Warner in the April 30 issue of the ELECTRICAL WORLD, page 980. For the benefit of any readers who may wish to check the results given or to investigate the matter further, attention is called to some typographical errors in the article. The notation under Fig. 3 should read: "The constants used in this case are $E_o = 100$," etc. This value of $E_o = 100$ applies to all three cases in the table. Under case 2 the approximate value of sin ε should be 0.199. The equation attributed to Specht should be $\tan \varepsilon = \frac{I_o}{E}[r_1 + (x_1 + x_2) \cos \theta_o]$.

The upper diagram on page 980, which should have been designated as Fig. 1, is the exact equivalent circuit and the lower diagram, which should have been labeled Fig. 2, represents the approximate circuit.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Architects' Plans Should Provide Adequate Convenience Outlets

To the Editor of the ELECTRICAL WORLD:

SIR: The writer recently examined plans issued by the Architects' Small House Bureau of Minneapolis. These were quite complete except for one important item. On one set of plans no "convenience outlets" were indicated in kitchen, dining room, sun porch, bathroom and two bedrooms.

Today nearly every house built is wired for electricity. Almost all of these homes are prospective customers for many electrical appliances. At our home we use the convenience outlet in the dining room about 400 times yearly, every morning for the toaster, many Sunday evenings for toaster or chafing dish. We should consider it an outrage to be compelled to climb on the dining table in order to connect the appliance to the chandelier whenever we wanted to use it. Would this not be a good subject to refer to the Society for Electrical Development and the other various electrical leagues, campaigns, etc., for action?

ISRAEL LOVETT,
City Electrician.

Omaha, Neb.

Government Aid Needed in Study of Fire Waste

To the Editor of the ELECTRICAL WORLD:

SIR: Articles have appeared in the ELECTRICAL WORLD which criticised the placing of electricity first in the list of fire causes. While in some respects these criticisms may be justified, discussion of a more constructive kind would doubtless follow had the articles been written under a debatable title, such as "The Relative Importance of Electricity as a Fire Cause Based Upon Financial Losses Versus Numbers of Fires." Arguments advanced would probably apply equally to other fire causes.

Any discussion of the National Board of Fire Underwriters' lists, from consideration of which the criticisms emanate, should be predicated upon the intent of the publisher as well as upon the accuracy of the assertions made. A part of this information is obtainable by reading the text of the statements. It must also of necessity be influenced by the status and responsibility of this highly specialized insurance organization, having a due regard for the obligations of the stock insurance companies forming its membership to the various states which require certain definite statistical data upon which the lists are based. The value of any interpretations of statistics depends largely upon the application of the interpretations and the defensibility of the statistics. The probable errors of interpretations for any given period will increase with the variability of the elements in the statistics considered. If the elements vary widely during successive periods, errors may be further magnified until interpretations for one period may become absurd when applied to other periods.

The futility of rating the importance of fire causes for the entire country upon the financial losses alone can be readily demonstrated by citing a few examples. Thus, were the financial rating alone regarded, the most important cause of fires during the year of the San Francisco disaster might be designated as "earthquakes." Again, Mrs. O'Leary's cow of Chicago fame might receive the doubtful honor for another similar period. Other striking examples might also be mentioned. Since there are many conflagrations each year, the possibility of making misleading interpretations is readily understood.

In all of our conflagrations the exposure hazard, usually coupled with the action of a strong wind and other contributory circumstances, is more important than the original cause of the fire in explaining the large financial losses. That the exposure hazard can be greatly reduced is evident. This is exemplified in the fire statistics of one of the largest European cities, where during a period of fifty years no fire has spread beyond the confines of the building in which it originated. On the other hand, there is no large city in the United States which can show a similar record for even one year.

To bring about a marked reduction of fire waste more statistical data should be obtained upon features such as the numbers of fires with respect to fire causes, number of fires with respect to building construction and occupancy and so forth. Comparison of such data with the general conditions prevailing in the various occupations housed in the different types of buildings would then provide a tangible basis upon which a reduction could be predicated. This would also operate to place individual and collective responsibility for different kinds of fires where it properly belongs.

Up to the present time the absence of definite unbiased data covering any large portion of the country has resulted in much confusion and misinterpretation. The varying practices in different sections of the country have discounted the work of individuals and associations. Education of the public through local groups has failed to kindle the enthusiasm and interest necessary to promote a country-wide improvement. Even the so-called scientific statements regarding fire prevention are based upon widely varying assumptions depending upon the exigencies of the issues at hand. Practices are far from consistent because of the difficulty of obtaining similar data in a sufficiently large number of cases to provide a basis.

The various states do not have consistent laws which enable their variously collected statistics to be readily compiled. No state receives a report upon every fire occurring within its jurisdiction. The federal government is virtually inactive. Indeed, there is no one agency which obtains this information for the whole country, excepting in so far as the National Board of Fire Underwriters receives a large percentage of data in connection with fire reports from its stock insurance companies. This body, however, does not publish data upon any considerable percentage of the fire causes based upon the number of fires in their relation to occupancies.

The most authoritative federal statement upon any large number of fires analyzed with respect to fire causes appeared in a table published in Circular No. 75 of the United States Bureau of Standards, page 92. This table refers to statistics on 189,228 fires collected

from a number of state fire marshals' reports extending over several years. Of these only 4,191 (2.21 per cent) are attributed to electricity. Fifteen more important causes from the standpoint of numbers are given. "Unknown causes" stand first on the list, with a total of 40,824 (21.57 per cent), and are followed by "smokestacks, chimneys and soot," accounting for 14,645 fires (7.74 per cent). "Matches" are third, with a total of 14,449 fires (7.63 per cent). Then are placed the following causes in the order named: "Exposure or adjoining," "explosions," "sparks," "overheated materials," "ignition" (of certain inflammable materials), "lightning," "defective flues," "cigars, cigarettes and pipes," "incendiaries" (excepting children), "acts of children," "spontaneous combustion," "rubbish and bonfires." All of these causes exceed electricity in point of numbers. This is but one effort to interpret such data upon a uniform basis.

Electricity, with heat and other forms of energy, possesses inherent qualities which produce harm as well as good. Much commendation is due those who have subjugated this great force of nature to do man's bidding with such a comparatively few fires to its account. It must be remembered, however, that this result has only been obtained under the watchful eyes of inspectors, the combined efforts of manufacturers of devices and appliances to make their product fire-resistive and foolproof, as well as the subsequent care given to installation.

Contrast electricity with the simple match and cigar, both of which occupy such prominent positions as fire causes. Should we build up with one hand while we destroy with the other? Suitable remedial measures must be adopted to bring about a reduction of fire waste. The interpretations of statistics for relieving this problem, together with the impartial explanation of present practices, must be made, and information must be gathered and dispensed to the public in regular reports. It is undoubtedly the function of the federal government to do the task. There is no other medium which can effect uniform results. It is well known that at present one can obtain only a few pamphlets upon isolated phases of the problem from the bureaus of the government.

While present appropriations are doubtless inadequate to furnish a comprehensive solution of the problem of fire waste, it is believed that the available sources of information would serve to show what further constructive measures should be taken and how the program should be arranged. Why should not the electrical fraternity voice its protestations against the unequal fight to insure careful practices? FRANK W. GLADING.

West Philadelphia, Pa.

Resistance of Graphite

To the Editor of the ELECTRICAL WORLD:

SIR: In the April 23, 1921, issue of the ELECTRICAL WORLD the writer noticed a table giving the properties of heat-resistance materials in which the resistance of Acheson graphite material was given in comparison with carbon and other resistor materials.

We should like to call your attention to the fact that, according to our laboratory analyses of Acheson graphite, the solid electrode material has a specific resistance of approximately 0.00035 ohm per cubic inch, and solid electrode material made of retort carbon has a specific resistance of about 0.0015 ohm. As regards granular resistor, a standard grade of this material which we have on the market at the present time shows a resistance of 0.5 ohm per cubic inch when measured lengthwise in a trough, and carbon resistor of approximately the same degree of fineness measures 2.20 ohms per cubic inch resistance. The fineness of this material varies in particles from 0.099 in. in diameter to 0.254 in. in diameter.

You will note that the difference in relative resistance between carbon and Acheson graphite, according to the above tests, is considerably greater than the resistance given in the table in circular mils. We call this to your attention, thinking that there must have been some unusual conditions prevailing to give the slight differences in resistance shown by the data you published. S. L. WALWORTH,

Niagara Falls, N. Y. Sales Engineer.

Electric and Magnetic Variations and Disturbances

To the Editor of the ELECTRICAL WORLD:

SIR: Referring to the editorial comment in your issue of May 28 on "Sunspots, Auroras and Disturbances in Communication Circuits," permit me to direct the attention of your readers to a very interesting summary of present knowledge in this field published by Prof. S. Chapman in a recent number of the *Journal* of the (British) Institution of Electrical Engineers. There are few natural phenomena which have been as obstinate to the attacks of modern research as terrestrial electricity and magnetism. The reason doubtless lies in our inability to control the phenomena in experiment. Nevertheless, observation extended over a number of years, together with further knowledge of the nature of electricity and magnetism acquired in other fields, now permits a very much more definite statement as to the origin of electric and magnetic variations and disturbances on the earth's surface. The discovery of the electron and the consequent development of theory as to the structures of the atom have caused what has heretofore appeared somewhat remote speculation to be considerably more definite and plausible.

We are given to understand, in Professor Chapman's interesting review, that the quiet-day diurnal magnetic variations are due to horizontal motion of the upper layers of the earth's atmosphere. These layers are rendered electrically conducting by ionization due to gamma rays emitted by normal radioactive transformations in the sun. Motion in the earth's field causes secondary currents in the air layers which react on the earth's field, causing the disturbances in question. The motion of the layers is partly tidal, owing to the action of the moon, and partly thermal, owing to the sun. Magnetic storms are due to abnormal radioactivity in the sun, usually attendant upon sun spots. The aurora is supposedly due to the radioactivity mentioned and is supposed to have its origin in the "alpha" particles discharged during radioactivity. The motion of these particles is absorbed entirely in the upper layers of the atmosphere, causing the luminosity of the aurora and also causing conductivity. This proposal is of special interest, as it provides the conducting layer at high levels which has been looked upon by radio engineers as necessary to explain the bending of the waves of radio transmission so that they follow the surface of the earth. J. B. WHITEHEAD.

Johns Hopkins University,

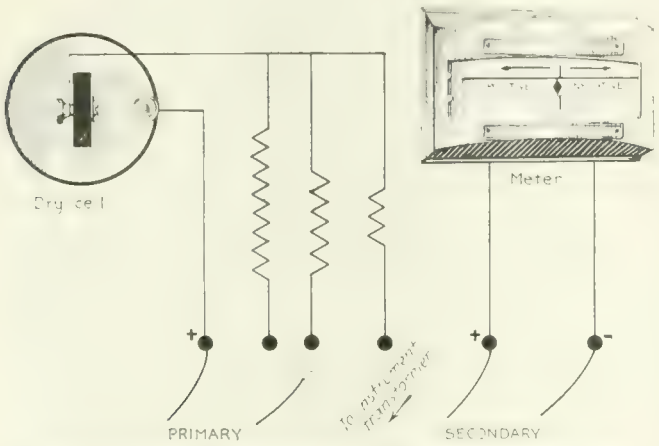
Baltimore, Md.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Testing Polarity of Instrument Transformers

TO FACILITATE testing of instrument transformers for polarity, the testing laboratory of the Connecticut Light & Power Company uses an indicator shown in the illustration mounted permanently on the test board. Such an indicator is more easily read than small



CONNECTIONS OF INDICATOR FOR SHOWING POLARITY OF INSTRUMENT TRANSFORMERS—NOTE HOW AMMETER IS MARKED FOR INDICATING POLARITY

portable instruments and has the added advantage of being out of the way. The indicator is made from an old switchboard direct-current ammeter with zero point shifted to the center and a new scale added. A dry cell mounted behind the board is connected through three resistances to four terminals on the front, from two of which flexible leads are brought to the primary side of the transformer to be tested. Two more terminals connect the indicator with the secondary side through flexible leads. Both terminals and leads are marked for polarity, while the word "negative" and the corresponding arrow on the meter scale are in red ink.

To test a transformer the secondary side is connected to the leads which go to the meter. Then the primary side of the transformer is connected to the battery posts. The transformer lead which is considered positive (usually painted black) is connected to the positive post of the meter and the negative lead is then touched to one of the negative posts. The pointer of the meter will move in one direction or the other. If it moves in the positive direction, the positive secondary transformer lead is the one connected to the positive post of the meter. If it moves in the negative direction, the negative transformer lead is connected to the positive meter post. Of course, when the primary lead is removed from the post the kick is in the reverse direction.

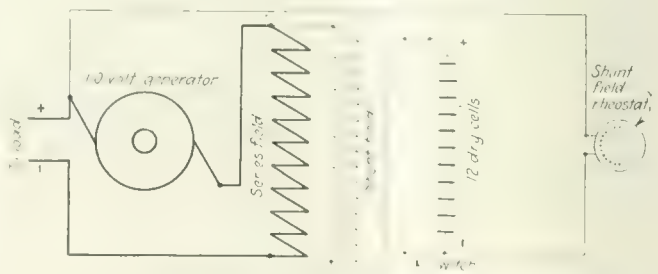
Resistance is necessary in series with the battery to limit the current through the transformer and to prevent too violent a kick of the indicator. By dividing the transformers into three classes and so marking the terminals, the proper connection may be made at once for any transformer without producing too great a deflection.

D. A. McNULTY.

Waterbury, Conn.

Making Generator Voltage Build Up

DIFFICULTY was experienced in making a generator build up voltage after it was installed recently in a New England plant. By connecting dry cells in series with the shunt field as shown in the drawing the voltage was made to build up properly. The machine was a four-pole compound self-exciting generator of 25 kw. rating and of somewhat antiquated design which had been in storage for a number of years. At the time of its replacement by a more modern machine it had given satisfactory operation. Recently it was removed from storage to give emergency service. After being placed upon its foundation and belted to a steam engine it was found that the generator would not build up. A number of methods were tried to make it operate correctly. A test for residual magnetism proved that this still existed, and another test showed the poles to be of correct polarity. The armature leads were reversed and another try-out made, but without results. The brushes were lifted from the commutator and a 110-volt current was passed through the field windings. The original connections were then made, the brushes replaced and another try-out was had, but without results. The brushes were again raised and an exciting current was again passed through the field coils, but in the opposite direction from the first time. Again no satisfactory results were obtained. The generator was next connected as a separately excited



DRY CELLS EMPLOYED TO BUILD UP VOLTAGE IN GENERATOR

machine. By this method full voltage was obtained, and upon being loaded to about one-half capacity the generator operated satisfactorily.

However, when it was again connected as a self-exciting machine, voltage would not build up. The armature was next short-circuited by a 25-amp. fuse. The machine was brought up to full speed, but no voltage was generated for several minutes, when suddenly the machine began to build up, the fuse was blown, and full voltage obtained under no load. Load was applied

to the extent of about three-quarters of the capacity of the generator, and this load was carried satisfactorily. A second trial, however, was unsuccessful.

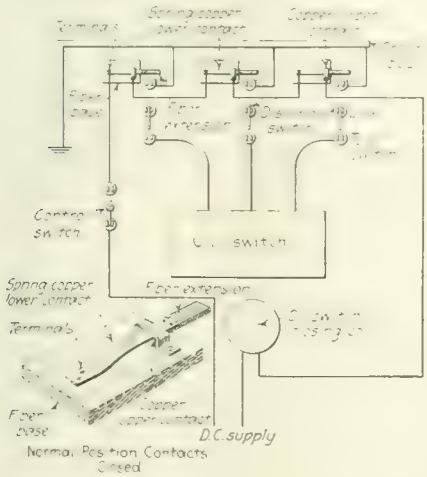
The final and successful method was tried after considerable more experimenting. A battery of twelve dry cells was connected in series with the shunt-field winding and rheostat, the other connections being those of a self-exciting generator. With these connections the machine immediately began to build up. Before full voltage was reached the battery was short-circuited and cut out of circuit, leaving the field circuit unbroken during the process of disconnecting the battery. The generator continued to build up when resistance was cut out of circuit by means of the field rheostat. Load was applied and carried satisfactorily. The generator was shut down and again started several times, each time giving satisfactory operation. Since then no trouble has been encountered while starting up.

It is assumed that, although the machine retained its residual magnetism, this was not in sufficient quantity to cause voltage to build up and that the dry cells, when connected in series with the shunt-field circuit, increased the magnetic flux sufficiently to make building up possible.

LEROY A. FRANCIS,
Chief Electrician.
Utica Steam Cotton Mills,
Utica, N. Y.

Accidental Closing of Oil Switch Prevented by Spring Contact Device

TO PREVENT a transmission-line oil switch from being closed while the line is connected to the ground bus through its disconnecting switches, an arrangement has been devised by the writer which is shown in the accompanying drawing. When the disconnecting switches are thrown to the ground bus the closing circuit of the remote-controlled oil switch is opened. This is accomplished by having the disconnecting switches bear upon the fiber extensions of the contact devices, thus breaking the control circuit. The contact device is a switch made with a spring strip for one of its terminals, and this spring normally rests against a small brass clip, both of the parts being mounted upon a fiber base. The spring strip has a fiber extension on which the disconnecting switch strikes, thus opening the circuit. Three of these contact switches are provided on a three-phase line and they are all wired in series with the control switch which closes the oil switch. Thus when even one of the disconnecting switch blades is thrown over to the ground bus the oil switch cannot be closed.



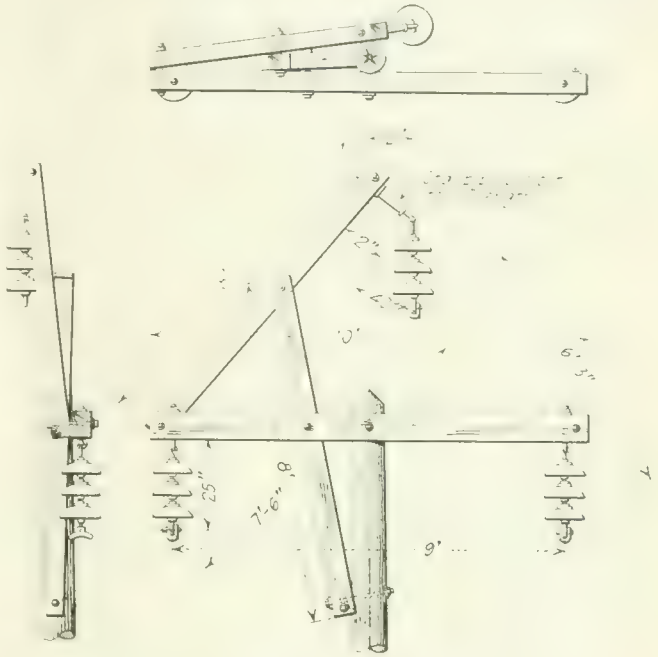
CONTROL TO OIL SWITCH OPENS WHEN DISCONNECTING SWITCH IS THROWN ONTO GROUND BUS

Of course, this contrivance will not prevent an oil switch at the other end of the transmission line from being closed on the line. Moreover, if the line is alive from the other end there is no arrangement to prevent the line from being thrown onto the ground bus through the disconnecting switches. Therefore the usual test should be made to determine whether the line is dead before it is thrown over to the ground bus.

Tuckahoe, N. Y. JOHN E. MCCARTHY.

Unusual Construction Greatly Reduces Pole-Line Costs

IN THE reconstruction and relocation of an old three-phase, 55,000-volt wood-pole transmission line conditions led to a departure from usual standards of construction on the Puget Sound Power & Light Company's Seattle division lines during 1920. This construction



MODIFIED WISHBONE CONSTRUCTION FOR 55,000-VOLT LINE CARRIED ON SINGLE POLES

cost about $860 per mile of line excluding conductors, saving probably 19 per cent of the standard pin-type construction. The standard construction for lines of this character, at points where the right-of-way facilities prohibited wide base towers, has been 50-ft. single poles with 300-ft. spans and pin-type insulators screwed on malleable-iron pins arranged in a 7-ft. triangle. The high unit cost of some items of material and the local operating conditions led to the use of the suspension-insulator construction illustrated here. This special design is not necessarily adaptable to other conditions and does not possess many of the advantages of standard pin-type-insulator or double-pole-tower construction.

Pin-type insulators of the best design for this service cost in the vicinity of $7.25 each at the time of construction, making the total cost of fitting a three-phase pole top about $32. It seemed inadvisable to buy any more insulators than necessary at such prices. Suspension-insulator equipment cost approximately $45 placed per pole, but permitted considerably longer spans, thereby reducing the cost of the pole line and effecting an economy in the net total cost per mile.

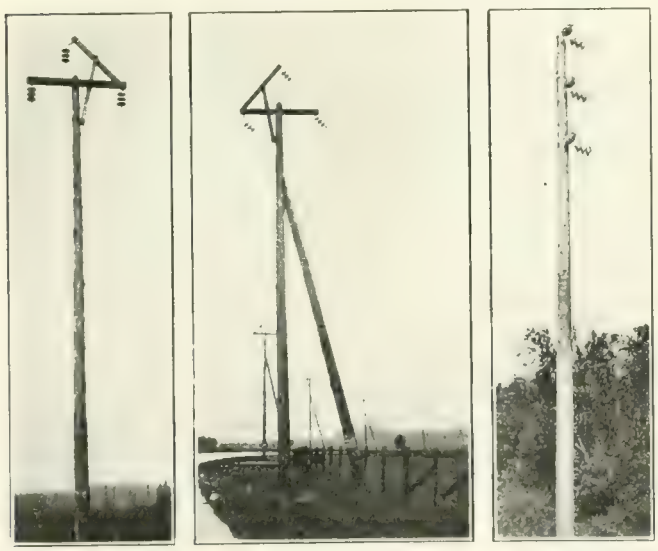
In the Puget Sound country tall trees are prevalent, and although all trees were cut down which, in falling, would reach the wires of this line, high winds sometimes break off small branches and carry them into the wires. Moreover, the blasting of stumps in clearing

land often carries fair-sized roots some distance. Snow is not unusual during winter in this climate, and at times it sticks to large wires and drops off in sections. Operating experience has shown that such conditions frequently result in making contact between two wires on long spans where the construction calls for suspension insulators with one wire placed above another. This made it very desirable to avoid a vertical arrangement of wires with suspension insulators, unless the spans were kept around 300 ft., in which case the economy of suspension-insulator construction would not have been obtained.

In the construction used cedar poles, 55 ft. in length, were employed having an average top diameter of 9 in. and 16 in. diameter at the ground level. Normal span lengths on tangents were made 475 ft. and could have been greater except for the soft ground at this locality. The conductors were 336,400-circ.mil (No. 4/0 copper equivalent), nineteen-strand, all-aluminum cables. The insulator strings on the section of line illustrated were made of three Jeffery-DeWitt disks, No. E-250, which provided some extra insulation for the line voltage of 55,000 volts with non-grounded neutral. On other lines Thomas, No. 1,054, link-type Hewlett insulators, three-disks to a string, and Ohio Brass, type B insulators, four disks to a string, were used.

The total cost of this construction averaged approximately $3,210 per mile, of which $860 represented the pole line erected and $2,350 was for the conductors strung in. Under similar conditions the standard 300-ft. span pole line with pin-type insulators costs about $1,065 per mile fitted ready for conductors. Linemen were paid $7 per day and groundmen $5.25 per day of eight hours. About 80 per cent of the line was along paved road in a valley and the poles were rock-tamped. The remainder was across rough country, but in more solid soil.

Stress computations were made of the loading of the conductors and supports, and the construction was designed to comply with the Bureau of Standards' requirements. Dynamometer tests were made to check twisting strain which would exist under all probable conditions.



ECONOMICAL CONSTRUCTION FOR 55,000-VOLT LINE ON NARROW RIGHT-OF-WAY

Left—Spans on tangent are 475 ft. long. Long turns are made as shown in the center. Right—No arms are used at sharp corners.

The arrangement of the cross-arms is a modification of the familiar wishbone construction and avoids a vertical arrangement of the wires. The cross-arms are of the same proportionate strength as on ordinary construction. The two small crossarms are alike and interchangeable and bolt holes are bored at the mill, so that the framing is simplified and cannot be placed wrong. The fitting which supports the top wire was made from obsolete 2½-in. malleable-iron pipe pins and is merely a spacer for the eye-bolt. It holds the insulator out from the cross-arm far enough for clearance. Lee pins could have been used for this purpose in place of the pipe pins.

The sag placed in the conductors was computed for the safe working load of 8 lb. wind and ½ in. of ice at 0 deg. Fahr. The sag was about 12 ft. in the average spans. The same loading with wind normal to the line stresses the pole cedar to an extreme fiber stress of 2,500 lb. per square inch. Under conditions of heavy loading on one span and none on adjoining span the wire in the loaded span will reach an extreme position about 25 ft. from the ground. With the triangular arrangement the probability of contact between phase wires under such unequal loading is much reduced.

M. T. Crawford,
Superintendent of Distribution.
Puget Sound Power & Light Company,
Seattle, Wash.

Waterwheel Pit Flooded When It Became Sealed with Water

A RATHER unusual case of trouble occurred in one of the smaller hydro-electric generating stations of the Southern California Edison Company caused by the outlet from one of the waterwheel pits becoming sealed by water. As soon as the seal became effective the outgoing water carried with it air from within the pit and wheel casing and caused the level of the water in the pit to rise.

When the water rose sufficiently high in the wheel pit the buckets struck it and the output of the generator was greatly reduced. Upon locating the cause the remedy was simple. A small hole was drilled in the casing, thus permitting the outside air to enter the casing and allow the water to recede in the wheel pit.

J. W. Andree,
Assistant Superintendent of Generation.
Southern California Edison Company,
Los Angeles, Cal.

Convenient Marking for Instrument Leads

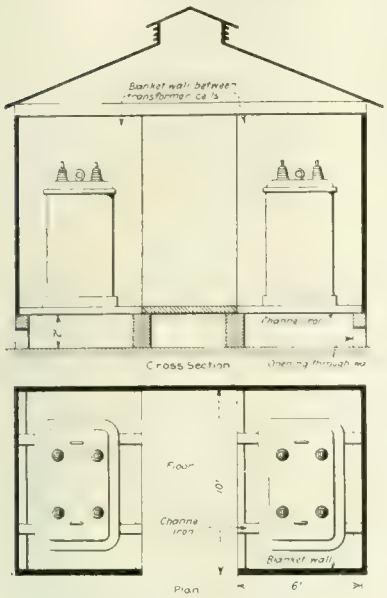
THE metal tags which are commonly used to mark control wires where they enter and leave conduits very often become lost or interchanged, particularly if the wires are cut and spliced. In order to prevent this an improved system of marking has been adopted in a substation recently constructed in San Francisco, Cal. Near the entrance to the conduit a number was stamped over each of the wires on a metal plate placed on top of a cleat which held the wires to the board. Similar numbers were placed over connecting wires at each end of the conduits, thus giving a positive and reliable marking. This information was contributed by J. E. Woodbridge, engineer for Ford, Bacon & Davis.

Field Editor Electrical World.
San Francisco, Cal.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Air Spaces Under Transformer Reduce Operating Temperature



SEMI-CHIMNEY CONSTRUCTION OF BUILDING LOWERS TRANSFORMER TEMPERATURES

A MARKED decrease in operating temperature of some 625-kva., three-phase, 6,600/440-volt naturally cooled transformers installed in a substation of the Miami (Ariz.) Copper Company was effected by constructing the building so that a strong draft around the transformers resulted. As shown in the cut, the transformers rest on channel irons with an air duct beneath. Cool air enters the building through the opening into this duct and after passing up along the transformers leaves through louvers in the roof. Blanket walls are placed between the several transformers as shown to maintain the chimney effect.

Miami Copper Company,
Miami, Ariz.

J. J. LUCHESSA,
Chief Electrician.

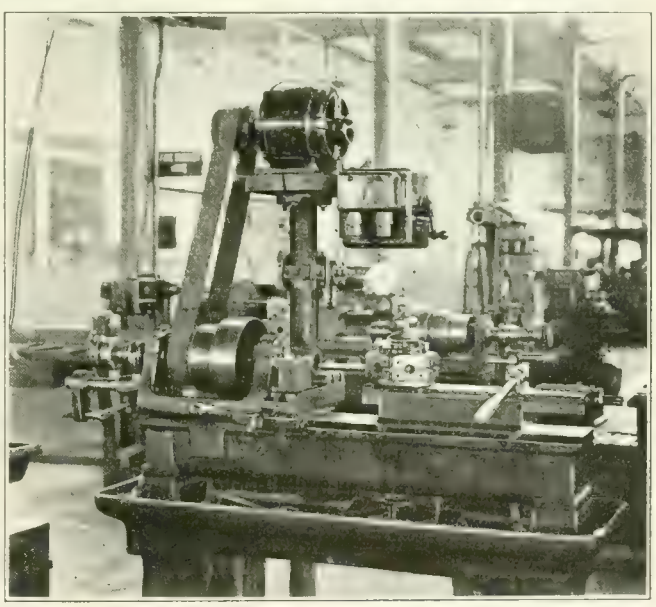
Locating a Very Small Leak in Storage-Battery Jar

A CASE in which a leak in the jar of a storage battery was very difficult to find recently came to the writer's attention. This leak, small as it was, caused the battery to give out when the vehicle on which it was installed had made only about half its normal number of miles. When it was found that this vehicle would not run it was thought at first there was some internal trouble in the battery, which was therefore tested for a ground by touching one end of a wire to the frame and the other end to one battery terminal. On withdrawing the wire a spark was produced which showed that one cell was grounded to the frame of the vehicle. The leaky cell, however, could not be found. Therefore the cells were removed from the vehicle, wiped perfectly dry, set down on a piece of brown paper and left over night. In the morning it was discovered that the paper underneath one of the cells was wet with acid. Still, however, the leak could not be discovered by inspecting with the eye. Therefore, in order to find just where the leak was, the cell was lowered into a bucket containing water which came just below the level of the top of the jar. A lamp was then connected in series with two test wires from a 110-volt line. This was done by dipping one lead from the line into the water in the cell and the other lead into the water outside the cell. When this was done the lamp lighted. When the cell was raised the lamp continued to light until the bottom of the cell was removed from the water. The cell was consequently wiped dry, and only the bottom of the jar was put in the water while the same test was made with the lamp. The lamp burned as before, showing that the leak was at the bottom of the jar. If the leak had been near the top of the jar, the lamp would not burn until the jar was lowered down so that the water covered the leak. By looking carefully a very small leak was found at one of the bottom corners. This leak was probably due to imperfect molding.

J. H. HENDERSON,
Battery-Repair Foreman.
American Railway Express Company,
New York, N. Y.

Convenient Adaptation of Motor Drive to Screw Machine

THE adaptability of individual motor drive for machine tools is well illustrated by the conversion from a group-driven installation of the East Springfield (Mass.) factory of the Westinghouse Electric & Manufacturing Company. In fitting up this plant after its conversion from group drive for producing rifles for war service individual motor drives have been chosen generally and a great variety of motor mountings were necessary. The accompanying photograph is a Garvin No. 2 hand-screw machine belt-driven by a 1-hp., 440-volt induction motor supported by a 3-in. pipe. The motor is mounted directly on a $\frac{3}{4}$-in. x $8\frac{1}{2}$-in. x $10\frac{3}{4}$-in.



INDIVIDUAL MOTOR MOUNTED FOR DRIVING SCREW MACHINE

wooden base bolted to a pipe flange at the top of the pipe which is set in the floor. The starting switch is attached to the base by ¼-in. x 1-in. iron straps. The arrangement carries both motor and starting switch above the machine and behind it, keeping the switch, however, within easy reach of the operator at his post in front of the machine. The belt is of sufficient length for smooth running.

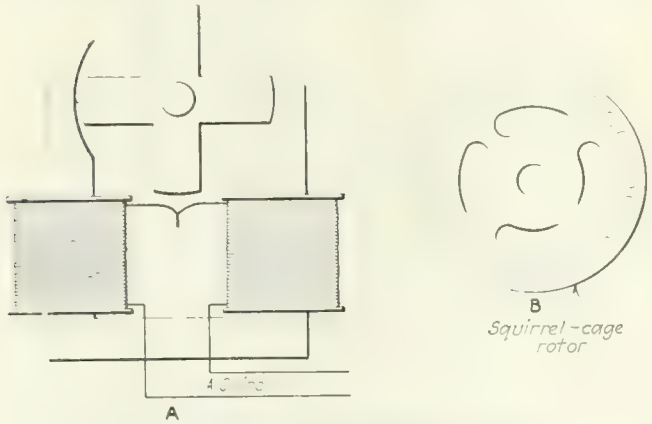
FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

Small Motors Made to Run at Synchronous Speed

A SMALL motor that will run at synchronous speed is often required for various apparatus such as slip-indicating machines, timing devices, etc. Such a motor may consist of a rotor having two or four bars of iron revolving between the poles of a laminated horseshoe magnet excited by alternating current as shown in the drawing at *A*. A motor of this kind is very simple, but it must be brought nearly to synchronous speed by hand or other means before connecting to the line, and this is an objection to its use.

A motor which is self-starting may be made from any



TWO TYPES OF SMALL SYNCHRONOUS MOTORS

small squirrel-cage induction motor by cutting openings in the rotor core to correspond with the number of stator poles as shown at *B*. There are generally four poles on small motors. Such a motor will start in an instant and run at synchronous speed after connection to the line. However, it will not hold in step if heavily loaded. If the openings are the proper distance below the squirrel-cage winding, the efficiency of the motor may not be changed at all.

There are certain makes of small squirrel-cage induction motors on the market that were found by experiment to run at synchronous speed, carrying about one-third of their rated load before starting to slip at all, but on heavier load they drop out of synchronism. The rotors of these motors have four holes through the core as shown at *B*, and the stator is wound for four poles, single-phase, with a teaser winding for starting which is ideal for light work. Any two-phase or three-phase motor would work in the same way with a similar rotor.

The magnetic reluctance varies with the position of the rotor in the magnetic field owing to the openings in the rotor. The rotor therefore tends to remain in a position giving the least reluctance or with the spokes directly under the poles of the stator, allowing the magnetism to divide around the openings.

East Orange, N. J. PHILIP G. BERNHOLZ.

Brush and Commutator Troubles Prevented by Proper Care

NOT only should great care be given to brushes when first installed but they should also receive careful attention throughout their life. Brushes, holders and commutator should be cleaned thoroughly and regularly, so that it will be certain that each brush shall have free play in its box and that the pressure arm also shall have free movement. Such attention to detail may mean the difference between good and poor brush operation. Usually when brushes are operating poorly they are shouldered with the entire blame irrespective of conditions. There are conditions, however, under which any brush will operate poorly. One very common fault is copper picking, and usually this is caused by other reasons than improper brushes. Often this fault is exceedingly difficult to correct. Occasionally brushes pick copper immediately after being first installed, while their surfaces are still freshly sandpapered and the commutator surface is raw. Under these circumstances brushes pick up copper that is liberated by mechanical abrasion. If this be the case, the trouble can be overcome by carefully wiping off each brush from time to time until the contact surfaces are polished. However, in most instances copper-picking is caused by circulating currents in the faces of the brushes. Machines with interpoles or pole-face windings are much less liable to copper picking than the non-interpole machines. On the latter type of machine a better brush position for the required load conditions may effect an improvement in this fault. Often poorly sanded brushes, with resultant small areas of contact, cause undue circulating currents to flow, resulting in extreme local heating, which in turn burns off particles of copper from the commutator bars, and these particles are caught by the brush surfaces. Sometimes under certain conditions brushes of only one polarity are affected—usually the positive brushes on a generator or negative brushes on a motor; that is, copper is carried along with current flow from copper to carbon. After all other efforts fail an improvement may be made by changing the grade of the brushes, this change having the effect of altering the amount of circulating current or acting as a damper to the passing of copper particles from commutator to brush.

Ridging or grooving of commutators is another fault that is distressing to the operator who takes pride in keeping his machines in the best condition. The location of the brushes on the commutator plays a great part in correcting this fault. The method of staggering brushes around the commutator which gives the best results is to have the staggering done in pairs of studs rather than alternately. The latter method permits the positive brushes to track on one part of the commutator while the negative track on another. It is found that usually the negative brushes on a motor wear the commutator much more rapidly than the positive; hence if all negative brushes are permitted to track each other, grooves will form, leaving ridges under the positive brushes. Excessive grooving may be caused by a too abrasive brush, by too much spring tension, which should be only great enough to keep intimate contact between brush and commutator, or by improper brush position or commutating-pole adjustment permitting undue circulating currents to be present in the face of the brush, causing excessive local heating which burns away the copper.

Frequently operators apply lubricant to the commutator in an endeavor to stop the grooving action. This practice is not advisable as the lubricant is liable to gum on the commutator, causing varying contact drop and position of the brush. For the same reasons the use of impregnated brushes is not recommended.

Chattering of brushes is another distressing fault, which is caused by using an improper grade of brush, by brushes operating at the wrong angle, by the commutator surface being uneven or out of "true," or by high mica. Trailing brushes work best at 15 deg. or less, while leading brushes, reaction type, should have an angle between 30 deg. and 40 deg. (The angles as here used are the degrees of tilt from the radial position.) It will not be necessary to elaborate on uneven or out-of-true commutator surfaces as all are familiar with this phase of trouble. However, high mica may be the cause of trouble when least expected. Even after a commutator is newly turned down, the mica may be slightly high because the machinist has not had the proper edge on the turning tool and consequently the copper has been cut away more than the mica. A good stoning or strenuous attack with carborundum cloth when the machine is cold will be necessary to take down the mica. Chattering is often present on a commutator having a surface speed too high for the particular grade of brush used, hence it is urged that operators keep within the limits of speed as outlined by the brush manufacturers.

A. L. HEATH,
Engineer.
Morganite Brush Company,
New York, N. Y.

Incorrect Spacing Wears Brushes

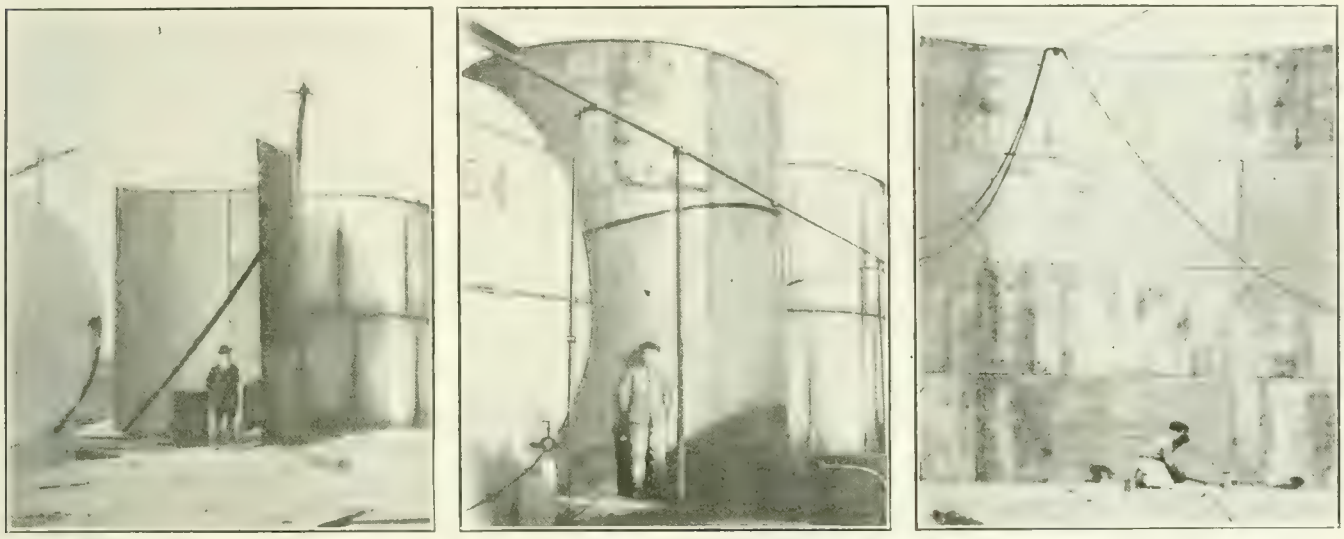
BRUSH spacing on a motor is more important than is often realized. If one brush is a little ahead of its correct position and another brush on some stud of the same polarity is a little behind its correct position, an unequal voltage is set up which may result in high circulating or short-circuit currents between these studs. This will result in abnormal brush and commutator wear.

A discussion at a meeting of the Iron and Steel Electrical Engineers brought up this point.

Electrically Welded Tanks Show Many Advantages Over Riveted Ones

ALTHOUGH the general method of building oil tanks by electric welding is similar to that of other tank work, there are certain advantages over the riveted construction which are of particular interest. For instance, the reduction of leakage losses is very important. One representative oil company has estimated its average yearly leakage loss at 5 per cent of the contents of storage tanks with a higher percentage for the lighter grades and a lower percentage for the heavier grades of oil. In the welded tank there is no danger of wind pressure, filling and emptying of tanks or temperature changes causing leaks as is often found to be the case in riveted construction.

In order to make a tank riveting job accessible, it is necessary to rivet the bottom and first course on horses and then lower into final position on the foundation. Very frequently the strains set up by lowering cause leaks in this portion of the tanks which are not discovered. The welded tank, on the other hand, is welded in the position in which it is to remain.



ARC WELDING HAS GIVEN EXCELLENT RESULTS IN BUILDING OIL-STORAGE TANKS

Tanks may be erected with vertical seams only or built in courses with horizontal seams. In some cases the plates are welded together while flat on the ground and the two halves of the tank bent to shape as shown in the left-hand view.

The life of a welded tank must be estimated as being at least twice that of a riveted tank, for the reason that the skin of the plate is not broken as is the case where riveting is done. Less painting is required as there is no leakage to cause discoloration, which often occurs with riveted joints. In refineries using tanks painted white the reduction in painting expense is considerable. As the roof section in a welded tank is gas-tight there is a reduction in evaporation losses, and at the same time insurance premiums are lower than for an oil tank which is not gas-proof.

From a construction standpoint the work of erecting a welded tank is much simpler than the corresponding work for a riveted type. In fabricating materials for the riveted tank it is usually necessary to make templates, mark, punch and ream the plates, and it is also important that the edges of the plates be "faired" and that the size of the sheets be accurate. In welded construction it is possible to eliminate the rivet holes, butt straps, bosom pieces, gusset plates, angles and fairing of

plates and to also reduce the amount of lap of the plates. With a few exceptions it is unnecessary to fabricate the plates. Inasmuch as the welded lap joints are fully as strong as or stronger than the plates themselves, it is possible to lighten the plates by at least 15 per cent and at the same time have a structure which is from 10 to 20 per cent stronger than the present standard of riveted tanks.

A 500-barrel tank was recently built the welding of which deviates somewhat from ordinary procedure and shows what may be accomplished with this method. The dimensions of the tank are as follows: Diameter, 16 ft.; height, 16 ft.; five 5-lb. plates of blue sheet steel (No. 10 gage), size 4 ft. x 11 ft. for the shell.

The bottom plates were laid out flat on the foundation and welded from one side. After this was concluded the bottom was turned over and welded from the other side. The shell was built up in a method differing somewhat from ordinary procedure. Instead of being built in several courses it was built in one single course, which meant that vertical seams were used in welding the shell together. The plates of the shell were first laid out on the ground and welded together so as to make two halves of the tank. One-half of the shell was then raised by means of a gin pole and one corner of it tack-welded to the bottom. The ends of a turnbuckle were fastened to the outside end of this half of the shell about half way up by means of clips that had been welded to the shell. By tightening this turnbuckle the shell was forced into place and tack-welded as it came into proper position on the bottom. The other half of the shell was raised in a similar manner and tack-welded into position. Naturally this left the upper part of the shell out of shape, and this was taken care of by looping a cable around the upper part and by tightening the shell to force it together.

A 6-in. I-beam was used to force the edges of the shell into position for welding. After the vertical seams had been welded outside, the I-beams were removed and the inside vertical seams welded. Bolt holes which were necessary in this method were then welded up.

A 2-in. x 2-in. x ¼-in. angle iron was welded around the top of the shell heel and toe. The roof was welded on this in three courses. The ends of the center course were split in the middle and a V-piece was cut out of each end. A 12-in. block was put under the middle of the center course to give the roof the proper pitch, and in this position the slits were closed and welded up. This course was then put in place and welded to the top angle, and the other courses were lapped to the center course and welded to it at the top angle. There was no frame used under the roof.

The tank on completion was filled with kerosene and found to be absolutely tight. It has been in constant use for seven months. This method has also been successfully used in a number of other cases.

The welding was done with electrodes of 0.134-in. diameter using a current value of about 125 amp. The average speed of down-hand welding was 10 ft. per hour, while the average speed of vertical welding was 5 ft. per hour.

In welding a 5,000-barrel tank the procedure was more nearly comparable to that found in riveting practice. That is, each course was bolted together before being welded, using bolts about every 3 ft. The dimensions of this tank were as follows: Diameter, 43 ft.; height, 20 ft.; bottom of ⅜-in. plate, first course of ¼-in. plate, second course of ⅜-in. plate, third course of 11/32-in. plate, fourth course of 5/16-in. plate, and the roof of ⅜-in. plate. The size of the shell plate was 5 ft. x 14 ft. A 1½-in. lap was used throughout welded from one side in the top and bottom and from both sides in the shell, the heavier weld being on the outside and in down-hand position.

A 2-in. x 2-in. x ¼-in. angle iron was laid on the bottom along the outside edge, leaving a ¾-in. space between the angle and outside edge of the bottom. This bottom flange of the angle was then welded to the bottom of the tank. The first course was set on the bottom and backed against the angle and welded to the bottom all the way around the sides by a ½-in. weld. The angle was welded to this course from the inside by a ¼-in. weld. A 2-in. lap was used between courses, and the outside welds were made for strength while the inside welds were made to seal the joints between the two plates. The plates were scarfed where three plates came together. The joints were welded in the ordinary way. The top angle, 2 in. x 2 in. x ¼ in., was welded heel and toe all the way around. The roof was of the ordinary type of steel roof with a center and radio plate. The angles and I-beams and roof construction were all welded in the simplest way according to common practice developed in constructural welding work.

In this case plates of ⅜ in. and over were welded with electrodes of 0.164-in. diameter, using a current value of about 145 amp. The plates under ⅜-in. were welded with electrodes of 0.134-in. diameter, using a current value of about 125 amp. The average speed for down-hand welding was 8 ft. per hour, while the average speed for vertical welding was 4 ft. per hour.

From the amount of work done to date it has been definitely established that the same procedure can be followed in construction of tanks of any size that may be desired. Various kinds of acid tanks, agitators, etc., are being successfully welded with the electric method.

Electric Arc Welding Company of America, New York, N. Y.
WILLIAM SCHENSTROM, Consulting Engineer.

Judging Temperature of Motor by Feeling with Hand

VERY often the user of an electric motor will wrongly conclude that it is operating at too high a temperature after testing it by feeling with the bare hand. However, it is known to those who are familiar with heat tests that to the touch of an inexperienced hand a rise of 40 deg. C. over the temperature of the average shop is exceedingly disagreeable, and with a 50 deg. C. rise the sensation is unendurable for even a few seconds. On account of the fact that the operator cannot comfortably bear these temperatures, he believes that the motor is overheating. Nor is the average operator convinced when a thermometer applied in the usual way shows that the operating temperature is well under the rating of the machine.

A check that usually finds favor under such circumstances is to heat a small quantity of water, when such may be readily done, to the temperature recorded on the machine and let the doubter test with his fingers. He will usually find that the water is uncomfortably warm although the temperature is still lower than that for which the motor is rated. Since there is nothing mysterious about such a demonstration, it will go far toward easing the mind of the operator.

WILLIAM THOMSON.
New York City.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

The Interest of the Public in Utility Development

James A. Perry Discusses the Handicap Caused by Lack of Information and Deplores Unfounded Political Agitation

ONE of the outstanding addresses delivered at the convention of the National Electric Light Association in Chicago last week was the one made by James A. Perry, president National Association of Railway and Utility Commissioners, Atlanta, Ga., on the interest the public should take in the development of public utilities. He said in part:

"One of the great handicaps in the operation of a successful public utility is lack of information and duty on the part of the public served by the utilities. If the public and the press of the country would only approach such a subject with the facts in mind that there are 1,450,000 private citizens in this country with their savings invested in the securities of electric light and power companies, that the insurance companies of our country have over $300,000,000 in the same securities, this representing indirectly the savings of the poorer class of people of the country, and that the 27,000,000 depositors in the 29,000 banks in the United States have a direct interest in such utilities, because of the fact that their money in the sum of $1,700,000,000 is invested in such securities—an amount which in thousands of cases represents the inheritance and savings of widows and orphans—I believe they would be less inclined to embark on a course that at times means bankruptcy to the business, a hardship on the public it serves and heavy losses to the investing public.

"The public is not entirely at fault for accepting as true reckless and untruthful statements of irresponsible individuals concerning the affairs of public utilities. At times we see newspapers playing up such statements, regardless of the facts or source from which they come. Such a campaign of misrepresentation should never be allowed to go unchallenged. The facts should be given to the public, and in most instances they will be readily accepted.

"In return for good service and reasonable rates for such service the public has a vital interest in such rates being maintained as will justify the investing public in furnishing sufficient money to guarantee speedy development. In the absence of such development the public must continue to pay a higher rate for a substitute service less efficient and giving less satisfaction.

"I know of no greater curse to the business interest of a community than has arisen where agitators have been allowed without answer to disseminate alleged facts in derogation of practical, legitimate utility development. I would say to the public, get our utility development as we may, the fact remains that we are going to pay a reasonable return on the fair value of the property used in giving the service—it makes no difference whether municipally owned, 'home-ruled' or privately owned and regulated. Dating from some two years ago, there is no question in my mind that many regulatory commissions throughout the country made the common mistake of holding light and power, gas and street railway companies to rates that were too low, hoping that the immediate future would amply justify the rates prescribed. This hoped-for condition was not realized. The experience was just the opposite of what we had expected to see.

"The law by which regulatory commissions are governed requires them to prescribe just and reasonable rates, and the courts throughout the country have declared that a just and reasonable rate is one that with competent management will afford the utility a reasonable return upon the fair value of its property used in the public service. Just compensation for the use of private property by the public is a constitutional right which cannot be denied.

"It seems to me that we have in the present-day hostile attitude of the public toward utilities a feeling somewhat similar to that which we recall existed toward railroads for years before government control—so much so that if there does not come into play a better feeling between the public and the utilities, and that right away, we cannot hope for any less expensive experience in this instance than we have had with railroads.

Universal Opposition of City Officials to Rate Increases

"At the present time, in many instances, a utility files an application with the regulatory board of the state in which it operates. This done, a copy of such application is served on the municipality affected by the change proposed. It makes no difference what the relief asked for may be, the mayor and council meet and promptly vote to instruct the city attorney to oppose the granting of the relief sought. No investigation is made as to the justice of the relief petitioned for, but the city attorney is directed to oppose it, not to investigate and ascertain the truth as information for the mayor and council before action is taken one way or the other.

"We seldom hear of a municipality under such circumstances making an investigation and ascertaining whether there is any merit in the claim of the utility company. Investigations are seldom made, little information is had, and seemingly none is desired.

"This, of course, is an unfortunate situation. In the end it will be overcome, but not without loss to the utility and the public while such a condition prevails. Competitive business had its day and failure. Regulated monopolies are now on trial. The public is still

paying 100 per cent more for some merchandise than the same articles sold for four and five years ago, but the thought of paying a 50 per cent increase in utility rates as compared with prices for such service three and four years ago meets with scant sympathy.

"Capitalization of years ago as an argument against increases in rates at the present time is taken seriously by no one who knows anything about the subject. Yet, in spite of the deception in the argument, we hear it stated that present increases are necessary to pay dividends on watered stock. Not a word of truth in the statement, but when sponsored by one who has no regard for the correctness of his statements you will find that here and there it is accepted as true. The regulatory commissions throughout the country, sustained by the reviewing courts, are in accord that the fair value of the property devoted to serving the public shall be considered in prescribing rates for utility service. Little or no consideration is ever given to capitalization. You never hear of a company basing an application for rates on the amount of capitalization. There is no justification in the position that old capitalization schemes are relevant in considering what is a reasonable rate of return on the fair value of the property used and useful.

"The public has a special interest in the expansion of utilities because a city can never grow faster or extend further than her utilities reach. The utilities of a community are the greatest developers any city ever had. No city can build beyond the lines of her street railroads, and this is true to a degree in comparison with the area covered by gas mains.

"Few sections of this country can finance utility development of any kind from local capital. The financial necessities of the development, therefore, carry us to foreign fields for money. Is there a man anywhere, regardless of his business interest, with surplus money for utility investments, who is going to send his money into communities where there exists a citizenry hostile to foreign capital for such investments? Even worse, will such a man send his money into a state for such investments where the state regulatory board refuses rates that will earn even less than the lawfully prescribed rate of interest as a return for utility service? Will such money find its way into a state where condemnation of such property is the talk of the day?

"The public has an interest in seeing that such conditions do not exist; it has an interest greater than the selfish interest of the few who would stop the utility development of every community while their political ambitions are satisfied or a personal grouch is assuaged. It is a sad picture to see a community of inflamed citizens following the leadership of one man, or even several men, in an effort to handicap or destroy a local utility, all because of a personal grudge on the part of the few self-styled leaders. This kind of thing has got to stop in this country, otherwise the public will pay the high price of stagnation in such growth with a breaking down of the present service rendered.

"I cannot believe the public will stand for a reactionary program that will certainly carry us back to crude methods with less service and at higher rates. We may halt, temporarily, here and there over the country, but in the end the production of electric power, as well as other utility services, is going to be carried on in a wholesale manner. Any other method is squarely opposed to the very fiber of our people and form of government."

Promoting Good Will by "Department of Greater Service"

THE "department of greater service" established by a Western company to create and nourish good public relations, as recounted in the ELECTRICAL WORLD for May 28, page 1230, by S. M. Kennedy, vice-president of the Southern California Edison Company, makes use of a folded card bearing on the inside the inscription here reproduced, and the name of the company and that of a special representative on the outside. When this representative calls upon any consumer to ascertain whether the company's service is satisfactory in every way one of these cards is left behind as a record of the company's attitude.

GREATER SERVICE

BELIEVING THAT TO SERVE

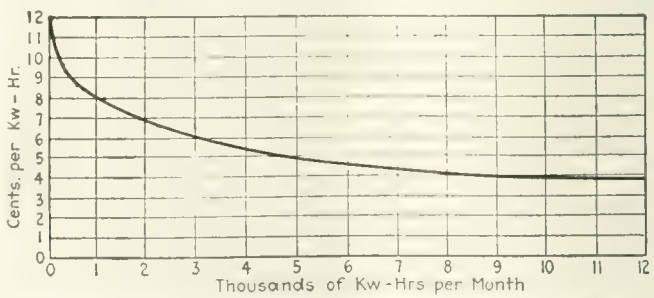
is both an obligation and an opportunity, the —— —— Power Company maintains that no consumer is properly served unless there exists that fine and intimate relationship inspired by mutual confidence.

Our unwritten agreement with every consumer provides that he may call upon us at any time for advice, suggestion or counsel in matters electrical. No problem is too large for our organization to handle and no detail too small to receive our most careful attention.

We will welcome every opportunity to extend our usefulness and to have you fully understand what we mean by GREATER SERVICE.

Small Company's Power Rates Consistent with Use

A SMALL central station in Massachusetts had fifty power customers in February, 1921, and an analysis of the bills rendered showed a symmetrical decrease in the price of energy per kilowatt-hour as the use increased. The fifty customers consumed 91,220 kw.-hr. in the month at a total billed cost of $4,006.85, making 4.4 cents per kilowatt-hour the over-all price. Twenty of the customers were billed the minimum charges only, on account of using but 3,164 kw.-hr., and the cost of this service was $542.25, or 17.1 cents per kilowatt-hour. The remaining customers used 88,056 kw.-hr. at a total price of $3,464.60, or 3.93 cents per kilowatt-hour. It was evident, as shown in the accompanying curve, that power customers who used even a moderate amount of energy were much better off per unit than those who used but little, and the figures showed that the burdens of "overhead" on the power user and central station make regular production extremely desirable economically.



RELATIVE PRICE PER KW.-HR. TO CONSUMPTION OF ENERGY

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Heat Losses in the Conductors of Alternating-Current Machines.—WALDO V. LYON.—The solution for the distribution of alternating current within conductors in high-capacity alternating-current generators has been worked out for a number of cases. Heretofore investigators have used trigonometric and hyperbolic functions of real angles in these problems. In the present investigation hyperbolic functions of complex angles are used and the results are accomplished, it is said, with much less effort.—*Journal A. I. E. E.*, May, 1921.

Suppression of the Third Harmonic in Three-Phase Transformers.—H. PISTOYE.—Magnetic flux set up in the steel tanks of transformers suppresses to a certain extent a third harmonic frequency, which is liable to appear in three-phase Y-Y types. But this suppression is accompanied by increased iron losses of the transformer. The author recommends and has actually built transformers with several tertiary windings embracing all three legs of a three-phase core-type transformer. With this arrangement the dangerous third harmonic has been successfully eliminated in Y-Y connected three-phase transformers with no additional losses.—*Revue Générale de l'Electricité*, April 23, 1921.

Generation, Transmission and Distribution

Electricity Supply and Housing Schemes.—A series of papers in which this and allied subjects are discussed under the following headings: "Electricity Supply and Housing Schemes" (some practical problems), by W. F. T. Pinkney; "The Supply of Electricity to Housing Colonies," by E. E. Hoadley; "The Place of Electricity in Town Planning," by C. B. Purdom; "Selling Electrical Energy in Bulk to the Domestic Consumer," by H. Richardson, and "Some Aspects of Domestic Lighting," by J. S. Dow.—London *Electrician*, April 8, 1921.

How to Protect Pulverized-Coal Plants from Dust Explosions and Fires.—A vacuum system should remove the dust from the air in the building. Excessive heat should be avoided in drying, as it might cause fires in storage bins. Air supplied for burning coal should be kept from forcing its way into the coal-supply line on account of the danger of its carrying sparks with it.—*Coal Age*, April 28, 1921.

Peat Power Plants in Germany.—An account of the results obtained from burning peat at the Wiesmoor plant, which was the first power plant erected in Germany for furnishing electrical energy from peat. Other proposed plants which have been suggested following the success of the Wiesmoor plant are described.—*London Engineer*, April 22, 1921.

Modern Practice with Steam Superheaters and Their Fields of Use.—H. B. OATLEY.—The writer discusses the design, including a detailed study of types of superheater installation, application and use. Tables of performance with saturated and superheated steam are given.—*Journal of Engineering Institute of Canada*, May, 1921.

Submarine Power Cables.—F. A. WESTBROOK.—Submarine power cables are made with large conductors and heavy insulation for voltages up to 30,000 and are consequently bulky, stiff and difficult to handle. They have therefore been limited to lengths of a few miles, the longest cable of this kind now in service in the world being about 3.5 miles (5.6 km.). The manufacture of such cables and methods of splicing are dealt with more particularly.—*Bulletin of N. E. L. A.*, April, 1921.

Utilization of Hydraulic Energy for Electrification of Steam Boilers for Heating Purposes.—P. BERGEON.—About 20 per cent of the total coal consumption of France is used under steam boilers for industrial heating. The efficiency of the coal-heated boiler, even in large units and modern plants, is only about 60 per cent, whereas an electrically heated boiler operates at about 95 per cent efficiency. Over-all-loss diagrams are shown which demonstrate that (1) the efficiency of the transformation of coal into steam is about 60 per cent, (2) the efficiency of the transformation of coal into mechanical energy is about 11 per cent, (3) the efficiency of the transformation of hydraulic energy into steam by electrically heated boilers is about 66 per cent, (4) the efficiency of the transformation of hydraulic energy into mechanical energy is about 62½ per cent. Technically the electric boiler has been brought to a very high degree of perfection. Any alternating-current voltage up to 10,000 may be used directly. Tests showed a consumption of 4½ kw.-hr. to be equivalent to 1 kg. of 7,500-B.t.u. coal. The author shows that if only one-half of the existing boilers generating steam for heating purposes in three French provinces were electrified, taking energy from an ample hydraulic supply, an annual coal saving of 180,000 tons would be realized.—*Revue Générale de l'Electricité*, April 23, 1921.

Traction

Diesel-Electric Motor Cars.—LUCIEN PAHIN.—The article is an interesting and detailed description of the four types of Diesel-electric motor cars built by the Allmänna Svenska Elektriska Aktiebolaget and operated since 1913 on different Swedish lines with marked success. The four standard types comprise a 75-hp. car and a 120-hp. car, each for both standard and narrow gage (1,435 mm. and 891 mm.). These are the main data for the standard-gage 75-hp. car: It accommodates fifty-one seated passengers, one baggage compartment, a lavatory, the engineer and the conductor, and weighs complete, ready for service, 29,300 kg. The Diesel six-cylinder engine is rated at 75 hp., 550 r.p.m., and is capable of a 20 per cent overload, consuming 200 grams of heavy oil per horsepower. The engine is started from a storage battery, which also illuminates the car. The air compressor, water pump and lubri-

cating-oil pump are driven from the main shaft. The cooling water of the cylinders is circulated through a system of cooling coils on top of the cap, in winter through radiators under the seats. The generator is direct-current, eight-pole (and commutating poles) dynamo, flexibly coupled to the engine. Its shaft runs in ball bearings. The speed of the two driving motors is changed very economically by a wide voltage regulation of the generator. During the normal run the generator operates as a plain shunt machine; at the starting it runs as a series motor. A complete train, weighing 40 tons, attains on the level a speed of 53 km. per hour; the motor car alone has run as fast as 80 km. per hour. At every station the Diesel motor is stopped. The first controller position corresponds to the start, bringing the generating set to full speed in a few seconds. The Diesel motor runs on an average only about 60 per cent of the running time of the car, which permits considerable saving in oil, lubricant and wear. The author gives several tabulations of cost comparisons between this car and gasoline-electric, benzol-electric and steam-locomotive types, and comes to the conclusion that the over-all cost per train-kilometer of the Diesel-electric train is about three-fifths that of the steam locomotive.—*L'Industrie Electrique*, April 25, 1921.

Installations, Systems and Appliances

X-Ray Apparatus for Workshop Use.—The apparatus described was designed in the form of a portable self-contained unit capable of continuous operation under rough workshop conditions and by unskilled labor.—London *Engineering*, April 29, 1921.

Study of Underground Electrical Prospecting—I.—A description of how prospecting is carried out by making a potential chart, with suggestions regarding the use of non-polarizing electrodes and the recommendation of direct current for this work.—*Engineering and Mining Journal*, May 7, 1921.

Variable-Speed Motors in Heavy Industries.—S. Parker Smith.—This discussion deals briefly with the application of variable-speed motors, both direct-current and alternating-current, to heavy industries from the point of view of the electrical designer.—London *Electrician*, April 29, 1921.

X-Rays and Their Industrial Applications.—Abstract of a lecture by G. W. C. Kaye. Characteristics of X-ray heat are discussed. Excellent work done in the investigation of crystalline material and the examination of products of the industrial plants is described.—London *Electrician*, April 29, 1921.

Electrodynamic Forces in Electric Furnaces.—Carl Hering.—A number of recently discovered mechanical forces are described which are of electrical origin and which may be made use of, or may be detrimental, in some types of electric furnaces, chiefly those in which the heat-developing resistor is a liquid, which responds to these forces more readily than a solid. Such forces may be usefully applied to cause the liquid metal to flow very rapidly through the heat-developing resistor, thereby enabling the furnace to be forced and to cause a strong upward circulation in an adjoining bath by which the metal is refined of suspended impurities and made homogeneous. After referring briefly to the formerly described "pinch effect," a description is given of the "stretch effect" and of the "corner effect," known also as the "motor effect."—From paper presented before American Electrochemical Society, April 21, 1921.

Electrophysics and Magnetism

X-Ray Crystal Analysis of Thirteen Common Metals.—Albert W. Hull.—The author's method of powder analysis was used. The metals investigated are chromium, molybdenum, tantalum, cobalt alpha and beta, nickel, rhodium, palladium, iridium, platinum, zinc, cadmium and ruthenium.—*Physical Review*, May, 1921.

Electrochemistry and Batteries

Electric Trucks and Industrial Locomotives.—In this concluding number of the series equipment and methods for charging storage batteries are discussed.—London *Engineer*, April 29, 1921.

Experiments on the Corrosion of Iron and Steel.—T. S. Fuller.—A record of observations on the behavior of drops of water standing on pure iron and other materials, also standing partly on iron and partly on zinc or brass. Results of oxidation are usually perceptible in one minute and quite marked in fifteen minutes. If the drop evaporates completely, well-marked zones remain on the metal. Progressive placing of fresh drops on the same spot and allowing them to evaporate showed that the first drop was much more active than subsequent drops, indicating that a partial immunity is progressively built up. Copper steels were compared with cold-rolled wrought iron, showing copper to slow up the rate of rusting.—From paper presented before American Electrochemical Society, April 21, 1921.

Units, Measurements and Instruments

An Electric Battery Vehicle Meter.—George J. Duckett.—The writer states his belief that there is one type of meter that stands up to the requirements of the electric road vehicle. This is the mercury motor meter designed to withstand the maximum rate of charge, in which the main current is carried by a shunt and only a small percentage is allowed to pass through the mercury bath.—London *Electrician*, April 29, 1921.

Electric Strength of Air Under Continuous Potentials and as Influenced by Temperature.—J. B. Whitehead and F. W. Lee.—The paper describes a series of experiments on the influence of temperature on corona-forming continuous potentials. The observations were made on three sizes of wire of diameters of 0.0251 cm. and 0.0933 cm., and in each case at several values of temperature within the range of 5 deg. C. and 70 deg. C. The observations show that under constant conditions as to pressure and temperature a higher value of negative potential than positive potential is required to form corona. The experiments substantiate the empirical laws developed by Whitehead and Peek, although the constants of the equations involved are higher than any heretofore observed. There are some indications that at temperatures in the neighborhood of 70 deg. C. a departure from the empirical laws mentioned may set in.—*Journal of A. I. E. E.*, May, 1921.

Telegraphy, Telephony and Signals

Static Frequency Doubles.—J. F. Peters.—The development of the static frequency doubler has been brought about by the difficulties in constructing alternators for very high frequency, the scheme being to generate at a lower frequency and raise this frequency by means of such a combination as two transformers with three windings each, as described by the writer.—*Electric Journal*, April, 1921.

Organization of Machine Telegraphs.—Arthur

JAMES POLLEY.—The writer calls attention to the need of machine telegraphy for modern high-speed work and describes some of the apparatus of modern design. *Beama* (British Electrical and Allied Manufacturers' Association), April, 1921.

Frequencies and Damping Factors of Coupled Circuits.—LOUIS COHEN.—The general theory of coupled radio-frequency circuits is developed for systems having two degrees of freedom and for the resonance and non-resonance conditions. The theory is mathematically applied to determine the frequencies and damping factors for inductively coupled, directly coupled and electrostatically coupled circuits.—*Proceedings Institute of Radio Engineers,* April, 1921.

Specifications and Characteristics of Moorhead Vacuum Valves.—O. B. MOORHEAD and E. C. LANGE.—A number of types of Moorhead tubes are described, together with the mode of testing them and the specifications to be met. The tubes obtained are classified as detectors or amplifiers, which types the authors regard as separate and generally non-inclusive. The effects of small variations in a number of the tube dimensions are exhaustively studied, and conclusions are drawn as to the effect of varying the various tube dimensions.—*Proceedings of Institute of Radio Engineers,* April, 1921.

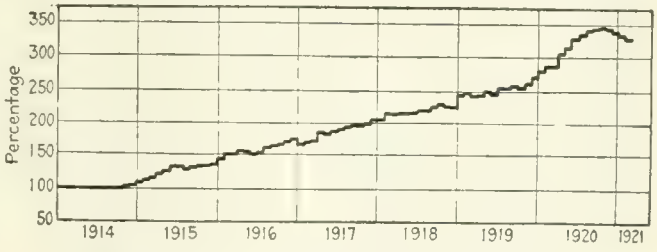
Continuous-Wave Radio Communication.—D. G. LITTLE.—The writer deals with the three principal methods of continuous-wave generation, namely, arc generators, high-frequency alternators and vacuum tubes.—*Electric Journal,* April, 1921.

Generators for Wireless Telegraphy.—KARL SCHMIDT.—Designers of medium-frequency and high-frequency generators will find in this article details, drawings and photos never before published. The bulk of the article deals with different types of generators used for the operation of quenched-spark sending stations, that is, machines producing up to 600 cycles per second. Several solid-steel-rotor, unipolar machines are described, and their characteristic curves are given. There is a large demand for medium-frequency machines of from 0.05 kw. up to 300 kw. output, which has resulted in highly developed standard types. During the war a large number of these machines, rated at about 350 watts, 600 cycles, and simultaneously at 200 watts, 500 volts direct current, operating at 4,500 r.p.m. and weighing only about 17 lb. (7.7 kg.), have been used on airplanes. A wound-rotor type for 1.5 kw. weighing only 48 lb. (22 kg.) is shown. Great prominence is given a new type of generator developed by the author during the war which found widest use in the German army and navy. It is a type with all windings stationary and a laminated, toothed rotor. The author claims for his machine the smallest weight and highest efficiency ever reached for such generators; for example, 11 lb. (5 kg.) for a 500-watt alternating-current plus 250-watt direct-current type, or 82 per cent efficiency for a 2-kw. type. A very compact, portable, gasoline-driven 1.5-kw. alternating-current plus 1.0-kw. direct-current type is described. Dealing with high-frequency machines, the author does not consider it as reliable to go beyond 3,000 r.p.m. or 450 ft. (137 m.) peripheral speed per second. The multiplying of frequency in stationary transformers according to Jolly-Arco and Goldschmidt is touched upon, assuming eightfold and threefold respectively as safe limits. Characteristic curves are given of a 7,000-cycle machine in actual operation.—*Elektrotechnische Zeitschrift,* March 17 and 24, 1921.

Importance of the Great Radio Center of Paris.—The present capacity of wire telegraph lines is not adequate to the needs of France. This applies both to inland use and to foreign communication. Radio service from the four existing large stations, however, amply fulfills all needs. The French radio service embraces four distinct divisions—service outside Europe, European service, colonial service and information service. To transmit from Paris to New York 500 kw. is used and from Paris to South America 1,000 kw. A short description is given of the high power stations in Paris (Eiffel Tower), Lyons, Nantes and Bordeaux. All four operate regularly with the Poulsen arc system. It is realized, however, that the arc system has many disadvantages as compared with a system with high-frequency generators. In two of the above-named stations, therefore, generators have been installed at first for experimental use. The state has erected high-frequency generators of 50 kw. to 500 kw. output, using an entirely French type, with simple, non-rotating winding, no condenser circuit and not requiring a specialist for repairs, and is equipped to build these machines, whose efficiency, it is claimed, is the highest ever attained in similar generators. Twenty of these machines have been delivered so far and fifty are under construction. Two methods of recording the received messages have been perfected—the phonographic system, capable of 100 words per minute, and the photographic system, reaching up to 500 words per minute. —*Radio Electricité,* Vol. I, page 378.

Miscellaneous

Engineering Costs.—FRANK WALKER.—An analysis of engineering costs from the period of 1914 to date. Under engineering costs are listed labor costs, material



INCREASE IN COST OF AVERAGE ENGINEERING PRODUCT, INCLUDING MATERIAL AND LABOR

costs, overhead charges and average product costs.—*Beama* (British Allied Electrical Manufacturers' Association), April, 1921.

Scholarship and Eminence in Engineering.—RAYMOND WALTERS.—Of 580 eminent engineers who were college graduates the collegiate records of 392 were examined. Of these 182, or 46.4 per cent, stood in the highest fifth of their classes scholastically; 109, or 27.8 per cent, stood in the second highest fifth of their classes scholastically; 72, or 18.3 per cent, stood in the middle fifth of their classes scholastically; 14, or 3.6 per cent, stood in the next to lowest fifth of their classes scholastically; 15, or 3.8 per cent, stood in the lowest fifth of their classes scholastically. This analysis is offered to show that scholarship is of equal importance with character, judgment and other requirements as brought out by the Mann report.—*Bulletin of Society for Promotion of Engineering Education,* April, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Niagara Falls Development to Use Water Under Higher Head

WITHOUT obtaining any additional water the Niagara Falls (N. Y.) Power Company is going ahead on its fifteen million dollar project by using some of the water under an increased head. The "Niagara" plant, which secures only a little more than half the power per second-foot of water as the new plant completed last year, is to be abandoned. The new plant will be extended further in about the same way as previously and the additional power developed there.

The full 314-ft. head is not being used in the present development. This would involve the abandonment of present efficient plants. Instead the head will be used in two stages, the first by 220 ft. and the second 94 ft.

A 32-ft. U-shaped tunnel, on which work is now progressing, will bring the water at a depth of approximately 100 ft. below ground from Port Day to the penstocks through a forebay similar to that provided for the plant finished last year. This, it has been reported, will raise the system capacity 187,500 hp. It is expected that the first unit of this new development will be ready for operation before May 1, 1923.

Part of this power, it has been learned, will be delivered over a new 66,000-volt line now under construction to the Buffalo General Electric Company. This new line, which will have a capacity of approximately 100,000 hp., will consist of two 500,000-circ.mil copper circuits.

A. I. E. E. Completes Convention Plans

FINAL plans for the joint thirty-seventh annual and tenth Pacific Coast convention of the American Institute of Electrical Engineers, to be held at the Hotel Utah, Salt Lake City, June 21 to June 24, have been made. An addition to the tentative program of the technical sessions, as published on page 1009 of the ELECTRICAL WORLD for April 30, comes in the form of an address entitled "Little Things from Little Places," by Guido Semenza, local honorary secretary of the A. I. E. E. for Italy, who is a consulting engineer at Milan. This address will be made at the Friday morning session.

Gov. Charles R. Mabey will welcome the convention on Tuesday, June 21. In the afternoon of that day there will be a trip on foot to the historical buildings of the Latter Day Saints, followed by a lecture and organ recital in the Tabernacle, with an evening trip by automobile to the Wasatch Boulevard and Capitol Hill. On Wednesday afternoon an excursion by train affording views of Great Salt Lake and an opportunity to inspect a typical mining canyon will be held, and a musical entertainment will follow in the evening.

On Thursday there will be special entertainment for the ladies, an afternoon trip to the Utah Power & Light Company's great outdoor substation, the terminus of three 130,000-volt transmission lines, and an evening illustrated lecture on the Utah canyons. On Friday golf and tennis finals and a baseball game between East and West will be played. A visit to Saltair Beach for bathing and a "big Western dinner" in the Ship Café, followed by dancing, are also scheduled for this day.

Arrangements for many "after convention" trips to points of engineering interest and also to various resorts, canyons and mountain parks, including Yellowstone and the Grand Canyon, have been completed. These trips will take from one to ten days each.

Damage to Electric Properties in Flooded District of Colorado Slight

REPORTS received by the ELECTRICAL WORLD for electric light and power properties operating in the Colorado flood area clearly indicate that the early newspaper reports were greatly exaggerated. The greatest damage was suffered by the Byllesby property at Pueblo, the Arkansas Valley Railway, Light & Power Company, and this it is estimated will not exceed $100,000. Damage to the Colorado Power Company was of a minor nature. The only source of anxiety to the management of this property was the possibility of curtailment of the coal supply at Sterling. The Electric Bond & Share Company's properties were to the west of the flood and consequently were not affected at all. Henry L. Doherty & Company properties serving Denver and Boulder and near-by towns report no serious effects from the swollen rivers. The service of the United Gas & Electric property at Colorado City was interrupted occasionally by lightning and was out of service in all for about half an hour.

Reports from the Pueblo property state that there were no breaks in dams or reservoirs. No damage was done to the Cañon City plant or to the transmission lines. Except a little caused by mud no damage was sustained by the Pueblo power plant. The company lost no street cars and its traction system is said to be in excellent condition. No loss from fire was sustained by the company and its office building and all records are intact. The lighting system is in operation, and the company said on Wednesday that it should be back completely on the old basis in ten days. The Pueblo power plant is closed down and will remain so until about the end of next week. In the meantime emergency service is being obtained from near-by industrial plants. The only damage done to the Skaguay hydro-electric plant was the tearing away of about 150 ft. of wood-stave pipe which at the time this was written was being replaced.

Most of the $100,000 needed for replacing service will be spent in removing mud and débris and in cleaning up.

A detailed report from the Colorado Springs company was to the effect that while some of the embankments for the conduits of the hydro-electric plants were

washed away no damage of a serious nature was done. There were some minor interruptions, amounting to half an hour in all and resulting from heavy short-circuits caused by lightning. The greatest inconvenience was caused by telephone lines going down owing to rock slides, making it impossible to get any information back and forth for load dispatching.

There were some temporary interruptions on the Doherty lines. The line to Denver from the Colorado Power Company was down in a few places for a few hours. The main transmission line of the Western Light & Power Company, Northern Colorado Division, was down about twenty-four hours. Repairs were effected at all places and service has been going on ever since.

Light and Power Financing of the Week

THREE light and power company issues were announced the past week—$3,000,000 of three-year 8 per cent sinking fund mortgage bonds of the Columbus (Ohio) Railway, Power & Light Company at 98, yielding more than 8.75 per cent; $750,000 of twenty-year 8 per cent bond-secured gold notes, series B, of the Southwestern Power & Light Company on an 8.10 per cent basis and $1,200,000 of first-lien and refunding 7 per cent bonds of the Northern New York Utilities, Inc., due 1946, at par. The latter issue is not subject to redemption prior to maturity.

In addition, the Department of Public Utilities of Massachusetts has approved the issue of $1,200,000 of 5 per cent first-mortgage bonds of the New England Power Company at 77½ and 12,000 shares of stock at not less than $120 a share. The Illinois Public Utilities Commission has authorized the Central Illinois Public Service Commission to issue $151,000 of first refunding 5 per cent bonds maturing Aug. 1, 1952, and $50,000 of general-mortgage 6 per cent bonds of the same maturity. The Massachusetts Department of Public Utilities has approved the petition of the Plymouth Electric Light Company to issue $100,000 par value additional capital stock to take up outstanding promissory notes.

Chicago Licensing Ordinance Widely Opposed

A COUNCIL committee hearing on the proposed Chicago ordinance to license and regulate the sale in that city of electrical goods, held June 2, brought out the fact that opposition to the ordinance is becoming national in character. The discussion, lasting three hours, early showed that sentiment among electrical manufacturers is almost solidly against the ordinance, and representatives of the music and real estate industries voiced their opposition also.

Letters gathered by Paul Westburg, representing the electrical division of the Chicago Association of Commerce, showed that the matter had become more than purely a local one. Manufacturers situated in all parts of the country backed up the Association of Commerce in its fight against the bill.

Mr. Westburg, who is Chicago representative of several meter manufacturers, declared that the ordinance would not accomplish its avowed object of protecting the public by testing all devices and licensing their sale. He said that unscrupulous firms would locate outside of the city and do a mail-order business while Chicago manufacturers and dealers were handicapped by the added overhead expense of license and test fees.

A. W. Berresford, president of the American Institute of Electrical Engineers, asserted that if there is need for such regulation it should be national and not local.

Ainslee A. Gray, representing the Electric Club of Chicago, mentioned as objections against the ordinance the great expense of maintaining sufficiently large municipal testing laboratories and the amount of power placed in the hands of one man, the city commissioner of gas and electricity.

Other speakers opposing the ordinance were J. W. Perry, representing the Associated Manufacturers of Electrical Supplies; C. H. Roth, secretary of the Power Club; W. L. Goodwin of the Society for Electrical Development, and several speakers representing local real-estate men. In all cases the demand was that the ordinance be killed entirely.

Much of the objection centered on the huge expense to both the industry and the taxpayers that the ordinance would entail. It was pointed out that a highly paid corps of experts and millions of dollars in instruments and buildings would be necessary to carry out the necessary testing.

The committee adjourned the hearing until the afternoon of June 16, when still others will be heard in opposition.

Electrical Supply Manufacturers' Summer Section Meetings

THE following schedule has been proposed for the summer section meetings of the Associated Manufacturers of Electrical Supplies to be held at the Griswold, Eastern Point, New London, Conn., from June 27 to June 30:

Monday, June 27.—Sub-committees of general standards committee, general standards committee, Wire and Cable Section, weatherproof-wire group, magnet-wire group.

Tuesday, June 28.—Heating Appliance Section, Signaling Apparatus Section, Armored Conductor Section, Non-Metallic Flexible Conduit Section, Metal Molding Section, Rigid Conduit Section, Snap Switch Section, Lamp Receptacle and Socket Section, Attachment Plug Section; banquet and entertainment in the evening.

Wednesday, June 29.—Panelboard and Switchboard Section, Air Circuit Breaker Section, Radio Apparatus Section, Industrial Lighting Section, Carbon Section; meeting of the board of governors.

Thursday, June 30.—Fuse Section, Knife Switch Section, Molded or Formed Insulation Section, Line Material Section.

California Safety Orders Progressing Rapidly

THE sub-committee engaged in the final revision of the electrical utilization safety orders of the Industrial Accident Commission of California have about completed their various sections for return to the general committee. It is expected to have a general committee meeting within sixty days, and after passage by this committee the revised orders will be sent to the printer for publication in tentative form. After this the commission will hold a public hearing for final discussion on the orders, and it is expected that the administration of them will begin Jan. 1, 1922.

These are general orders of the Industrial Accident Commission. They relate to the installation and use of electrical utilization equipment in industrial establishments and are designed to promote the safety of employees by the prevention of electrical hazards.

Patent Office Bill to Be Reported Out

THE bill introduced by Representative Lampert providing for increased salaries in the Patent Office is to be reported out in the near future. It is known that there is no opposition to the measure in the committee. Prompt action by the House is anticipated. This bill failed at the last session because of insistence by Senator Norris, then the chairman of the Senate committee on patents, that the Senate decline to recede from its amendment authorizing the Federal Trade Commission to administer patents for government employees.

Light and Power Users of Southern Idaho Form Organization

SOUTHERN Idaho electric light and power users perfected a permanent organization, known as the Southern Idaho Electric Light & Power Users' Association, at a meeting of more than thirty-five representatives of municipalities and irrigation projects held at Boise last month. An executive committee was named, with full power to act for the association before the State Public Utilities Commission in regard to the Idaho Power Company's valuation hearing and all other power hearings. Funds for the work of the association will be raised by contributions of members of 1 per cent of either their 1920 or their 1921 power bills. Members will not be called on for payment until at least $10,000 has been subscribed.

Technical Committee of Communication Conference to Meet in Paris

THE provisional technical committee appointed by the International Communication Conference, which met recently at Washington, will meet in Paris on June 20 to consider and report upon technical matters in advance of a general international conference. Among the matters with which the conference is dealing are the disposition of the German cables and some means of controlling international radio communication. The Paris meeting is to be attended by delegates from the same countries as participated in the Washington conference, namely, France, Great Britain, Italy, Japan and the United States.

The United States delegation will be headed by Gen. George O. Squier, the chief signal officer of the army. The Navy Department will also be represented by four officers who have specialized in radio, among them Admiral Bullard and Dr. L. W. Austin. The Department of Commerce will be represented by Dr. A. E. Kennelly and Dr. J. H. Dellinger.

Connecticut Industrial Plants May Market Energy

GOVERNOR LAKE of Connecticut has signed a bill providing for the sale of electricity for lighting, heating and power service incidental to manufacturing purposes by corporations authorized to construct and operate hydro-electric plants, subject to the approval of the Public Utilities Commission. The bill provides that no such company, however, shall distribute or sell electricity in any town in which any other company has already received the right to distribute and sell electricity. The commission is to have jurisdiction over the expediency, terms and rates of such electrical supply by a private corporation. When this bill was introduced it was feared that the broad powers conferred by it upon industrial and other corporations owning and operating hydro-electric dams and plants would threaten the tenure of the market of existing public utilities, but in the measure as passed the Legislature recognized the unwisdom of this sort of competition.

Electrical Industry Fundamentally Sound, Says Shiras Morris

"NOTHING in the present sub-normal business situation justifies the conclusion that the electrical industry as a whole is in anything but a fundamentally sound condition," said Shiras Morris, president of the Associated Manufacturers of Electrical Supplies, to a representative of the ELECTRICAL WORLD a few days ago. Without overlooking the large opportunity for improvement in both domestic and foreign trade, Mr. Morris stated that all over the United States hopeful signs can be seen pointing to a business revival. The speed with which normal conditions can be restored is the chief element of uncertainty, but a comparatively rapid recovery is anticipated, perhaps within a few months.



SHIRAS MORRIS

The liquidation of raw-material costs has been virtually completed, in Mr. Morris' opinion. Ample supplies of raw material are available now on prompt delivery for substantially every branch of electrical manufacturing. The liquidation of labor, while proceeding gradually, is not as yet finished. A better productive effort is evident through the entire range of employed labor today, and the electrical industry is fortunate in that the residual permanent demand for its products has enabled manufacturers to retain in their employment a much larger percentage of efficient labor than has been retained in many other lines.

Another point emphasizing the stability of the electrical industry is its catering to the necessities of the population. Beyond temporary shut-downs for inventories or short readjustments, manufacturing has continued at least on a moderate scale in almost every branch of electrical commodity production. In other words, electrical manufacturing plants have not "gone dead," as was the fate for the time being of many industrial establishments during the depression's worst phases. A gradual restoration of better business resulting from the liquidation of labor at a rate sufficiently slow to prevent sharp shocks to the economic structure of industry seems preferable to more sudden and violent readjustments.

For the first time American manufacturers are giving scientific study to tariff matters, and some degree of protection must be had against the dumping of inferior products or of commodities produced by low-

grade labor onto American markets, both North and South. The meeting by Germany of her reparations responsibilities will help international economic conditions somewhat, but probably not so much as some observers believe. The ultimate restoration of sound economic conditions in Russia will be another potent factor in world trade improvement.

Buying in moderate quantities is still justified in the American electrical industry. Mr. Morris recognized that prices advanced far less in the electrical industry during the war than in many others, and said that while further declines are possible, the present volume of business in many lines might be doubled without economically justifying reductions from the present level. Overhead expenses are so high under the existing volume of trade that unreasonable expectations should not be entertained as to price movements in the near future. Now is a good time for manufacturing plants to undertake rehabilitation work tending toward increasing production efficiency when "mass" orders are later handled.

Pacific Coast Men Discuss 220,000-Volt Transmission Problems

TRANSMISSION at 220,000 volts received more attention than anything else at the annual convention of the Pacific Coast Geographic Division of the National Electric Light Association, held this week at Del Monte, Cal. The total registration up to Wednesday night was approximately 250. In the opening session President L. H. Nerbert stated that improvements should be made in the organization of the division in order to extend the scope of its activities, make them of greater direct application to the membership and better knit the division with the national association. He suggested that several bureaus be organized, patterned along lines similar to those of the national organization.

The main problems remaining yet to be solved in the use of 220,000-volt transmission lines are principally those of insulation and refinement in the laws relating to corona, according to J. A. Koontz, electrical engineer of the Great Western Power Company and chairman of the 220,000-volt transmission committee. He asserted that there are still some doubts as to the effect of the surface of large-size conductors on corona. The effect of rope stranding or the use of special strand combinations to increase the effective diameter needed additional experimental work. He suggested that corona-loss measurements be made on a new high-voltage line and the test repeated after several years' service.

There are at present several methods of solving the insulation problem. One method is that of a larger unit than the common 10-in. disk, or a unit that will be capable of carrying a higher voltage duty. Another method would be to grade the units in an insulator string to give equal voltage distribution. From ten to fifteen such disks should be used on a 220,000-volt line, Mr. Koontz said.

In the discussion the general opinion was expressed that the problem of increasing transmission voltages to 220,000 or higher was now well understood and that the application of such voltages was a question of economics. As the use of more than eight units in a string will not reduce the voltage duty of the line-end unit, it will be necessary to use one of the several forms of shields which have been evolved to reduce the charging current now passing through these units. Of the forms of shields experimented with it appears more desirable to use one carrying a porcelain insulator. Mr. Koontz pointed out that lines operating at normal voltages cannot possibly have generated in them at normal frequencies voltages sufficiently large to flash over strings of thirteen or fourteen units, and consequently it is beyond question that the flashovers must be caused by high-frequency transients, because voltages of this character only are able to flash over air gaps of the length of such insulator strings. He expressed the opinion that the most feasible method of suppressing such transients is to design a line for operation at very nearly corona voltage so that any increase in voltage would be dissipated as corona. Experiments to so determine the form of the electrostatic field surrounding insulator strings as to relate the size, shape and location of the shields in such a way that the stress on the line-end units will be decreased and at the same time not unreasonably decrease the flashover distance to the tower and crossarm were described by Prof. H. J. Ryan. He pointed out that the suppression of flashovers on long strings of insulators is primarily concerned with control of the primary field. If this is correctly designed, the secondary field formed at the end of an incipient flashover streamer will not become predominant, with the result that a flashover would be directed away from the string by the primary field and thus prevent injury to the porcelain. He stated that altogether more than 400 different set-ups of insulators and shields had been made in order to study these points. The use of insulators other than standard in order to produce graded strings has not been thought desirable at this time by the Pacific Gas & Electric Company, which is at present installing a 220,000-volt line from the Pit River development.

Power Resources of California

A summary of the hydro-electric installations in operation and in progress of construction and the ultimate possible installation was presented to the convention by the committee on power resources of California under the chairmanship of P. M. Downing of the Pacific Gas & Electric Company. This report showed that on Dec. 31, 1920, there was in California 946,305 hydro-electric horsepower in service, 345,510 hp. in process of construction and an ultimate possible output of 4,646,357 hp. A summary of storage in reservoirs at present in operation showed 730,467 usable acre-feet, which could produce 773,631,610 kw.-hr. per annum. In progress of construction are reservoirs having a capacity of 243,500 acre-feet, capable of generating 422,040,000 kw.-hr. per annum. The ultimate storage, according to this report, was 2,857,778 acre-feet, which could produce 5,892,008,730 kw.-hr. per annum. The report listed in detail all of the present hydro-electric installations in the state, giving their location; the names of the power houses; the capacity of the installation in horsepower at present, in progress, and ultimately possible; and the ultimate output in kilowatt-hours from storage, from steam flow and the total.

The totals of the amount of hydro-electric power available in this report do not check with the totals given by other authorities, and it was believed that the committee making this investigation should continue its work.

Gradual Business Improvement Predicted by A. W. Douglas

NO IMMEDIATE return to prosperity is in sight, according to the semi-annual report of Archer Wall Douglas, chairman of the committee on statistics of the Chamber of Commerce of the United States, which deals with business and crop conditions. There need be no delusions about a resumption of a war-time volume of business, Mr. Douglas declares, but while things will be quiet during the summer, the termination of harvest may bring somewhat better business and a slow and gradual improvement.

"There is a growing realization of the fact," Mr. Douglas says, "that returning prosperity in this country depends upon the recovery of Europe, since she is and will be for a long time to come the best market for that surplus which we have accumulated and still have on hand in every kind of industry. Meanwhile the slow progress of business finds its chief stimulus in the gradual depletion of stocks both of merchandise and commodities and that demand for replacement and repair which in itself produces the principal volume of our domestic commerce. There is still money to be spent where bargain prices are in evidence."

Mr. Douglas finds agricultural prospects fairly satisfactory, declares that one of the serious conditions is the slow growth of building due to the continued high costs of construction, and says that there has been some increase in the output of automobiles, that leather production and manufacture have struck bottom and had a moderate rebound, and that the steel industry is running on short time with limited output and reduction of orders in hand. Railroad shops are very quiet. Textiles, particularly wool and linen, and shoes are doing somewhat better. Mining in general is very dull and where running is doing so on short time. The railroads, he says, are using their utmost endeavor to economize, and there is hope for a reduction in the cost of transportation. "One of the interesting developments of the time," he adds, "is the growth of the electric trolley car and the auto truck in short hauls, in which they are already formidable competitors of the steam railroad."

Most of the Responsibility for Waste Laid at Door of Management

MANY causes of waste and recommendations for their elimination are given in the report of the American Engineering Council's committee on elimination of waste made at a meeting of the council's executive board on Friday of last week in St. Louis. Responsibility for more than 50 per cent of these wastes are placed at the door of management and less than 25 per cent at the door of labor.

The investigation, which was in charge of a committee of sixteen, was carried on by a large force of field workers in New York, New England and Pennsylvania and deals with housing and building, ready-made men's clothing, shoes, metal trades and printing.

The report comprises 125,000 words and will be made public when some necessary changes have been embodied.

A number of other committees made reports, many of which were laid on the table. In the afternoon the report of the foreign relations committee was received and a list of appointments made consisting of Dugald C. Jackson, Boston, Mass.; J. Parke Channing, New York City; C. O. Mailloux, New York City; T. A. Richard, San Francisco; M. O. Leighton, Washington, D. C.; Nelson P. Lewis, New York City; John W. Lieb, New York City; Louis S. Cotes, Salt Lake City, and Bion J. Arnold, Chicago.

Election of a president to succeed Mr. Hoover will take place this fall.

N. E. L. A. Pledges Continued Aid to Federal Power Commission

THE following resolution was adopted by the National Electric Light Association at the Chicago convention last week, at the suggestion of the committee on water power:

Whereas the water-power development committee, after repeated conferences with the Federal Power Commission and its executive staff, has reported that in the opinion of the committee of this association the Federal Power Commission has adopted rules and regulations of a constructive nature, which, while necessarily definite and strict, will not prevent development of water-power resources under federal licenses, but will encourage much development, now, therefore, be it

Resolved, that this association express to the Federal Power Commission its appreciation of the spirit in which the Federal Power Commission has accepted the co-operation of this association and that this association pledge its representatives to continued co-operation with the Federal Power Commission to the end that the water-power resources of the nation may be developed without conflict between federal and state authorities and to the mutual advantage of the federal government and the people served.

Federal Power Commission Rulings

WHEN reservoirs are constructed in connection with any project coming under the jurisdiction of the Federal Power Commission, the applicant will be required to remove standing timber unless he can show sufficient reason why it should not be done, according to a ruling made by the commission on June 6 in connection with the reservoir of the Alabama Power Company at Duncan's Riffle. In that case the power company will be required to remove the standing timber at a cost of $20,000 or more.

The commission passed on several declarations of intention. It was decided that the interest of interstate or foreign commerce will not be affected by the project of Oran W. Montgomery for a power project on Rocky Creek near Lakewood, N. Y.

The interests of interstate commerce, it was found, would be affected by the development proposed by John W. Shafer on the Tippecanoe River, Indiana, unless the project could be carried forward without diverting water from the Kankakee River.

The Grand River Hydro-Electric Company's proposed development on the Grand River, Oklahoma, was also found to interfere, because it would reduce the normal discharge of the Grand River into the Arkansas, thereby affecting navigation on the latter stream.

The proposed developments by the Kentucky-Elkhorn Coal Corporation on the Big Sandy River, Virginia, and the Sequoyah Hydro-Electric Power Company on the Illinois River, Oklahoma, were found not to conflict with the interests of interstate commerce.

The commission consented to a joint meeting with the International Joint Committee at some future date, when the procedure to be followed in handling projects on boundary streams and projects involving the level of international waters will be discussed.

Award of Doherty and Billings Prizes

AMONG the features of the last day's session of the Chicago N. E. L. A. convention was the announcement of the winners of the Doherty and Billings prizes. They were respectively T. G. Price of the Commonwealth Edison Company, whose paper was entitled "The Friendship of Our Customers," and Clifford W. Bates, Philadelphia Electric Company, who wrote on "Power Factor, Its Cause, Effect, Measurement and Remedies."

Rocky Mountain Electrical Co-operative League Gets Together

MORE than two hundred members of the various branches of the industry attended the first "get-together" meeting of the Rocky Mountain Electrical Co-operative League, held at the Commercial Club at Salt Lake City on the evening of May 23. J. A. Kahn, president of the Capital Electric Company and chairman of the advisory committee of the league, was master of ceremonies.

The first speaker was George R. Randall, manager of the Salt Lake Electric Supply Company, who outlined the objects of the league, explaining why it was organized, what it had accomplished so far and what it hoped and expects to accomplish in the future. H. T. Plumb, local engineer of the General Electric Company, who is also chairman of the convention committee of the local chapter of the A. I. E. E., announced briefly the plans for the entertainment of the convention delegates in Salt Lake City in June and urged that every one in the electrical industry make it his particular duty to see that the convention guests are taken care of in a proper manner.

Wilson McCarthy, a Salt Lake City attorney, spoke on the subject of co-operation. Another feature of the evening was an illustrated lecture on Utah's scenic wonders by Dr. J. E. Broaddus. Mr. Kahn announced that the construction of the electrical home is now under way. It will be completed early in September. The league will have charge of the home for two weeks for exhibition purposes, during which time it will be open to the public for inspection. At the conclusion of the program a buffet luncheon was served.

No Pessimism Marks Electrical Supply Jobbers' Meeting

THE annual meeting of the Electrical Supply Jobbers' Association was held at Hot Springs, Va., on May 25-27. Although the electrical supply jobbing business shows a falling off, the showing over pre-war times is sufficiently large to give encouragement, and the jobbers in attendance at Hot Springs were anything but pessimistic. J. L. Owen of New York was elected a committeeman in the Atlantic division to succeed H. T. Hochhausen, and Clarence Wheeler was re-elected. The chairmanship of the Atlantic division, formerly held by F. E. Stow of Philadelphia, went to George L. Patterson of New York, and E. W. Rockafellow of New York, F. W. Bernardin of Kansas City and W. R. Hirstein of Memphis were elected committeemen at large.

M. H. Aylesworth, executive manager of the N. E. L. A., made such an impression with a talk on co-operative methods in upbuilding the industry that he was invited to address the executive session and explain more in detail how the electrical supply jobbers can co-operate with the N. E. L. A. in furthering electrical development. At his suggestion the supply jobbers sent representatives to the convention of the N. E. L. A. in Chicago.

Herman Plaut of Boston urged a greater interest by jobbers in proper electrical illumination and asked that they support the Illuminating Engineering Society through membership in that organization. The attention of the meeting was called by W. W. Low of Chicago to the menacing terms of an ordinance seeking to tax all electrical products used in Chicago, and plans were made to have delegates appear at the public hearing and present the views of the jobbers in opposition to the ordinance.

W. L. Goodwin described in a forceful manner the plans which the Society for Electrical Development has in contemplation for expanding its work. These plans were outlined in the ELECTRICAL WORLD on May 21. Great interest was evinced by the jobbers in the society's new work and in Mr. Goodwin's leadership.

Samuel A. Chase of the Westinghouse Electric & Manufacturing Company delivered an address on "The Straight Path," and A. MacLachlan of the Square D Company spoke on the jobbers' responsibility in the safety movement.

A strikingly illustrated lecture on the Hydro-Electric Developments of the Niagara Falls Power Company was given by George S. Anderson of that company. Various meetings of special committees were held during the week, and the convention, which was largely attended, was marked by the usual entertainment features.

Government's Attitude on Trade Association Stated

RECENT announcements by the Secretary of Commerce and by the Attorney-General make clear the attitude of the federal administration toward the trade organizations of the various industries. The Attorney-General has given notice that he will push a test case against one of the open-price associations, but there will be no dragnet thrown over all the associations and there will be no wholesale indictments.

Secretary Hoover authorized the following statement:

All are agreed that the purposes and actions of the vast majority of national associations are a constructive contribution to public welfare. Their activity in promotion of better business practices, advancement of technical processes, simplification of production, standardization of quality, extension of foreign trade, commercial arbitration, etc., all make for more efficient industry and business. Many of them collect information as to the production, stocks of raw and other material, percentage of industry in active operation, total orders in hand—all of which, when available to the public, contribute both to stability and the increasing efficiency of industry and to the protection both of the smaller manufacturer and the consumer. The Department of Commerce wishes to co-operate and assist in all of this sort of effort.

A smaller number of such associations have been engaged in the collection of data on the prices for the exclusive use of their members. Some of these associations have been charged with delimiting areas of commodity distribution among their members and other misuses of information.

Whether these latter practices constitute a violation of the national anti-trust laws must be determined by the courts, and this the Attorney-General is vigorously proceeding to find out.

Western New England Inspection Conference a Success

A JOINT electrical conference attended by about 150 manufacturers, consulting engineers, municipal inspectors, contractor-dealers, jobbers and insurance men was held at the Travelers' Auditorium, Hartford, Conn., May 18, for the discussion of fire and accident hazards. The program included topical discussions of grounding rules, terminology, safety problems and various code regulations. Dana Pierce, vice-president Underwriters' Laboratories and chairman of the electrical committee of the National Fire Protection Association, gave an illustrated talk upon "Fire and Safety Testing at the Underwriters' Laboratories," and Dr. Allan D. Risteen, director of technical research for the Travelers' Insurance Company, Hartford, spoke upon "Personal Accident Hazards." Sessions were conducted by John L. Thompson, superintendent engineering and inspection division Travelers' Insurance Company; A. A. Packard, superintendent Connecticut Power Company, Middletown, Conn.; E. S. Francis of Hartford, E. E. Sage and R. H. Mather. W. C. Wagner, assistant to the chief engineer of the Philadelphia Electric Company; Dr. M. G. Lloyd, assistant physicist United States Bureau of Standards, and Thomas Henry Day, New England Insurance Exchange, Hartford, also spoke. A resolution of sympathy with Dr. Lloyd was passed upon news of the death of Dr. E. B. Rosa, chief physicist of the Bureau of Standards. The Hartford Electric Light Company opened its steam plants to visitors during the meeting.

St. Louis Banker Pleads for More Liberal Treatment of Utilities

THAT more liberal treatment must be accorded to public utilities if they are to give the service the public demands was emphasized by W. F. Gephart, dean of the School of Commerce and Finance of Washington University and vice-president of the First National Bank in St. Louis, in an informal address before the St. Louis section of the A. I. E. E. on May 25. Even the better-informed people, he said, show a lack of appreciation of the utility problems, and he urged that the utilities give full publicity to their operations and problems.

Three factors, according to Mr. Gephart, are deserving of particular attention in a study of the public utility situation. The first is that service rather than low rates should be stressed by the utilities. Commissioners, unfortunately, have had to devote so much attention to valuations that the public views the situation as one of rates. He maintained that the American public is, after all, primarily interested in securing service and is willing to pay for good service whatever it may properly cost.

Mr. Gephart urged that utilities should be permitted to establish rates which will permit the making of plant extensions from earnings. With the competition for money which will exist for the next ten years, both domestically and internationally, utilities will find it difficult to give the public the service it wants and to make necessary extensions unless some such method can be adopted. The speaker deplored the necessity for making capital investments for additions and extensions and indicated that the result as far as the public is concerned will be substantially the same in the end.

The third factor was the necessity for broader-minded decisions on the part of the commissions. He indicated that radical changes in regulatory bodies and their functions must of necessity occur in the next few years if public utility properties are to function best.

Changes in Chicago's Electrical Code

A NUMBER of changes from the 1920 edition of the electrical code prepared by the Department of Gas and Electricity of the City of Chicago have been worked out by the committee in charge of the revision of the code and will appear in the 1921 edition, which has gone to press. One of the most important provides that alternating-current induction motors of more than 2 hp. must be equipped with starting and running fuses. In addition there must be a switch which will shunt the running fuses during the starting period, and this switch must be so designed that it cannot be left in the starting position. This requirement will not apply where thermal cut-outs or time-limit circuit breakers are used. The rule becomes effective on the issuance of the code.

Another new rule provides that after Jan. 1, 1922, one conductor of all branch circuits and one conductor of all two-wire mains from 125-250 volt systems, with the neutral grounded, must have a continuous identifying marker readily distinguishing it from the other conductor. This marked wire must in all cases be connected to the grounded wire of the system.

The new code rules that after Jan. 1, 1922, Edison plug cut-outs, except those used in connection with safety switches, must be of the dead-front or safety type. It recommends that covers for cut-out blocks where used in apartment buildings be provided with a means for designating the location of the circuits.

It has been announced by the Department of Gas and Electricity that the use of the knife switch will no longer be permitted. When the rule requiring the use of the safety inclosed switch went into effect July 1, 1920, contractors who had on hand a supply of the knife switches were requested to list them with the department and the installation of these listed switches has been permitted up to the present time. Hereafter all switches installed must be of the safety type where the rules require their use.

Western States Gas & Electric Plans Extensive Additions

THE Western States Gas & Electric Company, operating principally around Stockton, Cal., is planning the construction of additional hydro-electric plants to supplement those now in operation. The plans involve additions to its present plant on the South Fork of the American River and a new station, to be known as El Dorado, together totaling 156,000 hp. Applications have been filed with the Federal Power Commission, the California Water Commission and the Railroad Commission of California to receive the necessary authorizations to proceed with the work. It is estimated that the four units planned for the El Dorado development will be completed by the end of 1928 and that the enlargement of the present station will be finished in 1930. Since 1911 the collective load of the company has increased from 12,600 kw. to 43,100 kw. During 1920 the Western States Gas & Electric Company purchased 45,000,000 kw.-hr. of energy.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Efficiency of Electric Pumping.—Two new electric pumps installed recently at the Montreal waterworks which are guaranteed to pump 30,000,000 gal. a day each have exceeded this performance by 6,000,000 gal. each. The total supply of 72,000,000 gal. daily thus obtained has proved sufficient for the city's present needs and it has been possible to stop operation of a third electric pump and seven steam pumps.

Using Submarine Cable for Long-Distance Telephony. — An experiment in long-distance telephony by submarine cable is, it is announced, to be made by the French authorities. The Secretary of Posts and Telegraphs has left France for Morocco to arrange for the installation of the new system between the French coast and Casablanca. Experts are said to declare that telephone communication is possible by submarine cable up to a distance of 3,800 miles, which would bring France's Eastern colonies within the radius of Paris.

Westinghouse Sends Intercompany Messages by Wireless.—An interplant wireless communication service was formally opened on May 31 by the Westinghouse Electric & Manufacturing Company through the establishing of communication between the East Pittsburgh plant and the Cleveland foundry. Besides the Cleveland and East Pittsburgh factories the Springfield (Mass.) works and the Newark (N. J.) works are being equipped with stations for the transacting of company business. The system was formally opened by a message from E. M. Herr, president of the Westinghouse company, to the president of the Electrical League of Cleveland.

Water Power Versus Salmon.—Strong opposition to the Lochaber water-power bill, which embodies a large scheme for using available water power in the Scottish Highlands in generating electrical energy for the manufacture of aluminum and other industrial purposes, has been exerted by the salmon-fishing interests, which feared interference with the angling sport protected in Great Britain from time immemorial. This opposition is said to have been finally quieted by the provision that the natural flow of the Upper Spey above the intake at Loch Laggan is not to be diverted unless the flow exceeds 30,000,000 gal. in twenty-four hours. The Spey fishery board is, in addition, to have the right to demand on twelve days in the year that water shall not be taken unless the flow exceeds 100,000,000 gal.

Organization of Technical War Service.—A meeting to organize a Greater New York section of the Army Ordnance Association will be held at the Engineering Societies Building on June 15 at 8 p.m., General Guy E. Tripp presiding. All ordnance officers of the Officers' Reserve Corps and others interested are invited to attend. The object aimed at is to unite technical experts in support of the reserve armies of the United States to be organized by General Pershing.

Electrical Irrigation Agreement in Utah.—An emergency agreement has been reached between the Utah Power & Light Company and the Murdock irrigation companies whereby power will be furnished at once to begin pumping water for irrigation purposes. The agreement was the outcome of a conference held with members of the Public Utilities Commission. The irrigation companies objected to a clause in the rate as filed with the commission which required an advance payment of one-half the amount of the seasonal guarantee. The power company contended that because of the inability of certain irrigation customers to pay in the past, after they had discontinued taking service, it had sustained considerable losses. The irrigation people will furnish a bond guaranteeing the payment of the power bills.

California Power Tunnel Finished in Record Time.—The Shaver Lake tunnel of the Southern California Edison Company, which will save for southern and central California the run-off from the 32 square miles of the Shaver Lake watershed in the High Sierras and thereby increase the summer power supply, has just been completed in record time after fourteen months' continuous work, night and day, by William Kempt, tunnel superintendent, three foremen and 350 men. The tunnel, which diverts the water from Shaver Lake, is 15,720 ft. long and 8 ft. x 11 ft. in size. It was driven through a hard granite formation under Music Mountain for approximately three miles, terminating 2,400 ft. above the power house. The necessity for completing the job in time to save the snow waters of the watersheds resulted in it being pushed to completion on a bonus basis.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Empire State Gas and Electrical Association.—The Commercial Section of this association will meet at Cooperstown, N. Y., on Friday, June 24.

North Central Division, N. E. L. A.—The date of the coming convention of this division at Duluth, Minn., is June 21-23, not June 14-16, as stated in this column last week.

Oregon Association of Electrical Contractors and Dealers.—This association will hold its tenth annual convention at Eugene, Ore., next Monday and Tuesday, June 13 and 14.

Engineering Field Day at Philadelphia.—On Saturday next, June 18, the Philadelphia Sections of the A. I. E. E., the A. S. M. E. and the I. E. S. are to have a joint field day at McCall Field.

Engineers' Club of Philadelphia.—The following officers have been elected by this club: President, William F. James; vice-president, C. N. Lauer; treasurer, Clayton W. Pike; directors-at-large, H. B. Allen and H. F. Sanville.

New York Electrical Society Has Successful Year.—A most successful season was reported by the New York Electrical Society at its annual meeting on June 3. No fewer than 225 new members were enrolled, 171 were dropped, forty resigned and five died, leaving a membership of 770, with ten honorary members and seventy-six life members, or a total of 856. The lecture program of the season attracted the high average attendance of 242, and many exceptionally attractive subjects are already in view for the coming season. The following officers were elected: President, C. G. Young; vice-presidents, F. B. Colt, Ernest Woltmann and O. A. Kenyon; secretary, George H. Guy; treasurer, Thomas F. Honahan.

Coming Meetings of Electrical and Other Technical Societies

National Fire Protection Association—San Francisco, June 14-16.

N. E. L. A., Northwest Division—Portland, Ore., June 15-18. (For program see issue of May 21, page 1180.)

Tri-State Water and Light Association—Asheville, N. C., June 15-16.

Canadian Electrical Association—Quebec, June 15-17. (For program see issue of May 28, page 1265.)

California State Association of Electrical Contractors and Dealers—Santa Cruz, June 16-18.

American Society for Testing Materials—Asbury Park, N. J., June 20-24.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

N. E. L. A., North Central Division—Duluth, Minn., June 21-23. (For program see issue of June 4, page 1332.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Society for the Promotion of Engineering Education — New Haven, Conn., June 28-July 1.

Ohio Electric Light Association—Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers — Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Definition of "Attractive Nuisance."—"Any composition of matter which lures or attracts the confiding ignorance of childhood to its own harm" is, regardless of its lawful character, an attractive nuisance, according to an opinion of the Federal Circuit Court in New York. (271 Fed. 419.)*

City Liable for Injury to Child Who Climbs Elevated Road Pillar and Touches Wire.—Recovery of damages in Stedwell vs. City of Chicago was affirmed by the Supreme Court of Illinois, the case hinging on the city's liability for injury to an eleven-year-old boy who climbed a latticed pillar supporting an elevated railway and came in contact with a high-tension lighting wire. Whether this pillar was an attraction for children so evident as to suggest the probability of accident when an uninsulated wire was placed near it was for the jury to decide, the court held. As regards the city the child was not in the relation of a trespasser. (130 N. E. 729.)

Power Company Cannot Initiate Claim to Reservoir Withdrawn from Entry by Secretary of Interior.—In an action to quiet title, brought by the Verde Water & Power Company against the Salt River Valley Water Users' Association, the Supreme Court of Arizona declared that a certain order of the Secretary of the Interior withdrawing from entry a reservoir site having never been set aside, no valid claim to the lands embraced in such order could be initiated by a water and power company and notices of appropriation posted subsequently by the company were unavailable for such purpose. The laws of the United States in reference to the disposition of public lands are paramount and exclusive. (192 Pac. 227.)

Texas City Ordinance Not a Contract.—In sustaining the finding of the United States Court for the Western District of Texas in City of San Antonio vs. San Antonio Public Service Company (see ELECTRICAL WORLD for April 16, page 895), the United States Supreme Court declared that the city's right to regulate gave it no power to enforce a confiscatory rate unless this power arose from the obligations of a contract. It followed that the solitary question to be considered was whether such a contract existed. Primarily the answer to that question must depend upon whether the ordinance of 1899 fixing the 5-cent fare was a contract. "That it was not, and could not be," said the court, "we are of opinion, is the necessary result of the provision of the state constitution, existing in 1899, prohibiting 'any irrevocable or uncontrollable grant of special privileges,' etc., when considered in the light of the irrevocable and uncontrollable elements which must necessarily inhere in the ordinance of 1899 to give it the contract consequence relied upon." (41 S. C. R. 14.)

Reciprocal Duties of Governments and Owners of Franchises.—In the course of its decision in City of San Antonio vs. San Antonio Public Service Company the United States Supreme Court made the following observations on reciprocal rights and duties: "The duty of an owner of private property used for the public service to charge only a reasonable rate and thus respect the authority of government to regulate in the public interest, and of government to regulate by fixing such a reasonable rate as will safeguard the rights of private ownership, are interdependent and reciprocal. Where, however, the right to contract exists and the parties, the public on the one hand and the private owner on the other, do so contract, the law of the contract governs both the duty of the private owner and the governmental power to regulate." Where the regulating power of the government is wholly uncontrolled by contract, "that power would be required to be exerted, and hence the supposed condition operating upon the private owner would be nugatory." (41 S. C. R. 428.)

Prediction of Proper Rates Must, to Remain Valid, Square with Facts.—In its order dismissing an application made by the city of New York for an injunction against the enforcement of the order of the Public Service Commission increasing the rates of the New York Telephone Company, the New York Supreme Court, Special Term, made this observation: "An order fixing maximum charges when made, like a statute of the Legislature fixing maximum rates, is an attempt 'to predict for future years the charges that will yield a fair return. The prediction must square with the facts or be cast aside as worthless.' It must square with them in one year as in another, at the beginning but equally at the end. In all such legislation from the hour of its enactment there thus inheres the seed of an infirmity which the future may develop. It is the infirmity that always waits upon prophecy; the coming years must tell whether the prophecy is true or false. All that we can say at the outset is that the power to regulate exists. The validity of its exercise depends upon the nicety of the adjustment between forecast and events. This is as true of a regulation which looks forward a year as one which looks forward a decade or a century. In either case, with differences only of degree, there is a forecast of the future which must be justified by the event."

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Utility Profits During Business Depression.—The recently expressed opinion of the Public Service Commission of Indiana that a public utility is on a different footing from other kinds of business when faced by the losses incident to business depression and should not be required to forego profits like other corporations (see ELECTRICAL WORLD, June 4, page 1335) is shared by the Washington state commission, which, in a rate hearing concerning the Spokane Falls Gas Light Company, said: "It is the policy of law and of regulatory bodies generally to stabilize public investments. It is to the public interest that the utilities of the country should not be subject to the sharp fluctuations which affect private industries. Public utilities should not be permitted to reap excessive profits nor be compelled to suffer losses which would threaten their existence. Public service concerns should function efficiently at all times. It is to the interest of the public as well as of the utilities that regulation should permit them to earn a reasonable return as well as prevent them from reaping profits which are excessive."

Wholesaling Power Company Allowed to Do Retail Business.—Irrigation Contracts.—The Public Utilities Commission of Idaho has handed down a decision in which five rate schedules of the Ashton-St. Anthony Power Company are approved and one disapproved. The approved schedules allow the company to sell surplus power on a retail basis. In the past its entire business has been wholesale. The schedule disapproved by the commission was the changing of irrigation pumping service from flat rate to metered rate. "The district served is sparsely settled," the commission asserts in explanation of the decision arrived at, "and the irrigation projects therein have only begun their development, and a considerable period of time will be required before this development reaches a stage where its fullest possibilities will be known. The commission has the power and authority to change rates which have been fixed by contract upon a proper showing, but such changes should be made only for good cause clearly shown to exist, as it is only fair for us to presume that when a public utility enters into contracts with its consumers for service it does so with a reasonable knowledge of all the facts and with the expectation that the customer will in his turn, and relying upon such contracts, make investment and plans connected therewith."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

R. H. Tillman, who was elected chairman of the Commercial Section of the National Electric Light Association at the convention in Chicago last week, has been manager of the new-business department of the Consolidated Gas, Electric Light & Power Company, Baltimore, since 1916. Mr. Tillman has been



R. H. TILLMAN

a member of the commercial department of that company since 1909, when he entered the organization as industrial engineer. In 1914 he was appointed superintendent of power sales of the company, and in 1915 the commercial work of the industrial gas department of the company was also placed in his charge. Mr. Tillman is a graduate of the North Carolina College of Agriculture and Mechanical Arts at Raleigh, class of 1906. The two years after his graduation were spent in the testing department of the General Electric Company at Schenectady, and in 1908 he joined the engineering department of the Rochester (N. Y.) Railway & Light Company, being appointed associate engineer of the company in 1909. He has been active in N. E. L. A. work for a number of years.

J. W. Andree has recently been made superintendent of generation for the southern section of the Southern California Edison Company. Mr. Andree will have charge of the principal steam generating stations of that company and of the Eagle Rock substation, which is the terminal substation of the 150,000-volt transmission line from Big Creek. Mr. Andree was born in Germany in 1879 and came to this country late in 1883. He attended the public schools of Illinois and later was employed in the mining industry for seven years. He was graduated from the University of Illinois in electrical engineering in 1907 and then became associated with the Arnold Company of Chicago in general construction work. In 1908 he was employed by the Commonwealth Edison Company of Chicago. He left that employ to become an instructor in electrical engineering in the De Paul University in Chicago. He was employed by the Southern California Edison Company as an engineer in the department of generation in 1910 and has remained with that company up to the present time.

H. A. Von Schon, formerly a consulting engineer at Washington, D. C., has accepted the appointment of court commissioner to regulate water-power operations on the St. Joseph River, with offices at South Bend, Ind. Mr. Von Schon will continue his consulting practice in hydro-electric engineering, public utility valuations, underwriters' reports, water rights and public service legal issues.

R. S. Daniels, who has been on the engineering force of the Washington Water Power Company, Spokane, Wash., for the last fifteen years, has resigned to become assistant to the chief engineer of the California-Oregon Power Company, with headquarters in San Francisco. Mr. Daniels has long been active in engineering affairs in Spokane and was the chairman of the Spokane Section, A. I. E. E., last year.

James Rowland Bibbins has resigned as supervising engineer of the Arnold Company, electrical, civil and mechanical engineers, Chicago, to become manager of the department of transportation and communication of the United States Chamber of Commerce, Washington, D. C. Mr. Bibbins was educated at Baltimore City College and the University of Michigan. He first became engaged in electric and railway utilities work at Detroit. Later he entered the service of the Westinghouse Manufacturing & Electric Company, being engaged in economic research in the development of steam and gas power. In 1909 he became associated with the Arnold Company and since then has undertaken many important engineering investigations and reports for public bodies and various corporations. In his new work he will be in close touch with ocean and inland waterway shipping, steam and electric railroad transportation, cables and telegraphs, postal facilities and roads. Mr. Bibbins has been chairman of the Chicago Section, A. I. E. E., and of the terminal committee of the Western Society of Engineers.

Paul P. Ashworth, who has been elected chairman of the Utah Section of the American Institute of Electrical Engineers, is distribution engineer of the Utah Power & Light Company, Salt Lake City. Mr. Ashworth's first association with the electrical industry was in 1907, when he entered the employ of the Telluride Power Company in Colorado. Later he was associated with subsidiary properties of that company—the Wyoming Electric Company at Casper, Wyo., and the Bear River Power Company in Idaho. When the Telluride Power Company was, with other properties, consolidated into the Utah Power & Light Company organization Mr. Ashworth became associated with the latter company. He was graduated from Cornell in 1914. He is secretary of the



P. P. ASHWORTH

convention committee of the A. I. E. E. in charge of arrangements for the Institute's convention in Salt Lake City, June 2.

Walter A. Shaw, for seven years engineering member of the Illinois Public Utilities Commission, has opened a consulting engineering office at 30 North La Salle Street, Chicago. Mr. Shaw will handle public utility rate cases and public utility and industrial management.

C. W. Koiner, who for thirteen years has been general manager and mechanical and electrical engineer of Pasadena's municipal light and power department, was appointed city manager of Pasadena on May 2. The new position will invest him with the administration of all municipal affairs other than the library and legal departments.

Robert J. Mailhouse, formerly assistant engineer, motive power department of the Interborough Rapid Transit Company, New York City, has opened offices in New Haven, Conn., and is prepared to make estimates and design and supervise electrical installations. Joseph N. Golding, electrical engineer, joins Mr. Mailhouse in this undertaking. Mr. Mailhouse has heretofore been connected with the Youngstown (Ohio) Sheet & Tube Company and the Stone & Webster Engineering Corporation, Boston.

P. V. Moffat, who has been assistant credit agent of the Southern California Edison Company for some time, has been promoted to the position of credit agent.

T. O. Grisell has become sales manager of the Green Engineering Company, East Chicago, Ind., to succeed Walter S. Burke, who has been appointed New York representative of the company.

R. B. Randall, formerly connected with the Chicago office of the Blaw-Knox Company, Blawnox, Pa., has been appointed manager of the new sales territory in the Southwest, with headquarters in the Interstate Building, Kansas City, Mo.

H. S. Ross, formerly in charge of the record department of the Southern California Edison Company, has been transferred to the right-of-way department, and F. W. Morris has been advanced to the position of record clerk.

E. J. Wood has been appointed manager of the factory control department of the Columbian Enameling & Stamping Company, Terre Haute, Ind. Mr. Wood was formerly connected with the works management department of the Westinghouse Electric & Manufacturing Company.

Karl B. Crawford has been appointed superintendent of the Camaguey (Cuba) Electric Company. Mr. Crawford was formerly superintendent of the Ohio Gas & Electric Company, Leetonia, Ohio. Previous to this connection he was associated with the Electric Railway Improvement Company, Cleveland, Ohio, and the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

R. J. Bravand has been appointed Birmingham (Ala.) district manager of the Hazard Manufacturing Company, Wilkes-Barre, Pa. Mr. Bravand's connection with the Hazard company covers a period of twenty years, partly at the plant and partly in the field. Of recent years he has been service engineer and in that capacity made an intensive study of wire-rope engineering as applied particularly to mine hoisting and haulage.

F. B. Segur has retired as president of the Electrical Manufacturers' Equipment Company with the sale of the business to the Peerless Equipment Company. Mr. Segur became identified with the electrical industry in 1885 as an employee of the Western Electric Company. In 1892 he took charge of the Jenney Electric Company, Kansas City, Mo., and in 1894 became associated with Roth Brothers, Chicago. In 1904 he was made manager of the Northern Wire & Cable Company, and in 1909 he joined the Northern Electric Company in an executive capacity. He formed the Electrical Manufacturers' Equipment Company in 1911 with headquarters in Chicago to manufacture coil-winding tools and allied equipment of his own design, and he had served ever since as president and general manager.

G. G. Shannonhouse, Jr., formerly with the Du Pont Engineering Company, has resigned to become associated with the Industrial Controller Company of Milwaukee as a special factory representative.

Arthur L. Linn, Jr., has been elected vice-president of the United Gas & Electric Corporation of Connecticut, New York City, to succeed T. A. Johnson, who resigned a few months ago. Mr. Linn was formerly treasurer and controller of the company and will continue to fill that office in connection with the vice-presidency.

Jacob A. Kahn, who was recently elected president of the Capital Electric Company, electrical jobber of Salt Lake City, Utah, has served as vice-president and treasurer of the company since March 1, 1918. Mr. Kahn was born July 16, 1872, at Morrison, Ill. He moved to Leadville, Col., in 1880. After several years of banking



J. A. KAHN

experince he was elected a vice-president of the Baer Brothers Mercantile Company on Jan. 1, 1899, and in January, 1913, he was made president and manager of that company. That position he held until he became identified with the Capital Electric Company. Mr. Kahn is chairman of the advisory committee of the Rocky Mountain Electrical Co-operative League and takes a keen interest in the local affairs of the industry and of the city in general.

Stuart C. Irby has been appointed vice-president of the Cabell-Irby Company, Jackson, Miss., recently organized to conduct a wholesale business in electrical supplies in Mississippi and the northern part of Louisiana. For nearly two years Mr. Irby and T. C. Cabell carried on a retail and construction business. Previous to this Mr. Irby was connected with Henry L. Doherty & Company, New York City, for twelve years, resigning as business manager of one of their properties to go into business with Mr. Cabell, who is a graduate of the Massachusetts Institute of Technology and has had fifteen years' experience in electrical engineering, construction and sales.

Robert B. M. Wilson has been appointed sales engineer of the Chicago district of the Conveyors' Corporation of America, with headquarters at 326 West Madison Street, Chicago. With him will be associated as an assistant E. M. Wolfe.

R. H. Witherspoon has been appointed manager of the Atlanta branch of the R. B. Corey Company, New York City, marine electrical engineers and contractors. He has been identified with the electrical industry in the South for several years, having been connected with the Westinghouse Electric & Manufacturing Company and later with the Atlanta branch of the Western Electric Company.

William R. Cadwell has joined the staff of the Norwood-Noonan Company, contracting electrical and mechanical engineers, Chicago, and will handle industrial and railway electrical installations for the company. Mr. Cadwell for the last four years has been superintendent of the electrical contracting firm of A. S. Schulman. He was connected with the Chicago & Northwestern Railway for nine years, leaving its employ as assistant electrical engineer. He is a member of the American Institute of Electrical Engineers.

C. H. Purdy has been appointed manager of the new Cleveland and Pittsburgh offices which have just been opened by the R. W. Lillie Corporation, 50 Church Street, New York City. Mr. Purdy's headquarters are in the Engineers' Building in Cleveland, from which he will cover the State of Ohio and part of Pennsylvania. After his graduation from Union College in Schenectady, N. Y., Mr. Purdy became connected with the Consumers' Power Company, Jackson, Mich., and he is now leaving the Springfield (Ohio) Light, Heat & Power Company where he has been railway sales engineer.

Richard E. Caldwell of Salt Lake City has been appointed State Engineer of Utah, to succeed George F. McGonagle. The new engineer is a native of Utah and has been identified with some of the most important engineering projects in the West. He is the senior member of the engineering firm of Caldwell & Richards and has been in charge of the Millard County drainage project, one of the largest irrigation and drainage enterprises in the West, the purpose of which is to reclaim 80,000 acres.

Obituary

Karl G. Roebling, president of John A. Roebling's Sons Company, wire manufacturers of Trenton, N. J., died at his summer home at Spring Lake, N. J., May 29, at the age of forty-eight. He had been connected with the wire company all his business life, and since the latter part of 1918 had been the president, having formerly been treasurer of the company. He was a grandson of John A. Roebling, who built the Brooklyn Bridge.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Value of Electrical Exports in April Was $9,085,598

ALTHOUGH the value of electrical exports for the month of April—$9,085,598—is about $700,000 less than that for the month of March, it is nevertheless over $2,000,000 better than the exports of April of 1920. The total to date amounts to $47,833,076, which is $7,000,000 more than the total electrical exports for the year 1916. So far this year the exports are averaging almost $12,000,000 a month, which if continued would bring a record year of more than $143,000,000. The total for 1920 was $102,618,508.

Only two items exported in April were in higher amounts than in the three previous months this year—carbon filament lamps and rheostats and controllers. Carbons, fans, heating and cooking apparatus, interior wiring supplies, meters and measuring instruments, telephones and miscellaneous materials made low marks for this year.

With the general decline of prices over the last few months of 1920 and up to date in 1921, it is not surprising to find the values of sales drop off. If these lower prices affected April sales to an extent of only 10 per cent, still it would put April ahead of March.

The Bureau of Foreign and Domestic Commerce is responsible for the figures in the attached table.

	April		Four Months Ended April	
	1920	1921	1920	1921
Batteries	$487,472	$430,235	$2,080,040	$1,949,722
Carbons	84,967	12,059	429,724	196,802
Dynamos and generators	636,362	569,941	1,877,173	2,524,571
Fans	149,728	120,361	374,164	968,117
Heating and cooking apparatus	140,715	165,962	530,004	1,019,943
Insulated wire and cable	526,556	807,218	2,298,980	5,100,392
Interior wiring supplies	308,091	170,038	902,809	1,169,689
Arc lamps	698	1,927	2,049	7,469
Carbon-filament lamps	11,514	22,602	48,379	66,916
Metal-filament lamps	352,669	384,224	1,355,105	1,898,752
Magnetos, spark plugs, etc	310,744	131,474	1,268,402	707,421
Meters and measuring instruments	181,663	250,913	796,905	1,279,525
Motors	923,096	1,711,620	3,730,451	7,774,078
Rheostats and controllers	66,389	164,745	244,325	527,882
Switches and accessories	272,680	432,487	1,304,550	2,322,417
Telegraph apparatus	44,394	42,590	306,078	551,046
Telephones	326,497	447,530	1,224,591	2,425,777
Transformers	169,976	783,906	1,162,720	3,795,323
All others	960,139	2,435,766	8,823,451	13,547,234
Total	$6,954,350	$9,085,598	$28,759,900	$47,833,076

No General Increase in Prices of Bare Copper Wire

IN LINE with the gradual firming of the copper market over the past few weeks, at least two producers of bare copper wire have increased their base prices to the extent of ½ cent per pound. This is interesting in the light of the prevailing opinion that a rush to buy copper wire will follow a stiff advance of prices. That this increased demand has not materialized, it is thought, is because the copper market does not consistently hold its gains and the advance in base prices by wire producers has not been general. Within the past two weeks spot electrolytic copper touched a high range of 13⅜ cents per pound, but it has since receded to a weak 13¼ cents.

At the present time, though base prices are quoted, they do not represent an absolute indication of prices for the reason that the market is so strongly competitive these prices are not strictly adhered to. Among several of the leading producers quotations range in gradations of ¼ cent per pound from 15 to 16 cents. The market remains fully as quiet as it has been over the past few months. Central stations are showing little activity and buying is mostly for maintenance, though it is said that an increase in the number of inquiries from the West is noted. The foreign market is flat and, taken all in all, the outlook seems to point to a very quiet summer.

Producers are reconciled to this, however, and are buying copper from hand to mouth for the most part. Production is down commensurate with buying, and in a number of instances plants are operated only as orders are received. Deliveries can be made promptly and on an average range from ten days to two weeks and even better.

Hopes are now being pinned to the fall months, as it is generally expected that September and October will see a material increase in business in this line.

England's Future in Electrical Manufacture

UNDER the caption "The Future of Electrical Manufacture" Mr. Mensforth, Director-General of Factories, War Office, presents in the annual manufacturers' number of the London *Electrician* for May 20 what he believes to be the possibilities of electrical manufacture in England. He states that the part that electrical engineering will have in the removal of the difficulties incidental to electrical manufacture is dependent upon the vision and courage of the men responsible for its development. The possibilities of electrical manufacture, Mr. Mensforth states, can best be developed by:

1. The education of the general public as to the utility as well as the convenience of electricity.
2. The technical development to the highest state of efficiency and reliability of all apparatus.
3. The better standardization of apparatus to facilitate manufacture.
4. The provision of the best plants and facilities in the factory manufacturing the apparatus.
5. The efficient utilization by all concerned of these facilities up to the fullest extent.

"While much may be done to educate the public as to the possibilities of electricity, especially in the homes, is it sufficiently realized," asked Mr. Mensforth, "that while we have shortened hours and improved the working conditions of all classes of industrial workers we have done nothing to help the ordinary woman in her home? In this direction America is far ahead of us, a condition of affairs very largely brought about by the shortage of and difficulties with domestic help, which has been experienced there for years, a position in which we now find ourselves.

"The whole possibility of domestic electrical apparatus has been changed in the last two or three years by the servant problem, combined with the increasing cost of town gas, and a determined effort should be made to develop and market apparatus suitable to our needs, advantage being taken in its design of any ideas women may have in connection with its use.

"Our future prosperity is intimately associated with the supply of cheap power, the two largest items going to make the cost of power being coal and capital charges."

While Mr. Mensforth gives the electrical engineer credit for improvement in the efficiency of steam prime movers, he believes that he has until recently confined his attention too much to steam consumption in the prime mover and has not paid enough attention to the question of economy in boiler-house and auxiliary plants.

"It is only recently that the country has devoted any real attention to the study and commercial development of insulating materials," says the author, "and very much more will have to be done in this direction if we are to hold our own in the future and further to bring down the cost of much of our electrical apparatus.

"The problem of standardization from the point of view of manufacture of electrical apparatus is a difficult one, inasmuch as all design is a compromise based on the necessity of the individual case, and it is hard to decide whether it is wiser to sacrifice a certain amount of material in a machine to enable a size to be used which is in stock or to put in the exact amount and use special sizes with consequent increased stock and possible delays."

Improved Outlook Reported for Schedule Material Sales

THE outlook for schedule material sales is improving. The gradual resumption of building operations in many parts of the country is a helpful factor in the situation, and some producers of schedule material are now operating at or very near full time. There are still considerable stocks of raw materials on hand. The labor situation within the manufacturing branch is at present favorable. Up to Tuesday night there was no indication of a price decline.

Sentiment among jobbers is in favor of the adoption of net prices by the manufacturers instead of the present general method of applying a discount to an entire schedule. The net price plan, it is stated, would enable the distributer to sell fast-moving material at a lower margin of profit and allow him to place a sufficient margin on the normal and slow-moving lines to carry the burdens of investment and overhead on these products. This allocation of the overhead where it would seem to belong should enable the distributer to handle economically the staple commodities for which the demand is so great, including such articles as key, keyless and pull sockets, plug fuses, combination plug cutouts and service switches. These materials represent in some cases an annual turnover of ten or twelve compared with three or four in the slow-moving lines.

In the sale of No. 14 rubber-covered wire the net price method is reported to be working well, and one of the large manufacturers, it seems, has also been making net prices for some time on schedule material. Representative jobbers assure that they feel this to be to the advantage of the trade as a whole as the net price system means that the jobber would become a more efficient distributer for the manufacturer.

Hot Weather in Some States Brings Out Fan Motor Stocks

THE fan-motor business to date has been quite spotty, depending entirely upon the section of the country canvassed. The Central, Pacific and Southern belts have been the most active, while the New England and Middle Atlantic territories have been comparatively quiet. St. Louis reports heavy sales in fans as constituting the most prominent feature in the electrical jobbing field last week. Abnormally hot weather for the time of year was experienced throughout all of the surrounding territory, and the rush for fans quickly depleted the stocks of those who had cautiously laid in but a small supply. Stocks in the hands of the jobbers have been sufficient to meet this early demand, but movement of fans from the manufacturers is under way. One manufacturer reports a normal business so far this year.

Varied returns are received in Chicago on fan trade. While some jobbers there seem to feel that they will have difficulty in disposing of stocks, certain dealers report excellent business and say they fear inability to fill orders. Excessive heat is reported from southern Illinois and in Iowa, causing good sales in those territories. A feature noted is that while last year's requirements ran largely to household sizes many orders are coming in now for 16-in. and ceiling fans. Cincinnati, too, is one of the bright spots for recent fan movement.

Advices from Atlanta state that the protracted period of hot weather for the past two weeks has finally brought out the buying element, with the result that a very brisk movement of fans is noted, covering both the pedestal and ceiling types. For a time it was thought that fans were moving so slowly the pressure would be too great to hold up the price, but no second reduction has taken place and it is considered the prices will remain steady for some time.

The Pacific Coast States have responded well to early buying, according to certain manufacturers, and the present market there is reported good.

But from the Atlantic, New England and Eastern States the reports are not so good. Sales in New York as a whole are unsatisfactory. Initial orders were small because of heavy carry-overs from last year. While these may have been taken up in fair amount by dealers, the jobbers have held off on their reorders awaiting fan weather. Only moderately warm weather has struck New York to date. From one source of manufacture, however, good sales have been made in the New York territory.

It is felt that a great deal of pressure must be put upon sales of fan motors for residential use. When hot weather comes the commercial and industrial houses will enter the market, but up to the present the public in general at home has continued to suffer in peace.

The Metal Market Situation

THE copper market is weaker in tone despite the improving statistical position. Stocks in the hands of producers were reduced about 20,000,000 lb. last month, it is estimated, and current production continues below consumption. This is offset, however, by the weakness of demand. Domestic purchases are of the hand-to-mouth order, and foreign buying, which has heretofore been the mainstay of the market, has ceased.

This is due in part to a firming of export quotations recently but principally to the unexpected weakness of all foreign exchanges. Sterling this week dropped below $3.80, the lowest mark reached since last January, and this means a lowering of the equivalent price per pound of copper in London. Consequently, foreign consumers have held off placing orders in this country. The large producers are now nominally quoting 13.25 cents per pound for prompt shipment, 13.25 cents for June and 13.50 cents covering July, but these prices are shaded at least ⅛ cent, it is reported.

Zinc has declined to new low levels, and at its present extremely attractive price it is hoped that increased buying will result. Tin has dropped, too, following London prices and foreign exchange rates down. This market is largely speculative and consumers remain conservative, but should the price remain under 30 cents it is possible that consumers will be induced to buy. Lead demand is quiet with ¼ cent drop in price. Several of the scrap metals show slight advances.

NEW YORK METAL MARKET PRICE

	May 31, 1921	June 7, 1921
Copper	£ s d	£ s d
London, standard spot	72 10 0	72 15 0
	Cents per Pound	Cents per Pound
Prime Lake	13 25	13 25
Electrolytic	13 25—13.50	13.12½–13.25
Casting	12 50	12 37½
Wire bars	15 00—15 25	15 00—15.25
Lead, trust price	5 00	4.75
Antimony	5.25	5.20
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.20	5.00
Tin	31 62½	29 50
Aluminum, 98 to 99 per cent.	28 00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10 50—10 75	10.75—11 00
Brass, heavy	5 25— 5 50	5 25— 5 50
Brass, light	4 00— 4 25	4 00— 4 50
Lead, heavy	4 25— 4 40	4 25 - 4 50
Zinc, old scrap	2 50— 2 75	2 50— 2 75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A GENERAL increase in residential construction is reported from virtually every territory of the country; San Francisco itself is less active than it has been this year, and Chicago, too, has not picked up its accustomed pace. In the latter city, however, the feeling is that the labor difficulties will be over very soon. Commercial building, though, is rather more quiet.

There is an increasing movement of wiring materials in most centers. The jobbing trade is reported as supplying a firm demand that is tending upward in the St. Louis district. Poles and cross-arms are moving in better supply and line hardware has started. Washing machines are selling well there; they are selling well in the Chicago district, and vacuum cleaners are moving where real sales effort is applied. Boston shows an improvement in jobbing trade and washers too are in good demand. Residential and commercial building is becoming better in the South. New York jobbing trade continues quiet, and it is felt that it will stay so for the summer. Schedule material is not moving well there, and the trade asserts it feels the price is too high.

NEW YORK

Some jobbers report that May sales went ahead of the previous month, but others say either that business only held its own or else that it fell off slightly. The general situation is quiet and the trade has settled down to expect a summer of very light business.

Building construction looms up as one of the favorable factors promising future relief to the electrical market. As yet its effect has not been felt, however, and contractors are buying sparingly. Building plans filed during the week of May 14 to 20 inclusive, according to the Dodge reports, represented 572 new buildings, totaling about $17,583,000, of which total 418, or $11,300,000, were for residences. During the same week contracts actually awarded totaled $13,082,000 for 303 new buildings, of which 228, with a value of $9,731,000, were for residential buildings. The territory covered by the above figures is New York State and New Jersey north of Trenton. The outlook afforded by the construction program is somewhat dimmed by the employment situation, however, for in New York City alone at the present time it is reliably estimated that there are 300,000 out of work.

General reductions in the price of dry cells have been made as well as cuts on one or two items of individual manufacture.

A representative jobbing house is circularizing to dispose of a large stock of 16-in. non-oscillating fans at cost. These were carried over from last year.

Metal Molding.—Some jobbers find the market quiet on this item, but others report an active demand. The price of 1,000 ft. of the three-wire to four-wire size of different makes varies from $67.50 to $68.80.

Dry Cells.—General price reductions have just been announced by manufacturers, including "Columbia," "Red Seal," "Everready" and other batteries. In barrel lots jobbers now quote No. 6 regulars at 29 cents each, compared with 36 cents formerly. Igniters are now 30 cents.

Lighting-Fixture Chain.—National Chain Company, College Point, Long Island, has reduced the price of National "Unxld" guaranteed chandelier chain, effective June 1.

Socket Plug.—Ajax Electric Specialty Company, St. Louis, Mo., announces a reduction in list price on its new type of plural socket plugs. No. 22, double, now list for $1 each and No. 33, triple, at $1.25 each. The same discounts still apply.

Porcelain.—Demand shows no life and stocks are well filled, in some cases too much so. Since the reduction on "Nail-it" knobs jobbers quote from $18.37 to $22.50 per 1,000 in barrel lots. Tubes, 3 in. x $\frac{5}{16}$ in., are worth from $8.05 to $10.35, and two-wire unglazed cleats from $18.20 to $35 in the same quantity.

Rubber-Covered Wire.—The market is highly competitive. From $6.50 to $7 per 1,000 is obtained for 10,000 ft. of No. 14 single-braid. Stocks are good and demand small.

Flexible-Armored Conductor.—Price cutting continues but demand, with a few exceptions, is weak. About $55 is nominally asked for 1,000 ft. of No. 14, two-wire, double strip, though at least one house offers a good stock at $53.

Schedule Material.—Buying on the part of jobbers is flat, and they freely state they are holding off awaiting a lower price which they feel is imminent.

CHICAGO

All sorts of reports as to the progress of business have been obtainable this week, some jobbers, manufacturers and dealers reporting excellent business while others say there is absolutely no trade. Trade interest was centered on the N. E. L. A. convention. Industrial conditions remain unchanged, but it looks as though a stop is to be put to the existing labor controversy in the construction industry as both sides are reported as having agreed to arbitration. The tie-up has lasted five weeks and is holding up construction estimated to total close to $100,000,000.

Copper and its products have firmed up considerably during the period, while the downward tendency in the remainder of the electrical line has continued. The wire market was slow to follow the upward turn in copper, but during the past week the large handlers put their price up ½ cent, and it is no longer easy to locate distressed lots at a cent or more under the market.

Motors.—Trade in motors of all sizes remains flat, the general industrial inactivity preventing any demand for other than fill-in purposes.

Washing Machines.—These continue to be the one dependable source of business. The volume of business done is limited only by the sellers' ability to finance long-term payments. Wherever selling activity is a feature sales in pleasing volume are the result, and this seems to be true in regard to the higher-priced standard machines as well as newer and cheaper types.

Vacuum Cleaners.—Business in vacuum cleaners appears directly proportionate to sales effort. Manufacturers who stage selling campaigns in various towns for their distributers' benefit report excellent results from crew efforts even in those cities most affected by the present industrial depression.

Wire.—Weatherproof wire, obtainable from some sources on a 15½-cent base two weeks ago, is now firmly held at 2 cents higher. A leading jobber quotes No. 6 triple-braid at 18½ cents per pound in 1,000-lb. lots. Bare copper wire is up ½ cent to 17 cents for No. 8 in 1,000-lb. lots. In quantity it is possible to shade from ½ to ¾ cent per pound.

Flexible Armored Conductor.—From a weak, uncertain quotation basis last week the market has firmed up considerably in expectation of a resumption in building. The quotation is unchanged at $57.50 per 1,000 ft. for No. 14, two-wire, double-strip, but this quotation is not subject to much variation.

Cross-Arms.—Long-leaf yellow pine cross-arms are reported as taking another drop of about 10 per cent. Quotations are not yet available, but actual figures will be given next week. There is no change in the price of Pacific Coast arms.

Locust Pins.—A reduction of about $5 per 1,000 has just been reported by one large source of supply. The new price, in large quantities, will be about $35 per 1,000; in small quantities, $48.

BOSTON

Business is somewhat spotty at present, although improvement is reported in jobbing circles and building operations are more active. Building and engineering contracts in New England for the week ended May 31 totaled $4,998,200 against $3,218,000 for the same period last year. Gradually the labor situation appears to be getting more favorable. Jobbers are still buying mainly for current demands or a little more. Prices are unsettled in wiring material lines, with a tendency toward an open market on large-quantity quotations. Collections require close follow-up work and considerable caution is evident in granting credit. Deliveries continue easy and the outlook is for a good summer trade in many lines. The Holyoke Water Power Company is going ahead with important local hydro-electric development work and construction work has begun, it is reported, upon the New England Power Company's proposed development on the Deerfield River in southern Vermont. Important hydro-electric work is also under way at Berlin, N. H.

Appliances.—Despite complaints of some dealers that business is dull, other retailers are handling a fair volume of trade. Active sales effort with emphasis upon convenience is yielding good fruit. Washers are moving continuously, and considerable interest is evident in motor-driven ironers. Electrical wedding gifts are coming into prominence this month, but it is too early for results.

Motors.—Beyond spasmodic sales the market shows little evidence of vitality. A good amount, however, of betterment work is being done, and this is absorbing motors in moderate quantities, selected for particular jobs. Prices appear steady for the present.

Flexible Armored Conductor.—This material is weak on quantity sales, prices ranging from $57 to $60 per 1,000 ft. in No. 14 double-strip, 1,000-ft. lots, and lower on sharply competitive sales in fair quantities.

"Nail-it" Knobs.—Prices are soft, the current sales figure being about $21 per 1,000 in barrel lots. Improved building conditions are lightly reflected in the demand, which is still readily handled from local stocks. Porcelain tubes are steady in price.

Wire.—Rubber-covered No. 14 sells around $6.75 per 1,000 ft. in 1,000-ft. lots. Moderate sales are reported, with considerable competition. Weatherproof wire is selling moderately well. Base prices vary a cent a pound or more, with varied additions for size. A representative price to the contractor-dealer of No. 6 in 100-lb. to 200-lb. lots is $21.50 per 1,000 ft. Bare selling prices range around 15½ cents to 16 cents per pound, with light demand. Piecemeal central-station construction work, house wiring and new commercial structure wiring are helping sales.

Lamp Cord.—Easy deliveries and quiet prices prevail. No. 18 cotton-covered cord brings $18 in 1,000-ft. lots.

Storage Batteries.—A temporary recession is noted in demand for automobile purposes within a fortnight. Prices are steady and inquiries in good volume.

Dry Cells.—Prices are easier, a leading make moving for $30.35 per 100 in barrel lots, No. 6 size, and for $31.35 in the ignition type. As yet the demand is nothing striking.

Rigid Conduit.—A better tone is apparent, one leading house having inquiries Monday for two carload lots from different sections of the country.

ATLANTA

Activity in residential and commercial construction is growing each week, as indicated by building permits over the Southeast. Permits in Atlanta for May were considerably greater than for the same period of 1920, and from all reports it appears that a general building revival is slowly taking place in the surrounding states. The textile strike called June 2 has had a dampening effect on industries, but this probably will be of short duration as business in general has discounted the effect of wage reductions. It is felt that the textile situation will be cleared up in the course of a week or two, putting this industry on a more healthy basis. This will help the electrical industry in the increase of business as the industry stabilizes. The report of the Sixth Federal Reserve district for May shows a lull of buying in the rural district, which has in turn tended to slow up wholesale business. The contemplated reduction in discount rate has created an easier tone in the money market and more funds are in the bank for loans on legitimate enterprises. This in itself is one of the bright features at this time.

Industrial Lighting.—While business in this department of the electrical industry experienced a sag along with the rest, the industry as a whole is now devoting more thought to the possibilities of efficient illumination, and this, through the stimulation of lighting experts, has increased business materially. Standard RLM reflectors showed a reduction in price of approximately 10 per cent this week. Jobbers' stocks are well filled and manufacturers are not receiving many large orders.

Dry Batteries.—Regular dry cells dropped 7 cents each this week, due no doubt to the slackening in demand at this time of the year. The demand for dry cells for several months past has been very weak.

Vacuum Cleaners.—Efforts on the part of jobbers and dealers to turn over the heavy stocks of cleaners has resulted in sales stimulation, and it is fully expected that fairly good business will be experienced as the season advances. No price change is to be noted.

Insulating Materials.—Jobbers and manufacturers have noted the insistent call lately for repair material of all descriptions, this being brought about by industrials renovating during their shutdowns and endeavoring to utilize old equipment rather than go into the market at this time for new equipment.

Electric Drills.—The market for this specialty opened up briskly last week, but it is felt that this is sporadic and that the demand will not be sustained.

Heating Devices.—The demand was stimulated somewhat last week through the Hot Point campaign but has slumped off again this week, with the exception that flatirons and curling irons seem to be moving fairly well.

Electric Auto Accessories.—Nearly all items under this head are dormant and have been for some time, but spotlights and miniature lamps show some improvement.

Fixtures.—Dealers report a good demand for moderate-priced fixtures for residential work. It is expected that the demand will hold up fairly well throughout the summer and fall, in view of the present residential building program.

ST. LOUIS

The demand for most electrical goods has remained firm, with a tendency toward gradual growth, and it can be said that the jobbers view even the immediate future with entire confidence. Stocks, as a rule, are in satisfactory condition, there being few overstocks reported and the general tendency being to keep them at a minimum. As industrial buying is almost entirely for maintenance purposes, the contractor-dealers are loath to stock any appreciable quantity of industrial equipment. In schedule materials a fairly general overstock seems to prevail. One price change for the week is reported, namely, a reduction of about 15 per cent in dry cells. Credit conditions are unchanged, the average basis being from forty-five to sixty days. Money is somewhat easier to obtain.

Industrial building is still at a very low ebb, but the indications are that one or two large enterprises will be started in the next sixty days. Announcement is made of the commencement of construction on a five-million-dollar group of buildings for hotel and apartment purposes. The building wage situation is unchanged, but some express a hope of lower wages after July 1 as a number of the labor contracts expire on that date.

Dry Cells.—Effective June 1, a price reduction of approximately 15 per cent was made. In barrel lots the regular cell is now quoted at $31 per 100 and the igniter at $32. The demand is quite satisfactory over the entire territory and stocks are reported in excellent condition.

Fans.—A heavy retail demand continued last week, ex

hausting the stocks of many retailers who have been wiring jobbers for rush replacements. Jobbers had fairly good stocks in most instances but are asking for deliveries of their orders on factories. One large manufacturer reports that the demand so far this year, while not equal to that of last year, can nevertheless be considered as normal.

Poles and Cross-Arms.—One jobber reports a good business in these items for the week. This appears to be unevenly distributed. The demand is primarily for small extensions to distribution systems rather than for major transmission lines. Representative quotations on 3¼-in. x 4¼-in. Rainier fir arms, in lots of 1,000 linear feet, f.o.b. St. Louis, are: 3-ft., $42.53 per 100; 4-ft., $56.70; 5-ft., $70.68; 6-ft., $95.05.

Pole-Line Hardware.—A fairly good demand is found in keeping with that for poles and cross-arms. Stocks are reported on a conservative basis.

Wire.—The demand remains fairly quiet, the only kind selling in any appreciable quantity being No. 14 rubber-covered. The price for it varies from $6.50 to $7.25 per 1,000 ft. in 5,000-ft. lots. One jobber quotes a standard grade at $6.95 per 1,000 ft. in 100.000-ft. lots. The same jobber quotes the base on bare copper at 15¼ cents and that for weatherproof at 16 cents. Stocks are in reasonably good condition.

Tape.—Rubber and friction tape are being sold in gradually increasing amounts with the demand not far from normal. Stocks are in good shape locally.

Magnet Wire.—There is practically no demand and jobbers' stocks are being kept at low inventory. One jobber quotes on a 17-cent base.

Washing Machines.—A good demand continues over the entire territory, particularly toward the South, and it is reported that the call is principally from the smaller towns. A healthy stock is maintained by all of the jobbers.

SEATTLE—PORTLAND

Business generally in Seattle and the Puget Sound district remains sluggish, with no particular indication of improvement in sight. Retailers report washing machines, flatirons, electric tableware, etc., moving fairly well, but jobbers as a whole report business very poor. Collections are reported as showing little improvement. Residence building on a considerable scale is keeping up in the Sound cities, but construction involving big investments is being held up by lack of funds. In Seattle this is particularly true, and a number of construction jobs involving several million dollars are held up.

The employment situation shows improvement from week to week with resumption of activities in the lumbering and logging industries and increased call from agricultural districts. Employment in the Puget Sound cities is still a problem because of the slow resumption of manufacturing and industrial activities and a tendency to keep the overhead to a minimum in all lines. Domestic help is becoming easier to obtain, and there is also noted somewhat improved efficiency of the workers. Jobbers report that this condition is resulting in a stimulation in sales of washers.

Portland jobbers report business for the past week as rather slow, but prospects for the coming week look considerably brighter. The price change for the past week is a slight reduction on rubber-covered wire. Residence building activities are reflecting themselves in increased demand for wire and house-wiring equipment. Credits and collections are not showing any appreciable improvement.

Farm Plants.—While jobbers throughout the district report sales of farm plants considerably below last year, the indications for fall business are still more or less bright. Conditions which are holding back this movement can be summed up in three factors—failure of farmers to dispose of last year's crop, belief that prices of plants will drop, and uncertainty of the future market for farm products.

Electric Tableware.—June wedding gifts are creating a spurt in buying of percolators, chafing dishes, toasters and table stoves, the majority of this business developing through the department stores and gift shops.

Ranges.—These continue to show little movement owing to the high price and the determined stand of the public to wait for a reduction.

Fuses.—Plug fuses in the 5, 10 and 15-amp. sizes are moving fairly well on account of increased activity in residence construction. The movement in cartridge fuses remains light. Stocks are in good shape and prices fairly stable.

SAN FRANCISCO

Members of the San Francisco Building Exchange state that business will have been resumed by June 13 on the American or open-shop plan, and that they are assured by local employment bureaus of a sufficiency of workmen for outstanding jobs in case the unions composing the local building trades council do not accept re-employment at the 7½ per cent reduction advised by the arbitration board. Oakland and the other Bay cities, which have followed the lead of the San Francisco contractors, expect to put the same plan in operation at the same time. In return the local unions have appealed to the district attorneys of San Francisco and Oakland, preferring charges of conspiracy in restraint of trade against the respective builders' exchanges of those cities. The strike is reflected in the value of building permits issued. The figures for May, 1921, being: San Francisco, $1,097,151; Oakland, $1,033,-323, as compared with respective figures of $3,879,060 for San Francisco and $957,679 for Oakland, in May, 1920. In southern California, on the other hand, building is proceeding at a rate which nearly doubles the remarkable figures set for last year. The value of building permits issued in Los Angeles for May, 1921, was $7,433,760, as compared with May, 1920, figures of $3,160,300.

Fixtures.—Because of the building stagnation in the bay district fixture manufacturers are reporting a very poor business and jobbers who handle unit fixtures find their stocks to be slow-moving.

Ranges.—The Great Western Power Company has approximately 60,000 additional horsepower to deliver from its Caribou installation and is planning an intensive electric range campaign in the near future. Various types of ranges are now under consideration, and the actual purchase will be consummated within the next few days.

SALT LAKE CITY—DENVER

Judging from the steady increase of building permits being issued, construction work is picking up in a satisfactory way. The month of May showed an increase in percentage over the month of April. This big gain is evidence both of the easing of money and of the belief in many quarters that economic conditions are now sufficiently stabilized to permit at least the most pressing construction work. It is significant that by far the greatest number of permits are issued for the building of homes. A fully equipped electrical home in process of construction in Salt Lake City will be ready for demonstration by Sept. 1.

Ironers.—The sales of ironers are incidental and scattered, and the business has not yet reached a stabilized or regular state. Thus far, it is felt, the price forbids the extensive home use of ironers.

Sewing Machines.—For some reason sales have shown a remarkable increase in the past few months. Dealers are furnishing an outlet and making frequent calls on their jobbers. The several popular makes sell at $75 to $125.

Meters.—The type most in demand in this territory is the 5-amp., 110-volt. Prices are quoted at $25 to $30 and stocks are good.

Electric ranges.—A special price concession by a prominent manufacturer stimulated a temporary demand and resulted in a number of sales. The potential demand is big, and sales on a large scale are waiting on lower prices.

Wire.—The wire market is at a low ebb. Apparently it will require more than price cutting to stimulate a demand. Rubber-covered wire is now on a 16-cent base and weatherproof is 17 cents. Jobbers are overstocked with no relief at present in sight.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Keystone Ironing Machine Puts Headquarters in New York

The main and executive offices of the Keystone Ironing Machine Company have been removed from Pittsburgh to the Knickerbocker Building, Broadway and Forty-second Street, New York City. Under the new management the company plans to acquire its own manufacturing plant and connections are now under way for that purpose. The new officers are: Leo Potter, president and general manager; Sol Finkelhor, vice-president; Mark Schiller, secretary and treasurer; F. G. Jarabin, sales manager, and R. J. Mompere, chief engineer.

Gagen & Becker Formed in New York City

James M. Gagen has joined with Elvin J. Becker in the establishing of the firm of Gagen & Becker, electrical contractors and engineers, 750 West One Hundred and Eighty-first Street, New York City.

Mr. Gagen has been identified with the electrical contracting business in New York City for the past fifteen years, being the founder and president of Gagen & Butler, Inc., from which office he has recently resigned.

Mr. Becker has been engaged for fifteen years on large engineering and construction operations throughout the South and Middle West of the United States. Both men are technical graduate engineers with extensive experience.

Mica Insulator Company Wins in Trade Mark Suit

The Mica Insulator Company, 68 Church Street, New York City, announces that it has recently won a suit it brought last year against the Mica & Micanite Supplies Corporation, subsidiary of an English company, for infringement of its registered trade-mark "Micanite," which it has used for twenty-eight years to identify its built-up mica insulation, and for unfair competition because of the use of that trade-mark as part of the corporate name of the Mica & Micanite Supplies Corporation. Judge Knox of the District Court of the United States for the Southern District of New York has entered a decree sustaining the position of the Mica Insulator Company in all respects, ordering that the defendant corporation be enjoined from using the word "Micanite" in any way in connection with the sale of electrical insulation, even as a part of its corporate name

The demand for micanite has been so great that the company has been forced to expand its manufacturing facilities several times in the last few years. Five years ago a new factory was erected that more than doubled the manufacturing output at that time. A year ago an addition to the factory was erected, then increasing the capacity 50 per cent.

Walker Electric Vehicle Men Hold Convention

The sales staff of the Walker Electric Vehicle Company, whose home offices are at Chicago, held a convention of one day last week during the N. E. L. A. gathering in that city. About fifty attended and G. A. Freeman, vice-president, was in charge. The new factory of the company was inspected, and during the business sessions considerable optimism was expressed regarding the outlook for electric truck sales within the economic field of service to which this class of equipment is adapted.

Westinghouse Opens New House in Cincinnati

The Westinghouse Electric & Manufacturing Company has greatly increased its facilities in the Central States by moving into its new headquarters at Third and Elm Streets, Cincinnati, Ohio. All the business of this company, the Westinghouse Lamp Company and the Westinghouse service department in this district, which comprises the major part of Ohio, all of Kentucky and Indiana, of which James A. Brett is the manager, will be handled from the local headquarters. The building contains four floors and basement for the use of warehouse, lamp, service and office departments. It is so constructed that additional stories may be added as the business in this district expands.

Stoker Manufacturers' Convention Program Outlined

The Stoker Manufacturers' Association will convene for its summer meeting at the Red Lion Inn at Stockbridge, Mass., June 14, 15 and 16. During the sessions E. H. Sniffin, Westinghouse Electric & Manufacturing Company will outline the manner of handling stoker business in the past and at present. Harry E. Cleland, Philadelphia, will outline the advertising and publicity requirements of a typical stoker company and how this money should be spent, and the various committee chairmen will present their reports.

For the commercial committee, P. A. Poppenhusen chairman, the discussion will take in the advisability of reorganization of standing and other committees and the advisability of establishing a research committee for certain lines of work. For the publicity committee, R. C. Beadle chairman, a national advertising campaign will be discussed. The engineering committee, John Van Brunt chairman, has several topics for presentation, including new uses of stokers, etc. The A. S. M. E. conference committee, Loyd Stowe chairman, in its report will discuss the work of the recently created fuel sections of the professional section, and the A. S. M. E. revision of the power test codes. One of the topics for the membership committee, J. G. Worker secretary, will be the advisability of extending the association to include semi-automatic shaking grate manufacturers on some membership plan.

Arrangements have been made for golf and other forms of recreation and entertainment between the scheduled sessions.

Warehousers and Distributers to Convene Next Week

Traffic representatives of manufacturing companies which distribute their products through public merchandise warehouses will meet in convention at the William Penn Hotel, Pittsburgh, on June 16 and 17, under the auspices of the Shippers' Warehousing and Distributing Association, which was organized at Chicago a year ago for the general purpose of effecting standardization of forms, practices, rules and regulations in the business relationship between manufacturers and the public warehouse industry. The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the De Laval Separator Company, Chicago, are among the members of the association. Details regarding the convention may be obtained by addressing Kent B. Stiles, 239 West Thirty-ninth Street, New York City.

Federal Sign's Report for Fiscal Year 1920

The Federal Sign System (Electric), 8700 South State Street, Chicago, has added $200,415 net income to its surplus as the amount by which its revenue from all sources for the year ended Dec. 31, 1920, exceeded its expenses. This leaves a surplus as of Dec. 31, 1920, of $759,837. More than $88,000 was deducted for depreciation of the plant and sign investment. Income from all sources amounted to $5,524,844. Inventory of merchandise, raw material and supplies amounted to $952,693 and accounts were receivable to the amount of $1,153,282.

During the year the new building at Eighty-seventh and State Streets was

completed, and it is now occupied by the company for the Chicago factory and for general offices. It is believed that with the return of normal manufacturing conditions the operations of the company can be conducted with greater efficiency and economy than formerly.

The requirements of business during the year made the employment of additional capital necessary. There was a decided expansion in the sign-renting business and a consequent demand for new capital. Additional capital was also required in the manufacturing and jobbing portion of the company's business. It became necessary to carry a larger stock of merchandise to meet an increasing demand, and it was imperative that new machinery and other factory equipment be installed. Consequently the board of directors authorized an issue of $1,000,000 7 per cent ten-year debenture bonds, $800,000 of which has been used for the above purposes.

There was an actual increase in gross sign rental revenue in 1920, as compared with 1919, of 36.9 per cent.

Westinghouse Campaign of Education on Meters

The San Francisco district office of the Westinghouse Electric & Manufacturing Company has prepared a lecture accompanied by lantern slides covering the history and best practices of installing meters. All of the common types which are in general use are covered, and a brief discussion of their development, installation and operation is given. Of the 125 slides exhibited a number are devoted to the application of outdoor instrument transformers during typical installations. Proper and improper methods of meter installation are shown to illustrate the new rules which are expected soon to be put into effect to govern meter installations in California.

Walter Truck Offers New Electric Vehicle

The Walter Motor Truck Company, 227 West Sixty-first Street, New York City, producer of gasoline trucks since 1909, has entered the electric field and has developed a model of electric road truck from 1,500-lb. and 1-ton sizes to 2, 3½, 5 and 7-ton heavy-duty sizes. Interchangeability of parts throughout between the gasoline and electric trucks is an important feature of these vehicles.

The company has recently gone through an extensive reorganization, and new interests have become identified with it. The electric truck production is in charge of George W. Wesley, formerly vice-president and production manager of the General Vehicle Company. William Walter is vice-president and Maurice Walter chief engineer.

With the enlarged manufacturing schedule there came a necessity of determining a definite sales policy, and it was decided to turn the electric truck end of the business over to Fink-Dumont-White, Inc., 405 Lexington Avenue, New York City, that company agreeing to take over the entire production of the factory.

Fink-Dumont-White, Inc., is comprised of F. B. Fink, president, a former member of the General Vehicle Company sales organization; R. Duval Dumont, vice-president, also a former member of the G. V. C., and W. W. White, treasurer, formerly district manager of the G. V. C. Messrs. Fink, Dumont and White plan to place distributers and agents of Walter trucks, both gas and electric, throughout the country as well as to arrange the proper representation in foreign countries. The metropolitan territory is being covered directly from their own offices.

Mesco's 1920 Surplus Given as $1,239,891

From the balance sheet as at Dec. 31, 1920, of the Manhattan Electrical Supply Company, Inc., New York City, there was a surplus of $1,239,891.80, the sheet balancing at $7,466,246.66. Accounts receivable amounted to $754,248. Inventories of raw materials and work in progress came to $1,246,409 and inventories of finished stock to $1,520,965.

Change in Name for Esterline Company

The Esterline-Angus Company is the new name of the former Esterline Company, Indianapolis, Ind. The original company was organized in 1900 by J. W. Esterline and incorporated six years later. In 1910 D. J. Angus became associated with Mr. Esterline in a consulting engineering business, and in 1917 he became a stockholder and director of the Esterline company. Two years ago these two men bought the interests of all other stockholders, and in view of their long association in both engineering and manufacturing work they have decided to change the name of the manufacturing company to that given above.

There will be no change whatever in the general policy of the company, it is announced. Mr. Esterline will continue to be the executive in charge of sales promotion and advertising, and Mr. Angus will similarly direct the work of production and engineering.

Three new instruments have just been announced, a graphic kva. meter, a graphic alternating-current ohmmeter and a portable concentration meter.

York Jobber Moves and Adds Appliance Department

A department of electrical household appliances has been added to the business of Harry W. Motter, electrical sales engineer of York, Pa., and the removal of his office and storeroom to 335 West Market Street is announced. With these changes Mr. Motter expects to be able to render still more satisfactory service.

Better Business Being Booked by Hi-Voltage

The Hi-Voltage Equipment Company, Cleveland, according to L. C. Hart, president and general manager, is experiencing a better demand. The company is booking new customers and old customers are again buying. Quite a few inquiries have been obtained from abroad. The exchange rate, however, is holding this trade back. Mr. Hart says that he finds the American bankers very anxious to help out in this situation. His company recently secured a large order at current prices for Australia on the basis of sterling exchange established through London. The transaction will be handled by a Cleveland bank. With sixty days for shipping and 120 days credit, it is expected that sterling exchange will probably have improved. Mr. Hart is convinced that trading on sterling exchange, and not dollars, gives the best results.

The Gas & Electric Supply Company, Norfolk, Va., has filed notice of increase in capital stock from $15,000 to $50,000.

The Biscayne Electric Supply Company, Miami, Fla., is considering increasing its capital stock from $25,000 to $100,000.

Pass & Seymour, Solvay, N. Y., has filed notice of increase in capital stock from $300,000 to $1,500,000.

The Edison Fixture Company, 332 Broadway, New York City, has filed notice of increase in capital stock from $2,000 to $100,000.

Allan V. Garratt, hydraulic engineer, formerly chief engineer of the Lombard Governor Company and more recently consulting hydraulic engineer to Lockwood, Greene & Company, engineers, has established an office at 176 Federal Street, Boston, for consultation and advisory work in hydraulic engineering.

The Howard-Geeseka Company, 802 Plymouth Building, Minneapolis, has been appointed representative of the Condit Electrical Manufacturing Company, Boston 27, and will handle the complete Condit line in the States of Minnesota, North Dakota and South Dakota and the northern peninsula of Michigan.

The Schiefer Electric Company, 614 City Bank Building, Syracuse, N. Y., has been appointed to represent the Condit Electrical Manufacturing Company, Boston 27, and will handle its complete line of products in the vicinity of Syracuse and the eastern part of New York State exclusive of New York City.

The Combustion Engineering Corporation, 43 Broad Street, New York City, announces the removal of its Philadelphia office to the tenth floor, Finance Building, Philadelphia, where it has much larger quarters. The development of its business in the Philadelphia district has necessitated an increase in the sales organization of the company and the inauguration of a new service department. W. C. Stripe is manager of the Philadelphia district.

Foreign Trade Notes

THE LYONS (FRANCE) FAIR TO BE HELD IN OCTOBER.—The autumn meeting of the Lyons Fair will be held from Oct. 1 to 15 at Lyons, France. It will be of international character as all foreign articles and products will be admitted. Special attention will be given for the promotion of international trade. American manufacturers may obtain further information on application to Emile Garden, 150 Nassau Street, New York City, which is the head office of the fair in the United States.

PROPOSED HYDRO-ELECTRIC DEVELOPMENT IN FRANCE.—The French government, Vice-consul Corbitt at Lyons reports, is now considering the division of the country into districts for the development of hydro-electric power. As it will take some time for the completion of the government plans, an organization has been formed to be known as the Société de Transport d'Energie des Alpes which will insure further exploitation of resources in this region, and is intended to utilize the power from the many undeveloped waterfalls in the valleys of the Upper Isere and the torrents of the Alps. To the first line of this system will be connected the plant now under construction at La Viclaire, near Lyons.

NEW HYDRO-ELECTRIC PROJECT FOR THE PHILIPPINES.—According to the Bulletin of the Philippine Government Commercial Agency, plans are well under way for a hydro-electric development on the Abo-Abo and Tiawir Rivers, designed to furnish electricity for lamps and motors in the provinces of Bataam and Pampamga, comprising a population of about 48,000. It is estimated that 200 hp. can be developed on each river.

POSSIBLE ELECTRIC PROJECT FOR ASIA MINOR.—The National Assembly of the Angora government, according to a report from Assistant Trade Commissioner Gillespie at Constantinople, has authorized the construction of a railway from Sivas to Samsun on the Black Sea. It is quite possible that sufficient water power may be developed from the Kizil Irmak River to permit the electrification of this railroad, which will be less than 200 km. in length. As yet no equipment has been purchased nor has contract for construction been placed.

WIRELESS STATION IN COLOMBIA FINANCED BY MARCONI COMPANY.—The Governor of the Department of Norte Santander, Colombia, according to Commerce Reports, has corrected the impression that the wireless station at San José de Cucuta is being constructed with goverment funds by issuing the statement that its financing has been undertaken by the Marconi Company.

CONCESSION GRANTED FOR BRAZILIAN WIRELESS STATIONS. — The Companhia Radiographica do Brasil by a decree of March 7, 1921, has been granted a concession to install and operate high-power radio stations for direct communications with the Americas and Europe. The first two stations are to be established in the cities of Rio de Janeiro and Belem, in Para. The concession, which is for a period of forty-five years, grants no monopoly or privilege of any kind and restricts operations to international service, communications between localities within the national territory being prohibited.

REVISED LIST OF IMPORTERS OF ELECTRIC MACHINERY IN CHINA.—The Bureau of Foreign and Domestic Commerce list of importers and of dealers in electric machinery and supplies in China has been revised by the Far Eastern Division with the most recent information available, and is now ready for distribution under reference number FE-13,026-A.

NEW ELECTRIC RAILWAYS IN JAPAN.—The Mushashi Electric Tramway Company, recently organized, according to the Japan Advertiser, will construct and operate a new electric railway from Tokyo to Yokohama, running approximately 1½ miles inland from the present railroad. The company will also furnish electricity to the villages along the rounte. Plans are being made, according to a translation from the Nagoya Shimbun, for the construction of a railroad between Nagoya and Yamada, a distance of 61 miles. Power is to be supplied by the Ibugawa Electric Power Company. Another line 30 miles long, around the Chita Peninsula, is planned by a company to be capitalized at 4,000,000 to 5,000,000 yen. A translation from the Osaka Mainichi Shimbun reports a project for the construction of an electric railway between Nagoya and Gifu. It is proposed to construct a double-track line parelleling the present steam railway, at a cost of about 7,000,000 yen. A line between Gifu and Ogaki is also planned.

CHIEF ELECTRICAL ENGINEER OF AUSTRALIA TO INVESTIGATE AMERICAN TELEPHONE AND TELEGRAPH SYSTEMS.—Trade Commissioner Ferrin reports that F. Golding, chief electrical engineer and director of radio services of the Commonwealth of Australia, has left for a visit to the United States, Canada and Great Britain to inquire into telephone, telegraph and wireless developments in all phases of plant, communication and intercommunication of systems.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A mercantile firm in Canada (No. 34959) desires to purchase washing machines.

Bids are invited by a country in the Near East (34,951) for the construction of docks, quays and an additional warehouse and the installation of two electric cranes.

TENDERS ASKED FOR MATERIAL FOR MORWELL (AUSTRALIA) POWER SCHEME.—Tenders will be received by R. Liddelow, secretary State Electricity Commission, Victoria, 673 Bourke Street, Melbourne, Victoria, Australia, until Aug. 14, for material for the Morwell power scheme covering steel work for power-station buildings, water-tube boilers, stokers, fans, etc.; platforms and ladders, steel chimneys, flues and dampers and dust extraction equipment and ash-handling equipment. Copies of tenders, specifications, etc., may be obtained at the following offices of the Bureau of Foreign and Domestic Commerce: 734 Custom House, New York City, and 1424 First National Bank Building, Chicago.

New Apparatus and Publications

ELECTRIC WATER HEATERS.—"Hot Water by Wire" is the title of a recent publication issued by the Automatic Electric Heater Company, Warren, Pa., decribing its new D type Sepco automatic electric water heaters.

PORTABLE CONCENTRATION METER.—The Esterline-Angus Company, Indianapolis, has developed a portable concentration meter for showing the degree of concentration of chemical salts in water.

STEAM TURBINES.—Bulletin No. 42,-019 of the General Electric Company is on the Curtis Steam Turbines for mechanical drive.

SYNCHRONOUS CONDENSER. — The General Electric Company has issued Bulletin No. 41,311 A, superseding No. 41,311, on its standardized line of 60-cycle synchronous condensers.

MULTI-PHASE RENEWABLE FUSE.—The Federal Electric Company, Chicago, has developed a multi-phase time-limit renewable cartridge fuse designed to prevent polyphase motors running single-phase.

BUS AND BOARD FITTINGS—The Erie Electrical Equipment Company, Inc., Johnstown, Pa., has issued supplementary bulletins on split porcelain insulators, wall and floor flanges and main castings for three-way and four-way pipe combinations.

AUTOMATIC STARTER. — The Cutler-Hammer Manufacturing Company's new alternating-current automatic starter is described in bulletin 9604, just issued.

RELAY. — Bulletin 10,081, superseding 10,080, covers the new phase-failure and reversal protective relay of the Cutler-Hammer Manufacturing Company, Milwaukee.

INDUSTRIAL TRUCKS.—The Atlas Car & Manufacturing Company, Cleveland, has put out a new line of storage-battery trucks and tractors with interchangeable units.

FLASHLIGHT.—The American Eveready Works of National Carbon Company, Inc., Long Island City, N. Y., has put out a new line of three-cell flashlights.

MOTORS. — Bulletin 202 describes the Ohio ball-bearing splash-proof induction motors and direct-current motors of the Ohio Electric & Controller Company, Cleveland.

SPACE HEATERS.—Space heaters for commercial and domestic heating are discussed in a leaflet, 3112, just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

WASHING MACHINE. — The Minier Manufacturing Company, Inc., Minier, Ill., is putting on the market a new washing machine under the trade name of "Elite Electric."

HEADLIGHTS. — The Electric Service Supplies Co., Philadelphia, Pa., has issued a limited number of copies of its new engineering report, No. 351, on glass reflectors for headlights.

FUSED ENTRANCE SWITCH. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently placed on the market a fused entrance switch rated at 100 amp. and 2,500 volts.

INCLOSING STRUCTURES. — Inclosing structures with outside operation for manual and automatic starters are shown in the Cutler-Hammer Manufacturing Company's new bulletins recently issued.

New Incorporations

THE ACE BATTERY MANUFACTURING COMPANY, Brooklyn, N. Y., has been organized by L. P. Mendham and E. Klein, 44 Court Street, to manufacture storage batteries and other electrical equipment.

THE KEHRER DISTRIBUTOR COMPANY, 175 Smith Street, Perth Amboy, N. J., has been incorporated with a capital stock of $125,000 to manufacture and deal in electrical goods and machinery. The incorporators are C. Kehrer, Frank Koch and Emil Stremlau.

THE DELHI POWER COMPANY, Nevada City, Cal., has been incorporated by Fred Searls and Carrol Searls, Nevada City, and Harry B. Skewes. The company is capitalized at $300,000 and proposes to erect a power plant on the Middle Fork of the Yuba River at a point near the Delhi Mine to supply electricity for mining purposes and commercial use.

THE GEM (IND.) ELECTRICAL SERVICE COMPANY has been incorporated with a capital stock of $40,000 to supply electricity for light, heat and power purposes. The directors of the company are F. M. Thomas, W. E. Heller, G. C. Sander, J. A. Resener and W. A. Resener.

THE BROCKWAY LIGHT, HEAT & POWER COMPANY, Brockwayville, Pa., has been incorporated with a capital stock of $50,000 to operate a local light and power system. M. E. Keys is treasurer.

THE NEW ENGLAND SIGNAL REFLECTOR COMPANY, Boston, Mass., has been incorporated to manufacture electrical signaling equipment. The officers are Dudley M. Holman, president, and William H. MacDowell, 47 Liberty Street, East Braintree, treasurer.

THE RITCHIE COMPANY, Worcester, Mass., has been incorporated by William A. Ritchie, Sr., William A. Ritchie, Jr., and Harry A. Wheeler. The company is capitalized at $50,000 and proposes to manufacture and deal in storage batteries.

THE INDEPENDENT CONTRACT MANUFACTURING COMPANY, Union, N. J., has been incorporated by Clemens A. Laise and Albert J. King, Weehawken. The company is capitalized at $100,000 and proposes to manufacture electrical equipment.

THE MODERN ELECTRICAL SUPPLY COMPANY, Newark, N. J., has been incorporated by William Locke and Max Schoether. The company is capitalized at $50,000 and proposes to manufacture electrical products.

THE SUPERIOR INCANDESCENT LAMP COMPANY, 593 Ogden Street, West Orange, N. J., has filed notice of organization to manufacture electric lamps. Philip H. Harrison, 27 Babcock Place, is interested in the company.

THE F. & L. BATTERY & SUPPLY COMPANY, Trenton, N. J., has been incorporated by Charles Fishberg, Rubin Feldsher and Jacob Lens. The company is capitalized at $100,000 and proposes to manufacture electric batteries and other electrical products and is represented by Forman & Levy, 817 Broad Street.

Record of Electrical Patents

Notes on United States Patents

(Issued May 10, 1921)

1,377,915. SAFETY SHOT FIRER; Charles F. Oaka, Lovettville, Alberta, Canada. App. filed April 29, 1920. For use in mines and quarries.

1,377,939. PORTABLE BURGLAR ALARM; Samuel Sundel, New Haven, Conn. App. filed Oct. 2, 1919. For convenient attachment to door or window.

1,377,940. SOUND CONCENTRATOR FOR TELEPHONE TRANSMITTERS; Elmer E. Taylor, Loogootee, Ind. App. filed Sept. 23, 1919. For the deaf.

1,377,951. ELECTRIC FURNACE CONTROL; Alfred L. Wilkes, Los Angeles, Cal. App. filed June 17, 1919. Electric dental oven.

1,377,972. SPLICING EAR FOR OVERHEAD TROLLEY WIRES; Ralph Rose and Nicholas F. Cimaglia, Mount Vernon, N. Y. App. filed July 16, 1919. Removable wearing edge.

1,377,952. HEAT CONTROL FOR ELECTRIC FURNACES; Alfred L. Wilkes, Los Angeles, Cal. App. filed Aug. 2, 1919. Dental oven.

1,377,995. STORAGE BATTERY; Theodore A. Willard, Cleveland, Ohio. App. filed Aug. 7, 1916. For cross-connecting adjacent cells.

(Issued May 17, 1921)

1,378,010. MOTOR CONTROLLER; Charles E. Carpenter, New York, N. Y. App. filed Oct. 5, 1916. Variable speed by field regulation.

1,378,011. TELEGRAPH REGISTER RECEIVING APPARATUS; Nathaniel B. Cregier, Chicago, Ill. App. filed Feb. 11, 1918. For reporting and displaying market news.

1,378,012. ELECTRICALLY HEATED HAIR-WAVING DEVICE; Marie J. Cully, Chicago, Ill. App. filed March 18, 1920.

1,378,019. PHASE-BALANCING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed May 7, 1917. Polyphase transmission system.

1,378,041. PROCESS OF MANUFACTURING BICYCLE FORKS; Elmer M. Lewis, Dayton, Ohio. App. filed Sept. 2, 1919. Electric butt welding.

1,378,049. CURRENT-COLLECTING DEVICE; Chester B. Mills, East McKeesport, Pa. App. filed Oct. 24, 1917. Collector rings for alternating-current motors.

1,378,066. APPARATUS FOR HEATING LIQUID HYDROCARBONS IN DISTILLING AND OTHER PROCESSES; Albrecht F. von Groeling, New York, N. Y. App. filed Dec. 21, 1918. Distilling petroleum.

1,378,080. ELECTRICALLY HEATED BAKE OVEN; James C. Woodson, Mansfield, Ohio. App. filed Sept. 24, 1920. Reel-type oven.

1,378,082. AUTOMATIC CONTROL FOR ELECTRIC IRONS; Charles B. Yoder, Webster Groves, Mo. App. filed April 19, 1920. Prevents overheating.

1,378,094. METHOD OF AND MEANS FOR TREATING AIR; Egerton R. Case, Toronto, Canada. App. filed March 22, 1920. Humidifier.

1,378,095. ELECTRIC DEVICE FOR TREATING AIR; Egerton R. Case, Toronto, Canada. App. filed March 22, 1920. To humidify air.

1,378,120. METHOD OF AND APPARATUS FOR TREATING LIQUID; Clarence P. Landreth, Philadelphia, Pa. App. filed Dec. 20, 1916. Electrochemical treatment of waters.

1,378,126. RESISTANCE DEVICE; Harry C. Nagel, Wilkinsburg, Pa. App. filed May 14, 1915. Wire wound into series of integral compact sections.

1,378,137. HAIR-SINGEING MACHINE; Warren A. Ross, Haverhill, Mas. App. filed May 25, 1920. Electrically heated.

1,378,140. INSULATOR BRACKET; Warren B. Simpson, Huntingdon, Pa. App. filed Nov. 25, 1919. Pole-top three-pin.

1,378,145. ELECTROLYTIC DEPOSITION OF COPPER FROM ACID SOLUTION; Franz E. Studt, London, England. App. filed Aug. 14, 1917. Applicable to electroleaching processes.

1,378,146. ELECTRICALLY CONTROLLED TRANSMISSION; Max Taigman, New York, N. Y. App. filed May 17, 1918. For sewing-machine control.

1,378,151. ELECTRICAL TRANSFORMER; Chester H. Thordarson, Chicago, Ill. App. filed Nov. 6, 1916. Variable core.

1,378,170. REPEATER CIRCUITS; Lloyd Espenschied, Hollis, N. Y. App. filed Dec. 19, 1918. Telephone and telegraph.

1,378,187. FOCUS INDUCTOR FURNACE; Edwin F. Northrup, Princeton, N. J. App. filed Oct. 9, 1918. Heated by high-frequency current.

1,378,188. LADLE HEATING BY HIGH-FREQUENCY CURRENTS; Edwin F. Northrup, Princeton, N. J. App. filed Nov. 25, 1916. Also prevents piping in mold.

1,378,189. METHOD AND APPARATUS FOR MELTING OXIDES, ETC., WITHOUT CONTAMINATION; Edwin F. Northrup, Princeton, N. J. App. filed July 30, 1919. High-temperature melting and heat treatment.

1,378,192. ELECTRIC WELDING APPARATUS AND METHOD OF REGULATING THE SAME; Harry R. Pennington, Kansas City, Mo. Self-excited dynamo.

1,378,195. PIPE CAP FOR ELECTRIC CONDUITS; James C. Phelps, Springfield, Mass. App. filed Aug. 19, 1915. For outdoor use.

1,378,201. TERMINAL FOR ELECTRICAL PURPOSES; Elmer B. Stone, New Britain, Conn. App. filed Feb. 16, 1918. Fastened at end of insulated wire.

1,378,231. AUTOMATIC TELEPHONE SYSTEM; John H. Homrighous, Oak Park, Ill. App. filed March 10, 1919. Several exchanges.

1,378,247. ELECTRIC HEATER; Edwin N. Lightfoot, New York, N. Y. App. filed Jan. 31, 1920. Radiant.

1,378,256. ELECTRICAL HEATING APPARATUS; Maurice R. Malhomme, Paris, France. App. filed June 30, 1920. Melting pot.

1,378,266. PORTABLE ELECTRIC VAPORIZER; Henry Nagel, Davenport, Iowa. App. filed April 30, 1919. For disinfectants.

1,378,324. ELECTRIC HEATER; Charles A. Clark and Frank W. Blair, New York, N. Y. App. filed May 24, 1920. Soldering iron, laundry iron, stove top, etc.

1,378,345. METHOD AND MEANS FOR TRANSLATING ENERGY VARIATIONS; Ray E. Hall, Chicago, Ill. App. filed May 31, 1919. Periodic variations of definite frequency.

1,378,392. SIGNALING SYSTEM; Donald F. Whiting, New York, N. Y. App. filed Dec. 26, 1919. Talking and signaling currents.

1,378,454. ELECTRIC SWITCH; Charles T. Hentschel, Schenectady, N. Y. App. filed July 25, 1917. Ammeter switch.

1,378,461. METHOD AND MEANS FOR MAKING ELECTRICAL CONNECTIONS; Harry C. Hubbell, Cleveland, Ohio. App. filed July 12, 1920. Storage-battery manufacture.

1,378,467. LAMP SOCKET; Charles J. Klein, Milwaukee, Wis. App. filed Jan. 9, 1915. Push socket.

1,378,474. SAND BATH; Tiodolf Lidberg, Chicago, Ill. App. filed April 19, 1920. For physicians, surgeons and chemists.

1,378,477. ELECTRICAL FITTING CONNECTION; John A. McKay, New York, N. Y. App. filed Oct. 25, 1919.

1,378,511. ELECTRICAL SYSTEM OF POWER TRANSMISSION AND REGENERATIVE BRAKING; Clinton J. Axtell, Schenectady, N. Y. App. filed June 12, 1919. Electric railway service.

1,378,515. ELECTRIC HEATING DEVICE; Arthur F. Berry, London, England. App. filed Dec. 26, 1917. Perforated grids and bare resistance elements.

1,378,519. SUSPENSION FOR TROLLEY WIRES AND THE LIKE; George W. Bower, Schenectady, N. Y. App. filed Oct. 19, 1920. Insulated hanger.

1,378,526. MELTING FURNACE; Edgar F. Collins, Schenectady, N. Y. App. filed Jan. 10, 1920. For easily fusible metals.

1,378,547. RESISTANCE MEASUREMENT; Hendrik A. W. Klinkhamer, Hengelo, Netherlands. App. filed April 24, 1920. Modified Wheatstone bridge.

1,378,549. BATTERY; Arthur P. Manchester, Providence, R. I. App. filed Dec. 16, 1912. Gelatinous alkaline electrolyte.

1,378,552. ELECTRIC-HEATED THERMOSIPHON RADIATOR; Giovanni Monte, Turin, Italy. App. filed Dec. 20, 1919. Heat developed by electric resistances.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BELLOWS FALLS, VT.—Steps have been taken for financing improvements to the street-lighting system to cost about $5,000.

NORWICH, CONN.—The Legislature has adopted a bill amending the charter of the Eastern Connecticut Power Company providing for an increase in capital stock from $5,000,000 to $10,000,000. Part of the proceeds will be used for improvements.

Middle Atlantic States

BUFFALO, N. Y.—The Niagara & Erie Power Company is considering extensions to its transmission system at Lancaster, Hamburg, Depew, West Seneca and Cheektowaga. Transmission and distribution lines will also be extended to Dunkirk, Angola, Farnham, North Collins, Fredonia, Brant, Eden and vicinity. The cost of the project is estimated at $707,230.

ITHACA, N. Y.—The New York State Gas & Electric Corporation has applied to the Public Service Commission for permission to build an addition to its electric power plant at Plymouth, and make extensions to its system at this point.

NEW YORK, N. Y.—Preliminary plans are under way by the New York Edison Company for improvements and extensions to its two-story substation at 10-12 Elizabeth Street. William Whitehall, 12 Elm Street, is engineer.

ATLANTIC CITY, N. J.—A permit has been issued to the Atlantic City Electric Light Company to make improvements and to enlarge its plant at Missouri Avenue and the Thoroughfare. The cost of the additions is estimated at $150,000.

CAMDEN, N. J.—The board of directors of Cooper Hospital is considering rebuilding a portion of the power house at the institution, recently destroyed by fire.

NEWARK, N. J.—The installation of a complete new street-lighting in the city has been recommended by Harry R. Jackson, electrical engineer. The lighting service is furnished by Public Service Electric Co.

HARRISBURG, PA.—Bids will be taken at once, it is reported, for the installation of a new lighting system in Capitol Park for which plans have been prepared.

HARRISBURG, PA.—Dr. William L. Robb, lighting expert, has made a survey of the local light and power system and will submit report to the City Council for necessary improvemets and extensions.

SHARON, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 23 for conduits and wiring changes in the United States public building in Sharon, Pa.

CHESTERTOWN, MD.—Arrangements are being made by the Borough Council for the purchase of power plant and system of the Chestertown Light & Power Company.

WASHINGTON, D. C.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until June 23 for furnishing grab bucket, telephone cable, steel cable, wattmeter, heater cord, magnet wire, electric bells, receptacles, insulators, etc. Circular 1451.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until June 14, Washington, Schedule 8174—6,000 ft. electric cable. Until June 17, Mare Island, Schedule 8226—2,000 ft. electric cable; Philadelphia, Schedule 8151—one motor-generator set and switchboard. Until June 21, Portsmouth, Schedule 8183—batteries and spares; various Eastern and Western yards, Schedule 8178—fifteen motor-generator sets. Until June 24, Puget Sound, Schedule 8165—electric wire and cable; Mare Island, Schedule 8224—33,000 ft. electric wire.

WASHINGTON, D. C. — The Potomac Electric Power Company, 231 Fourteenth Street, N. W., is considering extensions to its electric generating plant at Bennings to cost about $250,000.

North Central States

DETROIT, MICH. The Board of Public Lighting Commissioners, 138 Atwater Street, has preliminary plans under way for the construction of a new power plant. Smith, Hinchman & Grylls, 710 Washington Arcade Building, are architects.

GRAND RAPIDS, MICH.—Petitions have been made to the Consumers' Power Company to extend its electric lines to villages of Comstock Park, Marne and Nunica.

MARSHALL, MICH. At a special election to be held on June 28 a proposal to issue $100,000 in bonds for improvements to the municipal electric light plant, including the installation of a steam engine to supply power during low-water periods, will be submitted to the voters.

CLEVELAND, OHIO.—An ordinance providing for approximately $200,000 for enlarging and extending the municipal electric light and power system has passed its second reading.

PAINESVILLE, OHIO.—Plans are under consideration for extensions to the municipal electric plant to meet the increasing demands for electrical service.

LOUISVILLE, KY.—The Louisville Gas & Electric Company has secured a permit for the construction of a substation, 73 ft. x 87 ft., in the rear of 1467 South Third Street, to cost about $25,000.

BEECH GROVE, IND. — The Public Service Commission has approved franchise of the Indianapolis Light & Heat Company to install and operate a local electric street-lighting system.

INDIANAPOLIS, IND. — The Indiana Power Company has applied to the Public Service Commission for permission to issue $1,000,000 in bonds, the proceeds to be used for extensions, etc.

INDIANAPOLIS, IND.—The Best Grand Laundry Company, Senate Avenue and Court Street, is considering extensions and improvements to its works to cost about $100,000. The plans include the construction of a new power plant and the installation of a water-softening plant.

RICHMOND, IND.—The Liberty Light & Power Company has applied to the Indiana Public Service Commission for permission to make an interconnection arrangement with the Dayton (Ohio) Power & Light Company for additional supply of electricity.

CHICAGO, ILL.—Installation of an ornamental lighting system on all streets in the loop is under consideration. It is proposed to use a combination trolley and lamp standard with a three-lamp arrangement on State Street and two lamps on the other streets.

FREEBURG, ILL.—Bids will be received at the office of the village clerk until June 23 for furnishing material and labor for improvements to the municipal electric light and power system as follows: Brick powerhouse building and machinery foundations, brick or concrete chimney, 100 ft. x 4 ft.; one 7-in. x 16-ft. H.R.T. boiler with shaking and dumping grates and horizontal breeching; one N.R.C. engine for direct connection to 120-kva. alternating generator, pump, heater, separator, steam trap, pipe, valves, fittings, covering; one 120-kva. direct-connected alternating-current generator with belted exciter; one 112½-kva. belted alternating-current generator and exciter; one four-panel switchboard; one 10-kva. series street-light regulator; station wiring; transformers, series street-light fixtures and line lightning arresters; poles, line wires, guys, pins, insulators, etc. Extra copies of the plans and specifications will be furnished upon receipt of six dollars to cover cost of printing. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

MINNEAPOLIS, MINN.—Electrification of the Electric Short Line and extension of the road from Hutchinson to Lake Lillian, it is reported, will be under way by July 1. The plans provide for replacing the gasoline motors now in use with electric power. The cost of the improvements is estimated at $1,000,000. W. L. Luce is vice-president and treasurer of the company.

LIBERTY, NEB.—A transmission line to cost about $6,000 will be erected to furnish electrical service in Liberty. Energy will be purchased from the Beatrice Power Company of Barnston.

NORTH PLATTE, NEB. — Steps have been taken by the Chamber of Commerce for improvements to the street-lighting system in the business section.

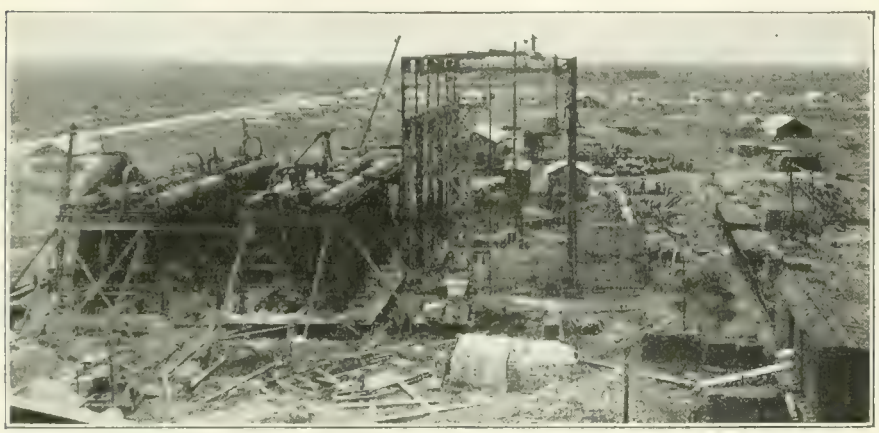


PHOTO OF PROGRESS ON MIDWAY STEAM PLANT OF SAN JOAQUIN LIGHT & POWER COMPANY. FIRST UNIT TO BE 12,500 KW. NATURAL GAS WILL BE BURNED

WESTPOINT, NEB. — Bonds to the amount of $58,000 have been voted for the construction of a municipal electric light and power plant.

Southern States

HENDERSONVILLE, N. C.—The installation of a lighting system on Main Street is under consideration.

SILVER CITY, N. C.—Arrangements are being completed for the development of a hydro-electric project on the Deep River.

WALTERS, OKLA.—The installation of an ornamental lighting system in the business district is contemplated.

CORPUS CHRISTI, TEX.—The electric light and power plant and the electric street railway of the Corpus Christi Railway & Light Company were recently disposed of. The former was sold to J. P. Connelly of Pittsburgh, Pa., for the sum of $50,000 and the latter to Claude Pollard of Houston for $500. It is understood that two new companies will be organized to take over and operate the railway system and power plant respectively. Extensions and improvements will be made.

HOUSTON, TEX.—The Houston Electric Company is considering improvements to its railway system to be made during next three or four years, to cost approximately $3,000,000, including power station, etc.

Pacific and Mountain States

GOLDENDALE, WASH.—The City Council has granted the Pacific Power & Light Company a franchise and has entered into a fifty-year contract for street lighting in Goldendale. The company, it is reported, contemplates extensive improvements to its electric transmission lines and generating plant on Little Klickitat River, 8 miles west of Goldendale.

TACOMA, WASH. — Bids will be received the latter part of June for the installation of a lighting system in the business section between A. Street and Yakima Avenue on Seventh, Ninth, Eleventh, Thirteenth, Fifteenth and Seventeenth Streets. Plans provide for luminous-arc lamps with cast-iron standards connected with underground cable. C. Lund, 402 City Hall, is engineer.

TOPPENISH, WASH.—The Pacific Power & Light Company, Portland, is considering the erection of an electric transmission line from Toppenish west to the McKinley school to cost about $9,000.

BELVEDERE, CAL.—J. M. Howells has applied to the State Water Commission for 300 sec.-ft. direct diversion and 200,000 acre-ft. from Deer Creek and Mill Creek, Tehama and Sacramento Counties, for power purposes. Diversion will be made by means of a dam, 20 ft. high, to develop 16,000 hp. The cost is estimated at $2,000,000.

EL SEGUNDA, CAL.—The installation of electroliers on the Boulevard is under consideration.

FRESNO, CAL.—The City Commissioners are considering an issue of $1,000,000 in bonds for the installation of fire-alarm systems, garbage-disposal plant and sewage improvements.

GROVELAND, CAL. — The Yosemite Power Company has filed application with the Federal Power Commission for permission to construct a dam and reservoir on the south fork of the Tuolumne River to develop 1,000 hp., and to construct a 7-mile conduit to a second power house at Wards Ferry to develop another 1,000 hp.

LOMITA, CAL.—A lighting district, it is reported, is being formed in this locality. Harry Phillips and C. G. Towne are interested.

MERCED, CAL.—The Original Mining & Milling Company has applied to the Federal Power Commission for authority to construct a 3,100 ft. conduit from the diversion dam in the Merced River to a power house developing 500 hp.

MODESTO, CAL.—Application has been made to the State Water Commission by Long Minor Pierce for direct diversion of 250 sec.-ft. from Dry Creek, Stanislaus County, for power purposes.

OXNARD, CAL.—Plans have been prepared for the installation of electroliers around Plaza Park.

PASADENA, CAL.—Plans are under consideration for placing all wires underground on East Colorado Street from Los Robles Avenue to old city limits.

KANAB, UTAH.—Negotiations are under way between the Dixie Power Company and the Commercial Club for the erection of an electric transmission line from Hurricane via Virgin, Rockville, Grafton and Springdale to Kanab and Fredonia, a distance of 46 miles. The cost of the line, including wiring of towns, is estimated at $50,000.

LAYTON, UTAH—The Utah Power & Light Company, Salt Lake City, has been granted a certificate of convenience and necessity by the Public Utilities to serve the town of Layton.

PRESTON, IDAHO.—The South Preston Irrigation Company, recently incorporated, has completed arrangements for the installation of an electrically operated pumping plant for irrigation purposes.

CASA GRANDE, ARIZ.—The Casa Grande Valley Electric Power Users' Association was formed recently to co-operate with the city to bring electricity from Sacaton to the Casa Grande Valley. The cost of the erection of a transmission line to Casa Grande, including transformers, motor-generator frequency changer set complete with switchboard, meter equipment and substation, is estimated at about $75,000.

Canada

CALGARY, ALTA.—R. P. Blakely, architect, Parliament Buildings, Edmonton, would like prices on equipment for power house to be built at the Technology and Normal School, Calgary.

ST. CATHARINES, ONT.—The installation of lamp standards on St. Paul Street from Burgoyne Bridge to Geneva is under consideration.

Electrical World

New York, Saturday, June 18, 1921

The American Business Man Voices an Opinion

NOT long ago the Chamber of Commerce of the United States made a survey of the business of the country. It endeavored to ascertain among other things what business men are doing to meet the conditions of the day. They were asked particularly as to their present policy respecting economy in advertising.

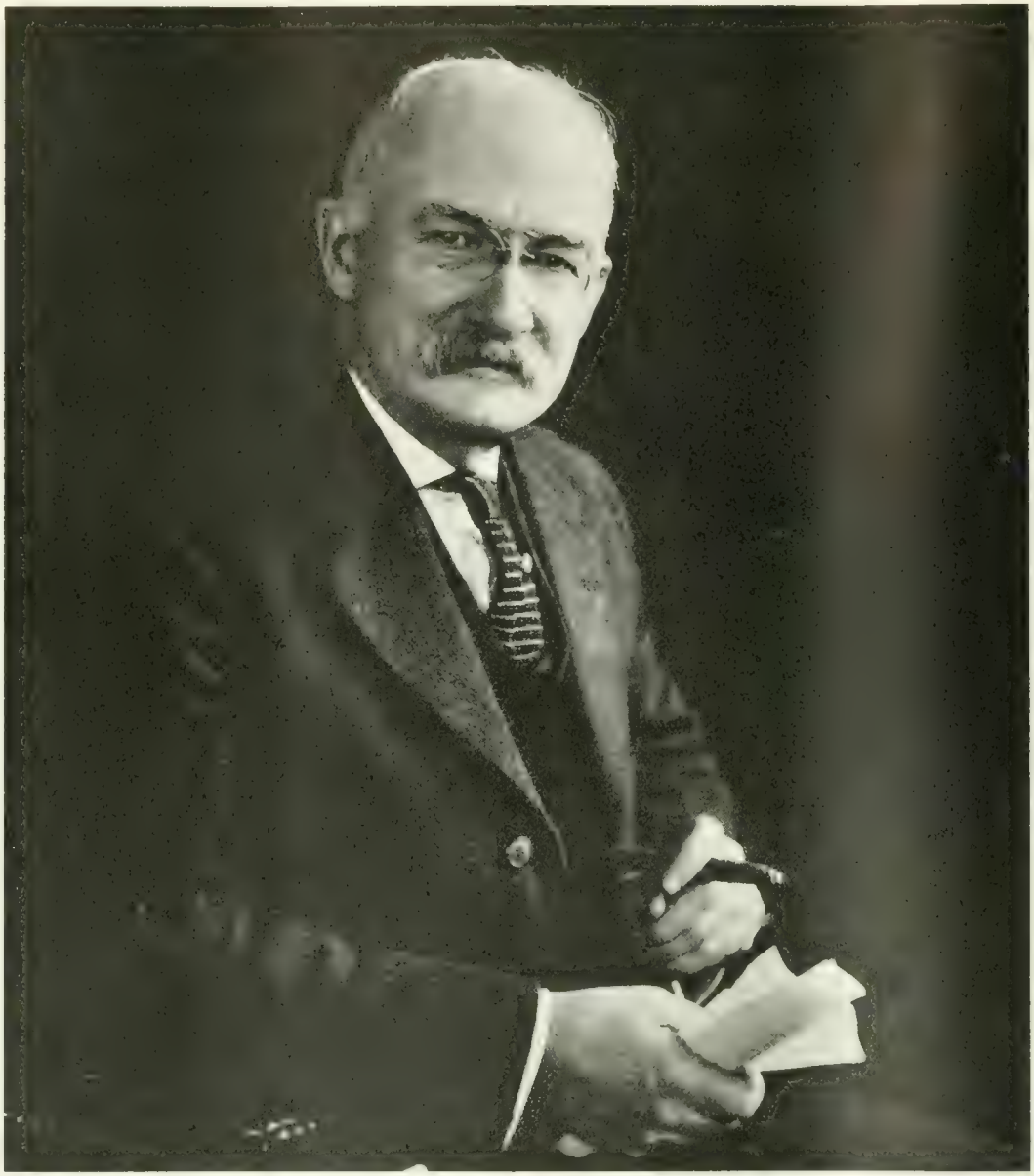
The only reason why there can be two opinions on the issue of whether or not to advertise at a time like this is because the true function of advertising is so beclouded in men's minds. Yet it is vital to the electrical industry and to every other industry right now. It is a matter of prime importance not alone to our manufacturers, but to our jobbers, central-station companies, contractors and dealers. Business is quiet. Demand is light. Earnings have fallen off. Should men spend money advertising?

There is a basic first point here that should be carefully disposed of in every man's thinking before he makes any decisions about advertising. That point is this: *What is advertising, anyway? What is it for?* The simple, ample answer is that advertising is just helping the salesman to sell more goods by telling his story in advance, saving his time, strengthening his influence and bringing in business for him. This being so, the question of whether or not to advertise becomes a question of whether or not to sell. For if a man wants business he must sell goods, and therefore he should advertise. The manner in which he should advertise and sell—this is the variable problem which must be settled to suit each business and the times.

The reaction to the inquiries of the Chamber of Commerce was convincing as to the attitude of the modern business man on this fundamental subject. These three brief quotations express it:

1. "We do not feel that we should decrease publicity. Our advertising expenditure should be increased to increase our business."
2. "Cutting down advertising would only increase the cost of selling merchandise, therefore we advertise heavily when business is hard to get and go easy when it is coming anyway."
3. "We kept our advertising appropriation down to bedrock when there was practically no sales resistance, conserving our funds for harder times. We feel that we now owe it to our distributers and dealers and to ourselves to insure a healthy flow of business by consistent, well-directed, forceful advertising."

Our national Chamber of Commerce has asked and the American business man has answered. It is advice for all of us. For now is a season when well-poised, full-bodied selling is needed in every industry, and no man's problem is too local or too small to be aided profitably by sensible advertising. He should give his salesmen this other voice to help them sell. They need it *now*.



Harry Bates Thayer

An executive whose perseverance, clear conception of responsibilities and ability to get things done have marked his career from office boy to the presidency of the world's largest public utility

THERE stands at the head of the world's largest public utility a man who by his own efforts and perseverance won his way up from office boy. H. B. Thayer, now president of the American Telephone & Telegraph Company, upon completion of his college course decided to start in at the bottom in some manufacturing industry of far-reaching scope. He began in 1881 with the Western Electric Company in Chicago, making out shipping tickets and indexing copy books and a little later making out bills. His work caught the attention of Enos Barton, founder and president of the company, and soon young Thayer became his assistant. At twenty-five, after three years with the company, Mr. Thayer was made manager of its New York branch. It was not long before he was doing more business in New York than was done at the parent factory. He was called back to Chicago as vice-president, and six years later, in 1908, was elected president.

When Mr. Vail came back in 1907 to take hold of the American Telephone & Telegraph Company, the parent company of the Western Electric, he chose Mr. Thayer as vice-president. However, in 1915, Mr. Thayer decided that he did not want to hold an active position in both companies and that his greatest value to the Bell Telephone interests was in the manufacturing end, so he gave himself wholly to the duties of the presidency of the Western Electric Company. The war came on and engulfed this country, and as an emergency measure the telephone service was taken over by the government. It became apparent, however, soon after the armistice that some reorganization of the telephone company was necessary to take over the business when the government should release it. Although Mr. Vail retained the control as chairman of the board he placed the executive management of the company in the hands of Mr. Thayer as president. Such is the bare story of achievement, but back of it are forty years of honest endeavor, initiative, application and the ability to get things done.

Mr. Thayer was born in Northfield, Vt., sixty-two years ago. At twenty-two he was graduated from Dartmouth. Since that time he has spent his life in the telephone industry, and thus he is a logical man to head this great business employing 270,000 people and so essential a part of the daily life of America. He took hold of the telephone at a critical time. During the federal control it was impossible to extend facilities to meet demand. As a result the system was returned to private control without the facilities for service and the public good will it had previously enjoyed. Since that time, in spite of high costs and wages, Mr. Thayer has never allowed the company to slacken in its efforts to bring the service once more up to that former high degree of efficiency known nowhere else in the world.

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Chicago Can Afford to Move Slowly

THE proposed ordinance regulating the sale, installation and use of electrical devices in the city of Chicago now under discussion before the City Council furnishes an example of one way that safety work cannot be effectively promoted. Designed ostensibly in the interests of public safety, but really as a revenue producer, the ordinance would place the future of the industry so far as Chicago is concerned in the hands of the Commissioner of Gas and Electricity and the political machine in power. If every city is to levy tribute on whatever is sold and used within its borders, manufacturers will have a glorious time of it. Nor is Chicago equipped properly to enforce the proposed ordinance. The city cannot by any stretch of imagination justify the establishment of a laboratory of sufficient size to test large turbo-generators, electric furnaces or a multitude of small devices not specifically covered by the various codes and standards already in operation. Chicago authorities will do well, therefore, to stop and think carefully before placing a burden on the electrical industry such as that made possible under the proposed ordinance. If the city is really desirous of reaching offenders against public safety, it should do so through an ordinance that cannot possibly be used as a club on the heads of the most deserving members of the industry. Even then it is a question whether Chicago can carry out such a task without the help of a national movement of the same character.

Perseverance in Co-operative Work

BECAUSE results do not always immediately come from the first steps taken in co-operative movements discouragement is likely to follow. This was the danger pointed out at the convention of the Pacific Coast Section of the National Electric Light Association held at Del Monte, Cal., last week, and an antidote was put forth in the form of stimulation of effort and earnestness. This message from the West to the electrical industry should receive careful attention, particularly from those guiding the first steps of the several groups now undertaking co-operative movements. Those voicing these warnings in the West have been through years of such work; they have passed through long periods of trial when it seemed as if they were doomed to almost certain failure; they have often met with little encouragement from the industry. It has been fortunate that the leaders there have shown unexcelled courage and steadfastness of purpose to continue until they have no longer been regarded as visionaries but as men of vision. Almost as obvious but not voiced so openly is the real need of guarding against complacency as the result of a measure of success. When after long trials success has at last been achieved it is the way of mankind to rest with smug satisfaction on the achievements of the past. Here is a temptation sedulously to be avoided, and so the message goes out from the Pacific Coast to the beginners in co-operation as well as to the veterans: If results are slow, keep pounding on; if results have come, forget them in greater efforts.

Politics Not Good for Utilities

AMONG the grievances, real or fancied, urged against utilities is the supposedly sinister influence exerted by them over municipal and state bodies by underground methods. One of the most important tasks of the campaign of education that the electric light and power industry is now conducting is to wipe out in the public mind the sting of that charge. If the task is to be accomplished, every contest must be fought in the open and won or lost on its merits. A battle won because some one can wield political influence is a battle lost in the establishment of the utilities in public confidence, because it will sooner or later be used to substantiate the charge that utilities are attempting unfairly to control governmental functions for selfish purposes. The underground political game carries a tremendous fascination for a certain type of mind. To play it is to play directly into the hands of the politicians who know it best and can stack the cards to win at every turn. Public utilities cannot afford to sit in such a game. We are moved to make this observation because in Oklahoma recently an engineer who traveled some distance to confer with the engineers of the commission was advised to lay his case before a utility attorney first because the latter would see that the engineer's recommendations were carried out. Such indirect methods are seldom efficacious and are always poor policy.

Sometimes Good Will Is Better than Efficiency

THE importance of the meter reader in making or breaking good will for his company is not always appreciated. Sometimes this functionary is the only representative of the company seen by a customer from one year's end to the other and the consumer's impressions of the lighting utility with which he is dealing are therefore due almost entirely to the man or boy who comes to read the meter. If he is brusque, unpleasantly insistent or in any way troublesome, ill will is sure to be created, and this usually overbalances any good will that may have been built up by long previous effort. The bonus system of paying for meter reading often tempts the reader to hurry in order to get a little more pay and thus actually works to the detriment of the

company. Hurried meter readings are liable to be tinged both with impoliteness and with inaccuracy. At such a cost efficiency in the total number of meters read in a day is dearly purchased.

An exactly opposite method is followed by the company mentioned in a former issue which picks out and pays exceptionally well a group of intelligent young men put on the meter-reading job for the special purpose of creating good will. Each man has plenty of time allowed him to cover his territory and is expected to keep within it except for good reason; but in particular he is instructed on his relations with the customers, is provided with blank complaint forms and authority to adjust small matters on the spot, and is made the active intermediary between the company and its consumers. Two years' experience showed that while meter-reading expense rose about 40 per cent on account of the better class of men employed, the adjustment bureau expense was cut down by one-half. Demands for special meter tests had almost disappeared and the general attitude of the public had been radically changed.

Adjustment and complaint service is, of course, necessary to any public utility, but large activities along this line should be anything but a source of pride. Costs transferred from settling complaints to promoting friendly contact with consumers are an asset instead of an expense.

Fuel Prices Necessitate Still Greater Economy

THE price of coal and oil seems likely to drive engineers away from their so-called standards toward greater economies than have ever before been considered feasible. An excellent example of this tendency as exemplified in the Calumet station of the Commonwealth Edison Company is briefly outlined in this issue. The plant will eventually contain six 12,000-volt generators, but at the present time two 30,000-kw. units are being installed—one a seven-stage impulse turbine and the other a tandem-compound Westinghouse turbine. Technically the most interesting feature of the plant is the boiler room. The plan calls for four boilers for each of the turbine units, but the two prime movers already installed will be served by seven. Each of the boilers contains a little more than 15,000 square feet of steaming surface, will evaporate 150,000 lb. of water per hour and is built for 350 lb. pressure at 250 deg. superheat. Two chain-grate stokers operated under forced draft will take care of the combustion for each boiler. Exceptionally large furnace space is employed and every facility for pushing combustion without serious loss of efficiency is provided. Each boiler is fitted with an economizer with steel tubes and headers, and indications are that by the use of these the total boiler efficiency will be pushed beyond 80 per cent of the theoretical limit. The character of the coal used, which is rather rich in sulphur, has necessitated some extra precautions, in particular pushing the temperature of the feed water to 175 deg. Fahr. before it enters the economizer to avoid any condensation of sulphurous gases on the economizer surface. All auxiliaries excepting the boiler-feed pumps are motor-driven, the larger auxiliary units being provided with 2,300-volt motors.

In this station the fuel costs are expected to account for about 86 per cent of the total operating expense, and it is believed that it will be possible to bring the station to a thermal basis of 19,000 B.t.u. per kilowatt-hour. This indicates how far the extreme measures taken will find justification in resulting economies.

Need of Looking Beyond the Meters When Errors Are Gross

GENERALLY speaking, the meter is an instrument of very fair degree of precision, much more likely to run slow than fast and not often committing serious errors of any kind. There are cases, however, in which through misconnection or gross misuse of some kind an electric meter performs badly, though it usually succeeds in punishing the central-station company more than it punishes anybody else. The importance of carefully following up the performance of meters is therefore emphasized, quite apart from its general desirability, by the need of looking out for the altogether abnormal performance sometimes noted.

Some striking examples of what may happen through the "boneheaded" (if that term may be permitted) use of what otherwise would have been an instrument of precision are given in the current issue by A. L. Johnston. "Mix-ups" in the wiring due to faulty installation are capable of almost any sort of enormity. One instance cited by Mr. Johnston is that of a meter which because it was badly proportioned to its work underregistered to such an extent that the station sustained a loss of about $10,000. Another interesting case which Mr. Johnston describes fully probably would not occur often, but the possibilities of wrong connections are always present, and it is worth while to see what may happen on occasion. All of this points to the moral that it is not sufficient to test meters in a perfunctory manner, because while the meter may appear to be accurate gross errors not due to the meter itself stand a chance of escaping detection.

The Virtues and Vices of American Manufacture

ONE of our foreign contemporaries has been making a study through a correspondent on this side of the water of recent tendencies in electrical manufacturing. The main tendencies that are summarized by this correspondent comprise a somewhat more vigorous exporting policy than has hitherto been displayed, an extraordinary activity in publicity work, more systematic standardization and more complete specialization, the development of planning and operating systems, the establishment of service departments for reaching the customers, and finally a strong development of research work. This summary, we think, is a very fair representation of electrical manufacturing tendencies in the United States. There is no doubt that we are seeking foreign markets, but if we are to capture them we must pursue in some respects policies contravening those now common. The foreigner looks at things in a somewhat more conservative fashion than we do, and sometimes objects to broad claims and meaningless trade-name designations unfamiliar to the consumer. Although the electrical industries have as a rule been conservative and judicious in their treatment of foreign markets, many manufacturers have attempted to sell goods abroad by the same methods which they adopt here and have failed dismally. The foreign trade is something which needs to be very carefully handled in every respect. The customs of South America, for instance, are not our customs, and we cannot force our

ways down South American throats. We must revise methods all along the line if we are to win and keep trade against the rising competition of Europe, and particularly of Germany, where the manufacturers for many years have wisely and consistently catered to the particular requirements of their foreign customers.

The same line of criticism applies to the complete standardization existing in America in many lines of work. Where deviations from our usual standards are for some reason required, the cost piled upon the customer is so enormous that the order frequently goes to a foreign competitor who is a little more flexible if not quite so efficient in his methods. Our tendency toward specialization in manufacture is a very healthy one provided that it does not tie itself up to standards so completely that it cannot readily change when a new demand arises.

Great improvements have been made in the last few years in the better planning and more systematic and efficient operation of works. However, it is not a difficult matter in following up the modern so-called efficiency methods to carry them to a point where they cost a great deal more than they save, making the whole organization topheavy and piling up overhead expenses which a less orderly competitor with a much simpler organization can in large measure avoid. Even system may be pushed too far.

Of the development of research work it is hard to speak in terms of too much praise. The present position of American manufacture, and particularly its rise in the last decade, is due very largely to the following up of a systematic policy of research. We would be even further ahead had that policy been carried out on a larger scale in earlier years. Our foreign competitors, too, have been for years ceaseless in research, and so far as can be ascertained they are not letting their activities slacken in the slightest degree. If we are to keep our present position in manufacturing, we must be equally persistent. The time of trial when we must match our wits against those equally clever, and perhaps more facile and flexible in their methods of attack, is clearly approaching.

Selecting Batteries for Electric Haulage

A VERY neat and simple analysis of the methods for adjusting battery capacity to demands of industrial locomotives, which in the last few years have come into greatly increased use, is presented in a brief paper by J. H. Tracy in the current issue. Starting with the grades and loads necessary to be dealt with, it is a fairly simple matter to calculate the tractive effort for each part of the proposed trip. When the total tractive effort per trip in whole or part has been found, it may be reduced to watt-hours per train mile for that particular section simply through multiplication by three. This step is one of the short cuts which providentially turn up now and then in the solution of engineering problems. The battery problem is handled most easily perhaps by reckoning on a six-hour discharge rate. Of course, for exceptionally high discharge rates at a particular section of the line allowance may have to be made in the simple ways which Mr. Tracy shows. The whole computation, however, will be found extremely convenient and easy to follow. It involves no recondite methods of any sort.

Aërial Cables Versus Open-Wire Lines

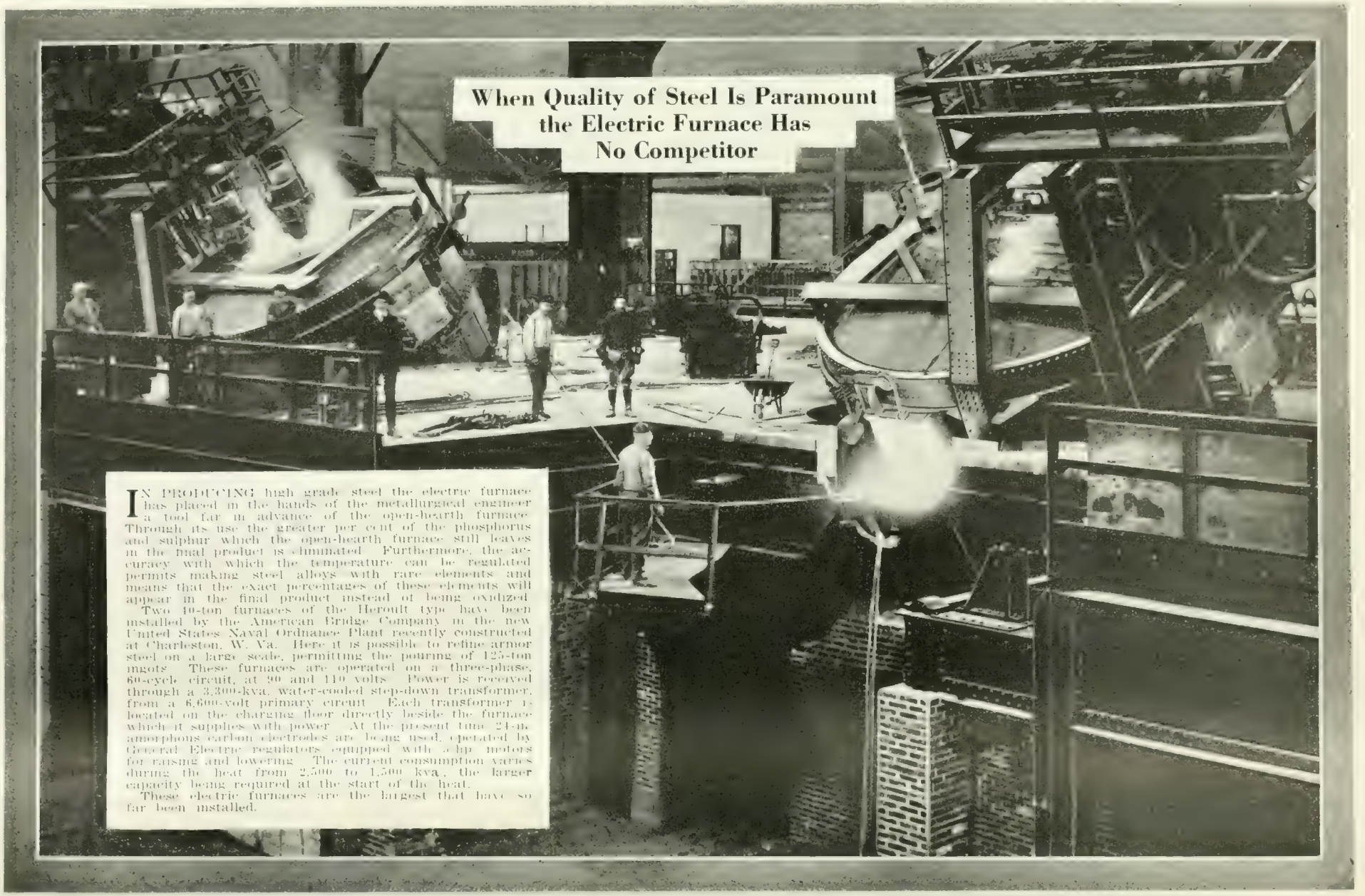
AËRIAL cables present possibilities that should appeal to central-station engineers, but the best means of realizing their proper application will come from a recognition of their limitations. Compared with an overhead open-wire line they will be more expensive, and they will always require relatively expensive joints to serve customers along the route. Furthermore, taps will make the handling of trouble very inadequate unless proper switches are provided at each one. Despite these limitations, however, there are many places where because of tree or building conditions, necessity of crossing railroad rights-of-way and so forth aërial cables are very advantageous. The manufacturer's design problem is one of producing a cheaper cable with the same reliability as that of an underground cable. This should be possible on account of the much better cooling obtained. Moreover, in order to decrease the stresses due to sleet and wind the cable should be made as small in diameter as possible, and for ease in handling it should be made as light as possible.

The article in the current issue by F. A. Westbrook should be of interest to our readers because it brings out in a concise manner the position that aërial cables should hold in the central-station system. The tables furnished should be particularly useful, for they enable anybody to compare the merits of the various kinds of cable that can now be purchased, and the data given should tend toward developing the application of aërial cables.

Maximum Demand a Necessary Factor in Rates

PROOF comes every day that rates for electrical energy based on maximum demand and total kilowatt-hours delivered are an economic necessity. Though this method of charging for central-station service is very common, there are still many who have not adopted it. Many of the details of the method may not have been sufficiently worked out owing to the magnitude of the task of determining the effects on a system of all different types of load and the actual cost to the company of furnishing each kind of service; but it is still generally accepted that the solution of the rate problem must be based on the fundamental principle involved in maximum-demand rates.

All those electric light and power companies which are still limiting their power contracts to a single kilowatt-hour charge, and which, realizing the shortcomings of their methods, still are unwilling to risk the change, should be interested in reading W. W. Arnett's short article in the ELECTRICAL WORLD of May 21 on "Tables for Estimating Customers' Maximum Demand." There they will find an exposition of the imperative necessity for the application of a rate based on maximum demand and total kilowatt-hours delivered, and beyond that an account of how one central-station company was able to make the change without delay. Facing the impossibility of obtaining and installing demand meters in a short period of time, it was found necessary to resort to some other method of putting the rate into effect. Mr. Arnett's conclusions show that maximum demand can be estimated with sufficient accuracy to satisfy both the customer and the producer during the interval required for the installation of demand meters.



When Quality of Steel Is Paramount the Electric Furnace Has No Competitor

IN PRODUCING high grade steel the electric furnace has placed in the hands of the metallurgical engineer a tool far in advance of the open-hearth furnace. Through its use the greater per cent of the phosphorus and sulphur which the open-hearth furnace still leaves in the final product is eliminated. Furthermore, the accuracy with which the temperature can be regulated permits making steel alloys with rare elements and means that the exact percentages of these elements will appear in the final product instead of being oxidized.

Two 10-ton furnaces of the Heroult type have been installed by the American Bridge Company in the new United States Naval Ordnance Plant recently constructed at Charleston, W. Va. Here it is possible to refine armor steel on a large scale, permitting the pouring of 125-ton ingots. These furnaces are operated on a three-phase, 60-cycle circuit, at 90 and 110 volts. Power is received through a 3,300-kva. water-cooled step-down transformer, from a 6,600-volt primary circuit. Each transformer is located on the charging floor directly beside the furnace which it supplies with power. At the present time 24-in. amorphous carbon electrodes are being used, operated by General Electric regulators equipped with 5-hp. motors for raising and lowering. The current consumption varies during the heat from 2,500 to 1,500 kva., the larger capacity being required at the start of the heat.

These electric furnaces are the largest that have so far been installed.

Power Distribution Over Aërial Cables

Construction of This Kind Appears to Have Many Advantages Over Open Wires Lead-Covered, Paper-Insulated Cables, Particularly, Are Advocated—Experience of Telephone Companies Indicates that Lead-Covered Aerial Cables Are Reliable

By F. A. WESTBROOK
Field Engineer Habirshaw Electric Cable Company

PROBABLY the most economical method of meeting the demands imposed upon distribution systems of central-station companies by the extensive electrification of industry now going on is to supply energy at higher voltages. This, however, raises serious construction problems, such as whether open-wire construction is practicable under the circumstances, whether the expense of underground cable is warranted, or whether some other method is preferable. There is a growing tendency on the part of a good many companies to meet the situation by the use of aërial multiple conductor cables, supported by messenger cables, for high-voltage distribution and transmission within municipal limits. Long experience of the telephone companies with aërial cables indicates that lead-covered, paper-insulated cables are amply rugged and reliable to warrant their use by power companies on pole lines. Up to the present time, however, the use of aërial cables has not been developed to the extent which the advantages of this practice would seem to warrant, and a discussion of different types of cables, together with data as to their weights under actual conditions of service, should be timely.

Advantages of Aërial Cables Are Summarized

The advantages of using insulated cables as compared with ordinary open-wire and cross-arm construction are briefly as follows:

1. In many cases municipal park authorities or shade-tree commissions have restricted tree trimming in residential sections, thus rendering open-wire construction impracticable.

2. Cable construction is advantageous where pole lines are too congested for additional circuits without providing taller poles.

3. Cables give greater assurance of continuity of service. They would remain in operation even when the poles are broken off and they are lying on the ground, provided that the cable itself is not seriously injured. The conditions approximate the advantages of underground construction at greatly reduced annual charges.

4. There is a reduction of hazard from the falling of high-tension wires in public places because of mechanical or electrical failure of the line.

5. Where a pole line carries several three-phase open-wire circuits of small-size wires which have been added from time to time as the load increased, the circuits may frequently be advantageously combined into one large-size three-conductor cable, perhaps at increased voltage. The cable, on account of being placed low on the poles, will reduce the stresses on the poles as well as make space available for other wires.

6. The question of substituting 6,600-volt primary distribution in place of 2,300-volt distribution, which is receiving considerable attention at the present time and is actually being carried out in some instances, would in many cases be greatly simplified by the use of cable for the 6,600-volt circuits. The expense of reconstructing 2,300-volt lines for the higher voltage can in many cases be substantially reduced in this way, especially where tree conditions are bad. In fact, bad tree conditions may make the increases in voltage dependent on the use of aërial cable.

7. The use of cables instead of open wires for circuits at transmission voltages should greatly simplify the question of conflicts with telephone lines on the same street or highway, on account of the reduced danger of accidental contact between the two systems.

In considering the question of attaching a cable to a line of poles the three following items must be taken into account:

(a) Ability of the poles to carry the cable weight.
(b) Protection against moisture.
(c) Protection against mechanical injury.

The lack of full knowledge as to the loads involved in attaching cables to poles, as well as the question of the most advantageous design for such cable, has so far resulted in greatly restricting the use of aërial power cable construction.

While reasonably substantial pole-line construction is required, it is felt that these requirements are generally greatly overestimated and that except where very large cables are involved the problem is no more serious than that incurred in the every-day practice of the telephone companies with similar construction. In many cases aërial power cables suspended from a messenger cable involve a much smaller load on the poles than a line with two or three cross-arms carrying open wires, especially under severe sleet and wind conditions.

As paper-insulated cable is the best type, especially for the transmission voltages, on account of its lower dielectric losses, higher current-carrying capacity and lower cost, the question of protection against moisture is particularly important. A lead sheath is undoubtedly the best protection.

There seems to be a feeling that power cables should be protected mechanically with steel-tape armor rather than by a lead sheath. The experience of the telephone companies, however, has indicated that there is no necessity for more than a lead covering from the standpoint of mechanical protection when the lead sheath is of adequate thickness for the size of cable used.

Aërial Cables Do Not Impose Excessive Loads Upon Poles

In order to determine what loads actually have to be supported by poles under service conditions, the resultant loading of various sizes of three different types of cables has been calculated, assuming the ½-in. (1.27-cm.) radial thickness of ice on cable and messenger, with the wind pressure of 8 lb. per square foot (39 kg. per sq.m.) on the ice-covered projected area of the cable and messenger, as prescribed for the

TABLE I—COMPARISON OF LOADS IMPOSED BY AËRIAL CABLES

Size, A.W.G.	Volts	Type No. 1* ⅛-In. Lead Sheath, Belt Insulation Same as Conductor Insulation: Diameter, In.	Weight of Cable, Lb per Foot	Resultant Load, Including Messenger† Lb Ft.	Type No. 2* ⅛-In. Lead Sheath, Belt Insulation, Half Conductor Insulation: Diameter, In.	Weight of Cable, Lb Ft	Resultant Load, Including Messenger, † Lb Ft	Type No. 3 Reinforced Rubber: Diameter, In	Weight of Cable, Lb Ft	Resultant Load, Including Messenger, † Lb Ft	Reduction in Loading of: Type No. 3 Over Type No. 1, per Cent	Type No. 3 Over Type No. 2, per Cent
4	6,600	1 54	3.85	6 73	1 41	3 43	6 25	1 78	2 49	5.64	16.2	9.8
2	6,600	1 67	4.45	7.33	1 54	4.09	7 00	1 91	2 94	6.19	15.6	11.5
1	6,600	1.75	4 86	7 63	1 63	4 48	7.43	1 99	3.27	6 54	14.3	12.0
0	6,600	1 84	5 33	8.32	1 72	4 93	7.95	2.08	3 63	6.95	16.5	12.5
2 0	6,600	1.75	5.34	8 26	1 61	4 91	7.84	1.99	3 79	7 02	15.0	10.5
3 0	6 600	1 83	5.94	8 90	1 71	5 50	8 20	2.07	4 27	7 54	15.3	8.1
4/0	6,600	1.93	6.57	9.58	1 80	6 19	9 23	2.21	4 93	8.28	13.6	10 2
250,000	6,600	2 07	7 39	10 49	1 95	6 92	10 06	2 47	6.49	10 05	4 2	....
4	13,500	1 94	5 20	8 25	1 75	4.57	7.61	2 06	3.11	6 38	22.7	14 9
2	13,500	2.06	5.82	8 95	1 87	5 21	8 33	2.22	3.71	7.14	20.2	14.3
1	13,500	2.14	6.25	9 40	1 96	5 65	8 84	2.41	4 89	8 42	10 4	4.8
0	13,500	2 24	6.78	10 00	2.05	6.14	9.35	2.51	5.36	8 93	10 7	4.5
2 0	13,500	2.14	6.77	9 95	1 95	6 20	9 34	2.41	5 38	8 88	10 8	4 9
3 0	13,500	2 23	7.40	10 62	2 04	6 67	9 87	2.50	5 99	9 52	10 4	3.6
4/0	13,500	2.32	8 08	11.35	2 13	7.39	10 63	2 59	6.53	10 12	10 8	4 8
250,000	13,500	2 47	8 92	12.31	2 28	8 13	11 58	2 74	7 28	10 97	10 9	5.2
4	25,000	2.53	7 47	10 9	2 24	6 42	9 76	2 80	5 80	9 58	12 1	2 0
2	25,000	2.65	8 17	11.33	2 37	7 10	10.55	2 92	6 50	10 34	8 7	2.0
1	25,000	2 73	8 67	12 10	2 46	7 44	10.94	3 00	6 89	10 80	10 7	1.3
0	25,000	2 83	9 12	12.7	2 55	8 13	11.67	3 10	7 20	11 18	12.0	4.2
2/0	25,000	2 73	8 56	12.12	2 44	7 95	11.43	3 00	6 74	10 63	12.3	7 0
3/0	25,000	2.81	9 85	13.42	2 54	8.61	12.12	3 08	7 93	11.85	11 7	2.2
4/0	25,000	2.91	10.59	14.21	2.63	9 41	12 99	3 18	8.71	12.70	10.6	2.2
250,000	25,000	3.05	11.50	15.21	2 78	10.13	13.77	3.32	9.47	13.52	11 1	1.8

* Insulation thicknesses have been assumed as follows: Type No. 1: 6,600 volts, 8/64-in. x 8/64-in. belt; 13,500 volts, 12/64-in x 12 64-in belt; 25,000 volts, 18 64-in x 18 64-in. belt. Type No 2: 6,600 volts, 8 64-in x 4 64-in. belt; 13,500 volts and 12/64-in. x 6/64-in. belt; 25,000 volts, 18/64-in. x 18 64-in. belt.
† 16,000-lb messenger cable has been assumed for all cables.

"heavy loading district" in the National Electrical Safety Code. Resultant loads in pounds per linear foot of cable imposed upon the pole are given in Table I. The three types of cable considered are all three-conductor, paper-insulated. No. 00 A.W.G. and larger are sector cables. Construction is as follows:

1. Outside covering consisting of ⅛-in. (3.2-mm.) lead sheath with belt insulation of same thickness as insulation around each conductor.

2. Outside covering consisting of ⅛-in. lead sheath and belt insulation one-half thickness of insulation around each conductor.

3. With a portion of the paper belt replaced with reinforced rubber covered with saturated braid, steel-tape armor and asphalted jute.

Cables of the first and second types are well known and require no comment. The third type has reinforced rubber, saturated braid, steel-tape armor and asphalted jute in place of a lead sheath. Considered alone, it is much lighter than type No. 1, but the diameter is so much greater that the sleet and wind load largely counterbalance this. (See Table I.)



WEATHER HAS AFFECTED CABLE WITH JUTE COVERING OVER ARMOR

It is now preferred to omit the jute and protect the steel armor by painting

Cables approximating type No. 1 are much more commonly used than cables strictly of this type. It is to be noted that with type No. 2 the reduction of belt thickness has a greater proportional effect with lead-covered cables than would be the case with type No. 3 on account of lead having a higher specific gravity than the outer coverings of steel-tape armored cable. Such a reduction will, of course, make possible the use of larger cables from the standpoint of both conductors and voltage without exceeding the weight of telephone cables as shown in Table II.

The saving in weight obtained in using aërial cable of type No. 3 construction instead of type No. 1 construction amounts to 50 per cent, as shown by the figures given in Table I, where only the weight of the cable is considered. But where the wind and sleet loading are taken into account it will be seen that the saving is on the average only from 10 to 20 per cent over type No. 1, due to the larger diameter of type No. 3 cable. It would seem, moreover, that a thorough consideration of this matter requires that the sleet and wind loading be taken into account as prescribed by the National Electrical Safety Code.

In order to reduce the figures in Table I to a readily comprehensible standard of actual practice, comparison is made in Table II between the resultant loadings of the three types of various sizes of power cables and of aërial telephone cables. They are grouped in sets of approximately the same resultant loading. From this it will be seen that common sizes of paper-insulated, three-conductor cable, type No. 1 or No. 2, do not require any heavier pole-line construction than is required for standard telephone cables.

It will be noted by reference to Table I that for small cables in which the resultant loading is unimportant the reinforced rubber type has the advantage, whereas for large cables the difference is negligible.

It is interesting to bear in mind in this connection

that some of the telephone trunk lines, in addition to carrying the largest size of lead-covered cables, also frequently carry three or four cross-arms of ten wires each, the combined resultant loading of which under the most adverse conditions would greatly exceed the weight of a 250,000-circ.mil, 25,000-volt power cable of type No. 1 construction.

In fact, telephone engineers have reached the conclusion that the factors of safety of the poles used for aërial cable construction at the present time are ordinarily much greater than necessary, and in the future they expect to use class B or C poles where they formerly used class A poles. The very heaviest lead-covered underground power cables could readily be supported on poles where the sections are not very long so far as strength of the latter is concerned. Stronger fittings of this kind can easily be developed as occasion demands.

It is felt that lead-covered power cable can be most advantageously used wherever the weight does not exceed the maximum encountered in telephone construction. Telephone practice has been thoroughly justified over a long period of time and wide range of territory. The reasons for this conclusion are:

1. Among the advantages of having paper insulation are the use of a standard product and the high carrying capacity of paper insulation.

2. The use of paper insulation calls for an effective outer weatherproof covering which can only be secured either by rubber in some form or by lead sheathing, and the latter eliminates the necessity of steel-tape armor, which has to be painted frequently to preserve it. Where steel-tape armor is protected from corrosion with asphalted jute, the latter rots after a few years and hangs down in a very unsightly manner.

3. The advantage of having aërial and underground cables practically similar in construction and eliminating special and more or less complicated types of cable.

4. Moisture-proof splices are more surely obtained.

5. Paper-insulated, lead-covered cable is the least expensive which can be used for this service.



AËRIAL POWER CABLE PASSING THROUGH HEAVY SHADE TREES

6. Smaller diameter of cable is obtained by using a lead sheath than with steel-tape armor with jute, resulting in lower sleet and wind loading.

7. Lead-covered cable can be more easily pulled through rings attached to the supporting messenger cable than steel-tape armored cable.

The fear has been expressed by some engineers that lead-covered aërial cables would be subject to deterioration of the lead sheath as the result of crystallization due to vibration. It has been found that when the lead sheath consists of commercially pure lead deterioration does take place, but a small amount of tin or antimony eliminates this difficulty.

TABLE II—COMPARISON OF RESULTANT LOADINGS OF TELEPHONE AND POWER CABLES

W = weights in pounds per foot, with ice, wind load and supporting messenger cable

Telephone Cables		Power Cables								
		Type No. 1 Lead			Type No. 2 Lead			Reinforced Rubber		
Pairs of No. 19	W	Size	Voltage	W	Size	Voltage	W	Size	Voltage	W
101	6.54	No. 4	6,600	6.73	No. 4	6,600	6.25	No. 4	6,600	5.64
					No. 2	6,600	7.00	No. 2	6,600	6.19
								No. 1	6,600	6.54
								No. 0	6,600	6.95
								No. 00	6,600	7.02
								No. 4	13,500	6.38
								No. 2	13,500	7.14
152	7.88	No. 2	6,600	7.33	No. 1	6,600	7.43	No. 000	6,600	7.54
		No. 1	6,600	7.63	No. 0	6,600	7.95	No. 0000	6,600	8.28
		No. 0	6,600	8.32	No. 00	6,600	7.84			
		No. 00	6,600	8.26	No. 000	6,600	8.20			
		No. 4	13,500	8.25	No. 4	13,500	7.61	No. 1	13,500	8.42
					No. 2	13,500	8.33			
202	8.95	No. 000	6,600	8.90	No. 4/0	6,600	9.23			
		0000	6,600	9.58						
		2	13,500	8.95	1	13,500	8.84	No. 0	13,500	8.93
		1	13,500	9.40	0	13,500	9.35	00	13,500	8.88
		0	13,500	10.00	00	13,500	9.34	000	13,500	9.52
		00	13,500	9.95	000	13,500	9.87			
					4	25,000	9.76	4	25,000	9.58
303	10.93	250,000	6,600	10.49	250,000	6,600	10.06	250,000	6,600	10.05
		No. 000	13,500	10.62	4/0	13,500	10.63	4/0	13,500	10.12
		0000	13,500	11.35	250,000	13,500	11.58	250,000	13,500	10.94
		No. 4	25,000	10.90	No. 2	25,000	10.55	No. 2	25,000	10.34
		2	25,000	11.33	1	25,000	10.94	1	25,000	10.80
					0	25,000	11.67	0	25,000	11.18
					00	25,000	11.43	00	25,000	10.63
								000	25,000	11.85

The experience of a number of power and lighting companies as well as telephone and telegraph companies with lead-covered aërial cables may be summed up about as follows:

1. Failure due to crystallization are negligible.
2. If failure occurs, it is always at the poles, where it is easily located and repaired.
3. Long spans, especially those exceeding 140 ft. (43 m.), are conducive to this trouble, but where the pole sections are only about 100 ft. (30 m.) this is not serious. In the urban districts, where aërial power cables are likely to be used, the spans are usually short.
4. The stiffer a cable, the less the liability of trouble.
5. It is important that the cables be run past poles without bending of any kind so that the contraction and expansion due to temperature changes will not cause cracks.
6. Cutting of the lead sheath by supporting rings can be eliminated by placing a saddle of lead between ring and sheath at two rings each side of the pole, or by using marlin hangers. Sometimes a marlin wrapping is used around the cable where it touches the pole, to prevent chafing.
7. Before tin or antimony was used with the lead considerable trouble was incurred.
8. Many of the largest cables have been in use from ten to fifteen years without any kind of trouble. The result of the telephone companies' experience is such that they do not feel it necessary even to consider a substitute for lead sheaths.
9. Power cables larger than the largest telephone cables may perfectly well be used by adopting easily developed modifications of the ordinary methods of suspension, such as catenary reinforcing cables, etc. Ordinary class B poles in good condition will support almost any cable which could be used provided that the pole sections do not exceed about 100 ft. (30 m.).

The experience of a few of the power companies that have lead-covered power cables follows:

1. The New York & Queens County Railway Company has a cable about 3 miles (4.8 km.) long which has been in service several years without breakdown.
2. The New York & Queens Electric Light & Power Company has a cable approximately 3 miles in length which has been in service about four years without developing trouble.
3. The Yonkers Lighting Company has, in addition to other types, a small amount of lead-covered aërial cable installed during the war period which has proved entirely satisfactory.
4. The Public Service Electric Company of New Jersey has about 8 miles (13 km.) of lead-covered aërial cable in addition to the reinforced rubber-covered cable. The lead-covered cable has been in service for more than ten years without ever having had a breakdown.
5. The Elmira Water, Light & Railway Company has two lead-covered aërial cables, totaling 3 miles in length, which have been in service for ten and four years respectively without serious trouble. Some troubles would undoubtedly have been avoided if the cables had been run straight past holes and if tin or antimony had been used in the sheath.
6. The Central Hudson Gas & Electric Company has about a mile of cable at Cornwall, N. Y., installed in 1916, which to date has not developed trouble of any kind.

Water-Power Applications Total 14,547,476 Hp.

Federal Power Commission Reports the Receipt of 222 Applications for Preliminary Permits and Licenses Up to and Including June 4

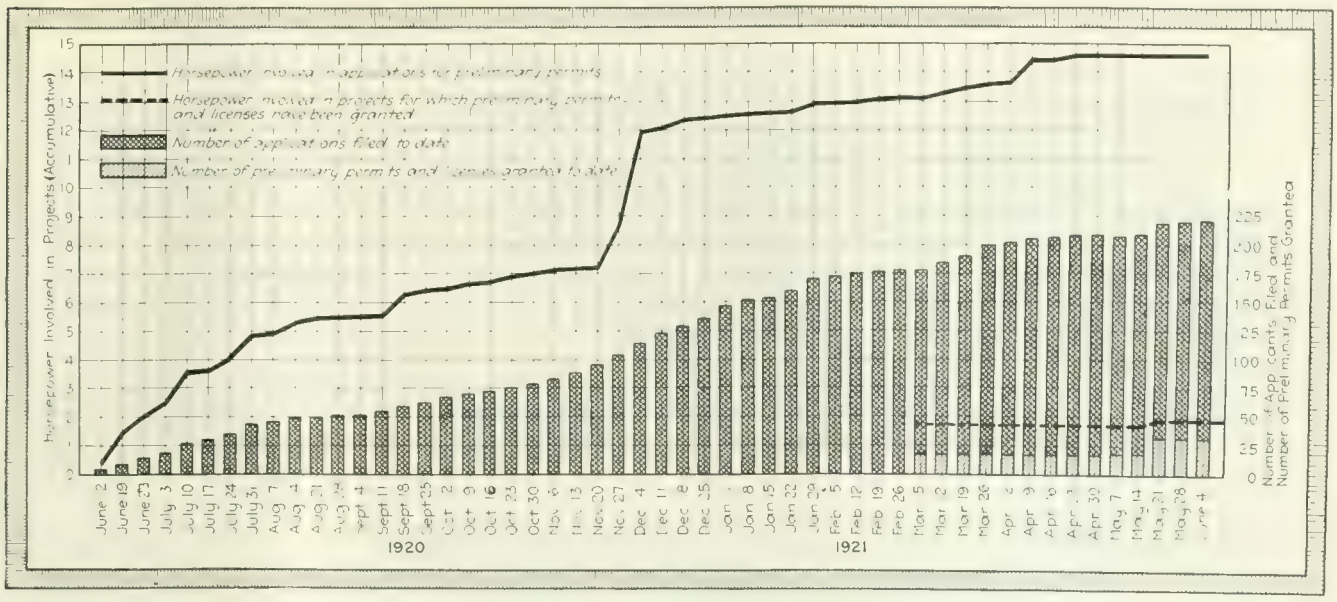
TWENTY-TWO permits were filed with the Federal Power Commission during April and May, involving a total of 1,300,645 hp. The latest data issued by the commission indicates that the net capacity of the 222 projects now on file totals 14,547,476 hp.

The applications filed since February indicate that the larger projects were included in applications filed prior to that date or that the later projects conflicted to a large extent with prior filings. The applications filed subsequent to February involve an average of only 31,753 hp., while those filed up to and including February involved a total of 73,878 hp.

With the exception of a small project on the Muskingum River in Ohio, the eastern portion of the coun-

TABLE I—LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH APPLICATIONS FOR PRELIMINARY PERMITS WERE FILED WITH THE FEDERAL POWER COMMISSION FROM MARCH 26, 1921, TO AND THROUGH JUNE 4, 1921.

Name of Company	Location of Project	Capacity, Hp
ALASKA:		
Town of Petersburg, Petersburg, Alaska	Crystal Lake on Mitkoff Island	2,500
George Inlet Packing Co., Peninsula National Bank Bldg., Portland, Ore.	Beaver Falls Creek, 12 miles from Ketchikan	100
Hirst Chicagof Mining Co., 316 First Ave., South Seattle, Wash.	Small lake at head of Didrickson Bay, Chicagof Island	360
L. H. Cann, Box 284, Juneau, Alaska	Cann Creek at head of Lisianski Inlet, Alaska	75
Saw Tooth Power Co., care F. B. Colton, 256 Broadway, New York City	Pass Creek and tributary streams, Kongarok Precinct, Seward Peninsula	40,000
ARKANSAS:		
Dixie Power Co., Title Guaranty Bldg., St. Louis, Mo	North Fork White River in Baxter County	
CALIFORNIA:		
E. B. Walthal, 1860 Van Ness Ave., Fresno, Cal	Middle and South Forks of Kings River	125,000
City of Los Angeles, Dept. of Public Service, 603 Knickerbocker Bldg., Los Angeles, Cal	Two power installations in San Francisquito Canyon in connection with Los Angeles Owens River Project	70,000
Yosemite Power Co., Groveland, Cal	South Fork of Tuolumne River	9,000
Original Mining & Milling Co., Merced, Cal.	Merced River, Mariposa County	500
Ed. Fletcher, 920 Eighth St., San Diego, Cal	Boulder Creek, San Diego County	
Luther O. Griffith, Oroville, Cal.	Middle Fork of Feather River	1,700
COLORADO:		
Thomas P. Mitchell, Ouray, Col.	Transmission line	
IDAHO:		
Grangeville Electric Light & Power Project, Grangeville, Idaho	South Fork Clearwater River	960
OHIO:		
Harry W. Deprezo, Shelbyville, Ind	U. S. Government Dam No. 5 on the Muskingum River	550
OREGON:		
California Oregon Power Co., San Francisco, Cal.	Klamath River	94,000
UTAH:		
Green River Power Co., Pacific Electric Bldg., Los Angeles, Cal.	Green River, from point near Green River, Wyo., to its junction with Grand River, Utah	912,600
WASHINGTON:		
Kelly Mines Co., 1213 L. C. Smith Bldg., Seattle, Wash	Fishhook Creek and Little Susitna River	3,000
Royal Development Co., care James Naughten, Wenatchee, Wash.	Dry, Chipmunk and Phelps Creeks	200
Lewis River Hydro-Electric Power Co., 704½ Main Street, Vancouver, Wash.	Lewis River in Clarke, Skamania and Cowlitz Counties	20,000
WYOMING:		
Colowyo Gold Mining Co., Centennial, Wyo.	Middle Fork of Little Laramie River	100
John T. Clarke, Room 314, 503 Fifth Ave., New York City	Big Horn River, Fremont County	20,000



GROWTH IN NUMBER OF APPLICATIONS FILED AND GRANTED AND HORSEPOWER INVOLVED

try is not represented in the applications filed during April and May. Five of the projects are in Alaska, six in California, three in Washington, two in Wyoming and one each in Utah, Idaho, Ohio, Arkansas and Oregon. One application for preliminary license was filed for a transmission line to be located in Colorado. The largest project recorded during these two months was that of the Green River Power Company, involving a comprehensive scheme to develop all the water powers in the Green River from a point near Green River, Wyo., to its junction with Grand River in Utah. A total of 912,000 hp. is involved in this project. Another proposed large development is that of E. B. Walthal, on the forks of Kings River in California, which involves a total of 125,000 hp. Both of these applications are in conflict to some extent with prior applications.

Table I gives the location and size of water-power projects for which applications for preliminary permits and licenses were filed with the Federal Power Commission from March 26 to and through June 4, 1921. The list of applications filed prior to March 26 appeared in the ELECTRICAL WORLD of Jan. 1, Jan. 15, Feb. 12, March 12 and April 9.

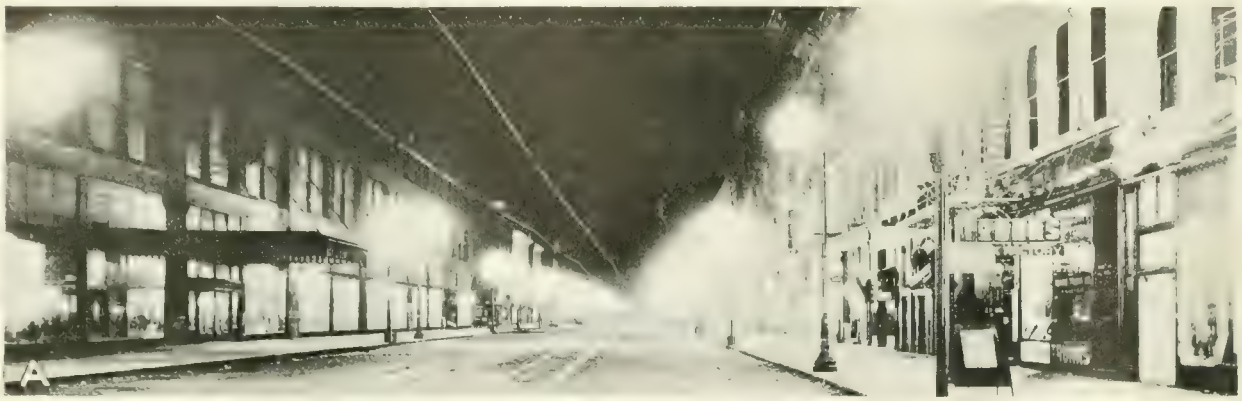
Twelve applications for preliminary permits and licenses were granted by the commission during April and May. Table II gives the location and size of these projects. Applications granted prior to April were noted in the April 9, 1921, issue of ELECTRICAL WORLD.

Twenty-nine applications for preliminary permits have been granted by the commission involving a total of 1,980,746 hp. This is only about 14 per cent of the total horsepower involved in the 222 applications now on file. These applications granted are for projects located in seventeen different states, California leading the list with eight projects, followed by New York with four. The largest project for which a preliminary permit has been granted by the Federal Power Commission is that of the Southern California Edison Company for a project on the South Fork of the San Joaquin River in Fresno County, California, and involving an ultimate development of 425,000 hp. This is followed by the project of the Niagara Falls Power Company at Niagara Falls, involving an ultimate development of 400,000 hp. Three other large developments for which preliminary permits have been granted are those of the Washington Irrigation & Development Company, involving 300,000 hp.; the Lower Niagara River Power & Supply Company's project, involving 250,000 hp., and the project of the Southern California Edison Company in Big Creek, California, involving 120,000 hp. The eight projects in California for which preliminary permits have been issued involve a total of almost 680,000 hp.

TABLE II LOCATION AND SIZE OF WATER-POWER PROJECTS FOR WHICH PRELIMINARY PERMITS OR LICENSES HAVE BEEN GRANTED BY THE FEDERAL POWER COMMISSION FROM MARCH 26, 1921, TO AND THROUGH JUNE 4, 1921

Name of Company	Location of Project	Capacity, Hp.
ALABAMA:		
Alabama Power Co., Birmingham, Ala	Coosa River	30,000
ARIZONA		
James B. Girand, Dave Parsons, Klapp, Brinckerhoff & Douglas, 84 Pine St., New York City	Colorado River near Diamond Creek	60,000
CALIFORNIA:		
Merced Irrigation District, Merced, Cal.	Merced River at Exchequer	40,000
C. B. Johnson, care V. G. Preston, Bishop, Cal.	Transmission line	
COLORADO:		
Thomas P. Mitchell, Ouray, Col.	Transmission line	
IDAHO:		
John R. Love, care V. G. Preston, Bishop, Cal.	Salmon River, Custer County	400
Utah Power & Light Co., care M. O. Leighton, National Savings and Trust Bldg., Washington, D. C.	Soda Point, Lava, Narrows and Mink Projects, Bear River	21,500
ILLINOIS:		
State of Illinois, care the Governor, Springfield, Ill.	Desplaines and Illinois Rivers	40,000
NORTH CAROLINA:		
Granite Falls Manufacturing Co., Granite Falls, N. C.	Wilson Creek, Caldwell County	2,000
UTAH		
Great Basin Power Co., Walker Bank Bldg., Salt Lake City, Utah	North Fork Duchesne River	25,000
VIRGINIA:		
Roanoke River Development Co., 318 Mutual Bldg., Richmond, Va.	Roanoke, Va.	60,000
WYOMING:		
Home Colony, care L. R. Ewart, Cody, Wyo.	Kitty Creek, Park County	10

Past Inactivity in Street Lighting Has Left a Big Field for New Work









What improved street lighting has done for cities shown can be accomplished in every town and city.

A—Multiple gas filled tungsten lamps are mounted inside stippled glass globes on State Street, Chicago.

B—Shows clusters of three 6.6-amp. luminous-arc lamps per pole on Main Street, Salt Lake City.

C—On Broadway, Los Angeles, are two-globe standards, also containing luminous-arc lamps.

D—Grant Avenue, San Francisco, is lighted by standards carrying two 6.6-amp. luminous-arc lamps each.

Calculating Battery Sizes for Locomotives

Method of Figuring the Energy Consumption Is Based on the Division of the Load Cycle Into Sections According to Train Weights and Grades Number of Plates in Battery Determined on Basis of Energy Used and Discharge Rate

By J. H. TRACY
Engineering Department, Electric Storage Battery Company, Philadelphia

IT IS frequently necessary for electrical engineers to make calculations of the approximate size of batteries for locomotives having a certain duty cycle. The first step in this procedure, the determination of the watt-hours output for the duty cycle, is independent of the type of battery to be selected. However, after the energy consumption is determined and the maximum rate of discharge calculated the selection of the battery size will depend on the characteristics of the particular type of battery chosen.

To determine the energy consumption the typical round trip should be divided into as many parts as have different characteristics such as different weights of train and different grades to be encountered. The requirements of each of these sections in each direction of haul should be treated separately. For purposes of illustration a problem may be taken as follows:

Assume 600 ft. of level track and 800 ft. of 1.2 per cent grade. A 3-ton locomotive is to be used and the load to be hauled is a 15-ton trailing load in the direction against the grade and a 6-ton trailing load in the direction with the grade. The work calls for twenty round trips per day and it is desired to use a forty-eight-cell battery.

The round trip can be divided into three parts—first, a travel of 800 ft. up a 1.2 per cent grade, the load and locomotive totaling 18 tons; second, the return trip light load or empties down a 1.2 per cent grade, total 9 tons; third, all level running can be grouped, using the full distance and the average load, which would mean a distance of 1,200 ft. with a 13.5-ton train.

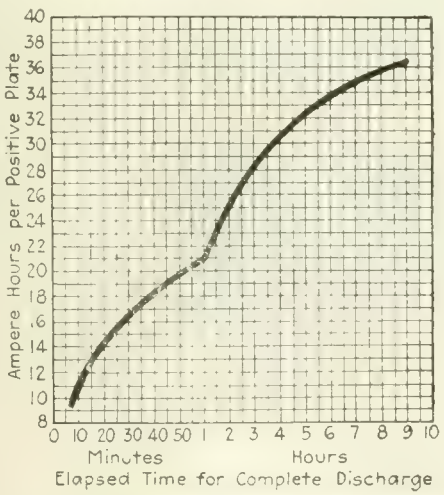


FIG. 1—VARIATION OF CAPACITY WITH ELAPSED TIME OF DISCHARGE FOR A TYPE "MV EXIDE" BATTERY

The tractive effort to overcome friction for level running is determined by multiplying the weight of the train, including locomotive, in tons by 30 lb. To find the tractive effort for grade multiply the grade expressed in per cent by 20 and multiply this by the weight of the train in tons. This tractive effort is taken as positive for an up grade and negative for a down grade. To get the total tractive effort add that required for level running and the tractive effort required for grade. If this sum is negative, it means the train is coasting and no power is required.

After the total tractive effort for a certain part of the trip has been determined it may be reduced to watt-hours per train-mile for that section of the trip by multiplying by 3.

The derivation of this factor comes from the fact that 1 watt-hour equals 2,655 ft.-lb., which is practically $\frac{1}{2}$ mile-lb. Therefore tractive effort in pounds multiplied by 2 equals watt-hours per train-mile at the locomotive wheels. Assuming $66\frac{2}{3}$ per cent efficiency between the battery and the wheels, substitution can be made as follows:

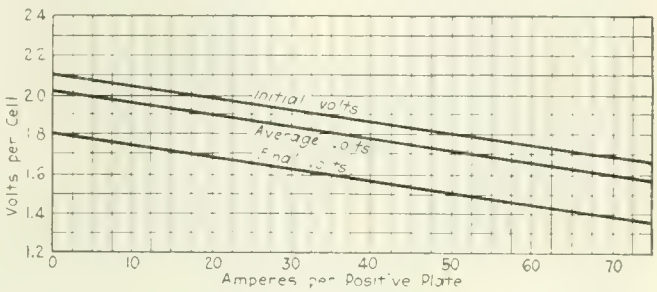


FIG. 2—INITIAL, AVERAGE AND FINAL VOLTS FOR A TYPE "MV EXIDE IRONCLAD" BATTERY AT VARIOUS RATES OF DISCHARGE

(Tractive effort × 2) ÷ $0.66\frac{2}{3}$ = watt-hours per train-mile at the battery.

This reduces to:

Tractive effort × 3 = watt-hours battery per train-mile.

Returning to the problem at hand, the first part of the round trip can be calculated as follows:

18 tons × 30 lb. per ton friction = 540 lb. tractive effort for friction.

1.2 per cent grade × 20 lb. per percentage per ton × 18 tons = 432 lb. tractive effort for grade.

The total tractive effort is therefore 972 lb. and multiplied by 3 equals 2,916 watt-hours per mile for the first section of 800 ft.

As there are twenty round trips for this section of the haul, the total distance in miles is (20 × 800) ÷ 5,280 = 3.03 miles. As previously determined, the watt-hours per mile is 2,916; therefore the total watt-hours is 3.03 × 2,916 = 8,830.

In the same way the second part of trip may be calculated. As this run is for 800 ft. down a 1.2 per cent grade, the tractive effort for grade will be negative. Therefore the total tractive effort is 270 lb. + (— 216 lb.) = 54 lb. The energy consumption is 3 × 54 × 3.03 = 491 watt-hours.

As the third part of the trip is a run of 1,200 ft. on level track, the tractive effort required is simply that to overcome friction. Therefore 13.5 tons × 30 lb. per ton friction = 405 lb. tractive effort × 3 = 1,215 watt-hours per mile. The distance in miles for the twenty trips is 4.55, and so the energy consumption is 5,530 watt-hours.

The total energy consumption for the twenty round trips for the complete run is the sum of the requirements found for the three parts or 8,830 + 491 + 5,530 = 14,851 watt-hours.

Determining the Battery Size

Up to this point the procedure is the same regardless of the battery which may finally be chosen. The actual determination of the battery size is, however, dependent on the type of battery being considered and under certain conditions on the rate of discharge. In order to give a specific illustration of how the general method is applied, the "MV Exide Ironclad" battery, which varies from seven to thirty-three plates, has been used.

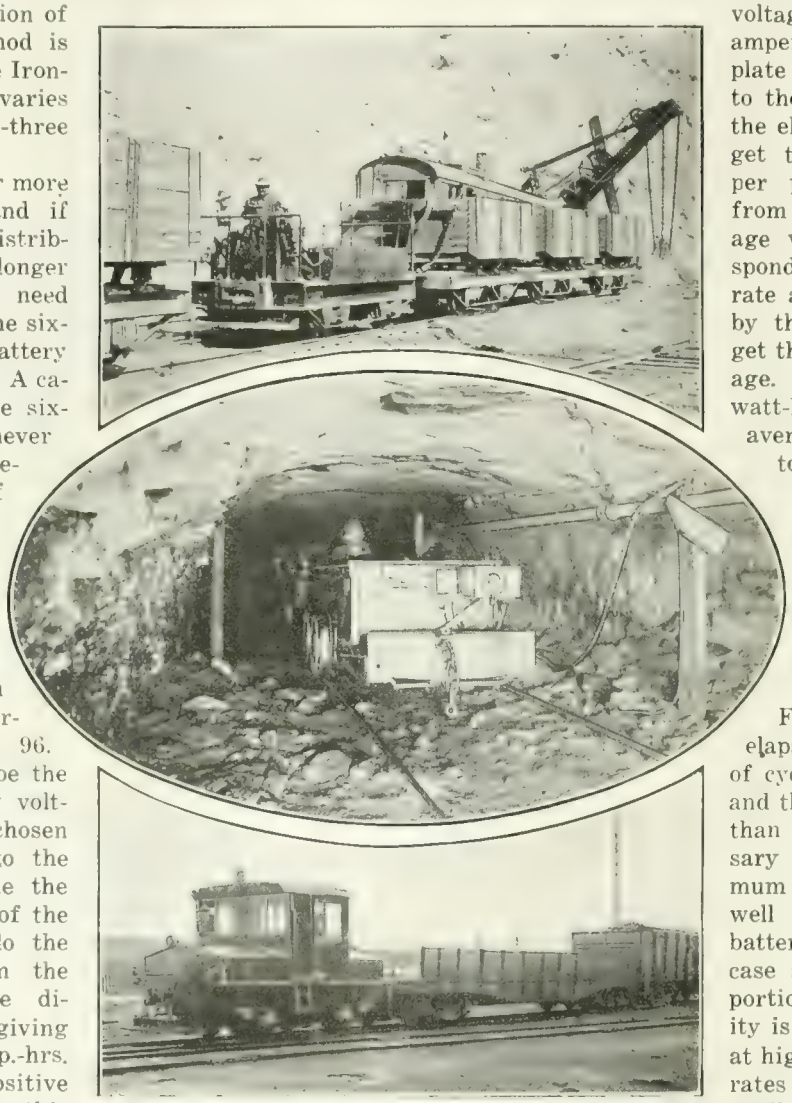
If there are fifteen or more cycles of operation and if these operations are distributed over six hours or longer the rate of discharge need not be considered, as the six-hour capacity of the battery will be fully available. A capacity in excess of the six-hour capacity should never be used as a basis for determining the size of the battery required.

The battery voltage is equal to number of cells multiplied by 2, and as the number of cells chosen in the problem was forty-eight, the corresponding voltage is 96. The procedure might be the reverse as the battery voltage is sometimes chosen and the cells fitted to the voltage. To determine the ampere-hour capacity of the battery required to do the work in the problem the watt-hours should be divided by the voltage, giving 14,851 ÷ 96 = 155 amp.-hrs.

The number of positive plates per cell to give this capacity is dependent on six-hour capacity of a single plate, which is 34 ampere-hours. Therefore 155 ÷ 34 gives the number of positive plates or four and a half. The nearest larger whole number should be taken, which would give five positive plates for the battery. To get the total number of plates per cell multiply the number of positive plates by 2 and add 1, as there is always an odd number of plates. In this case the battery required to do the work would be a forty-eight-cell battery of eleven plates per cell.

When the battery is to be used for service requiring less than fifteen cycles, or when the total elapsed time during which discharges are taken is less than six hours, or when both of these conditions are involved, the curves in Figs. 1 and 2 give the necessary data for the "MV Exide Ironclad" battery. In Fig. 1 is shown the variation in available capacity with elapsed time of discharge for a positive plate, and Fig. 2 shows the initial, average and final voltages per cell at various discharge rates.

If, for instance, there are more than two and one-half cycles per hour but the elapsed time is less than six hours, the calculation for the size of the battery is the same as given above except that the average voltage per cell will not be 2. In this case to get the average voltage per cell divide the ampere-hours per positive plate (Fig. 1) corresponding to the total elapsed time by the elapsed time in hours to get the amperes discharge per positive plate. Then, from Fig. 2, read the average voltage per cell corresponding to this discharge rate and multiply this value by the number of cells, to get the average battery voltage. Then divide the total watt-hours required by this average voltage to get the total ampere-hours required. To get the number of positive plates in a cell divide the total ampere-hours' capacity required by the ampere-hours per positive plate, as read on the curve of Fig. 1 for the total elapsed time. If the number of cycles is less than fifteen and the elapsed time is more than six hours, it is necessary to consider the maximum rate of discharge as well as the total watts of battery capacity. In this case a relatively large proportion of the battery capacity is used in each cycle and at high rates, and these high rates have an effect on the available battery capacity which must be allowed for in choosing the proper size of battery. For example, the following problem may be taken:



STORAGE-BATTERY REQUIREMENTS FOR INDUSTRIAL AND MINE LOCOMOTIVES MUST BE CAREFULLY STUDIED IF THE PROPER SIZE BATTTERY IS TO BE USED

Top—At the quarry of the California Portland Cement Company in "Death Valley."
Center—Electric haulage in coal mines is in many cases very nearly on a definite trip basis.
Bottom—A 14-ton locomotive used for moving cars at the plant of the Newport News Shipbuilding Company

Assume a 75-ton trailing load and a 25-ton locomotive operating up 300 ft. of 3 per cent grade and down the same grade with a load of 25 tons, five round trips, a forty-eight-cell battery, speed with full load up 3 per cent grade 1.25 miles per hour.

It will be found by following the same method as in the previous problem that the energy requirements will be 27,000 watt-hours per mile, which is used entirely on the up grade as the tractive effort for down grade is negative and overbalances the tractive effort for friction. The total distance traversed is 0.284 mile, so the

energy consumption is 7,670 watts for the five round trips.

As the rate of speed is 1.25 miles per hour and the rate of energy consumption is 27,000 watt-hours per mile, the maximum rate of discharge is 27,000 × 1.25 = 33,700 watts. To get the equivalent time of complete discharge at the maximum rate, the rate of discharge should be divided into the total watt-hours energy consumption. Therefore, 7,670 ÷ 33,700 = 0.228 hour, or 13.7 minutes. From the curve of Fig. 1, 12.5 ampere-hours corresponds to the equivalent time of 13.7 minutes (0.228 hour), which divided by 0.228 hour gives 55 amp. discharge per positive plate. From Fig. 2 the average voltage corresponding to 55 amp. discharge is 1.66 volts per cell, or 79.9 volts for the forty-eight cells. As in the previous problem, divide the watt-hours by the voltage to get the ampere-hours of battery capacity. In this case

$$7{,}670 \div 79.9 = 96 \text{ ampere-hours}$$

As the capacity of the positive plate has already been found to be 12.5 ampere-hours, the number of positive plates required would be 96 divided by 12.5, or 7.6. The battery would therefore be made up of forty-eight cells with seventeen plates.

If the equivalent time for discharge is less than ten minutes, the battery size will have to be determined by the maximum permissible rate of discharge. For work of the character described this should not exceed 67 amp. per positive plate.

For example, if only two round trips were required of the locomotive used in the previous example, the equivalent time of discharge would be only 5.46 minutes. Therefore 67 amp. can arbitrarily be taken as the discharge rate. From Fig. 2 the voltage per cell would be 1.58, or 76 volts for the battery. In that case if the maximum rate of discharge is 33,700 watts and the battery voltage is 76, the amperes maximum discharge would be 33,700 divided by 67, or 444 amp. The rate, however, must be held to 67 amp. per positive plate, therefore the number of positive plates would be 444 divided by 67. or 6.6 positive plates. The battery in this case would consist of forty-eight cells made up of fifteen plates per cell.

In these calculations the determination of the battery size is reliable from the point where the watt-hour capacity and maximum rate of discharge are known. The calculations of energy consumption are based on certain approximations such as 30 lb. per ton for tractive effort. This figure is usually considered sufficient to include an allowance for curves as well as some allowance for tracks which are not up to good railroad standard.

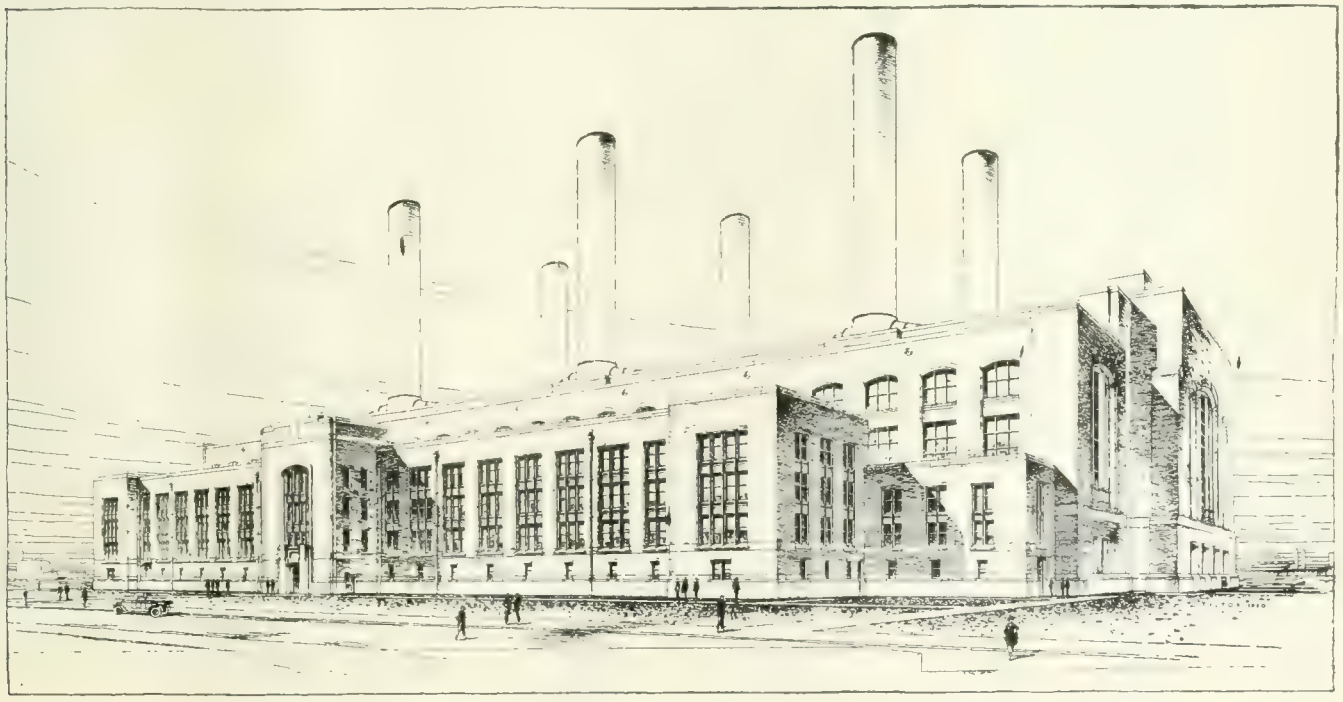
The efficiency of 66⅔ per cent assumed between the battery and locomotive wheels includes an allowance for rheostatic and braking losses as well as motor and gear losses. Different values may be assigned to these constants as the judgment of the engineer making the approximations may dictate.

Features of New Commonwealth Edison Station

Steam Will Leave Boilers at 685 Deg. Fahr.— Feed Water Will Enter Economizers at 175 Deg. Fahr. to Avoid Condensation of Acid Gases

VIRTUALLY all of the latest features of power-plant design will be incorporated in the Calumet station of the Commonwealth Edison Company, which is now in the course of erection, according to a description of the plant given by Alexander D. Bailey, superintendent of generating stations, before the Mechanical Engineering Section of the Western Society of Engineers and the Chicago Section, American Society of Mechanical Engineers. High boiler pressure and superheat, economizers with steel tubes and headers, preheating of furnace air, high feed-water temperatures for economizers and two sets of revolving screens at the condenser-water intake were a few of the plant's characteristics to which reference was made.

The boilers are Babcock & Wilcox cross-drum type



CALUMET STATION WILL EVENTUALLY CONTAIN SIX 30,000-KW. TURBO-GENERATORS

with 20-ft. (6.1-m.) tubes 4 in. (10 cm.) in diameter. Each contains 15,089 sq.ft. (1,388 sq.m.) of steam-making surface. The boilers are built for 350-lb. (24.6 kg. per sq.cm.) pressure and 250 deg. of superheat supplied by 4,000 sq.ft. (368 sq.m.) of superheating surface. At this pressure and superheat steam will leave the boilers at 685 deg. Fahr (363 deg. C.). There are four boilers per unit in the plan, but the first two units are to be served by seven boilers of the size previously given. The guaranteed evaporation from each boiler is 150,000 lb. (68,000 kg.) of water per hour, amounting to about 300 per cent of normal rating.

There are to be two forced-draft Coxe chain-grate stokers per boiler, having an active area of 376 sq.ft. (34.6 sq.m.) and a ratio to the steam-making surface of one to forty. With a head room of 20 ft. (6.1 m.) from the grate to the tubes, the furnace of each boiler will have a volume of 6,700 cu.ft. (190 cu.m.), which reduces to nearly 18 cu.ft. per square foot of grate area, or to 0.36 cu.ft. per pound of coal burned per hour, figuring on a combustion rate of 50 lb. of coal per square foot of grate per hour. The steel stacks serving the boilers will be considerably shorter than at the other stations. They will be 16 ft. (4.8 m.) in diameter and rise 167 ft. (51 m.) above the grate. Forced-draft fans, each having a capacity of 50,000 cu.ft. (1,415 cu.m) per minute, will serve the boilers, and the induced-draft fans drawing the gases from the economizers will require 200-hp. motors to drive them.

Economizers Will Be Used

Economizers with steel tubes and steel headers will be installed. There will be one per boiler, containing 9,600 sq.ft. (883 sq.m.) of surface split up into three sections with the tubes running crosswise with the boiler tubes. In the use of these economizers a net gain of about 10 per cent in economy is anticipated, adding about 7 or 8 per cent to the possible 74 or 75 per cent obtainable from the boilers without the economizers. To guard against the condensation of sulphurous-acid gases on the steel economizer tubes, the temperature of the feed water before entering the economizer is to be raised to 175 deg. Fahr. (79.5 deg. C.). At this temperature any condensation of sulphurous gases should be avoided and the life of the economizer prolonged. To obtain it sufficient steam will be bled from the lower stages of the main turbines.

In addition to the economizer an air preheater of the plate type is under consideration. The gases will leave the economizer at about 350 deg. Fahr. (177 deg. C.). By the use of the preheater their temperature would be reduced over 100 deg. Fahr. (37.8 deg. C.), the air for the boiler furnaces being preheated to about 200 deg. Fahr. As a better generator of sulphurous acid could scarcely be obtained when coal containing nearly 5 per cent of sulphur is being used, the installation of the preheater is doubtful, although a try-out may be given to one of them.

Continuous bucket elevators will be used to elevate coal to the level of the overhead bunker, and from here belt conveyors will distribute it to the bunker. In crushing the coal an innovation is to be the use of a Bradford breaker. This breaker will be unusually heavy and substantial and will automatically pass out the scrap iron, slate, etc., which so frequently put out of action the roll-type crushers employed in the other plants. Ashes from the hopper under the stoker will be dumped directly into railway cars at grade, as the plant has been built at a sufficient elevation to permit this practice.

One of the two generating units now being installed is a General Electric seven-stage impulse machine having highest economy at three-quarters load. Steam is to be delivered to the turbines at 300-lb. pressure (21 kg. per sq.cm.) and about 225 deg. Fahr. (107 deg. C.) of superheat, giving a final steam temperature of approximately 650 deg. The speed is 1,800 r.p.m. The other turbine is a tandem compound Westinghouse machine of the same type as the one installed at the Northwest station.

Plans have been made for a six-unit station, but at the present time only two 30,000-kw. units are going in. The power-plant buildings are to consist of a switch house, transformer house, turbine room and boiler house. Just enough of the new structures are to be completed to house the first two units. Both turbo-generators are rated at 30,000 kw. at 85 per cent power factor, three-phase, 60-cycle, and will generate at 12,000 volts with a speed of 1,200 r.p.m. Two 33,000-volt cable lines will connect the new plant with the Fisk and Quarry Street stations. Incidentally, this is the highest voltage ever carried in a cable.

Each turbine will be served by a surface condenser containing 52,000 sq.ft. (4,784 sq.m.) of surface, or about 1.73 sq.ft. (0.16 sq.m.) per kilowatt of generator rating. The circulating pump will have a capacity of 55,000 gal. per minute. It will be motor-driven, as will be all auxiliaries in the plant with the exception of the boiler-feed pumps. Three out of the four pumps installed will be turbine-driven. For operating the oil switches 230-volt direct current will be used, and for auxiliary motors above 50 hp. 2,300-volt, 60-cycle alternating-current power. For the smaller motors 440-volt service will be provided. The use of high-voltage alternating-current service on the larger auxiliary motors is an innovation for the company.

In the condenser special washers are to be provided which will allow cleaning the condenser while in operation. To reduce hand labor there will be double sets of revolving screens at the intake for condenser circulating water. In the other stations double sets of stationary screens and one revolving screen have been employed.

One of the interesting points in the development of stations of this company has been the increasing area occupied by the boiler equipment. In each new station the boiler-room area has shown considerable increase, and in addition the boiler room has gone farther up into the air and farther down into the ground, until at the new Calumet station the boiler room takes just 65 per cent of the total building area.

By means of charts it was shown that the fuel costs run about 81 to 82 per cent of the station generating costs, and at the Calumet station they will be about 86 per cent. The pounds of coal per kilowatt-hour are being reduced constantly, but with the price of coal going up there has been a continuous increase in its cost per kilowatt-hour generated. With coal such a large item, higher-priced men are being sent into the boiler room. In fact, much of the money paid for labor is apportioned to this division of the plant. In reply to an inquiry concerning the plant economy anticipated, Mr. Bailey said that it was expected to generate a kilowatt-hour on 19,000 B.t.u.

Applying Relays to Large Power Systems

Considering a Typical System of Stations and Substations, Relay Selections Are Made to Insure the Orderly Functioning of Circuit Breakers—Detailed Analysis of Reverse-Power Relay Characteristics

By R. F. GOODING
Superintendent of Construction, Tucker & Laxton, Charlotte, N. C.

DIFFERENTIAL relays are particularly useful in isolating generators and transformers from the system in case of internal trouble in these units, and radial feeders are best protected by overload relays, as pointed out in an article by the writer published in the ELECTRICAL WORLD of Feb. 19. This discussion is continued in the present article to cover the characteristics of reverse-power relays, especially useful for parallel feeder service. Group feeder relays are considered, and finally a typical system is outlined and analyzed to show just what relays are best adapted to the various elements from generating station to remote substations.

On large systems it is often desirable to interchange power between two power stations, and this is especially desirable when the load characteristics are such that the peak loads on the two stations do not coincide. For this purpose several parallel feeders are run between the stations, and these are protected by cross-connected reverse-power relays as shown in Fig. 2. This diagram shows four such tie lines, but this number can be increased or decreased as necessity may demand. It will be noted that the current from any particular current transformer divides, part going through its own relay, the other part through the similar relays on the other circuits but in opposite direction. For instance, with 5 amp. secondary current in all circuits (normal full load) the current from transformer on circuit *A* will divide, 3¾ amp. going through relay *A* and 1¼ amp. in the opposite direction through relays *B* and *C* and *D* in series. The current is inversely proportional to the impedance of the two circuits. As this same condition exists in the other relays, the resultant current through each one will be zero.

ANALYSIS OF REVERSE-POWER-RELAY ACTION

The table shows the different stages of this scheme, and the best way to get a clear idea of its operation is to study this table. To begin with, station No. 2 is assumed to be supplying power to station No. 1, and this direction of power will hold for all of the "conditions." The + or — sign above each figure shows direction of current to trip relays at each station. No potential connections are shown.

Condition 1.—Assume normal operation, with 5 amp. secondary current in current transformers at station No. 1. It will be seen, as pointed out before, that each transformer is supplying to its own relay 3¾ amp., but *not* in the tripping direction, while it also supplies 1¼ amp. *in* tripping direction to the three other similar relays. There is, therefore, no current through the relays at station No. 1.

MAGNITUDE OF CURRENT IN CROSS-CONNECTED REVERSE-POWER RELAYS (FIG. 2) UNDER DIFFERENT CONDITIONS

The + and — signs show direction to trip relays at each station, + indicates energy flow *up* through the relay; — sign means energy flow *downward*.

Conditions	Description	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Relay	Current Due to D	C	B	A	Total Current	Remarks
1	Normal operation 5 amp. in current transformer station No. 1	D-1	+ 3¾	− 1¼	− 1¼	− 1¼	0	C-1	− 1¼	+ 3¾	− 1¼	− 1¼	0	B-1	− 1¼	− 1¼	+ 3¾	− 1¼	0	A-1	− 1¼	− 1¼	− 1¼	+ 3¾	0	No current in relays at station No. 1.
2	Same as No. 1, but for station No. 2	D′-1	+ 3¾	− 1¼	− 1¼	− 1¼	0	C′-1	− 1¼	+ 3¾	− 1¼	− 1¼	0	B′-1	− 1¼	− 1¼	+ 3¾	− 1¼	0	A′-1	− 1¼	− 1¼	− 1¼	− 3¾	0	No current in relays at station No. 2.
3	Assume 40 amp. ground at *O*, and 15 amp. load at station No. 1	D-1	+ 8¾	− 2½	2½	+ 5	+ 7½	C-1	2½	+ 8¾	− 2½	+ 5	+ 7½	B-1	− 2½	− 2½	+ 8¾	+ 5	+ 7½	A-1	− 2½	− 2½	− 2½	− 15	− 23¼	Oil breaker *A* will be tripped by relay *A*-1
4	Assume same 15 amp. load at station No. 1, instant after breaker *A* trips	D-1	+ 3¾	− 1¼	− 1¼	0	+ 1¼	C-1	− 1¼	+ 3¾	− 1¼	0	+ 1¼	B-1	− 1¼	− 1¼	+ 3¾	0	+ 1¼	A-1	− 1¼	− 1¼	− 1¼	0	− 3¾	Current in relay *A*-1 in direction to keep breaker *A* open.
5	Same as No. 3, but for relay station No. 2	D′-1	+ 8¾	− 2½	− 2½	− 5	− 2½	C′-1	2½	+ 8¾	− 2½	− 5	− 2½	B′-1	− 2½	− 2½	+ 8¾	− 5	− 2½	A′-1	− 2½	− 2½	− 2½	− 15	− 6¾	Current in relay *A*′-1 will trip breaker *A*
6	Same as No. 4, but for relay station No. 2	D′-1	+ 3¾	− 1¼	− 1¼	− 10	− 8¾	C′-1	− 1¼	+ 3¾	− 1¼	− 10	− 8¾	B′-1	− 1¼	− 1¼	+ 3¾	− 10	− 8¾	A′-1	− 1¼	− 1¼	− 1¼	− 30	+ 26¼	Relay *A*-1 will trip breaker *A*, if not already tripped by condition 5.
7	Same as No. 6, but with breaker *A* open	D′-1	+ 3¾	− 1¼	− 1¼	0	+ 1¼	C′-1	− 1¼	+ 3¾	− 1¼	0	+ 1¼	B′-1	− 1¼	− 1¼	+ 3¾	0	+ 1¼	A′-1	− 1¼	− 1¼	− 1¼	0	− 3¾	Current in relay *A*′-1 will not tend to trip breaker *A*.
8	Same as No. 4, but with relay *A*-1 short-circuited	D-1	+ 3¾	− 1¼	− 1¼	0	0	C-1	− 1¼	+ 3¾	− 1¼	0	0	B-1	− 1¼	− 1¼	+ 3¾	0	0	A-1	0	0	0	0	0	No current in relays at station No. 1.
9	Same as No. 7, but with relay *A*-1 short-circuited	D′-1	+ 3¾	− 1¼	− 1¼	0	0	C′-1	− 1¼	+ 3¾	− 1¼	0	0	B′-1	− 1¼	− 1¼	+ 3¾	0	0	A′-1	0	0	0	0	0	No current in relays at station No. 2.

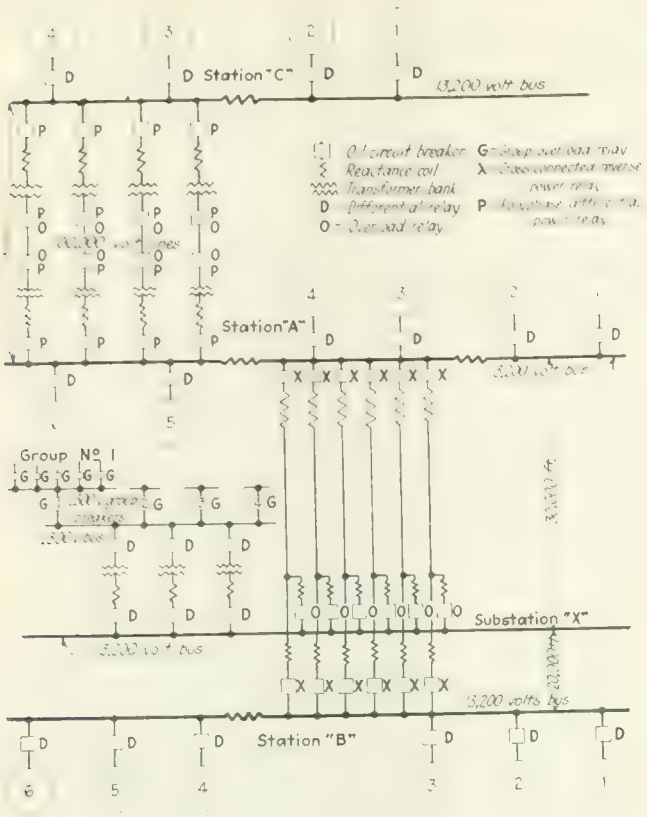


FIG. 1—HOW RELAYS MAY PROTECT A TYPICAL SYSTEM

Condition 2.—This assumes 5 amp. secondary current in the current transformers at station No. 2, and conditions are identical with those existing at station No. 1. In other words, under normal conditions there will be no current in the relays at either station.

Condition 3. — This condition assumes a 40-amp. (secondary-current) ground at point *O* on feeder *A* and a 15-amp. load on station No. 1. The 40-amp. ground current will be divided, one-half coming from station No. 1 and one-half from station No. 2.

Taking relay *A*-1 first, it will have from its own relay 15 amp. in the tripping direction, and from each of relays *B*-1, *C*-1 and *D*-1, 2 $\frac{1}{2}$ amp. also in the tripping direction, making a total of 23$\frac{3}{4}$ amp. in the tripping direction. Thus breaker *A* will be tripped by relay *A*-1. The total current in transformer for relay *A*-1 is 20 amp., the amount this line is supplying to the ground. This 20 amp. divides, 15 amp. through its own relay in tripping direction and 5 amp. in non-tripping direction through *B*-1, *C*-1 and *D*-1.

With a load of 15 amp. at station No. 1, the three lines corresponding to relays *B*-1, *C*-1 and *D*-1 will each carry 5 amp. In addition to this they must also supply the 20 amp. ground current (6$\frac{2}{3}$ amp. each), making a total of 11$\frac{2}{3}$ amp. through their current transformers. This assumes that station No. 1 is a substation or a generating station with no generators on the bus. Taking transformer for relay *B*-1, this current will divide as follows—three-fourths, or 8$\frac{3}{4}$ amp. (non-tripping), through relay *B*-1; one-fourth, or 2$\frac{1}{2}$ amp. (tripping), through relays *A*-1, *C*-1 and *D*-1. Similar conditions will exist through relays *C*-1 and *D*-1. The total current in relay *B*-1 then will be 5 amp. (non-tripping) from *A*-1, less 2$\frac{1}{2}$ amp. (tripping) each from *C*-1 and *D*-1, with 8$\frac{3}{4}$ amp. (non-tripping) from its own transformer. This makes a total of 7$\frac{1}{2}$ amp. in the non-tripping direction, so breaker *B* will not trip. As conditions for *C*-1 and *D*-1 are identical with those for *B*-1, these breakers will also stay closed.

Condition 4.—The instant after breaker *A* trips, relay *A*-1 will still have 1$\frac{1}{4}$ amp. (tripping) from feeders *B*, *C* and *D*, making 3$\frac{3}{4}$ amp. (tripping) tending to keep breaker *A* open. Relay *B*-1 will receive no current from feeder *A*, but will have 3$\frac{3}{4}$ amp. (non-tripping) of its own and 1$\frac{1}{4}$ amp. (tripping) from feeders *C* and *D*, making 1$\frac{1}{4}$ amp. (non-tripping) total current—same values for relays *C*-1 and *D*-1.

Condition 5.—This makes same assumptions as condition 3, but for station No. 2.

The total current in transformer for relay *A'*-1 is 20 amp., 15 amp. (tripping) going to relay *A'*-1 and 5 amp. (non-tripping) to relays *B'*-1, *C'*-1 and *D'*-1; but from feeders *B*, *C* and *D* relay *A'*-1 receives 2$\frac{1}{2}$ amp. (non-tripping) each, or 8$\frac{3}{4}$ amp. (non-tripping) total, making the total resultant current 6$\frac{1}{4}$ amp. (tripping) and tripping breaker *A'*.

Relay *B'*-1 receives 8$\frac{3}{4}$ amp. (tripping) of its own, 5 amp. (non-tripping) from feeder *A* and 2$\frac{1}{2}$ amp. (non-tripping from feeders *C* and *D*, making a total resultant current of 2$\frac{1}{2}$ amp. (non-tripping). Breaker *B'* will therefore stay closed, as will also breakers *C'* and *D'*.

Condition 6.—The instant after breaker *A* trips, the total current in transformer for relay *A'*-1 will be 40 amp. (ground current), 30 amp. (tripping) through relay *A'*-1 and 10 amp. (non-tripping) to relays *B'*-1, *C'*-1 and *D'*-1. But relay *A'*-1 is also receiving 1$\frac{1}{4}$ amp. (non-tripping) from feeders *B*, *C* and *D*, making a total of 26$\frac{1}{4}$ amp. (tripping). Thus breaker *A'* will be tripped, if not already opened by condition 5. (Had the ground current been assumed at 20 amp. or 30 amp. instead of 40 amp. this condition would be more apparent.) Relay *B'*-1, *C'*-1 and *D'*-1 need not be considered in detail here.

Condition 7.—After breaker *A'* opens, the resultant current in relay *A'*-1 is found to be in the non-tripping direction.

Condition 8-9.—When a circuit breaker opens, its relays are automatically short-circuited, so there will be no current in the relays for feeder *A*. The load formerly carried by the four feeders is now taken care of by the three remaining ones, and normal conditions have been restored. This scheme actually operates with "almost human intelligence," and, better yet, it is not apt to "lose its head" as an operator might do in an emergency.

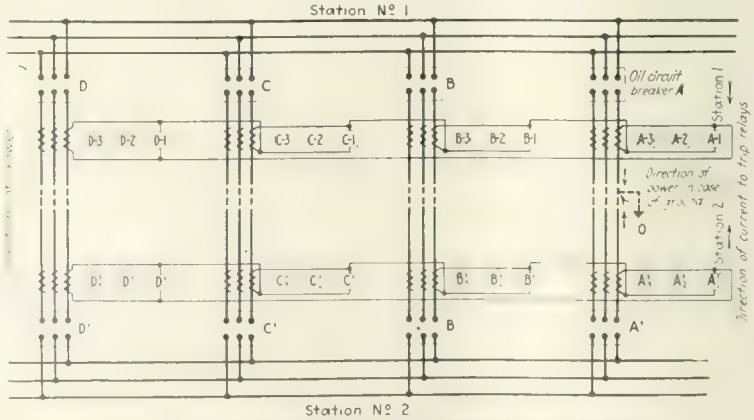


FIG. 2—CROSS-CONNECTED REVERSE POWER RELAY SCHEME APPLIED TO FOUR PARALLEL LINES

At substation X (Fig. 2) the 2,300-volt breakers are

shown in groups of five, each group having its own group breaker. This is done in order to obviate the necessity of using a breaker of high rupturing ability on each 2,300-volt circuit, thereby reducing the cost of breakers, structure, etc. The idea here is that a short-circuit on a 2,300-volt feeder will immediately open the breaker for that group. The opening of the group breaker will then trip the breaker on the damaged feeder, after which the group breaker will automatically reclose, restoring service to the other feeders of the group. As this scheme is somewhat complicated and of rather limited application, it will not be discussed in detail.

When one leg of a circuit becomes grounded, one of two things may happen—either the ground may immediately develop into a short circuit or it may be of rather high resistance with insufficient current to trip the breaker, in which case it may "hang on" for quite a while. An overload relay placed in the neutral (secondary) of the current transformers, as shown in Fig. 3, may be used to remedy the latter trouble. Under normal conditions, the currents in other parts of the circuit being equal, there will be no current through this relay, but if conditions become disturbed, as just described, the unbalanced current in the neutral will cause the relay contacts to close, tripping the breaker. When such a scheme is used it is impossible for the operator to tell whether a breaker opened on a short circuit or a ground, but the fact that the breaker did open is evidence to him that there is something wrong on that circuit, and he should immediately take steps to locate the fault and remove it. It is interesting to note in this connection that the cross-connected reverse-power relays will often trip a circuit on a ground before the ground develops into a "short."

Choice of Relays For a Typical System

Having outlined the various relay schemes, our next step is to see what applications should be made on a system such as shown in Fig. 4. The radial feeders from various stations have been omitted from this sketch, as they are shown in Fig. 1.

We find on studying Fig. 1 that all generators are equipped for differential protection. The power transformers at substation X likewise have differential relays.

On the transformer banks between stations A and C polyphase differential power relays give the differential protection needed, while straight overload relays are

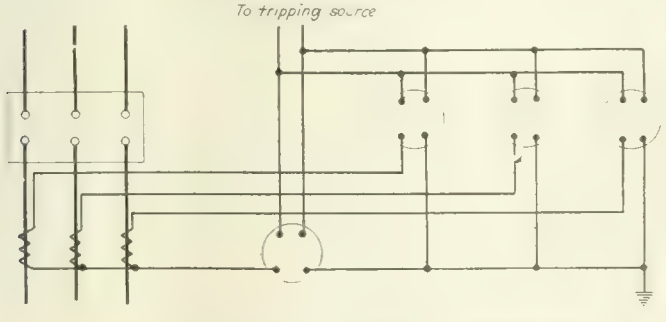


FIG. 3—GROUNDED LINE IS QUICKLY DISCONNECTED BY RELAY IN NEUTRAL WIRE

added to take care of line troubles. These overload relays would operate on the high-tension breakers only, isolating the 100,000-volt line, but leaving the transformer bank "alive." If it seemed advisable, connections could easily be made so that the overload relays would trip both high-tension and low-tension breakers.

On the 13,200-volt tie lines between stations A and B the cross-connected reverse-power relays would be used. If conditions between stations A and C are the same as between A and B, the cross-connected scheme can be applied instead of the differential and overload scheme just outlined. As a rule, however, these 100,000-volt lines would be run in different directions to insure continuity of service. Therefore, these lines would be of unequal lengths, unequal resistance, etc., and the cross-connected scheme would not be so easily applied in their case. For the tie lines supplying substation X plain overload relays will suffice, as their main duty is to protect the substation apparatus. At substation X the group system can be used for the 2,300-volt distribution system. The group breaker, or one controlling every set of five smaller breakers, would be set for almost instantaneous operation, as its high rupturing ability will allow this. The sequence of operation here should be as rapid as possible, in order to restore service on the remaining circuits of the group with the least possible delay.

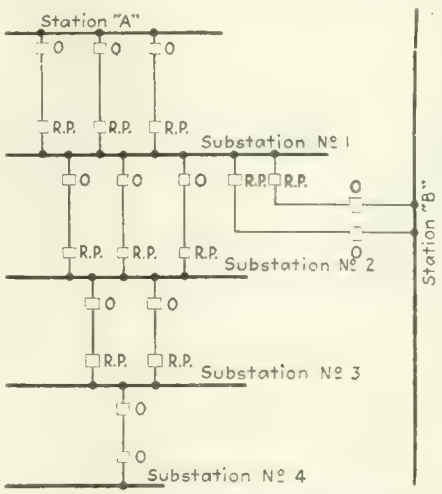


FIG. 4 — COMBINED REVERSE-POWER AND OVERLOAD RELAY PROTECTION FOR RADIAL FEEDERS

Fig. 4 shows three parallel feeders leaving a power station—say A—and supplying several substations Nos. 1, 2, 3 and 4. The feeders leaving station A and substations Nos. 1-2, 2-3, and so on, are equipped with overload relays, but where these lines go into the various substations reverse-power relays are used. For instance, if trouble should develop at substation No. 3, the overload relays at substation No. 2 would operate and clear the trouble. But suppose a ground should occur on one of the lines between 2 and 3, then the overload relay at 2 would operate and isolate that end of the line. The remaining good line between 2 and 3 would tend to supply current to the fault, but this would cause the reverse-power relays at 3 to function, thus completely isolating the damaged line from the system. As there is only one feeder from 3 to 4, there is no occasion for reverse-power relays, and plain overload relays would be used on both ends of this line.

At substation No. 2 are shown two incoming lines from station B in addition to the three from station A (through substation No. 2). These two lines would have overload and reverse-power relays, the same as from station A possibly—however, with a different time setting.

The overload relays are so set that the ones farthest from the source of power operate in the shortest time. In this case, if relays at substation No. 4 are set for one-half second, there might be found one second for No. 3, one and one-half seconds for No. 2, two seconds for No. 1 and two and one-half seconds for station A.

As these substations are normally supplied from station A, with station B as an emergency source of power, the overload relays at station B would probably have a low setting, say one second, so that trouble originating at these substations could not seriously affect the system supplied from station B.

All of the reverse-power relays shown in Fig. 4 would have a low time setting. If the breakers will stand the service, these should be set for practically instantaneous operation.

There are many other combinations of relays that might be discussed in this connection, such as balanced current protection for parallel lines (instead of cross-connected reverse-power relays), mechanically balanced differential relay for two parallel lines, balanced power protection between two parallel lines, etc. As stated before, however, the study of relays is a never-ending process, and it is not in the scope of this article to discuss all schemes, but merely to bring out the salient points of the ones most commonly used.

Regular Meter Inspection as Money Saver

Inherent Errors of Meters Are Not So Serious as Much Larger Discrepancies May Result from Improper Connections, Miscalculated Ratios and Existence of Both Three-Wire and Four-Wire Service from Same Transformers

By A. L. JOHNSTON
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SINCE the income of lighting and power companies is almost entirely dependent on metering, it is very important that the metering devices should register accurately and that the meters with their potential and current transformers should be properly connected and of proper ratio.

Notwithstanding the precautions taken by most companies of any size, the writer believes that many power systems have metering equipments and installations which are causing the companies thousands of dollars' loss annually, much of which could be detected by a careful general inspection without the necessity of checking the meter against a standard. In fact, a superficial general inspection will sometimes show discrepancies probably not discoverable in a routine test.

Numerous cases can be recalled which illustrate this contention. In one particular instance a consumer had 400-amp. current transformers, ratio 400 to 5, connected to a meter calibrated for 200-amp. current transformers, ratio 200 to 5. The result was that the meter registered only one-half of the load which it should have registered, and as this condition had continued for three years the loss involved a total of $10,000 for this one installation. In another case the wrong gear train was discovered on a meter registering a 400-kw. load and the resultant registration was one-half of what it should have been. The loss was very considerable as the condition had continued for years. It is quite probable that this irregularity would have escaped undetected in a routine test.

Many errors arise through the difficulty of tracing out the current and potential secondary wiring. This is usually eliminated by the use of a standard color scheme. Experience has shown that it is desirable to use solid colors, as red, white and blue for potential and red, green and black for current, red being used for the grounded middle wire in both instances. Solid colors are more desirable on account of the ease with which a marker in the braid becomes obscured by dirt or coal dust. Some companies carry the idea further and paint the color scheme on the meter to aid the less experienced metermen in connecting up the meter correctly.

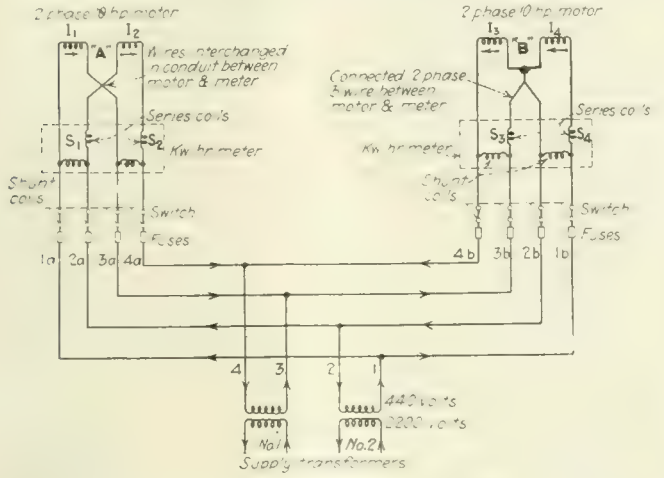
A very common error familiar to all metermen is to find the shunt coil of a meter supplied with potential from one phase and the corresponding series coil supplied with current from a different phase, or to find the current or potential reversed. If the potential and current in the same element are both reversed and are opposite in polarity to that shown in the diagram of connections as furnished by the manufacturer, the meter will register correctly. Comprehensive detail tests for the accuracy of meter connections are given in the "Electrical Meterman's Handbook," N. E. L. A., 1912.

Where two-phase is used for power there are usually cases of metering errors to be found due to the fact that some companies permit both three-wire and four-wire connections from the same set of power transformers. Recalling a special case, a consumer who may be designated as B raised objection to the amount of his power bill. On testing the meter it was found to be within the prescribed limits of accuracy when checked against a rotating standard. It was discovered, however, that when the one and only motor on the premises was idle the meter still showed a load of approximately one-third of what it did when the motor was running. On tracing out the wiring it was noted that the conduit between the meter and the motor contained a two-phase, three-wire system instead of two-phase, four wires. The two middle wires were spliced within the conduit to one wire. This of itself could give rise to no such irregularity as existed, the series coils of the meter being connected to measure the current properly and the potential coils being connected to the proper phases. The only other load on the transformers supplying this motor was about four blocks away, where there were a two-phase motor of the same size and a similar metering equipment. A careful inspection of the wiring of this second motor disclosed that four wires were run to the motor but that inside the conduit one wire of each phase was interchanged with the other.

Calling the latter consumer A, it is evident by referring to the diagram of connections shown herewith that A's motor could not have been started up had it been the only motor on that set of transformers, since both phases of the motor would have been operating in series with the two transformers and this would have been equivalent to running on single-phase. But on account of the two middle wires being tied together inside B's premises A's motor was able to operate satisfactorily on what was really a two-phase, three-wire system. By tracing out the diagram of connections it will be evident

how this condition causes B's meter to run approximately 50 per cent faster than it should and at the same time causes A's meter to run at approximately one-half speed.

Referring to the accompanying diagram again and assuming for simplicity that the power factor in both cases is unity and that the same amount of current flows



UNUSUAL CONNECTIONS THAT CAUSED INCORRECT REGISTRATION

through the phases of both motors, it is interesting to trace the current:

From transformer No. II it goes through wire 1, 1-*b*, series coil of meter *S*-4, one phase of B's motor, 2-*b*, wire 2, back to transformer No. II. From transformer No. I through wire 3, 3-*b*, series coil *S*-3 of B's meter, through remaining phase of B's motor, 4-*b*, wire 4, and back to transformer No. I. As the potential coils on B's meter are connected in a proper manner the meter thus far registers power accurately.

Considering A's motor, current leaves transformer No. II, passing through wire 1, to the left through 1*a*, one phase of A's motor, 3*a*, 3*b*, series coils *S*-3 of B's meter, in the same direction but in quadrature with the former current in this coil, back through 2-*b*, wire 2, and to the transformer from which it started.

Note that in this case the current did not pass through a series coil of the meter in A's possession and that this phase of the motor was not metered.

Starting from transformer No. I, the current passes through wire 3, to the right through 3*b*, series coil *S*-3 of B's meter, in the same direction and in phase with the first current through this winding, through 2*b*, 2*a*, series coil *S*-1 of A's meter, through the second phase of motor, through series coil *S*-2 of A's meter, 4*a*, wire 4 and back to tranformer No. I.

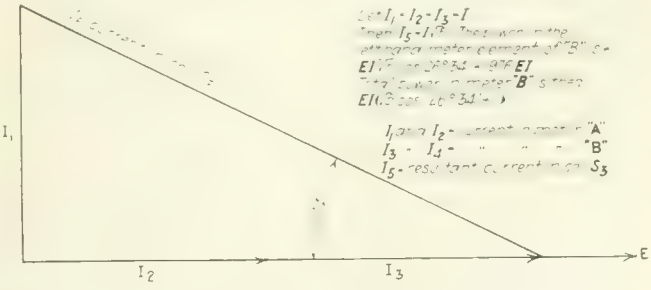
The current in the potential coil, operating with the series coil *S*-1, is approximately in quadrature with the current in *S*-1, being connected across a different phase, and the element of this meter will not cause registration. In the other element of the meter the shunt and series currents are in phase and will cause one phase of the motor to be metered. This meter registers one-half of what it should. Considering B's meter, it is seen that the current in the series coil *S*-4 operates in phase with the potential as above noted, and this element records correctly. In the other element the current in the coil *S*-3 is $I\sqrt{5}$ as shown on the vector diagram and is about 26 deg. out of phase with the voltage in the shunt coil. The resultant registration for this element is very nearly twice what it should be, thus causing the meter as a whole to record 50 per cent fast.

Another case, different from the above, is recalled for which there would appear to be no excuse. In metering a two-phase mining load of about 500 hp. the series coils of an indicating wattmeter were connected in parallel with the series coils of a watt-hour meter. Assuming the impedance of the series coils to be all equal, the resultant registration as indicated by the meter would be one-half what it should have been. This condition, incredible as it may seem, had existed for about fifteen years.

Large errors in metering are somtimes detected by the simple expedient of estimating the motor load and timing the speed of the disk of the meter. Some meters are designed to run twenty-five revolutions per minute at full load. For others it is necessary to know the watt-hour or watt-second constant of the rotating element, as indicated on the disk of the meter, in order to determine the load. As an example of this superficial test assume a 50-amp., 500-volt, polyphase watt-hour meter registering the power taken by a 50-hp. motor which one believes to be running close to full load and to be taking about 36 kw. Since the full load for the meter is 50 kw., its speed should be $(36 \div 50) \times 25 =$ 18 r.p.m. Now, if the rotating element of the meter runs only 10 r.p.m., there is reason to suspect its accuracy and further investigation should be made.

Where the full-load speed of the meter is not known, the disk constant must be used and the checking of the meter as above is equally simple. Assuming the same motor load as above and that the disk constant of the meter is 20 watt-hours, the kilowatt load on the meter as recorded is equal to $(20 \times \text{r.p.m.} \times 60) \div 1{,}000$. Now, if the speed of the meter is 18 r.p.m., the recorded load will be, according to this formula, 21.6 kw. This would be too great a discrepancy to allow to pass without further investigation.

It would materially assist in the detection of errors if the load corresponding to one revolution of the disk per minute were indicated on the name plate, taking into account the ratios of the current and potential transformers. Some companies follow the practice of using 5 amp. watt-hour meters on their systems. The power consumption is, of course, multiplied by a constant depending upon the above ratios. When it is necessary to install larger capacity transformers the constant is changed. Another aid to the detection of errors is to



RELATION OF CURRENTS IN CIRCUITS SHOWN IN ACCOMPANYING DIAGRAM

have where possible a totalizing meter which will check against several separate meters.

If errors in metering were not so surprisingly frequent and costly, their simplicity would prevent mentioning them except as of academic interest. The losses are, however, so very considerable and the probability of the bills being adjusted after a lapse of time is so remote that no efforts should be spared for their prevention.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Quick Solution of Line-Drop Problems

To the Editor of the ELECTRICAL WORLD:

SIR: In looking over the voltage-drop chart inserted in the ELECTRICAL WORLD for May 28, page 1238, with my article entitled "Chart for Quick Solution of Line-Drop Problems," I find two or three points which should have some explanation or correction.

There is no reference on the chart itself to the fact that it covers 60-cycle lines of stranded copper conductors only. Referring to No. 2 conductor, top line, this should have been marked 15-ft. instead of 10-ft. spacing. The correction curve would probably have been more readily understood had it been marked "subtract percentage correction from drop at receiver to obtain drop from generator to receiver."

Your readers undoubtedly noticed that, for the example worked out in the text, the constant K was printed 20 instead of 200.

E. P. PECK,
General Superintendent Electrical Department.
Utica (N. Y.) Gas & Electric Company.

Utilities, Not Engineer-Bankers Alone, Should Educate Investors on Their Securities

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with interest your editorial in the ELECTRICAL WORLD of May 21 on the need for an executive-engineer-banker in the electrical industry. Without attempting to discuss the matter at length, I would offer one or two suggestions which may prove beneficial.

First—There are already many engineer-bankers in financial circles. The partners of many of our larger bond houses graduated into financial circles from engineering. They are thoroughly conversant with conditions in the electrical industry as well as in financial affairs. In my opinion the banking profession is well equipped to understand the problems of the light, power and traction companies. Funds for the development of such companies come ultimately from the investor and not from the banks. In some instances banks may purchase issues of bonds, but they are distributed ultimately through the bond houses or through the banks' own distributing salesmen to the private investor. In days gone by, when there was such a thing as a capitalist in this country, the bonds and stocks of new enterprises were purchased and held either in bank loans or by the capitalist until they could be distributed. But such funds are no longer available.

Second—Irresponsible jitney and other competition, the restrictive attitude of public service commissions and the tremendous increased cost of labor and supplies, on the one hand, and the denial of rate increases to offset these factors, have so hampered the traction investment field that such financing is extinct. Not only is it extinct, but it rises up from its grave and casts its black shadow over light and power financing. Many an investor in this country in the past few years has been caught between the devil of the traction strike and the deep, very blue sea of receivership—and in many instances he has had to face both ways at the same time.

Third—Banks, investing institutions and bond dealers, or individual investors, will purchase electric light and power securities because they believe this part of the industry is relatively free from labor troubles and the business can be made comparatively stable, provided that rates are by definite agreement made commensurate with costs of supplies, including coal. However, in this branch of public utility financing even, conditions have changed materially and the competition of foreign and domestic government loans has so raised the price of capital as to make it prohibitive under the old rates and public service restrictions.

The remedy for these conditions and the loosening up of capital for light and power financing lies not in the creation of a new national engineer-banker, but in the education of the investing public by those most deeply interested—that is, by the light and power companies through their national organizations.

1. The general investor must be shown that his property values are safe and that his securities are protected as to earnings. The citizen in the territory served must be shown that if he does not encourage the investment of capital he will lose the service. Two objects can be accomplished at once by the sale of junior securities in a local community. Junior financing is accomplished and every citizen is made a partner in the enterprise.

2. A sliding scale of charges for service should be provided in some legal form, as has been done with success in several instances. The scale should not only include the price of material and supplies but also the price of labor and capital.

3. Sufficient returns should be allowed on new construction to encourage investment in such new construction. The expansion of the industry and the development of new enterprises will never be accomplished as long as the reward is dependent simply upon the economies which can be effected in the art itself.

The light and power companies are well equipped to enter such a campaign of education of the private investors. The newspapers, monthly magazines and general publications will be not only glad to publish discussions of this problem, but will be anxious to do so.

Campaigns which many concerns have conducted to sell preferred stock to their customers have resulted in tremendous good and in my opinion have been responsible in many instances for the changed attitude of public service commissions and the public behind them. The physical merger of large interconnected systems will, undoubtedly, result in many economies which will bring some benefits to the consumers, some profit to the stockholders of the various companies involved and some additional element of safety for the senior security holders in increased net earnings available for interest charges. But the development of service for each community can never be accomplished until the general investing public has concrete evidence that its investment is safe and profitable.

No engineer-banker, single-handed, can do this work of educating the public and the investor. No banker, bond dealer or investment bankers' group can be expected to do this work, because these interests are all concerned in general financing—other financing as well as public utility financing. It rests with the light and

power companies alone to see that the public shall be educated so that its property and earnings will be protected and that thereafter the investor shall be shown that his investment is both safe and profitable.

Harvey Fisk & Sons, F. O. MARCH,
New York City. Vice-president.

Analysis of English Investigator's Comment on Sparking Voltages in A. I. E. E. Rules

To the Editor of the ELECTRICAL WORLD:

SIR: An editorial in the ELECTRICAL WORLD for April 9, 1921, has called my attention to the paper of Dr. Alexander Russell on "Sparking Voltages Between Spherical Electrodes" in the *Journal* of the (British) Institution of Electrical Engineers for October, 1920.

Dr. Russell does not give any new experimental results but limits his investigation to an analysis of existing data. In this are included the curves given in the Standardization Rules of the American Institute of Electrical Engineers, as well as other data extending back some twenty-six years. As a result of a mathematical study Dr. Russell concludes that the curves of the A. I. E. E. for the case where one sphere is earthed or grounded are incorrect because of apparent inconsistencies between the mathematical study and the experimental results. His speculation as to the probable cause of the apparent inconsistencies, namely, that the earthed sphere was not at zero potential because the neutral and the end of the testing transformer winding were both grounded at the same time, is, from the practical standpoint, impossible. This is, of course, obvious when it is considered that the transformers used in making these tests had capacities varying from 200 kva. to 500 kva. and that the power was often connected for several hours.

There can be no reasonable doubt that the experimental curves as given in the A. I. E. E. rules are correct within the limits claimed. The data were obtained and checked independently by separate investigators.* Any appreciable error would have been found in the many tests made during the years that the gap has been in use, as there is always a check in the way of a voltmeter coil, transformer ratio or step-down transformer with a crest voltmeter.

If Dr. Russell had consulted the original papers published in the *Transactions* of the Institute, his conclusions would probably have been quite different, since virtually all the points that puzzled him were not only pointed out in 1913-1914 but thoroughly discussed. The equations for the gradient and the spark-over voltage of the gap were also given at that time.

It may help to go briefly over the points under discussion. Dr. Russell's analysis consists in mathematically calculating from the measured voltage the gradient at which breakdown occurs for different sizes of spheres at different spacings. It seems reasonable to expect a constant value for each size of sphere if the calculations can be correctly made. These calculations show that over a prescribed range of spacing the gradient at breakdown is constant when both spheres are insulated. When one sphere is grounded or earthed the mathematical calculation of the gradient does not give a constant value for the apparent strength of air. So far I agree with Dr. Russell and I have pointed this out in the discussion in 1913 referred to above and upon other occasions since then.

The gradient is calculated from the experimental data as follows:

$$g = (e/x)f \text{ kv. per cm.}$$

where

g = gradient,
e = measured voltage,
x = spacing,
f = a factor calculated from geometrical dimensions.

The factor f is different for the grounded and non-grounded cases. In determining f mathematically, because of complications, it is necessary to neglect the effect of shanks, connecting leads, the distance above ground, etc., and to make the calculations for two spheres in space at given potentials. For the case in which both spheres are insulated the above factors have very little influence at the spacings used in practice. Where one sphere is earthed or grounded, however, they may have a decided influence. It was for this reason that we determined the factor f experimentally. It differs considerably from the mathematical value. In fact, the distance above ground and the size of the shanks have a considerable influence. For this reason the size of shank and distance above ground are specified in the Institute rules.

The deviation noted by Dr. Russell could be due to error in the measured e, to the potential of the grounded sphere or to the mathematical f. Since in the measured curves there can be no reasonable question as to the accuracy of e, or as to the fact that the grounded sphere was at zero potential, the cause of the deviation must be in the mathematical f. It is easy to demonstrate experimentally that the apparent increase in the gradient is due to the mathematical f, which does not take into account the effect of surrounding objects. The question is discussed in the references given above.

It is interesting to note that the formulas given by Dr. Russell for the strength of air at the sphere-gap surface at the instant of discharge check well with those derived by us in 1913.

Dr. Russell finds:

$$R_{max.} = 27.4 + (14.1/\sqrt{a}) \text{ kv. per cm.}$$

$$E = \frac{x}{f}\left(27.4 + \frac{14.1}{\sqrt{a}}\right) \text{kv.}$$

Our original formulas were:

$$g_s = 27.2\left(1 + \frac{0.54}{\sqrt{R}}\right) \text{kv. per cm.}$$

$$e = \frac{x}{f}27.2\left(1 + \frac{0.54}{\sqrt{R}}\right) \text{kv.,}$$

which put in the same form and terms given by Dr. Russell become:

$$R_{max} = 27.2 + \frac{14.7}{\sqrt{a}} \text{kv. per cm.,}$$

$$E = \frac{x}{f}\left(27.2 + \frac{14.7}{\sqrt{a}}\right) \text{kv.}$$

The formulas are identical with the exception of a small difference in the constants. The check is quite remarkable when it is considered that Dr. Russell used the data of a number of investigators extending over a long period of time.

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Pittsfield, Mass.

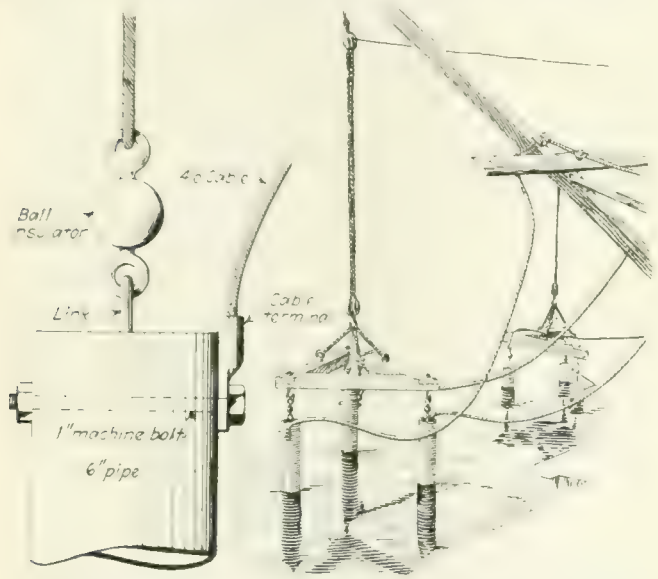
*Chubb and Fortescue, "Calibration of the Sphere-Gap Voltmeter," *Transactions A. I. E. E.*, February, 1913, Vol. 32, page 739; Peek, discussions, *Transactions A. I. E. E.*, February, 1913, page 812; Peek, "Sphere Gap as a Means of Measuring High Voltage," *Transactions A. I. E. E.*, June, 1914, Vol. 33, page 923; Peek, "Dielectric Phenomena in High-Voltage Engineering," pages 92 and 93, McGraw-Hill Book Company.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Fresh-Water Rheostat Handles 900 Kw. at 4,000 Volts

A MEANS for loading a 1,000-kw., 4,000-volt, three-phase, waterwheel-driven generator to full capacity was desired recently for a test at the new power plant of the Lockwood Manufacturing Company, Waterville, Me. The conditions of the test were that the load should



BALANCED CURRENTS OF 128 AMP. AT 4,000 VOLTS WERE TAKEN BY THIS RHEOSTAT

be maintained with little variation for long periods and that it should be easily controlled and quickly adjusted to widely different values. The fresh-water rheostat was decided upon as best meeting these conditions.

Attempting to determine the final form of rheostat to be used, the specific resistance of the water not being known, the writer first constructed a rheostat of three 10-ft. lengths of 6-in. iron pipe hung in a straight line, each outer electrode being spaced 15 ft. from the center electrode. With each electrode immersed 8 ft., this rheostat was expected to carry a balanced load of about 1,500 kw. at 4,000 volts, but the load actually obtained was 300 kw., with phase currents of 50, 25 and 50 amp. respectively. A second rheostat was then constructed, using the three 10-ft. lengths of 6-in. pipe hung in an equilateral triangle with 4-ft. sides. The load obtained with the electrodes immersed 9 ft. 6 in. was 392 kw. with phase currents of about 57, 53 and 60 amp. The final rheostat was composed of the second one and another unit made of three 10-ft. electrodes hung in an equilateral triangle with 3-ft. sides, the two elements or triangles being hung on 15-ft. centers. The electrodes of the two units were connected in parallel, but unsymmetrically. With all electrodes immersed 9 ft. 6 in. the load obtained was 890 kw. at 4,000 volts, with phase currents of about 128 amp. balanced within 0.1 per cent. The load for any setting of the electrodes remained within 0.2 per cent for hours at a time. With only a gentle flow of water there was no dissipation of heat perceptible to the eye. Had the electrodes been long enough to immerse 10 ft. 8 in., the load would have been about 1,000 kw.

The rheostats were hung in a forebay about 18 ft. deep and several hundred feet wide. The water was somewhat affected by industrial wastes from upstream, which caused the specific resistance of the water to vary from day to day. The only structure near the electrodes was an iron intake grating, electrically neutral and about 15 ft. distant on one side only.

It appears from the results of the tests that the load varied with the separation of the electrodes and that a symmetrical arrangement is necessary for satisfactorily balanced loads.

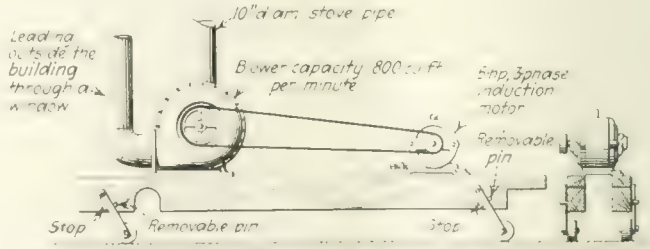
D. J. LOCKE,
Electrical Engineer.

With Albert S. Richey,
Consulting Engineer,
Worcester, Mass.

Removing Dust from Building When Blowing Out Generators

WHEN blowing out generators in a Canadian plant a great deal of trouble was experienced some time ago because the dust from one generator was blown into the other machines and was never removed from the building. To remedy this difficulty the writer designed a box tent which was placed over the machine being worked on. When the dust is blown from the windings it is drawn out of the tent through a pipe connected to a blower and discharged on the outside of the building. The man inside wears a gas mask while blowing the dust from the windings with an air hose.

Iron pipe 1¼ in. in diameter is employed for the frame of the tent. This is fastened together with pipe brackets and U-bolts. Cross pieces of ½-in. pipe run across



EXHAUST OUTFIT FOR BLOWING OUT GENERATORS

the frame near the bottom to steady it. Each upright member has a flat fitting at its lower end to give a steadier support. The exhaust pipe is made of 10-in. stove pipe in 3-ft. sections. The end entering the tent is fastened in a sheet-iron plate which rests on two cross-pipes at the top of the frame. The exhaust line is also of stovepipe, which is led through a window to the outside of the plant. The blower and the motor are

set on two timbers. For convenience in handling, rollers have been fastened to the timbers on pivoted arms as shown.

When the blower is to be placed in operation the rollers are let up into the recesses cut in the timbers, which then rest firmly on the floor. When it is desired to move the outfit the rollers are let down and the pins are inserted in place. One man can move the unit with very little trouble. R. H. N. LOCKYER.

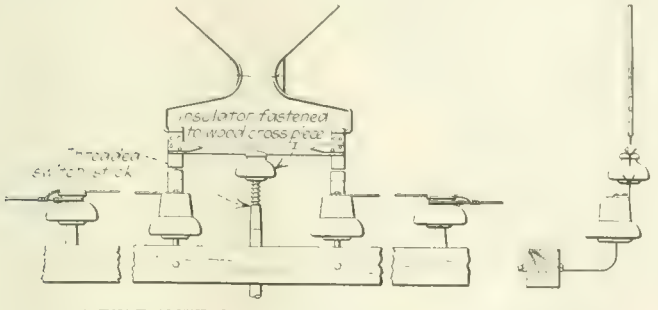
Bonnington Falls, B. C., Canada.

Fused Horn-Gap Cut-Out and Disconnecting Switch

FREQUENTLY in construction work an inexpensive primary cut-out is needed that will safely handle the current it may be called upon to break and that can be quickly and cheaply installed. In such work there may be several transformer banks that are installed only for a short time, and some device is needed whereby each may be cut off from the others in case of trouble, or to permit repairs to connected apparatus. High-voltage oil switches are desirable, but the expense of these is prohibitive. For several years the San Joaquin Light & Power Corporation has used a bracket with a fuse contained in a porcelain tube for such purposes where the load did not exceed 10 amp. This gave good results, but when heavy currents were broken in this fuse the arcs were so severe that the tube and holders were sometimes destroyed.

As an improvement on this arrangement the porcelain tube was replaced with horns of copper rod and the gap, equivalent to double the spark-over distance for the voltage used, was closed with fuse wire. Tests on a 50-kva., 11,000-volt transformer showed that the arc was quickly extinguished after the fuse had blown. A number of sets of these horn-gap cut-outs were used on one of the large construction projects completed during the past year and gave results which have been very satisfactory.

The method of installation is clearly shown by the cut. The threaded stick in the center is used to place or remove the cut-out, after which it is unscrewed from the insulator in the center. The cut-out is intended only as a protective and disconnecting device and has not been used to switch on or off apparatus carrying current. In an emergency the current can be quickly



THIS INEXPENSIVE SWITCH IS OF VALUE ON CONSTRUCTION WORK

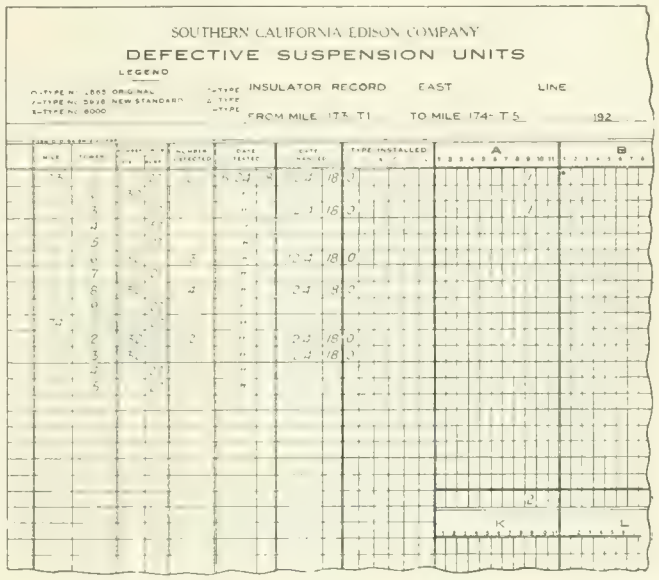
Threaded stick is used for handling gap which is mounted on horizontal wooden crosspiece

broken by mechanically breaking the fuse wire with the switch stick, after which the cut-out is removed and re-fused when it is ready to be placed again in service. HARRY L. WOOD.

San Joaquin Light & Power Corporation,
Fresno, Cal.

Records Show Life of Suspension Insulators

ANALYSES of insulator failures and tabulations to show the life of suspension-insulator units placed in various positions in the strings of insulators have been made available through the use of a complete record-keeping system devised by the Southern California Edison Company. These records are kept on the insulators on the 240-mile, 150,000-volt Big Creek transmission line of that company. The Big Creek line consists of two single-circuit steel-tower lines with the conductors insulated by nine suspension units in suspension and two strings of eleven units each in parallel on dead-ends. All of the units on the line are meggered at about one-year intervals, and the results are entered in surveyor's field books by the patrolmen who make the test. In these books are indicated the mile



THESE RECORDS CONSTITUTE COMPLETE HISTORIES OF INSULATOR UNITS

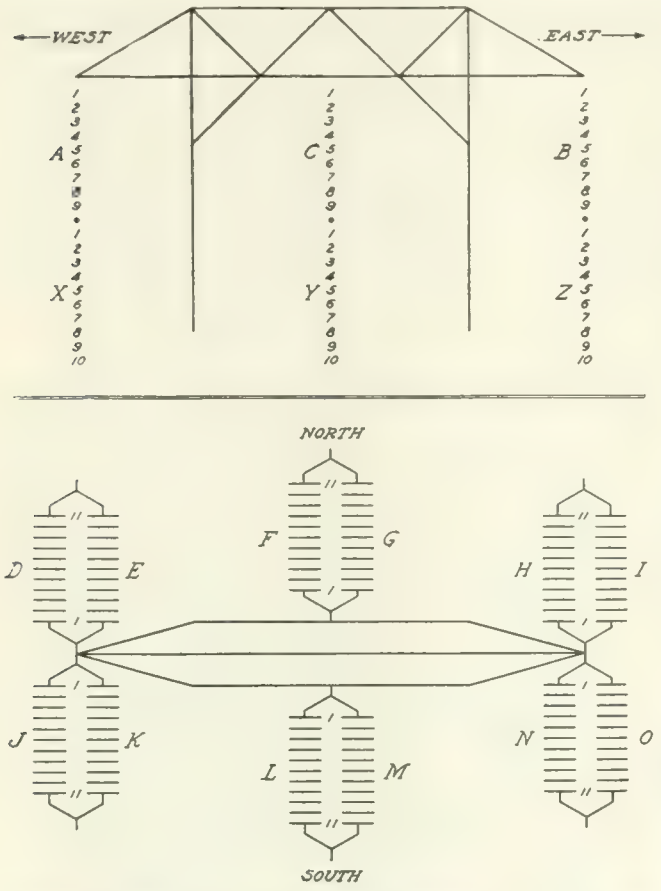
Each sheet is 12½ in. × 28 in. and is bound in a ledger-type binder

and tower number, the kind of construction (whether suspension, dead-end or tie-downs), the make of the insulators, the total number of insulators tested on each tower, the number of insulators found defective, the position in the particular strings of the defective units, the date when the defective insulators were changed, the type of insulators removed and the type of insulators installed to take their places. If there are two or more defective units in one string at the time the megger tests are made, these are changed immediately, but if there is only one in a particular string found defective, they are not changed at that time, but left until some future date when all of the defective units in a particular section are changed.

The field books are turned in to the office of the chief patrolman, who enters the records on a loose-leaf form sheet as shown in the cut. There is sufficient space on each of these sheets to enter the records of the insulator tests on twenty towers. The sheets are made in duplicate, one set being for the general office and the duplicate set for the use of the chief patrolman. On the front of these sheets are shown the number of insulators on each tower, the number found defective on the towers, the date of the test and the date when the insulators were changed, together with the make of the

insulator. As shown on the reverse side of the sheet, to each of the strings of insulators on the several types of tower construction a letter is given to designate it, and the individual units are numbered, begining with the one nearest the attachment to the tower.

Interesting data as to the character of the country traversed by the line is printed on the back of one of



THESE DIAGRAMS ARE USED IN KEEPING RECORDS OF INSULATORS

The diagrams are printed on the back of the record sheet shown at the preceding page. Each string on a tower is given a designating letter and each insulator in the string has a number.

these sheets, which is of use in analyzing the cause of insulator failures.

The average life of the suspension insulator has not yet been determined. By the systematic use of this method of keeping the records the average life of the different types of insulators and of insulators in different localities and in different string positions will be obtained.

S. R. Van Drezer,
Chief Patrolman of Big Creek Lines.
Southern California Edison Company,
Kern, Cal.

Automatic Operation of Substation in Emergency

THE effectiveness of automatic substations for light and power service was shown recently when trouble occurred on the system of the St. Paul Gas Light Company. The trouble began on one of the trunk lines and caused a momentary drop in voltage. The line was not cleared immediately, and all of the synchronous apparatus at the manual station was put out of service. The automatic substation cleared itself from the line but was restored automatically to service in a few seconds. It helped to take care of the direct-current network, which was immediately picked up automatically by a storage battery at the manual station. The voltage on the direct-current system dropped from 240 to 180. The contactors on the line panel of the automatic substation opened, cutting in resistance. This station continued giving service, however, through this resistance until enough of the manual station equipment was brought back into operation to restore service to normal. The period of trouble lasted for about five minutes.

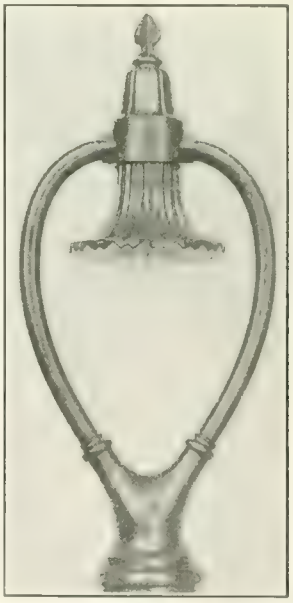
The automatic substation installed on the system of the St. Paul Gas Light Company was the first automatic substation ever put into use in light and power work, according to the Westinghouse Electric & Manufacturing Company. The substation was placed in operation some months ago, and the result has been entirely satisfactory.

Extensions on Cross-Arm Braces Support Ground Wires

AN ARTICLE under this heading published in the Electrical World for April 30, page 995, through mistake appeared over the name of A. N. Voss. As a matter of fact the article was contributed by J. J. Luchessa, chief electrician of the Miami Copper Company, Miami, Ariz.

Globeless Street-Lighting Unit

GLOBELESS standards for series incandescent street lighting have been adopted by the city of Rochester, N. Y. About two hundred of these units were installed in an endeavor to secure an attractive and efficient lighting system for a residential district, with a minimum initial and upkeep expense. The globeless unit does away with the absorption of a diffusing globe, which, according to the General Electric Company, may be as high as 25 per cent to 40 per cent.



NO GLOBE EMPLOYED WITH THIS LIGHTING STANDARD

One piece of porcelain serves for insulator, reflector and socket holder. Lamp is bowl-frosted.

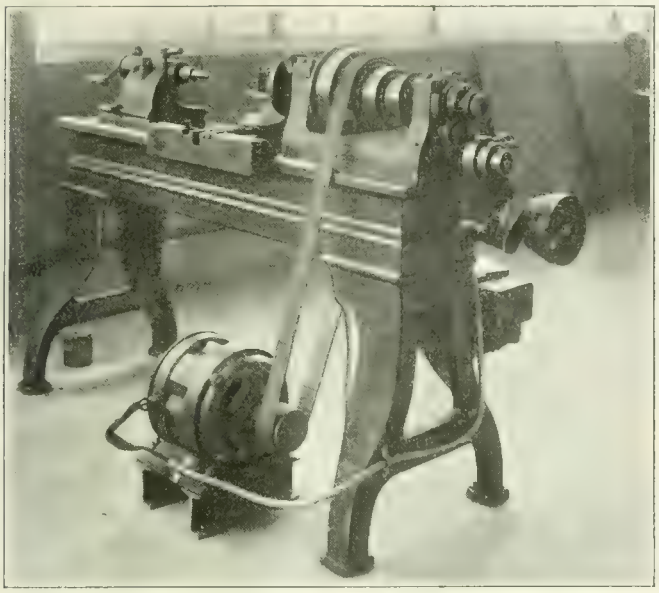
By extending the porcelain insulator of the new unit and flaring it at the bottom it is made to serve three purposes—those of insulator, reflector and socket holder. The design of the reflecting surface is said to be such that all the light from the lamp is sent down. Glare is eliminated by the use of bowl-frosted lamps so placed that the light source can be seen only against the white background of the porcelain reflecting surface. The globeless unit eliminates the initial expense of glass ball globes and the breakage in handling and operating. These factors and the utilization of one porcelain piece for both insulator and reflector give an added mechanical and dielectric strength. Moreover, the lamp support has a decidedly decorative appearance.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Lathes Changed from Group Drive to Individual Motor Drive

A LATHE originally designed for belt drive from countershafts above has been changed over to individual drive by a motor mounted on the floor in the factory of the Westinghouse Electric & Manufacturing



LATHE FRAME CUT AWAY TO ALLOW ROOM FOR BELT

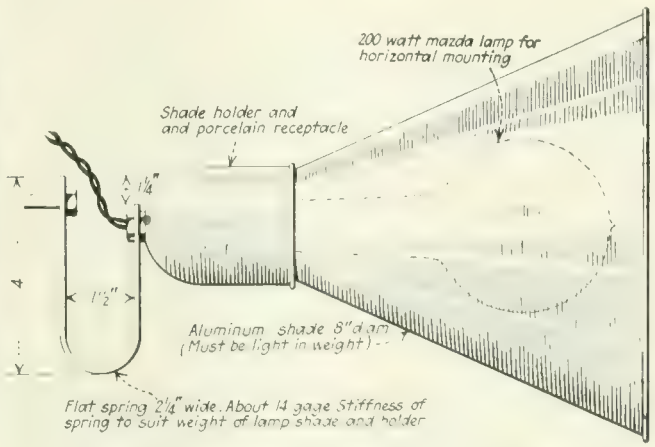
Company at East Springfield, Mass. As seen in the accompanying illustration, this 14-in. lathe is now driven by a 2-hp. motor mounted on two 4-in. I-beams bolted into the floor. To give clearance for the belt a portion of the frame of the lathe was cut away.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Spot Lamp for Traveling Cranes

ONE of the greatest handicaps to the safe and speedy operation of a crane is poor light, especially in crowded mills and where the overhead clearance is slight. A craneman should be able to see his cables at all times in order that even a broken strand may be noticed and give warning of a weakening cable. He should be able to see the hook plainly and get a clear view of his trolley so that he will be able to get square over the "lift." It is necessary that he see the limit switch so as to prevent closing it and causing delay. A mill or factory may have a good overhead lighting system, but when the crane is directly over the load the bridge will cast a shadow.

Owing to excessive vibration causing breakages of lamps, there is usually no attempt to place them on the crane, the logical place for them. The accompanying diagram shows a spot lamp that throws its rays just where the craneman needs it and furnishes light for the "hookers up." It is mounted on the cage on a spring which prevents breakage from vibration. It can be made in a few minutes and is inexpensive. It should be attached through a switch and a fuse to the crane switchboard and mounted on the front corner of



SPRING PREVENTS BREAKAGE OF THIS LAMP MOUNTED ON CAGE OF TRAVELING CRANE

the cage near the bridge girder, using one of the bolts that fasten the cage to the bridge. If desired a bar of iron may be used to extend the lamp out between the girders but not far enough to be struck by the cables or hook. R. S. LOWRY.

Cambridge, Ohio.

Treating an Edison Battery that Has Decreased Output

AN EDISON battery should be taken out of service whenever it fails to give its normal amount of work. Even if it does not fall off greatly in output, it should be treated every ten months. When a battery is removed from service, after the cells are flushed or watered it should be given a two-hour charge so that the solution will be thoroughly mixed. Take off of charge and test the gravity of the cells with a hydrometer.

If a reading below 1.140 is obtained, the solution will have to be renewed. This is done as follows: Discharge the battery completely (until its voltage is zero) by short-circuiting it. Do not allow such a heavy current to flow that it will overheat the connectors. Then pour out about half of the solution, shake the rest vigorously and empty the cell; then immediately pour in Edison standard renewal solution. The proper height of the solution is ½ in. above the plate tops.

When the battery has been refilled connect up and charge for twelve hours at the normal rate of charge. The next step is to determine whether the output of the battery is normal. Connect it across a suitable resistance that can be adjusted for the various steps needed

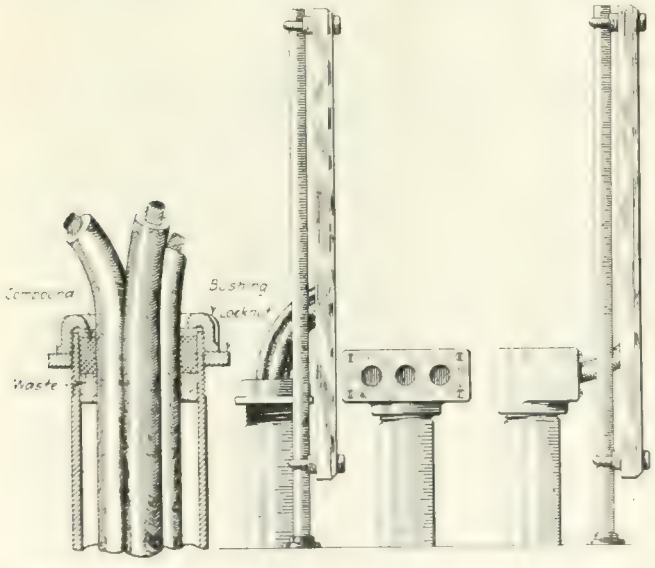
and insert an ammeter in series with it. Then close the circuit and set the rheostat to give the same current as the normal charging one. Discharge the battery at this rate for five consecutive hours. Each individual cell should be tested with a low-reading voltmeter at the beginning of the discharge and at the end of each hour. At the fifth hour each cell should have a voltage of 1, though as low as 0.97 volt is possible.

If there are any reversed cells, they should be removed and returned to the battery manufacturer for repairs, as such a reading indicates an internal short circuit. Any cell which has dropped below 0.97 volt but has a positive voltage (not reversed) can in the majority of cases be brought up in voltage by the following procedure: Remove the cell from the battery; charge fifteen hours at normal rate and discharge at normal rate to 0.5 volt; charge twelve hours at normal rate and discharge at normal rate to 1 volt; charge seven hours at normal rate and discharge at normal rate to 0.5 volt; charge twelve hours at normal rate and then discharge at normal rate for five consecutive hours and take the readings as before. This should bring the cell back to its normal rated capacity.

Fred A. Reibert,
Foreman of Battery-Repair Department.
American Railway Express Company,
New York, N. Y.

Neat and Economical Large-Conduit Terminal Saves Space

For terminating runs of conduit in sizes above 2½ in. a construction which requires little space and economizes in material cost and labor has been employed by the writer. The accompanying drawing shows the scheme as applied to ore bridges where there is much vibration. Where there is little vibration the



SPACE SAVED BY ENDING CONDUIT RUN IN THIS MANNER

compound and waste may be omitted. If the compound is used, some means must be provided to allow the escape of the moisture of condensation. If the conduit runs continually down grade and its end may be left open, no special precaution is necessary. If, however, there is a low point from which moisture cannot run out, a small opening should be made at this point.

This conduit terminal does not require the room required for the ordinary conduit fitting employed for this purpose. When such a fitting is used, for instance, behind a switchboard where space is limited the conduit must often be brought up to a foot or more away from the panel to allow the fitting to be turned on or off the conduit. Furthermore, the fittings take up considerable space sideways and thus prevent placing the conduits close together. By bringing the wire out straight through a bushing and a lock-nut space and labor are saved and the resulting appearance is better.

Chicago, Ill. Thomas Naf.

Requirements of Insulating Material in Motor Service

There are certain fundamental characteristics that insulations must have if they are to meet the operating requirements of motor service. While tests to determine these characteristics appeal particularly to motor designers, they should also be of interest to repairmen because they give about the best idea of what duty insulations must withstand and thus enable better selection and application.

The following characteristics are particularly important: Dielectric strength, mechanical strength, flexibility, susceptibility to acid, oil, moisture and heat; ability to conduct and radiate heat, cementing and sticking qualities, and finish. It is difficult to obtain any one insulation which ranks high in all these characteristics; hence a combination of treated and composite materials is usually required.

Some of the most important tests which experience has shown are essential and required on this variety of insulating materials will be given to show the refinement necessary in order to produce a motor correctly insulated that will finally pass the specified factory tests and at the same time stand up under the severe operating conditions to which it is subjected in service. These are outlined in the tabulation on page 1433.

To test the mechanical strength of cords, untreated and treated tapes and cloths to insure the selection of good strong materials that will stand the pull exerted by the workman, when these materials are being wrapped in place on the armature or field coils, the

TEST MADE ON FIVE SAMPLES OF CAMBRIC SHOWING BREAKING STRENGTH

	1 Lb	2 Lb.	3 Lb	4 Lb.	5 Lb.	
Warp—50	52	49	41	42		45 lb. average
Woof—22	27	24	31	29		27 lb. average

tensile test is used. The materials tested are cotton, tape, cotton sleeving, surgical tape, gray webbing, drilling, treated cloth, friction tape, friction cloth, treated duck, torpedo twine, jute rope and linen twine. One type of apparatus used in making this test is an automatic power cloth tester having a capacity ranging from 50 lb. to 300 lb. Specimens of cloth are cut 1 in. wide and about 6 in. long, while samples of tape and cord are cut 6 in. in length.

The test strip of sample material is clamped in the jaws of the testing machine, which are 2 in. apart, and power is applied through a motor-driven worm. The pull or breaking point in pounds is registered on an indicating scale attached to the upper clamping jaw of the machine. Tests are made on a number of samples and an average value is taken as the final result.

The warp represents the thread running lengthwise in a woven material, while the woof is the name given to the threads carried by the shuttle; *i.e.*, those running crosswise in the fabric.

To determine the comparative strength of the various papers used for winding cells, U-pieces and for foundations for built-up mica wrappers, etc., a rupture test is used. The apparatus used is a Mullen testing machine having a capacity of 100 lb. pressure. The test specimens are cut 3 in. square from the commercial rolls of paper. The test piece of paper is clamped in the machine over a plunger which is forced up against it by means of a hand-operated pump. When the paper is ruptured the gage pressure is read and recorded. Fish paper such as is ordinarily used in built-up mica wrappers shows a rupture test of about 40 lb.

An air porosity test is made to determine the degree of porosity of paper used in making micarta insulating material. During the process of manufacturing this material it is necessary to select a paper that will take up a certain definite amount of shellac during the treatment process.

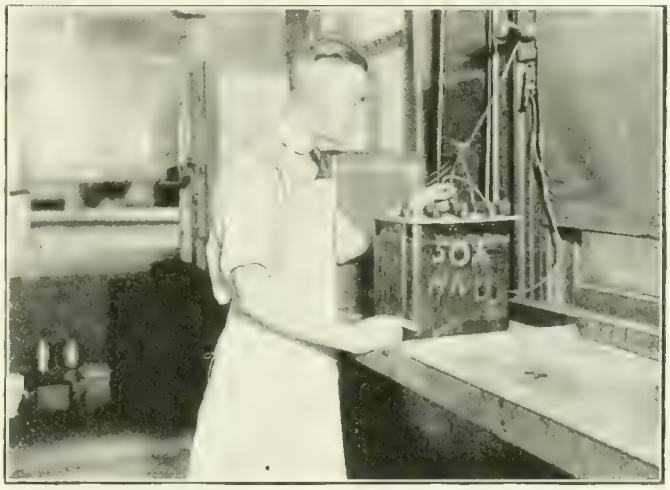
To test the strength of the cements used in connection with the construction of a direct-current motor a pulling test has been found practicable. These cements, which are used primarily in back of the commutator neck to seal up the openings around the windings, are put in place in a plastic condition and allowed to harden.

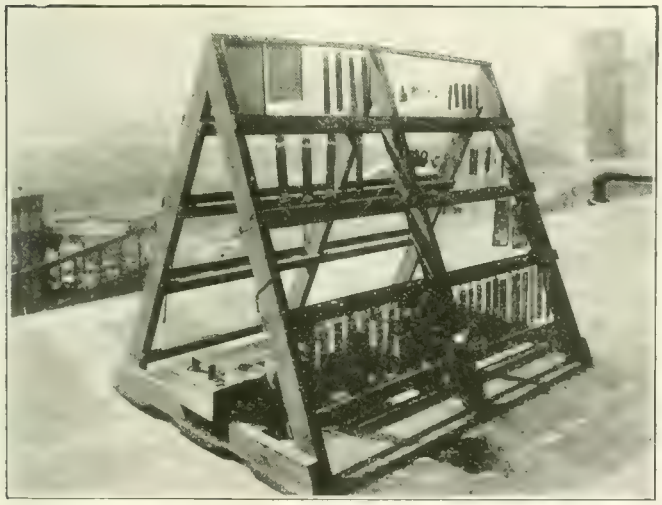
A destruction test is made to determine the durability of the rubber bushings used to protect the motor-lead cables where they come out through the frame of the motor. It is important that these bushings shall not break down mechanically owing to the strains and vibrations to which they are subjected in service. The apparatus used is a special intermittent compression testing machine.

To determine the softening at different temperatures of insulating gums such as are used in impregnating motor field coils, a drop-point test is used. In connection with this work it is important to use a grade of gum that will not soften and run out of the windings under the most severe operating conditions of the motor.

The test cup for determining the dielectric strength of varnishes is adjusted by spacing the electrodes $\frac{1}{10}$ in. apart. The cup after being carefully cleaned, using benzine or gasoline, is filled with the test varnish to within $\frac{1}{2}$ in. of the top. After being filled it is allowed to stand until all air bubbles have disappeared. The terminals of the testing circuit are connected to the binding posts on the test cup, and the voltage is applied first at a low value and increased at the rate of 3,000 volts per second until the oil in the cup is punctured and a breakdown occurs. During the test the temperature of the varnish is kept at from 20 deg. to 25 deg. C. Five tests are made on the sample varnish, and the average of these five voltage readings is recorded as the dielectric strength of the varnish.

An aging test is made to determine the ability of a varnish to retain its flexibility under the action of continued heat such as is found in a motor in service. It is important that the materials treated with a varnish retain their flexibility under these conditions; otherwise the continued jars and vibrations will crack it and destroy its insulating value. To make this test the only apparatus required is a suitable baking oven fitted with a high-reading thermometer or an indicating or recording pyrometer. The test specimens consist of







INSULATING TESTS GIVE AN INDICATION OF MATERIAL CHARACTERISTICS

On the left are shown weather-test rods where the action of the weather on paints and insulating varnishes may be noted. Acid, alkali and salt-water tests are made as shown in the center view. Liquid insulating materials are tested in the same way as the more familiar oil-test method. The test cup is adjusted by spacing the electrodes $\frac{1}{10}$ in. apart.

strips of sample cloth cut 6 in. x 3 in., which are given several dippings of the varnish to be tested. A space is left untreated at the top of the samples to record the test data.

Four samples are prepared as outlined above and placed in an oven which is maintained at a temperature of 100 deg. C. The samples are removed as follows: One at end of 100 hours, two at end of 200 hours, three at end of 250 hours, four at end of 300 hours.

These samples are then tested by folding or bending over rods of different diameters and noting the smallest diameter around which they may be formed without cracking. A test specimen, after baking 300 hours at 100 deg. C., which can be taken at room temperature and folded and creased without showing any indications of cracking is considered very satisfactory.

In the operation of motors, owing to carelessness and in some cases to too frequent oiling of the bearings, excess oil finds its way inside the motor frames. It is important that the varnish used for insulating purposes should not be affected by this oil, and to this end it is advisable to use an oil-proof grade of varnish.

CLASSIFICATION OF INSULATING MATERIALS AND TEST USED TO DETERMINE PROPER CHARACTERISTICS

Insulating Materials	*Tests*
LIQUIDS	ON UNTREATED MATERIALS
Amber insulator	Tensile test
Plastic insulator	Rupture test
Asphaltum Varnish	Air porosity test
Insulating varnish	Pulling test
Shellac	Destruction test
PAPERS	Creepage test
Untreated—	
Fish paper	ON MATERIALS USED IN TREATING:
Asbestos	Drop-point test
Fullerboard	Viscosity test
Cement paper	Dielectric test liquid insulating materials
Treated—	Penetration test
Micarta	Aging test
Japanese paper and mica	Oil-proof test
Mica tape	Acid, alkali and salt-water test
Fish paper and mica	Cementing and sticking qualities
CLOTHS	Heat conduction and radiation tests
Untreated—	Baking or drying qualities
Cotton tape	Weather test
Cotton sleeving	
Surgical braid	ON TREATED AND COMPOSITE MATERIALS:
Gray webbing	Adhesion test
Drilling	Slip test
Treated—	Treating test specimens
Treated cloth	Dielectric test, sheet-insulating materials
Friction tape	Moisture absorption test
Friction cloth	Gaging built-up mica board
Treated duck	Dielectric test, built-up mica and paper
CORDS:	Experimental treating tower
Torpedo twine	
Jute rope	
Linen twine	
SOLIDS:	
Mica	
Porcelain	
Rubber bushings	
Impregnating gum	
Cement	

Samples of cloth are prepared similar to those used in connection with the aging test, and after being thoroughly baked, they are placed in a mineral oil bath, which is held at a temperature of approximately 60 deg. C. for several days. If the varnish on the treated samples shows no signs of softening or becoming tacky, this is an indication that it is proof against the action of the oil. A similar test can be quickly made on the baked treated samples of cloth by rubbing them with oily waste. Under these conditions, if the varnish is oil-proof, it will not soften and cannot be rubbed off the surface of the cloth.

A test is made on insulating varnishes used in treating coils, etc., to determine their ability to withstand the action of acids, alkali and salt water. A large rectangular glass jar fitted with a wood rack, a number of metal test rods and a testing circuit with a light in series is arranged as shown in the illustration. Test specimens consist of $\frac{3}{8}$-in. round steel rods 12 in. long, well rounded at the lower end, which receive a uniform coating of varnish $2\frac{1}{2}$ mils thick baked on the entire surface within several inches of the top of the test rod. In preparing these test specimens the bare rods are first thoroughly cleaned and dipped in the sample of varnish and baked. This operation is repeated not less than three times, and sometimes more, depending upon the fluidity of the varnish, in order to get the desired $2\frac{1}{2}$ mils thickness of film which is specified for this test.

The treated test rods are placed in the rack, which insulates individual rods, and are then suspended in the acid, alkali or salt-water solution contained in the glass jar. During the first four hours of the test an alternating current from a 110-volt circuit with a light in series is applied every fifteen minutes through the terminals, one of which is connected to the liquid solution and the other applied to the individual test rods for a short interval to locate any breakdowns. After this set of short-time readings is taken, similar tests are made each morning and evening until the insulation breaks down or the test has run its specified time limit. In connection with these tests either a saturated-acid, an alkaline or a salt-water solution is used, depending upon the nature of the test. The final results are represented by the average on three test rods of each grade of varnish. The amber insulator used in connection with the dipping and baking of motor armatures when tested under the above conditions shows an average of 880 hours in a saturated solution of salt water.

It is necessary to know something about the time and temperature required thoroughly to dry or bake out the insulating varnish in order to get the best results with the least possible delay to production. Samples of cloth or tin are dipped in the air-drying varnish and hung up in the open and the time required to dry is noted and recorded. In testing the baking varnishes the test samples after being dipped in the varnish are placed in the oven and baked at a constant temperature for a definite period of time until thoroughly dried. The temperature is then increased and the time noted. In this manner a number of tests are made with varying temperatures through a range of from 90 deg. to 120 deg. C., noting the time required to bake thoroughly. The maximum temperature which will not damage the texture of paper or cloth to be treated is taken, as this increased temperature will expedite the production in the factory.

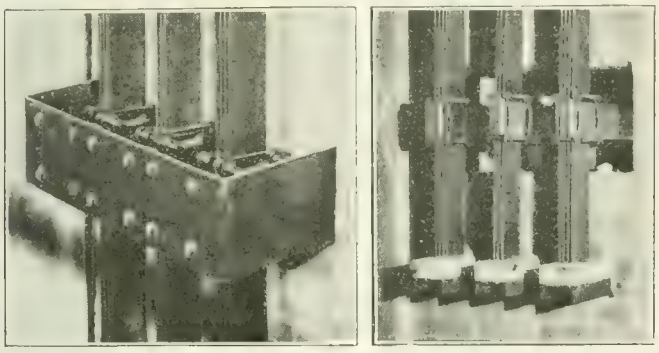
It is very important to know just how certain paints and varnishes resist the action of weather under varying conditions, and to determine this a weather rack, such as shown, has been constructed and placed on the roof of one of the shop buildings. On this rack the various treated samples are securely suspended and exposed to all weather conditions over a long period of time, and they are carefully inspected at stated intervals of time to determine their deterioration. These observations are recorded and comparisons made of the condition of the various samples of paints and varnishes under test.

The entire list of tests given in the tabulation may thus be carried out, but the few given are indicative of the methods used.

JOHN S. DEAN,
Railway Motor Engineering Department.
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

Method of Supporting Vertical Run of Very Heavy Bus

SUPPORTING a 70-ft. vertical run of three copper busbars, each made of three ¼-in. x 4-in. strips, was one of the problems met in designing the electrical system for the Famous Players-Lasky motion-picture studio in Long Island City, N. Y. The great weight of these buses is carried by special wrought-iron supports attached to the wall at 6-ft. intervals. Heavy insulators at the base also assist in absorbing the vertical thrust. As may be seen from the illustration, each support is made of 10-in. x ½-in. wrought iron bent in the form of a U 20 in. wide and extending out from the wall 14 in. To this are fastened three Engineering Equipment Company common busbar-type insulators spaced 6 in. on centers. The U-shaped supports are attached to the wall by a number of anchor bolts on each side. At the bottom end of the buses are porcelain heel plates 3 in. wide, 2 in. thick and 8 in. long.



VERTICAL BUS RUN BRACED AT INTERMEDIATE POINTS AS SHOWN ON LEFT AND SUPPORTED AT BOTTOM BY PORCELAIN HEEL PLATES

These heel plates are supported by 3-in. channel irons embedded deeply into the wall.

Usually in the case of long runs of busbars provision is made for expansion bends to take up the longitudinal movement of the bars, but this was not done at the Famous Players studio. Instead, the bars are held in the insulators in such a manner that they are free to slide back and forth. In addition to this the insulators themselves are slotted where they are fastened to the hangers, thus allowing the insulators a certain amount of travel. It was thought that by providing these two opportunities for the bars and their insulators to slide in the direction of the run there would be no need of expansion bends or similar provisions. Although the studio had been unheated during much of the winter, there was no evidence that the unusual amount of contraction was not adequately cared for by this system of support.

It had been calculated that the horizontal thrust strain on short circuit for this feeder system would be 409 lb. per foot with 8-in. centers between opposite polarities. The insulators within the wrought-iron braces must stand a short-circuit stress of 2,454 lb. each. For this reason they were tested at 4,100 lb. cantilever stress before installation.

At the top of the studio another set of open busbars runs across the building, and these are supported at 6-ft. intervals on heavy high-tension insulators. After completion, the entire busbar system was inclosed in a stout metal grid of fine mesh so that the feeders could not be short-circuited by tools or other objects falling across them.

In addition to the fact that this system requires no conduit, it also permits of heavier loading because of the greater radiation obtained by the laminated construction and at the same time permits easier and more frequent inspection throughout its entire length.

Famous Players-Lasky Studio, E. L. BRAGDON.
Long Island City, N. Y.

Eliminating Brush Trouble on a 500-Volt Motor

A MOTOR of 5 hp., 500 volts, had been blowing fuses quite frequently when the writer was called upon to remedy the trouble. The brushes were found to be tight in the holders, preventing them from making good contact, thereby causing sparking, which in turn caused frequent flashovers. Accordingly the commutator was turned and a new set of graphite brushes with shunts were installed of the same kind as those which had been used before.

However, these brushes sparked badly and sparks traveled around the commutator. Wiping the commutator would temporarily relieve this condition, but at every application of the load the brushes would spark, and also when the main line switch was opened the field discharge would cause a bad spark of short duration. Thinking that this trouble was due to the brushes being too soft and having the wrong contact resistance, a harder brush was tried. As a result sparking disappeared. A. HERVEY.

New York City.

Self-Starting Synchronous Motor

A SYNCHRONOUS motor which will start and come up to speed under load was developed recently. It makes use of a new principle of design in a squirrel-cage starting winding. For this winding copper or brass tubing is used, instead of solid bars. Obviously the outer diameter may remain the same for all standard designs, this feature in connection with standard manufacture eliminating the necessity of using various index dies for the pole punchings. The resistance, however, of the tubular conductor may be varied over a wide range by changing the wall thickness of the tubing. Inside of this tubing are embedded conductors of magnetic material, such as iron or steel. The bars are fastened to end-ring segments, which also serve as upper coil supports for the field coils. These end-ring segments, forming a continuous ring, are connected together between poles by the use of a split sleeve which fits into holes drilled on the job when the poles are assembled. A taper pin is driven in to insure contact and mechanical stability.

At starting the frequency in the squirrel-cage winding is the same as in the line, but as the rotor comes up to speed the frequency will fall off to zero. Owing to the skin effect the inner bars of magnetic material will not be effective at starting, but a high starting torque is established if the copper or brass tubing has the proper resistance. As the rotor, however, is accelerating, the inner conductors will become effective and in the neighborhood of synchronous speed will furnish a high pull-in torque in addition to the rather small torque furnished by the tubing at that speed. It is possible by changing the squirrel-cage winding to make the torque characteristics adapt themselves to various applications of synchronous motors.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

House-Wiring Growth Featured at Boston Show

A FULL-FLEDGED company office, where applications for lighting service were received, was a feature of the exhibit of the Edison Electric Illuminating Company of Boston at the Boston "Home Beautiful" Show, open from April 16 to 30 inclusive, in the Mechanics' Building. Leading distributers of domestic lighting, heating and power equipment co-operated to



OFFICE OF BOSTON EDISON COMPANY AT "HOME BEAUTIFUL" SHOW

mass the more prominent electric exhibits in the central portion of the hall.

An interesting feature of the Boston Edison exhibit was two charts showing the growth of house wiring in the company's territory since 1912. In that year only 15,000 houses were wired out of 128,000, whereas in 1920 60,000 out of 165,000 had been wired. The other chart showed that from an extended analysis of Boston Edison customers' bills $2.33 per month is the average

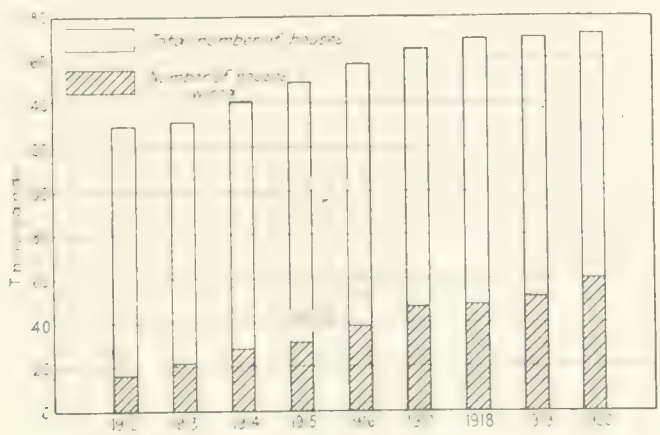
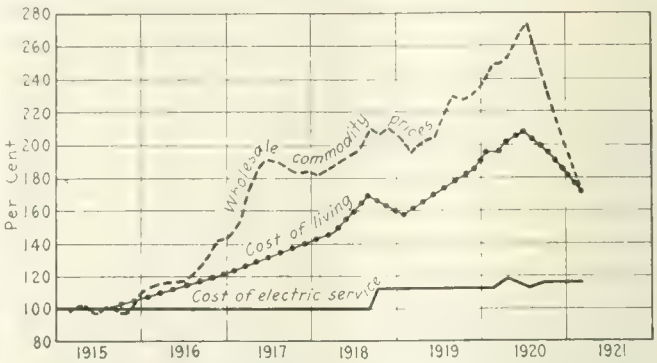


CHART SHOWING GROWTH OF HOUSE WIRING SINCE 1912



COMPARISON OF INCREASE IN COST OF ELECTRIC SERVICE AND INCREASED LIVING COST

cost of electric service in the average apartment and that $4 per month is the average cost of all dwelling-house use. These figures were based on a study of more than 73,000 houses and apartments, housing 400,000 people. The diagram shows that electric service now costs only about 18 per cent above the pre-war rates against a 75 per cent increase in the cost of living, and that electric rates increased only 20 per cent maximum against a 108 per cent cost of living increase in the summer of 1920.

Promoting a Good Understanding Between Utilities and People

IN THE forceful address delivered at the N. E. L. A. convention in Chicago by E. I. Lewis, formerly chairman of the Indiana Public Service Commission and now a member of the Interstate Commerce Commission, on the mutual obligations of the utilities and the public, he counseled the utilities to educate public opinion to the true conditions of the utilities, to discontinue all practices which are subject to legitimate criticism and to stop dodging responsibility.

Reviewing the many obstinate problems which confront the industry, he pointed out that utility rates as a whole have not advanced comparably with other commodity prices and that therefore a reduction to pre-war levels could not be expected. Continuing, he said:

"Another reason for failure of public utility rates to drop is that the utilities were called on to keep up with the abnormal war growth and expansion of cities and industry and with the extravagances of the individual citizens. The plants are there with their financial obligations incurred at a time when the cost of such incurrence was at its height. They are ready to serve the 1917-1920 volume of business. But the business and convenience whose demand was so insistent are temporarily gone or less active. There is a shrinkage in revenues, but no corresponding shrinkage in fixed obligations, overhead or even in operating expenses.

"Then the drop in operating costs, so far as public utilities are concerned, has been more apparent than

real. Then, too, there are taxes. Though public utilities constitute the only business of which I know whose operating sheets do not record payment of excess profit taxes during the war, they are bowed under the steadily accumulating burden of local taxation.

"Now, when utility rates were weakly trailing far behind ascending commodity prices, the public could easily understand the relation between cause and result. It must be admitted that formerly the public did not show very vital concern in such small items as utility rates. But it is different now. Business served by public utilities has been hit; there is some unemployment; wages are beginning to descend; some commodities have hit pre-war levels. People are beginning to scrutinize and to count cost. They do not understand these more or less intricate conditions which result in utility rates failing to respond to the downward readjustment. Too, the public attitude is less broad. There is a disposition to criticise, and to raise false issues."

Utility Situation Changed

Mr. Lewis then spoke of the change in the whole utility situation brought about by the war and of the new and difficult position in which regulatory commissions have been placed by the need to increase rather than to reduce rates. Regulation, he said, faces a most critical period. He went on:

"There is now a most compelling necessity that public utilities relieve regulatory bodies of some of the tremendous pressure falling upon them by reason of this new state of affairs. This the utilities can do in three ways:

"1. By educating public opinion to the true condition of the utilities and by taking that public into their confidence by placing all of their cards face up on the table.

"2. By removing all features of their business which are subject to legitimate criticism by the public and by going more than half way to conciliate public opinion.

"3. By stopping some utilities' practice of dodging responsibility and of 'passing the buck' to the commissions in matters in which the responsibility lies entirely in the utility."

He contrasted purely municipal enterprises such as fire protection, police protection, schools, roads and so forth with utility service and showed how much more important the latter is than the former.

"When we gain a clear understanding of what public utilities are," he said, "we must then get as clear an understanding that if these great services of modern city life are starved, they cannot perform reliable service, and also an understanding of the incomparably greater costs of cheap, poor service than of properly sustained good service. Then let the city get a clear understanding of the unescapable fact that cities can grow and expand only as these, their great servants, are able to command the credit necessary to enable them to contract for capital to meet that growth and expansion.

"Let the city also face these conditions: That there has grown up a sentimental prejudice—on a considerable foundation of objections to the attitude of communities toward public utilities—against investment in public utilities, and that the difficulties and costs of contracting for this needed capital are now increased by all nations and governments, even down to the local townships, and cities owning their own utilities, frantically bidding unheard-of prices for money and offering tax-exemption bonuses.

"Let us all get a clear understanding that there has to be a broadening of view and policies to such an extent that regulation will provide utilities with liberal margins of cash working capital that will permit adequate storage of coal, and also with cash surplus, fat, well invested and quickly convertible, that can be drawn on to bridge temporary sags in revenue or to meet calamities, without that recourse to rate adjustments which is the necessity of utilities that are held to the bare existence which inspires fear of any prospective change.

Nothing So Expensive as Cheap, Poor Service

"There must be an understanding on the part of industry, now so generally served by the public utilities, that it must pay a rate for power that will approximate the value of the service, that the old days of bleeding central-station companies white and leaving losses to be carried by higher rates paid by smaller consumers are certainly well at an end. Particularly, let these industrial patrons understand that nothing is so expensive as poor and unreliable service and nothing so short-sighted on their part as a policy of utility starvation which will certainly kill an industrial community and individual industries.

"Let the utilities thoroughly understand that they are public servants; that good will, good public relations, are to be acquired not alone by good service but by frankness and an every-day policy of treating even the smallest of their patrons with that consideration which is practiced by successful business in non-regulated fields.

"The public must acquire an inkling of understanding that public utilities, whether they be privately or municipally owned, are not philanthropies; that they operate with costly materials and have heavy wage rolls and heavy investment obligations; that nothing short of real money, and a certainty of it, will satisfy the tax collector, those who furnish coal and supplies, the laborer and the much-courted investor.

Rates Based on Fair Valuation

"Let there be a clear understanding on the part of all that the day has passed, under public utility regulation, when the amount of stocks, bonds and other evidences of indebtedness outstanding are determinative of the rates to be charged; that the rate is built on an ascertained fair valuation irrespective of securities; that the public, having rightfully demanded such a basis, has on it a moral obligation of adequate maintenance, replacement and return on that property dedicated to the public use; that repudiation of that obligation brings disaster not alone to the utility but to the community.

"Let there be a full and frank understanding that on such basic conditions as have been enumerated is built the policy—the very best system known up to the present—of public utility regulation, which is primarily designed not for the utilities or those served, but for promoting and extending public welfare.

"Finally, let there be a clear understanding that the disturbance of a good code of relations between those served and the servants—and this code is undergoing unusually severe strains—would, in the absence of substitution of another adequate system, throw the utility situation into chaos and create a condition that would be highly detrimental to local welfare and demoralizing nationally to an extent little comprehended."

Southern California Edison Distributes $6,634,800 Stock in Four Months

IMMEDIATELY following authorization of the California Railroad Commission for the sale of an additional $10,000,000 par value of its common capital stock, the Southern California Edison Company, on Jan. 24 of this year, resumed its campaign to distribute its stock among the people in the territory served. In a period of exactly four months, down to May 24, the total sales reached the high figure of $6,634,800 par value to 8,823 subscribers, which is an average of seven and one-half shares, or $750 par value, purchased by each subscriber. The campaign is actively continuing and being handled entirely through the company's organization with its 5,200 employees. To each geographic district and each department quotas have been allotted, with the result that keen friendly competition prevails and all employees are stock salesmen. Incidentally, several prizes for best results have been offered and a small commission is allowed employees for sales, but, according to A. N. Kemp, vice-president in charge of finance, these considerations are minor as compared with the spirit of constructive service which is behind the movement.

The company officials have been attending three or four evening meetings each week all through the territory where the company operates, encouraging the employees in their work and giving new thought and inspiration to the program.

"Realizing that the widest distribution of our stock can best be obtained by having a large number of our employees understandingly and enthusiastically working on stock sales," said Mr. Kemp, "we have been careful to explain thoroughly the need for power development and the benefits of customer-ownership. We all recognize that the proceeds from the sales of our stock go into new water-power development, increasing production, conserving the natural resources and encouraging thrift, and this has aroused a spirit of national patriotism among our forces. We know that the future growth and prosperity of our state depend upon rapid development of water power and that our community growth in Southern California and the San Joaquin Valley is being enhanced by the rapid increase along the lines of industrial and agricultural development, both absolutely dependent upon an adequate supply of water power. We all appreciate the added strength of the company's position in the territory it occupies which results from the wide distribution of its stock among the people at large throughout this territory. This stimulates a keen personal interest in the building up of our company's business, particularly among employee stockholders, who number more than 80 per cent of our employees.

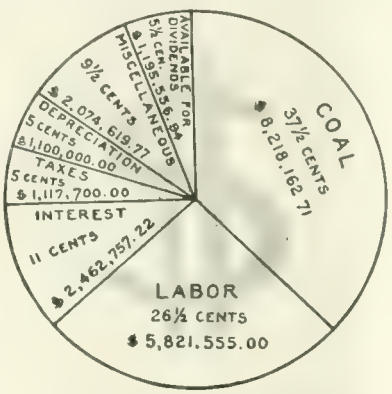
"The result of the large sales in the past four months has been to increase the number of the company's stockholders to 13,255, of whom more than 11,000 are in the territory served. This affords an interesting contrast to the number of stockholders in 1917 when we first undertook the distribution of our stock at home. At that time we had 1,864 stockholders, of whom only 600 were residents of Southern California. Among our present stockholders the company numbers 2,694 employees who are purchasing on an installment plan $4,927,700 par value of stock.

"Heretofore the primary aim of utilities desirous of placing their securities with the people in the territory served has been to sell stock, and the wide distribution of the stock has been of secondary importance. The Southern California Edison Company was probably the first in the country definitely to reverse this program and base its campaign on obtaining stockholders and more stockholders, with the result that the amount of stock sold took care of itself. Many of our railroads and industrial corporations number their shareholders by tens of thousands, and it is our ambition to put the Southern California Edison Company among the leaders in the number of stockholder partners."

How the Detroit Edison's Revenue Was Spent

TO SHOW how its 1920 gross revenue was spent the Detroit Edison Company recently issued the accompanying chart with the following interesting analysis of the expenditures:

The revenue received by the company in 1920 amounted to $21,990,351.64—quite a sizable sum—but, after all, to most mortals not much more than a row of figures. The brain does not readily wrap itself around a million and absorb its meaning. For the purpose of this little story, therefore, let us make believe, as the children say, that the entire revenue of last year was shrunk to the dimensions and value of one of those big, opulent looking silver dollars that used to weight our pockets—and see how it was split up.



HOW EACH DOLLAR WAS SPENT

Taking the items of expenditure in the order of their magnitude, it will be seen that coal, in spite of its poor quality and bad behavior last year, demanded the largest share, grabbing off 37½ cents ($8,218,162) as against $4,642,789 in 1919, or an increase of 77 per cent.

The next largest item is labor, which received 26½ cents of the fast-diminishing dollar ($5,821,550) as against $3,894,175 in 1919, or an increase of 49 per cent.

Our dollar has now been whittled down to 36 cents, and there are still a lot of things to come out of it. Interest on the company's borrowings (funded and unfunded debt) must be paid, or the wheels will no longer go round. This obligation took 11 cents more; and taxes, that twin brother of death, neither of them to be dodged, would not be satisfied with less than 5 cents.

All that is now left of our once impressive looking dollar is 20 cents—and still they come, these hungry items. "Miscellaneous," for example, a blanket term covering a large family of expenses—rentals, adjustments, discounts on bond sales, compensation for injuries, lamps and other things far too numerous for recital here. These took 9½ cents, leaving a remainder of but 10½ cents with which to make the necessary provision against depreciation of plant and for the payment of dividends to owners of the company's stock. As a matter of fact, this remainder was not sufficient to provide adequately for depreciation and for stockholders' dividends, and the slender surplus set aside in happier years for emergencies was drawn upon to make up the deficiency of 1920.

It is interesting as well as painful to observe the steady ascent of operating expenses in the past few years—from the year we entered the war. In 1916 these expenses took 54.5 cents of every dollar received; in 1917, 63.8 cents; in 1918, 67.2 cents; in 1919, 68.9 cents, and in 1920, 77.6 cents. One may hope the peak is reached and that so-called "normalcy" will be gradually restored, but who can tell?

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Circle Diagram of the Repulsion Motor—E. SIEGEL.—The characteristics of a repulsion motor may be plainly shown graphically on a specially developed circle diagram giving stator current, phase angle, torque, output, speed and rotor current. To each possible brush angle a certain diagram circle corresponds. The characteristic points of the repulsion motor (short-circuit point, synchronism point and no-load point) describe circles at the varying brush angles, the positions of which are given definitely by the amount and phase of the current flowing into the stator at the no-load position of the brushes ($\beta = 90$ deg.) and the short-circuit position of the brushes ($\beta = 0$ deg.). These two currents being known, it is easily possible to draw the complete diagram, giving all the above-mentioned characteristics.—*Elektrotechnik und Maschinenbau*, April 24 and May 1, 1921.

Generation, Transmission and Distribution

Generating System of the West Penn Power Company.—G. G. BELL.—A discussion of engineering features and economies in power-plant design and operation as worked out for the system of the West Penn Power Company.—*Electric Journal*, May, 1921.

Calculation of Pins for Pin-Type Insulators.—M. DONATH.—The author has developed a very exact method of calculating the most favorable shape and cross-section of shanks for the support of pin-type insulators, and the results have been incorporated in the standardization rules for overhead line construction. Full mathematical derivations are given with practical examples. — *Elektrotechnische Zeitschrift*, April 28, 1921.

Keeping Steam-Turbine Lubricating Oil in Good Condition.—CHARLES H. BROMLEY.—The author reviews the severe conditions that have to be contended with in steam-turbine bearings. No satisfactory lubricant has been found which will not deteriorate with continuous use without purification, he says. The various processes employed for removal of sediment and moisture are described and a list of the requirements of an efficient oil filtration system is given.—*General Electric Review*, May, 1921.

Hydro-Electric Plant on the Arly at Ugine.—F. BABEY and P. GUIN.—This hydro-electric station in the Savoy, France, supplies the Paul Girod iron and steel works, employing about 2,500 men. The main energy consumers are six furnaces of 20 tons to 25 tons, one 6-ton and four 2½-ton Girod furnaces. A head of 19 m. is utilized in nine units of 600 hp. each, seven units of 300 hp. each and one unit of 2,000 hp. A second plant, further down the river, also uses a head of 19 m. and generates 1,200 hp. in two units of 600 hp. each. All turbines are of the horizontal-shaft type. The sections of one of the 600-hp. turbines and one generator are given. Very few electrical data are contained in the article—*L'Electricien*, April 15, 1921.

Development and Speed Regulation of Hydraulic Turbines.—M. EYDOUX.—An interesting article describing and criticising a number of existing hydraulic turbines of the Pelton and Francis types. It contains very useful assembly drawings of a 16,000-hp. double-nozzle Pelton wheel, a 3,000-hp. quadruple-runner Francis turbine with horizontal shaft, a 12,000-hp. slow-speed vertical-shaft American turbine and a 3,800-hp. high-speed vertical-shaft turbine.—*Revue Générale de l'Electricité*, April 30, 1921.

Traction

Diagram of Vibration Phenomena of Electric Locomotives with Rod Drive.—A. WICHERT.—A special registering apparatus was built to plot simultaneously the revolutions of the wheel per minute, the time and the torsion vibrations of the armature of a locomotive. This instrument was properly installed upon a 1-C-1 passenger-type locomotive driven by one 16⅔-cycle alternating-current motor. The author reproduces the complete diagram and explains it step by step, showing how perfectly this actual test proves his theories on vibrations laid down six years ago. As vibration must be expected on all locomotives with rod drives, he suggests making similar graphic investigations for all types, which will throw light on many an otherwise mystifying problem. The author does not give a description of the recording instrument.—*Elektrotechnische Zeitschrift*, April 28, 1921.

Installations, Systems and Appliances

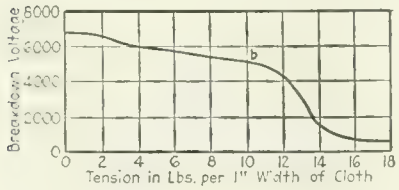
Operating Safety of Fuses.—W. HOPP.—This paper gives the results of a great number of tests made on different makes of fuse plugs and fuse cartridges. The operation of fuses in series and in parallel is discussed, and the different behavior of fuses in direct-current and in alternating-current lines is shown graphically. The author emphasizes the fact that it is extremely difficult to build a safe and uniform 500-volt fuse for more than 6 amp. Very elaborate manufacturing and testing facilities are required to be sure of a reliable and uniform product. Some theoretical considerations of the circuit-opening phenomena of fuses are given which might bear further investigation. Finally some technical data are offered for such important details as the proper fastening of the fuse wire to the contacts, influence of the size of the fuse wire and the contact resistance of the plugs and cartridges. This is a very useful article on a subject which is rarely dealt with in electrical literature.—*Elektrotechnische Zeitschrift*, May 5, 1921.

Overvoltage Protection in Theory and Practice.—W. PREHM.—Properly dimensioned and well-located condensers are frequently used for the protection of high-voltage networks against overvoltages and line surges. The author has conducted a long series of very exacting laboratory and actual line tests with condensers in connection with switches, transformers and cables and

has found that the customary use of condensers always introduces trouble rather than protection. For all laboratory tests a 15,000-volt, 7.5-kva. oil-immersed transformer was used. The existence and magnitude of excess voltages were determined with needle-point spark gaps. Line disturbances were caused by repeatedly opened and closed disconnecting switches. Eighteen main groups of tests were made, both for single-phase and three-phase systems. In every case the addition of condensers either caused or increased existing surges. A series of interesting tests was made on a 16-kva., 15,000-volt transformer to show how the dangerous discharge waves from a condenser affect the different parts (coil sections) of its windings. Curves plotted along the diagram of the winding as abscissas showed triple voltages on the end coils. Concluding, the author sounds a general warning against any use of condensers as possible line protectors.—*Elektrotecknische Zeitschrift*, April 21, 1921.

Electrophysics and Magnetism

Industrial Research Work on Insulating Materials.—The work of a committee representing British industries on the effect of testing the insulation of varnished cloth and varnished silk, adhesive tape and varnished paper is dealt with. In the accompanying curve it is shown that varnished cloth, commonly known as "Em-



EFFECT OF MECHANICAL TENSION ON THE VOLTAGE BREAKDOWN OF VARNISHED CLOTH

pire cloth," is not seriously affected under tension until the point *b* is reached, at which the elastic limit of the varnished film is approached, with consequent rapid deterioration thereafter.—London *Engineering*, April 22, 1921.

Electrochemistry and Batteries

Ductile Electrolytic Nickel.—Charles P. Madsen.—An outline of the experimental work on the electrolytes, cathodes and anodes leading to the production of electrolytic nickel of greatly improved mechanical properties.—*Chemical and Metallurgical Engineering*, May 25, 1921.

Units, Measurements and Instruments

Null-Deflection Constant-Current Type of Hot-Wire Anemometer.—J. S. G. Thomas.—The laws governing the convection of heat from fine heated wires are such as to indicate the hot-wire anemometer as pre-eminently the type of instrument to be employed in the investigation of slow rates of flow of gases. Employing the Morris type of hot-wire anemometer in such investigations, difficulties are encountered owing to the existence of the free convection current arising from the heated wire. The author discusses the type of directional hot-wire anemometer, in which these difficulties are largely obviated and by the use of which the range of application of the hot-wire anemometer may be extended to the investigation of very slow-moving streams of gas.—*Philosophical Magazine*, May, 1921.

A Microphone "Stethoscope" for Bearings.—A device in which a microphone is substituted for the rod frequently used for detecting abnormal noises in moving machinery. The condition of bearings and gears can, according to this article, be ascertained without requiring the observer to leave his office.—London *Engineering*, May 6, 1921.

Telegraph, Telephony and Signals

Submarine Cable to East Prussia.—E. Muller.—East Prussia has been separated from the German mainland by a wedge-shaped territory assigned to Poland. To obviate international difficulties from overland telegraph and telephone lines, Germany decided to lay a submarine cable, bridging by sea the Polish wedge. This is the longest submarine telephone cable in existence, having a length of 170 km. The cable contains six telephone pairs and three single telegraph wires. Each of the twelve telephone wires is covered with a double layer of annealed iron wire. All conductors are paper-insulated. Owing to a depth reaching 110 m. at its greatest point a double lead sheath, a double spiral of steel wire and finally an outer interlocked steel armoring have been used. Each 1½ miles (2.4 km.) a water stop has been built into the cable to localize any entrance of water into the cable in case of break. The over-all diameter of the submarine cable is about 2 in. (52 mm.), and its weight is 8 lb. per foot (11 kg. per meter). The manufacturers delivered the cable in three lengths (21 + 77 + 77 km.). A 1,000-ton freighter with a modern paying-out machine mounted on its stern was used and finished the work in two trips of sixteen and thirteen hours actual laying time. A sectional drawing of the exceptionally strong joint boxes used is given in the article. The required guarantee data for 1 km. of telephone (double) line, alternating current, 800 cycles and 15 deg. C., were: Effective resistance, 12 ohms; self-inductance, 0.009 henries; mutual capacity, 0.052 Mfd.; specific damping (β), 0.015; insulation resistance, 2,000 megohms. The required data for the telegraph wires for 1 km. at 15 deg. C. were: Direct-current resistance, 9.5 ohms.; capacity, 0.075 Mfd. (other lines grounded); insulation resistance, 2,000 megohms. The author gives a complete account of actual test methods and results obtained by the postal authorities at the final inspection. The telegraph lines operate with Siemens rapid telegraphs, and vacuum-tube amplifiers are used for the telephone lines. Wiring diagrams for both operations are given in full detail.—*Elektrotechnische Zeitschrift*, April 7 and 14, 1921.

Developments of Radio Communication in French Aviation—I.—M. Bernard.—The author describes the different stages of the development of radio communication from and between airplanes. The first satisfactory operating set contained a spark coil fed from a 20-volt storage battery. Special attention had to be paid to the interrupter. Later the heavy storage battery was superseded by a small propeller-driven direct-current dynamo running at an average speed of 4,500 r.p.m., and delivering 20 volts at 5 amp. Finally two types of propeller-driven 900-cycle alternators were developed, differing only in weight and bulk from each other. Both are rated at 50 volts and 7 amp. at 4,500 r.p.m. The machines contain a direct-connected exciter and a toothed-wheel generator with no rotating windings. A ratio transformer with a ratio of 1 to 300 furnishes the necessary antenna current. A rotary spark gap mounted on the main generator shaft is used on both types.—*Radio Electricité*, April, 1921.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ARC LAMP, MAGNETITE.

Recent improvements in magnetite arc lamps have made it possible to reduce the wattage consumption, in the case of a 4-amp. lamp, from 320 watts to 270 watts. This gives a greater lamp capacity to a lighting circuit, allows new lamps to be put in existing systems without adding extra circuits, and results in reduced investment charges per lamp.—*N. E. L. A. Lamp Committee.*

ARC LAMP, MAGNETITE, ELECTRODES FOR.

An improvement in operation has been obtained as a result of the use of a flattened electrode which is interchangeable with an ordinary round-type electrode. The life of the electrode is increased by compounding the material under extremely high pressure so that more material can be packed into a given space. This increased density and uniformity of composition results also in greater uniformity of life and candlepower of the electrode.—*N. E. L. A. Lamp Committee.*

CORE LOSS AT LOW MAGNETIC DENSITIES.

In designing electrical apparatus in which a differential magnetic action of two windings is used, as in a differential transformer, it is sometimes of importance to know the core loss at very low magnetic densities. A ring was tested consisting of soft-iron wire, with two windings, at 50 cycles, within the limits of flux densities of from 27 to 127 gausses, and it was found that the loss increased as the flux density to the power of 2.19. A Rowland dynamometer wattmeter was used, the stationary coil of which was in the primary circuit and the movable coil in the secondary of the ring under test. The method is a combination of the methods used by the Bureau of Standards for steel testing and for measurement of dielectric losses.—*Boris Podolsky, University of Southern California, Los Angeles.*

DEMAND METER, GRAPHIC.

Tests have been made on the adaptability of the Lincoln demand meter of the graphic type for recording the maximum demand on highly fluctuating loads, such as a rubber mill, a street railway, etc. A standard paper feed of 0.5 in. (1.27 cm.) per hour was used, and also a special feed of 2 in. (5.1 cm.) per hour. In spite of the violent fluctuations of the load, each ten-minute peak could be read easily as the highest point on the traced curve.—*Hydro-Electric Power Commission, Toronto, Canada.*

ELECTROLYSIS, AMERICAN COMMITTEE ON.

The American Committee on Electrolysis, which is composed of representatives of the electric light, street railway, telephone and other interests, has established a research sub-committee to conduct local investigations. Prior to the organization of this research committee these investigations were conducted by the Bureau of Standards, and since the establishment of the committee the bureau has been co-operating with it.

ELECTROMOTIVE FORCE, NATURE OF.

Free electrons are considered in a metal, and a distinction is made between their volume density, or space charge, and the number of electrons which pass through a cross-section of the conductor and constitute an electric current. A relationship is deduced between the electromotive intensity and the mechanical force acting on electrons, to explain why the induced e.m.f. is independent of the material of the conductor. The resistance of the conductor is shown to be inversely proportional to the square of the quantity of electricity in the space charge per unit length of conductor.—*C. E. Underhill, New Haven, Conn.*

ELECTRONIC MOTION.

A great deal of work has been done on the motion of electrons between coaxial cylinders, in particular between a straight filament and a concentric cylindrical anode. Theory shows that the thermionic current in this case is unaffected by a uniform magnetic field parallel to the filament so long as this field is smaller than a critical value, but falls abruptly to zero when the field is increased beyond this value. The theory is completely confirmed by the experiments made, and applications are discussed in a paper delivered before the A. I. E. E. May 20, 1921.—*Albert W. Hull, Schenectady, N. Y.*

ELECTROPLATING, "BLACK NICKEL," SOLUTION FOR.

Black nickel, used for producing a dark finish on brass or other metals, has been produced by alkaline cyanide and neutral sulphocyanate solutions. The latter have been found to be the most satisfactory. The solution can be applied to brass either directly or after copper plating, to copper and to steel which has been coated with copper, nickel or zinc.—*Bureau of Standards, Washington, D. C.*

FATIGUE IN METALS.

Research in fatigue phenomena in metals is now in progress and has been further aided by recent contributions. One industrial electrical corporation has given a large sum so that the program may be extended to cover nickel steels of special interest to it.—*Engineering Experiment Station, University of Illinois, Urbana.*

HUMAN BODY, ELECTRICAL RESISTANCE OF.

Measurements have been made of the electric resistance of the human body for the first time in such a way as not to include the resistance through the skin where current entered and left the body. For this reason the results are more consistent than any previously obtained. These show that (a) the resistance of the same part of the body of different individuals may differ by a ratio of three to two or even more, (b) the resistance of a person changes from day to day and often by small amounts in an hour, (c) the resistance depends to some extent upon the position of the body and the extent to which the muscles are relaxed, (d) part of the difference found between different persons and some of the changes observed in the same persons depend upon pathologic conditions. Complete report of results will be available at a later date.—*Bureau of Standards, Washington, D. C.*

INDUCTANCE COILS, STANDARDIZATION OF.

A careful study of the constants and behavior of inductance coils has been begun with a view of the production of standards and also of their practical development and use in radio work. The results of this work have given formulas for the calculation of the capacities of short single-layer solenoids, pancake coils and multi-layer coils of circular or square section and large diameter. Special shielded coils of calculable capacity have been developed for use as standards. No printed information is yet available, as the work is still in progress.—*Bureau of Standards, Washington, D. C.*

INDUCTION MOTORS ON UNBALANCED POLYPHASE CIRCUITS.

A method has been developed by which the characteristic of a polyphase induction motor with unbalanced applied voltages can be predicted with considerable accuracy. The work is complete for the two-phase motor and is now under way for three-phase motors.—*B. F. Bailey, University of Michigan, Ann Arbor*

Suggestions for Research

CABLES, UNDERGROUND, LOCATION OF FAULTS IN.

A detailed report on the methods of locating faults in use by various operating companies will be found in the *N. E. L. A. Proceedings*, 1920, pp. 735-738. The great variety of these methods and the growing importance of underground cables indicate a need for further research as to the best method for each particular set of conditions. A few such methods, standardized in their details, will save the operating companies considerable money and help to maintain better service.—*Editorial Suggestion.*

CONDENSER, HIGH TENSION, LARGE CAPACITY.

Information has been requested regarding the simplest and least expensive means of building a condenser of ½ mfd. to mfd. capacity, 100,000 volts, for the purpose of extending an investigation on the spectrum of explosive discharge through fine wires.—*National Research Council, Washington, D. C.*

GENERATOR, THIRD-BRUSH.

A further investigation is desired of the characteristics of the third-brush generator used for automobile lighting. My previous investigation reported in my book on the "Principles of Direct-Current Machines" does not cover the general case of the third brush in any arbitrary position, and it assumes a straight-line magnetization curve which is certainly not correct. —*A. S. Langsdorf, St. Louis.*

INDUCTIVE INTERFERENCE, FIELD INSTRUMENTS FOR.

One of the most important steps to be taken at this time is to make available a set of comparatively rugged and fairly accurate field instruments with which the essential data on the communication circuits as well as on the power circuits while under regular operation may be obtained. Otherwise the information will continue to come in the form of qualitative, inaccurate data and personal opinion.—*H. L. Wills in the N. E. L. A. Bulletin.*

TRANSFORMERS, LOAD INDICATOR FOR.

One of the most perplexing problems regarding transformers in a distribution system is to know the load conditions under which they are working. It is desired that a load-indicating device be developed which shall be inexpensive and so designed that transformers now in service may be equipped with it. It should be maximum-reading and indicate whether the transformer has been overloaded. It should be made so as to admit resetting at any time and should preferably be visible from the ground.—*N. E. L. A. Overhead Systems Committee.*

WATT-HOUR METERS, INDUCTION TYPE.

The claim has been made that the usual induction watt-hour meter is inaccurate on heavy overloads. This matter has become of considerable practical importance since there are many small consumers with 5-amp meters who at times use 10-amp. domestic appliances, sometimes in addition to a lighting load. A simple attachment is desired which would not affect the speed of the meter up to a reasonable overload and would automatically correct the speed on heavy overloads. The name "curve-straightening device" has been suggested for such an attachment.

WELDING, ELECTRIC.

There is need for further research in electric welding practice. Tests indicate that there is a margin of about 25 per cent for improvements over the present average quality of weld. The factors to be investigated are as follows: (a) The proper current to use with the various sizes of electrodes for different thicknesses of plates; (b) the effect of the size of the angle of opening upon the strength of the weld; (c) the relative efficiencies of different types of joints; (d) the proper number of layers and the current to be used with various thicknesses of plate and positions of welding; (e) the kinds of electrodes to be used; (f) the proper method of welding long seams; (g) a simple non-destructive test of the strength of a welded joint.—*William Spraragen, New York City.*

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Senate Rider to Start Great Falls Project Killed in Conference

THE Senate amendment to the army appropriation bill authorizing the expenditure of $200,000 to start work on the Great Falls water-power project was eliminated from the bill in conference. The House conferees insisted that a project which ultimately was to cost $50,000,000 should not be authorized by means of a rider on the appropriation bill. A separate measure which will insure thorough consideration by Congress will be introduced at once.

Alabama Power Company Offers $2,500,000 in 6 per Cents

AN ISSUE of first mortgage refunding gold bonds totaling $2,500,000 has been placed on the market by the Alabama Power Company. These are thirty-year bonds in the 6 per cent series and are offered at 84¾ and interest, to yield 7¼ per cent. They are callable as a whole or in part on any interest date, on thirty days' notice, at 105 and interest, to and including June 1, 1932, and thereafter at a premium reducing one-quarter of 1 per cent per annum.

The company plans soon to begin construction of a second large hydro-electric development to be known as the Mitchell power plant, which will have an initial installed generating capacity of 60,000 hp. and an ultimate capacity of 120,000 hp. The addition of this new 60,000-hp. unit will increase the company's present hydro-electric capacity by over half and will increase its total installed generating capacity to 220,000 hp., of which more than 77 per cent will be hydro-electric.

The United States Chamber of Commerce Urges Governmental Reorganization

IMMEDIATE departmental reorganization of the federal government along more modern and efficient lines is urged by the Chamber of Commerce of the United States in a communication sent to members of the joint congressional committee on reorganization by Elliot H. Goodwin, resident vice-president of the chamber.

"At a time when the expenditures of our government exceed four billion dollars a year," the communication says, "it is self-evident that all possible economy in the operation of the machinery of government is a matter of vital concern to every citizen, and particularly to every taxpayer. The present system of departments and bureaus, with their network of subsidary offices and services extending over the entire country, has developed bit by bit through a great number of years. It has long been a matter of general belief that the system as a whole lacks co-ordination and general efficiency.

"It is evident that many public officials are underpaid. But it is highly probable that the saving which can be effected through the combination of similar services now separately and wastefully handled will save money ample to provide not only for needed salary increases but also for entirely new services which modern conditions urgently demand and still leave a handsome unexpended balance."

Canadian Electrical Association Faces the Business Situation Confidently

CANADIAN electrical utilities reflect in a measure the present depressed business conditions existing in the Dominion. At the thirty-first annual convention of the Canadian Electrical Association, held at the Chateau Frontenac, in the ancient city of Quebec, on Wednesday, Thursday and Friday of this week, there were indications that the electrical utilities are meeting the situation resolutely, and while the period of depression is expected to last a while longer, there is no alarm felt as to the outcome. Throughout Canada almost all of the electricity used is obtained from hydro-electric sources, hence the cost of the user is low and the use per capita high. Curtailments in manufactures have necessarily reduced the industrial demands on the electric light and power systems, but not to such an extent as to interfere with new construction work now going on in the Provinces of Quebec and Ontario. The loss of revenue up to the present has not been serious.

Being a geographic division of the National Electric Light Association, many of the papers read at the convention of the Canadian association reviewed the work of the national committees, and the reports made at the Chicago convention were interpreted and modified to meet Canadian conditions. On Thursday morning a series of papers requiring lantern slides was presented by representatives of manufacturing companies, and for that reason the morning session on that day was held in the Empire Theater. The principal committee reports presented dealt with meters, apparatus, overhead systems and rates. In addition papers were read as follows: "Electrical Standards and Their Application to Trade and Commerce," by O. Higman, director of the Electrical Standards Laboratory at Ottawa; "Electrons," by W. B. Cartmel of the Northern Electric Company; "Modern Street Lighting," by A. B. Cooper of the Canadian General Electric Company; "Switchboard Equipment," by L. B. Chubbuck of the Canadian Westinghouse Company; "Manufacture and Testing of High-Tension Porcelain Insulators," by A. D. Allen of the A. D. Allen Inspection Company; "The Consulting Engineer and the Power Company," by J. M. Robertson of Montreal.

The speakers at the Wednesday night dinner included President A. Monroe Grier, W. L. Goodwin of the Society for Electrical Development, Samuel Chase of the Westinghouse Electric & Manufacturing Company and W. H. Onken, Jr., editor of the ELECTRICAL WORLD.

Milo R. Bump, president-elect of the National Electric Light Association, was in attendance on Thursday and Friday and took part in the deliberations.

The committee on meters, in view of the excellent service given by the induction-type meter, suggested that the inspection-seal period of five to six years now provided for in the Dominion of Canada electricity inspection act be increased by three years. The committee on electrical apparatus voiced the desirability of some standard schedule for rating large oil circuit breakers as to rupturing capacity and performance. Mention was made of a recently developed sectionalized drive for paper-making machinery consisting of many individually driven units of different speeds the relation of which to each other does not change. All of the motors are driven from a direct-current adjustable-voltage generator with a separate constant-voltage exciter capable of furnishing excitation for the synchronous-motor fields, the motor fields and the various control circuits. The entire equipment is automatic and is installed in the plant of the Abitibi Pulp & Paper Company. The desirability of minimum guarantee clauses in power contracts to cover the full expense of maintaining service was recommended by the Commercial Section committee. In his report as chairman of the Public Relations Section D. M. McDougall cited the good-will campaign of the National Electric Light Association and suggested that the "Kilo Watt" pamphlets be rewritten, giving Canadian statistics and comparisons so as to make them applicable to the needs of the Dominion of Canada.

British Manufacturers' Association Holds to 40-Deg. Standard

COPIES have just been received in this country of specifications for industrial electric motors and generators published in May by the British Electrical and Allied Manufacturers' Association. These specifications, which represent present-day British practice with regard to industrial motors and generators up to 1,000 kw., still cling to the 40-deg temperature rating for class A, or fabric, insulation for all machines other than totally inclosed. The question of whether 40 deg. or 50 deg. is the better rating has been under discussion in England for some time, and while it is not felt in this country that there was unanimity of opinion among "Beama" members, still it is apparent that there was a majority opinion of sufficient strength to warrant the action of the association in specifying 40 deg. as the official rating.

City of Los Angeles Would Obtain Private Plant by Condemnation

THE CITY of Los Angeles has instituted a condemnation suit in the United States District Court to obtain possession of the Adams station of the Southern Sierras Power Company. The city contends that the needs of a municipality rank above those of private interest. To this the defendant answers that the needs of the cities of Redlands, Riverside, and towns in the Imperial Valley served by it are of equal importance since they depend partly on the output of this plant for their power supply. This station, rated at 3,750 kw., is in the Owens River gorge in Mono County, Cal., and is valued by the Southern Sierras Power Company at approximately $1,000,000, including 320 acres of land.

Bureau of Standards Electrical Work May Be Divided

NO SELECTION has been made for the important post in the Bureau of Standards made vacant recently by the death of Dr. E. B. Rosa. It is not improbable that the work in electrical physics and that in electrical engineering may be conducted in the future by separate chiefs. It is recognized that it will be very difficult to obtain a man of Dr. Rosa's capabilities for a salary of $4,800. The problem will be simplified, it is believed, by placing the two sections of the electrical division under separate directors. E. C. Crittenden is acting as chief of the electrical division.

Power Club Unanimously Opposes Chicago Ordinance

TARIFF, the 40-deg. or 50-deg. temperature question, the proposed consolidation of the three manufacturers' associations and the proposed Chicago electrical ordinance received the major portion of attention at the annual meeting of the Electric Power Club held June 6, 7, 8 and 9 at Hot Springs, Va. The members declared themselves as one in opposition to the proposed Chicago ordinance, which would license and regulate the sale and installation of electrical appliances and passed a resolution to that effect.

The regular routine of business, including the reports of the committees of the separate sections, was carried out, and the reports were adopted. On the evening of June 6 at the annual dinner John W. O'Leary, vice-president of the Chicago Trust Company, made a very interesting address on "Some Business Observations."

The report of the tariff committee was listened to with considerable interest. There is now one committee representing the entire electrical industry and known as the tariff council committee, of which S. L. Nicholson is chairman and A. W. Hanshaw secretary. It has a paid adviser, William Burgess, in Washington to keep the committee fully advised of political developments and so protect the interests of the industry. The committee is very much in favor of American valuations on imports rather than those declared at the port of shipment. The American electrical manufacturers are not endeavoring to build up a tariff wall, but rather to bring about a tariff that is just and reasonable to American labor.

The proposed consolidation of the electrical manufacturers' associations was fully discussed, but it is still in a formative state. A constitution and set of bylaws were presented by the committee for consideration, and to these certain modifications were suggested.

No definite action was taken on the question of 40-deg. versus 50-deg. temperature rise, although it was very fully discussed at a special meeting of the motor and generator section.

R. J. Russell, vice-president and secretary of the Century Electric Company, St. Louis, was chosen president of the Electric Power Club; C. H. Roth, president Roth Brothers & Company, Chicago, was made vice-president and re-elected secretary, and J. K. Bass, president Kimble Electric Company, Chicago, was chosen to be treasurer. Four governors were elected as follows: S. L. Nicholson, Westinghouse Electric & Manufacturing Company, and F. M. Kimball, General Electric Company, re-elected, and J. F. Lincoln, Lincoln Electric Company, and J. K. Bass.

New Federal Department Proposed to Take Over Power Work

A PROPOSAL that the Federal Power Commission be "abolished and all duties, powers, equipment and all that pertains to said commission be transferred to the Department of Mines and Mineral Resources and placed under its jurisdiction and made a part thereof" is contained in the bill drafted by Senator Shortridge of California.

In the new Federal Department of Mines and Mineral Resources which Senator Shortridge would set up he proposes to have a Bureau of Power Development. This bureau would be under the immediate direction of a chief engineer to be appointed by the President at a salary of $7,500. He suggests two consulting engineers for the bureau, at $5,000 a year each.

The Secretary of Mines under this bill would have authority to transfer to the Bureau of Power Development the work of the United States Geological Survey dealing with the gaging of streams and the investigation of water resources. In addition this bureau would be the custodian of the records of the Superpower Survey.

The new department as proposed by Senator Shortridge would absorb the work now being done by the United States Geological Survey, the Bureau of Mines, the War Minerals Relief Commission, the California Débris Commission, the Federal Power Commission and the Bureau of Explosives of the Interstate Commerce Commission, as well as such portions of the work of the Bureau of Standards, the General Land Office and the Indian Office as pertain to mineral lands or the regulation of mineral activities on the public or Indian lands.

Iowa Section, N. E. L. A., Will Discuss Farm Lines and Rates

MEETING at the Inn Hotel, Lake Okoboji, Iowa, next week, the Iowa Section of the National Electric Light Association will follow this program:

WEDNESDAY, JUNE 22

Morning—Reports and general discussions.

Afternoon—"Overcoming Excessive Loss in Farm Lines," by E. L. Fischer, general manager Muscatine Lighting Company; "Reports of Tests on Typical Farm Line Installations," by V. L. Hein, engineering extension department, Ames; paper on subject to be selected, by A. B. Campbell, electrical engineer Iowa Railroad Commission, Des Moines; "Liability Insurance Covering Electric Transmission Lines," by W. A. Woodward, Iowa Railway & Light Company, Cedar Rapids, and Mr. Block, Lynton T. Block & Company, St. Louis, Mo.; "The Law of Tree Trimming for Clearance of Electric Transmission Lines on Public Highways," by Rex H. Fowler, Des Moines; "Liability of Transmission Line Companies for Assessment Incident to Drainage Projects," by Rex H. Fowler, Des Moines; "Inductive Interference," by John M. Drabelle, electrical and mechanical engineer Iowa Railway & Light Company, Cedar Rapids.

THURSDAY, JUNE 23

Morning—"Modern Power-Station Economies," by E. S. Hight, chief operating engineer Illinois Traction System, with discussion by John M. Drabelle, C. A. Sears and C. G. Johnston; "Electrical Merchandising," by Ira Steele, commercial manager Des Moines Electric Company; paper on "Electric Cooking and Heating."

Afternoon—"Valuation and Rate of Return," by L. R. King, valuation engineer United Light & Railways Company, Davenport; "Rates," by Austin Burt of Waterloo, N. T. Wilcox of Keokuk, C. N. Chubb of Davenport, H. C. Orton of McGregor, M. G. Linn of Des Moines and J. B. Hill of Iowa City; "The Establishment of an Iowa Committee of Public Utility Information," by O. H. Simonds, general manager Dubuque Electric Company, and Horace M. Davis, director Nebraska Committee on Public Utility Information, Lincoln, Neb.; committee reports and election of officers.

Evening—Banquet, with address by speaker to be selected. Col. W. G. Dows, president Iowa Railway & Light Company, Cedar Rapids, will be toastmaster, and the convention dance will follow the banquet.

FRIDAY, JUNE 24

(Joint session with Iowa Electric Railway Association)

Morning—"The Sale of Public Utility Securities," by H. E. Weeks, treasurer United Light & Railways Company, Davenport, with discussion by S. Dows, E. F. Bulmahn and C. Miller; "A Discussion of the Law Pertaining to the Regulation of Electric and Gas Rates and Street Railway Fares in Iowa," by William Chamberlain, general counsel United Light & Railways Company, Cedar Rapids, and John A. Reed, general attorney Iowa Railway & Light Company, Cedar Rapids; report of legislative committee, by F. J. Hanlon, Mason City.

Afternoon—Separate session of the Iowa Electric Railway Association.

Pacific Coast Electrical Utility Men Hold Industrial Symposium

THE last afternoon and evening of the convention of the Pacific Coast Division, N. E. L. A., were devoted to a symposium of papers and addresses on the industrial standing and prospects of the Pacific Coast. To the prominent men of the industrial world who were specially invited to the convention it was emphasized that the further progress of the West as an industrial center was inseparably bound up with the development of hydro-electric power. In order to make this point as definite as possible an industrial survey had been made in that territory by the Western section of the N. E. L. A. and the *Journal of Electricity and Western Industry*. This survey presented by means of charts the growth of the West industrially in relation to hydro-electric development.

Phases of the survey were presented by Robert Sibley, editor of the *Journal of Electricity and Western Industry;* W. E. Creed, president Pacific Gas & Electric Company; H. G. Butler, Power Administrator of California, and A. E. Wishon, general manager San Joaquin Light & Power Company. Mr. Creed stated that the successful financing of the huge construction program facing the Western companies lay in the sale of junior securities. J. B. Miller, president of the Southern California Edison Company, who presided at this meeting, said that his company was not planning the development of the tremendous powers of the Colorado River alone, but that it was working on a plan whereby the other companies in the territory could receive the benefits of large blocks of power.

M. H. Aylesworth, executive manager of the N. E. L. A., addressed the general session on Friday on public relations, pointing out the necessity of telling the story of the electrical industry to the man in the street so that he may understand that his self-interest is inseparably bound up with the success of that industry.

A. B. West, vice-president of the Southern Sierras Power Company, was elected president of the Division, J. B. Black, commercial manager Great Western Power Company, first vice-president; L. M. Klauber, general superintendent San Diego Gas & Electric Company, second vice-president, and Henry Bostwick, Pacific Gas & Electric Company, treasurer.

Pennsylvania Power & Light Company Not Contemplating New Plants

REPORTS have been circulated that the Pennsylvania Power & Light Company has obtained power sites in the territory in which it operates and on which are to be erected large electric generating stations. The latest report is that the company has obtained a site on the Susquehanna River near the mouth of Roaring Creek, just below Catawissa, Pa. It was authoritatively stated to a representative of the ELECTRICAL WORLD that the reports of these projected central stations are entirely incorrect. The company is now actively engaged in increasing the facilities of its two present electric generating stations at Harwood and Hauto, and this is the only power station construction now contemplated by the company.

The generating capacity of the Hauto station is being increased from 30,000 kw. to 50,000 kw., and the generating capacity of the Harwood station is being increased from 33,000 kw. to 41,500 kw.

New Electrical Industrial Co-operative Course at Worcester

A NEW course, designed to provide for a closer connection between the curriculum and outside industry, has been announced by the Worcester (Mass.) Polytechnic Institute for its department of electrical engineering. Under the new plan each student registering in the department will have his choice of two courses—first, the regular four-year course as at present, and, second a course corresponding to the present course for the first three years, but with the provision that at the end of the third year the student will enter one of the electrical industries for a period of from twelve to fifteen months. At the conclusion of this period, he will return to the institute for his final year. The main object of the alternative course is to furnish training of a type which is ordinarily received only after graduation. The training will be carried on under direct institute influence, and each participant will be considered a non-resident student, keeping in close touch with the department. Among the companies interested in co-operating are the General Electric Company, Westinghouse Electric & Manufacturing Company, American Telephone & Telegraph Company, Worcester Electric Light Company and New England Power Company. Prof. Harold B. Smith is head of the department of electrical engineering at the Worcester Institute.

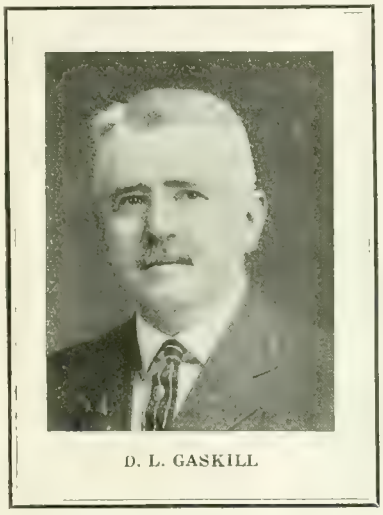
International Chamber of Commerce Meets on June 27 in London

MORE than two hundred leading American business men have sailed to participate in the first annual meeting of the international Chamber of Commerce in London during the week of June 27. With the restoration of the world's commerce as the main theme, this conference promises to be one of the most important international meetings of business men held in recent years. Eleven countries will send delegates—Belgium, France, Italy, Great Britain, the United States, Poland, Greece, Holland, Czechoslovakia, Denmark and Sweden.

The program has been divided into five general subjects, all having an important bearing on the main theme of the conference, and the convention will be organized into five groups, each group taking up one of these five general subjects. The subjects are transportation and communication, finance, production, distribution, and devastated regions.

D. L. Gaskill Sees Profitable Field in Rural Service Lines

TEN years from now rural service lines will cover just as much territory as do the telephone lines at the present time. This statement was made by D. L. Gaskill, president of the Greenville (Ohio) Electric Light & Power Company and secretary of the Ohio Electric Light Association, who was in New York recently and was asked by a representative of the ELECTRICAL WORLD to express his views on the rural-line situation. Mr. Gaskill's company serves upward of 400 rural customers.



D. L. GASKILL

"The principal load on our rural lines," said Mr. Gaskill, "comes from lighting and small appliances. It must be remembered that we are serving a territory where there are real farmers who live on forty, sixty or eighty acres of land and make their living from it. These farmers have very little use for large power and what requirements of 10 hp. to 15 hp. they have can be procured much cheaper than in an electrical way. Threshing grain takes but a day or two and ensilage cutting perhaps three days per year on each farm, while the necessary grinding of feed for a month can be done in half a day. It would not pay the farmer to install transformer capacity and motors large enough to do this work, especially as the present farm tractors are provided with a band wheel and will do the work much more cheaply.

"Lighting, small power for pumping water, operating cream separators and washing machines, flat irons and other appliances make up the load on the average farm. The demand is at almost all times less than 1 kw. In fact, among more than 400 rural customers served by us, I never knew of the demand exceeding this amount. The total use of energy is small, averaging 12.5 kw.-hr. per customer per month. Our rate for this service is a fixed charge of $1 per kilovolt-ampere of transformer capacity per month plus an energy charge of 10 cents per kilowatt-hour."

Asked what the fixed charge covered, Mr. Gaskill pointed out that while there are no interest charges on the lines, as these are built by the farmers, then turned over to the company and cannot be capitalized, there is a maintenance charge of 5 per cent. Transformer and copper losses average 15 kw.-hr. per customer per month, and the cost of reading meters is approximately 7 cents in the country against 2 cents in the city.

"These extra expenses of maintenance, reading meters and high transformer losses," said Mr. Gaskill, "must be covered by a fixed charge. The expense of

maintaining service—that is, answering trouble calls or making other miscellaneous repairs—is much lower than would be expected. The farmer has always been accustomed to doing his own repairing on farm implements and machinery and seldom calls on the company to replace blown fuses or make other minor repairs.

"On our rural lines the number of customers averages five to the mile, and the average gross revenue per customer is $24 per year. All of these lines have been built by the farmers at a cost of from $700 to $1,000 per mile, depending upon whether they were for 2,300 volts or 6,600 volts. The company specifies that not less than No. 6 bare copper wire be used, and all work must be of standard construction.

FARMERS BUILD LINES

"We do not push the construction of these lines, but when a group of farmers desires to construct a new line we hold a meeting, at which time we explain all the details and conditions. No attempt is made to compel the farmers to purchase material from the central-station company; in fact, we advocate their procuring bids and buying from the jobbers as much as possible. We have found that this policy puts the company in the right light and the farmers do not get the impression that they are being exploited. At this time we also fix in the farmers' minds why they must pay a higher rate for service than that paid by customers in town, and when the reasons for the fixed charge are explained the farmers readily understand and accept them.

"The expense of constructing a new line is shared equally by the farmers taking service. That is, if a line 2 miles long costing $1,500 is required to serve ten farms, each would pay one-tenth of that amount. As a rule all available customers are taken on when the line is built, but should another connect to the line within ten years he must pay in his prorated share, or one-eleventh of the cost, which is divided among the original ten. For extensions to the end of a line the new customers do not pay a part of the cost of the original line, but for side lines and taps we have a special form of agreement covering the varying conditions which arise.

"So far it has not cost any of the farmers more than $300 to obtain service, this including the building of the line and necessary wiring in the house, barn and outbuildings."

Wisconsin Utility Tax Rate Increased 11 per Cent

THE Wisconsin Tax Commission is authority for the statement that the rate of taxation on electric light, heat and power, electric railway and gas utilities for 1921 has been increased more than 11 per cent. The rate determined on for 1921 is 0.02106389, or $21.06 per $1,000. The rate for 1920 was 0.0185318. Assessments on these public utilities will be considered by the commission in July and August.

Taxes paid by the utilities mentioned amounted to $2,151,466.72 in 1920, an increase in ten years of 238 per cent. Values increased in the same length of time 101.4 per cent. Taxes paid by street-railway and electric light and power companies are paid into the state treasury. The state retains 15 per cent; 65 per cent goes to cities, towns and villages, and 20 per cent to the counties.

Navy Department Satisfied with Final Test of Tennessee

THE Navy Department is understood to be entirely satisfied with the final tests of the battleship *Tennessee*, according to information received by the ELECTRICAL WORLD from its Washington correspondent. The electric propelling machinery functioned perfectly and demonstrated the superior maneuvering power of the electric drive. The salvo test—the firing of all twelve of the 14-in. guns at once—caused no injury to the electrical equipment of the ship. The propelling machinery of the *Tennessee* consists of two 15,000-kva. Westinghouse turbo-generators and four 8,375-hp. Westinghouse motors.

I. E. S. Elects Officers for Next Year

ANNOUNCEMENT was made this week of the results of the balloting for officers of the Illuminating Engineering Society for the fiscal year commencing Oct. 1, 1921. The officers elected are:

President—Dr. George S. Crampton, Philadelphia.

Junior past-presidents—Samuel E. Doane, Cleveland; George H. Harries, Chicago.

Vice-presidents—F. M. Feiker, New York; James J. Kirk, Chicago; H. F. Wallace, Boston.

Secretary—Clarence L. Law, New York.

Treasurer—L. B. Marks, New York.

Directors—F. C. Caldwell, Columbus, Ohio; A. D. Curtis, Chicago; P. S. Millar, New York; Francis E. Cady, Cleveland; D. McFarlan Moore, Harrison, N. J.; Robert B. Ely, Bloomfield; Adolph Hertz, New York; Walton Forstall, Philadelphia; Frank S. Price, Boston.

Section chairmen for the fiscal year 1921-1922 will be: New York, H. V. Bozell; New England, William J. Drisko; Philadelphia, H. B. Andersen; Chicago, F. F. Fowle.

Dr. Crampton, the new president, is an ophthalmologist practicing in Philadelphia. He has previously served the society on committees and as an officer.

New England Public Utility Information Bureau Organized

TO DISTRIBUTE correct information about public utilities in the six New England states a public utility information bureau has been established under the direction of C. L. Edgar, president of the Edison Electric Illuminating Company of Boston; A. M. Barnes, president of the Cambridge Gas Light Company; E. W. Longley, vice-president of the New England Telephone & Telegraph Company; Arthur E. Childs, president of the Massachusetts Lighting Companies, Boston, and H. T. Sands, president of the Haverhill Electric Company. The bureau plans to maintain an office in Boston in charge of a salaried director and, besides issuing reading matter of interest to the public, expects to furnish commercial organizations with competent speakers.

Work Started on New Arkansas 33,000-Volt Line

WORK has started on the construction of a new 33,000-volt aluminum line for the Arkansas Light & Power Company from Stuttgart to Clarendon, where it will tie in with the Arkansas Utility Company, a distance of 20 miles. Work is expected to be completed by July 15. The Arkansas Utility Company will distribute to Clarendon, Brinkley and Cotton Plant.

Gas-Filled Lamps to Replace Series Arcs in New $40,000 Installation

THE Department of Public Service of Hamilton, Ohio, has announced the completion of plans to rebuild the street-lighting system of that city. The system as laid out will require 1,400 lamps, 1,100-c.p. lamps being used in the business district, 600-c.p. lamps on the main thoroughfares, 400-c.p. lamps in the thickly-settled residential districts and 250-c.p. lamps in all outlying districts and in the middle of blocks where the distance is too great for street intersection lighting. Gas-filled lamps will be used, displacing series-inclosed arc lamps. In announcing the change, the department stated that it had been decided on for reasons of efficiency, lower maintenance charges and better illumination.

The installation will require a new switchboard of eleven circuits and eleven series transformers. The system at present has eight circuits. The cost of the installation will be approximately $40,000 and most of the material has been contracted for. It is expected to have it in operation by Nov. 1.

Foreign Countries to Be Asked to Participate in Exposition

ANOTHER step has been taken by way of preparation for the international exposition to be held in Portland, Ore., in 1925. The Senate has passed a bill authorizing the President to invite foreign countries to participate in the exposition, which is intended to celebrate the completion of the transcontinental and Pacific highways and the centennial of the invention of the electromagnet, as well as to exemplify the development of hydro-electric energy.

Rulings of Federal Power Commission

A RULING to the effect that the leasing of a project by a licensee to another would not be a voluntary transfer within the meaning of the water-power act has been approved by the Federal Power Commission. It was held, however, that the commission would have to give its consent to the terms and conditions of the sub-lease since it clearly was the purpose of Congress to have the commission retain control over its operation. A licensee may not escape his responsibility by leasing the property to another and will be held to account by the commission for the earnings of the project.

Another ruling is that the temporary withdrawal of public lands included within proposed extensions of the Sequois, Yellowstone and Crater Lake National Parks in no way interferes with the authority of the commission to license any water-power development within the areas temporarily withdrawn.

The commission also holds it to be unnecessary to advertise a project upon the filing of an application for license if it has been advertised at the time the application for a preliminary permit was filed.

In connection with the applications of the United Mills Company, the Granite Falls Manufacturing Company and the Catawba Valley Light & Railway Company, involving lands in the Boone national forests of North Carolina, the commission holds that the provision of the law providing for filing notice in the local land office is inapplicable, as in the provision regulating the opening of power-reserve lands to disposition under the public land laws.

In connection with the application of the Citizens' Light, Power & Water Company of Ketchikan, Alaska, to purchase timber from lands embraced within a power reservation it has been ruled that timber on such lands may be sold under the authority of the Secretary of the Interior.

Research and Labor Outstanding Problems, Says Dr. Nichols

IN THE presence of a distinguished assemblage of scientists, educators, engineers and public officials, Dr. Ernest Fox Nichols was inaugurated seventh president of the Massachusetts Institute of Technology at Cambridge on Wednesday of last week, succeeding the late Dr. Richard C. Maclaurin. Although the exercises were of extreme simplicity, the occasion was marked by a profound appreciation of the importance of engineering education and scientific research in attacking the problems of modern civilization, including labor issues as well as material advancement.

The inaugural took place in the Walker Memorial building, fronting the Charles River Basin, and included an invocation by the Rev. George A. Gordon, D.D., pastor of the Old South Church, Boston, and addresses by Dr. Elihu Thomson, acting president of the institute; Gov. Channing H. Cox of Massachusetts, President A. Lawrence Lowell of Harvard University, Prof. H. P. Talbot, chairman of the institute faculty, and President Nichols. In inducting President Nichols into office, Dr. Thomson said in part:



ACADEMIC PROCESSION AT INAUGURATION OF PRESIDENT NICHOLS

Left to right—Governor Channing H. Cox of Massachusetts, Edwin S. Webster of Stone & Webster, President Nichols, Dr. Elihu Thomson, acting president M. I. T.; Chief Marshal Frank L. Locke.

"The service rendered by the Massachusetts Institute of Technology during its existence of some few years more than half a century in establishing upon a firm basis technical education and engineering training would not have been possible had it not been fortunate in having exceptional men at its head—men of great ability, high ideals and intense, almost passionate realization of the future of science and its applications. The building up of a great school from small beginnings amid many difficulties required their unselfish devotion to a difficult task and earnest support from faculty,

alumni, at first very few, and the friends of the school. Their tireless effort led to increasing public confidence and general recognition of the value and necessity of the kind of training for which the school has stood—technology, broadened and illuminated by scientific study, work founded on thorough scientific research and investigation as against rule-of-thumb or traditional methods merely—not a narrow specialization, but learning which looks forward as well as backward, that uses history as a means of inspiration for further advance and achievement."

Closer contact between educational institutions and industry was commended by Professor Talbot, who said: "Most problems relating to the improvement or development rather than to the control of industrial operations resolve themselves into abstract problems in physics, chemistry, mechanics or electricity. The smaller research organizations have neither time nor facilities for their solution; even the largest are confronted with questions which demand access to large libraries, or special equipment, or co-ordinated attack by several specialists, and on such problems the staff and facilities of a technical school can be brought to bear with peculiar effectiveness, and the findings will be regarded as authoritative and impartial."

Broad Education Essential

The temptation to introduce more detailed technical courses at the expense of other background-building studies was discountenanced by President Nichols, who spoke in part as follows:

"The two outstanding industrial problems today are: (1) The more intensive application of scientific knowledge and research to the processes and products of industry; (2) the cultivation of better understanding and more wholesome relations between labor and management. Both of these problems may rightly claim attention in any modern scheme of technical education.

"With depleted reserves applied science must soon face one of two alternatives. Either it must descend from its past and present rapid succession of revolutionary achievements to a more modest hand-to-mouth existence, reworking old accomplishments and consuming next year whatever pure science at its present working rate may discover, or else the hosts of pure-science research must be vastly strengthened and the volume of their yearly output many times increased.

"Under these circumstances technical schools owe to modern industry the more intensive cultivation of research, with increasing emphasis on pure science.

"No industrial question is of greater importance than human relations in industry, and none is more complex or baffling. Yet no pains can be spared, or are being spared, to find remedial measures. Many hopeful schemes for a better human organization of industry have been suggested and are under trial, some fortunately with encouraging promise.

"The dominant bearing of this discussion on technical education is this: Our technical schools are training the future brain workers and managers of industry. We may, therefore, well ask ourselves at this time if there is anything we can do beyond what we are now doing to train our students to understand more fundamentally and to meet more successfully the gravest of all their future responsibilities, the organization and management of men—a responsibility which they and we owe, not to industry alone, but to the whole economic, social and political stability of the nation."

New Orleans Alarmed Over Inability of Utility to Meet Demands

THE gas and electric equipment of New Orleans, La., is no longer adequate, according to Receiver J. D. O'Keefe of the New Orleans Railway & Light Company, who announced last week that he will not be able to meet the demands for new installations. The receiver accompanied his announcement with a table showing the growth of the electric department in the past seven years, from 1914 to 1920. This indicates an increase from 120 per cent in the number of meters and 250 per cent in the output. The present generating capacity of dependable units is shown to be 45,000 kw., while the connected load is in excess of 67,000 kw.

The growth of the gas department is shown in a similar table to be as great. The city authorities have now suddenly awakened to the dangers that threaten the industrial expansion of the city and the complete cessation of the building program, at present on the eve of development. The industrial bureau of the Association of Commerce is really alarmed over the outlook and a hurried meeting of that body has been called to consider the problem.

No Bituminous Coal Shortage Anticipated

A REPORT by George H. Cushing, managing director of the American Wholesale Coal Association, to the members of the association at their annual convention June 7 and 8 gives five conclusions relative to the near future of the bituminous coal market that are of interest to electric light and power men. They are:

First—A general and pronounced revival of business at home is out of the question until after the middle of July, 1922; it will be unprecedented if it comes prior to July, 1923.

Second—No dependable revival of the export business is possible until political conditions in Russia have been stabilized.

Third—Without a marked revival of domestic or foreign business, or both, the existing capacity of the railroads cannot be so seriously taxed as to create another coal shortage.

Fourth—Except between Jan. 15 and March 15, 1922—when industrial consumers will be buying coal for storage in anticipation of a strike of the bituminous miners on April 1, 1922—the bituminous mines will not during this coal year produce in excess of 50 per cent of their rated capacity or in excess of 75 per cent of their normal production.

Fifth—By the end of 1923 the home market will express a demand for bituminous coal considerably in excess of 600,000,000 tons per annum; the foreign market should want 40,000,000 tons, and it will be with difficulty that we shall meet home demands. Then will follow a protracted period—hardly less than five years—during which bituminous coal prices will be uniformly high.

Stanley Patent Amendment Reported

THE Senate committee on patents has reported favorably and recommends the prompt passage of the Stanley amendment which requires foreigners to whom American patents are granted to conduct manufacture on a reasonable scale within the continental limits of the United States. Manufacture must begin within two years.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

Radio Connects United States with Indo-China.—Plans have been completed whereby commercial radio messages may be sent from San Francisco via Hawaii, Guam and the Philippines to Hanoi or Saigon, in French Indo-China.

University of Arkansas Has Metermen's Course.—A special metermen's course under the direction of the department of electrical engineering of the University of Arkansas, Fayetteville, Ark., will be held from June 20 to June 24, with alternate class and laboratory work.

Popularizing the Electric Range in Virginia.—The State Corporation Commission of Virginia has granted permission to the Virginia Railway & Power Company to cut its domestic rates for electrical energy at Petersburg squarely in half, or to 5 cents a kilowatt-hour, for cooking, heating, battery charging and ice-making purposes. The consumer must use a minimum of 30 kw.-hr. It is hoped that under this rate electrical cooking will gain great popular favor.

Manufacturers of Indianapolis Ask Lower Rates.—At a meeting of the Indianapolis manufacturers, power rate committee recently plans were made to appeal to the Public Service Commission, to lower electric power rates in Indianapolis. This committee is composed of representatives of Indianapolis manufacturers who use electric power provided by local companies. It will ask the co-operation of the manufacturers' committee of the Chamber of Commerce in the movement.

Electrical Development in Russia.—According to a young Russian engineer, C. L. Lipman, who spoke recently in London before the Institution of Electrical Engineers, initial efforts to further the much-advertised soviet scheme of nation-wide electrification have actually been made under government control, though the general destitution and the dearth of engineering materials have not permitted progress much beyond the excavating and layout stage. Work on the Kashir generating station to supply Moscow and its environs is being rushed day and night, according to Mr. Lipman. At present the city is being illuminated by the Bogorodsky transmission station helped out by a temporary district station, and some large industries are said to be receiving power. In the Petrograd district a new station has been begun, the speaker said, on the Viazen marshes, and a huge hydro-electric plant has been put under construction on the River Svir. In the Donetz basin thirty power houses, with a total rating of 190,000 kw., are in operation in three of the chief districts, while 3,000 motors, totaling 122,240 hp., have been repaired and put to use. Another large power house was said to be under construction in the Kizelovsk coal district in the Ural.

Copies of Scientific Articles to Be Made Available.—The Research Information Service of the National Research Council announces that it is prepared to assist investigators by locating scientific publications which are not generally or readily accessible. It will also, when desired, have manuscripts, printed matter or illustrations copied by photostat or typewriter. The cost of copying varies from 10 cents to 25 cents per page. Requests for assistance should be addressed National Research Council, Information Service, 1701 Massachusetts Avenue, Washington, D. C.

Electric Irrigation in California.—San Joaquin County, California, has 183,853 acres of land under irrigation, according to the latest census figures, of which amount 31,915 acres is irrigated by means of electric power furnished by the Western States Gas & Electric Company, Stockton division. Electrical energy is rapidly becoming the most popular means of irrigating lands because of its flexibility, reliability and economy. Scarcely a week passes, it is reported, without applications to the company for service of this kind, which dates back only ten years. Today it serves a total of 13,527 hp. of this class of business, nearly all of which is in San Joaquin County.

International Lighting Commission to Meet in Paris in July.—The International Commission of Lighting, which was founded in 1913 to continue and extend the work of the International Commission of Photometry, will hold its first session at Paris on July 4 to July 9 next. Five technical sessions of the commission will be held, at which there will be considered the proposed international standard of lighting advocated by the British national committee, with reports by the committees of the United States, France and Great Britain, and the photometric nomenclature and definitions proposed by the same committees. Reports will be presented to the commission on the following subjects, among others, by the committees of the countries respectively indicated: Heterochromatic photometry (France and United States); use of light filters in heterochromatic photometry (United States); properties of the normal eye (Italy); relative visibility function and the mechanical equivalent of light (United States); automobile headlamps (United States); lighting rules from the point of view of safety and of health (France); lighting legislation (United States). The president of the commission is Prof. T. Vautier of the Lyons faculty of Science.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Utah Section, A. I. E. E.—Officers of this section have been elected as follows: Chairman, Paul P. Ashworth, distribution engineer Utah Power & Light Company; secretary, C. R. Higson, assistant to general superintendent Utah Power & Light Company; junior past-chairman, J. F. Merrill, dean of School of Mines, University of Utah; executive committee, H. W. Clark, J. A. Kahn, Robert Miller and W. A. Moser.

Spokane Section, A. I. E. E.—B. M. Merrill, superintendent of light and power for the Washington Water Power Company, was elected chairman of this section at the annual meeting on May 20. The other officers elected were: Vice-chairman, L. J. Pospisil; secretary and treasurer, H. L. Melvin; members of the executive committee, J. W. Hungate, J. S. McNair and D. F. Henderson. Following the A. I. E. E. election and annual dinner a meeting of the Associated Engineers of Spokane was held, at which Carl F. Uhden, chief engineer of the huge Skagit River project of Seattle, told of his work.

Denver Section, A. I. E. E.—At the annual meeting of this section, held Saturday, May 21, officers for the coming year were elected as follows: Chairman, Burton C. J. Wheatlake, manager supply department of the General Electric Company; vice-chairman, Edward A. Phinney, vice-president and general manager Jefferson County Power & Light Company; secretary-treasurer, Robert B. Bonney, educational director Mountain States Telephone & Telegraph Company. Prof. L. D. Crain, of the Colorado Agricultural College, Fort Collins, spoke on "Electricity on the Farm."

Coming Meetings of Electrical and Other Technical Societies

American Society for Testing Materials—Asbury Park, N. J., June 20-24.

A. I. E. E. Annual Convention—Salt Lake City, June 20-25. (For program see issue of April 30, page 1009.)

N. E. L. A., North Central Division—Duluth, Minn., June 21-23. (For program see issue of June 4, page 1332.)

National District Heating Association—Cedar Point, Ohio, June 22-24. (For program see issue of May 7, page 1069.)

N. E. L. A., Iowa Section—Lake Okoboji, June 22-24.

Association of Municipal Electrical Utilities of Ontario—Niagara Falls, Ontario, June 23-25.

Associated Manufacturers of Electrical Supplies—New London, Conn., June 27-30.

Society for the Promotion of Engineering Education—New Haven, Conn., June 28-July 1.

Ohio Electric Light Association—Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Transmission Tower on Right-of-Way Not an "Attractive Nuisance."—A boy who climbed an electric transmission tower erected on a right-of-way through land owned by the boy's father and, though he did not touch the wires, received a shock while in the "danger zone" that caused him to fall and sustain fatal injuries was a trespasser, the Court of Civil Appeals of Texas found, in McCoy vs. Texas Power & Light Company, and damages for his death could not be recovered. Notwithstanding that the tower bore no warning sign it did not constitute a nuisance attractive to children, in the legal meaning of the term. (279 S. W. 623.)*

Ownership of Supporting Structure by Another Does Not Abolish Duty of Protecting Wires.—Affirming a judgment for damages because of injuries sustained by a boy who climbed on a railroad bridge and came into contact with electric wires (New York, New Haven & Hartford Railway Company vs. Fruchter), the United States Circuit Court of Appeals asserted that a lawful structure may because of its attractiveness to children render its owner liable for harm resulting to a child lured by it. (See issue of June 11, page 1392). The company, it further held, was not relieved from its duty to guard the wire by the fact that it did not own the bridge, even though it was the bridge and not the wire which was the real attraction. (271 Fed. 419.)

What Constitutes a Navigable Stream?—In Economy Light & Power Company vs. United States the question of navigability came up for examination by the Supreme Court of the United States (see ELECTRICAL WORLD for April 30, page 1010.) The test of navigability, the court stated, "is whether the river in its natural state is used or capable of being used as a highway for commerce over which trade and travel is or may be conducted in the customary modes of trade and travel on water. Navigability, in the sense of the law, is not destroyed because the watercourse is interrupted by occasional natural obstructions or portages; nor need the navigation be open at all seasons of the year or at all stages of the water." A decision of a state supreme court that a river was not navigable is not conclusive on a federal court having different evidence before it. It is for Congress and not the courts to declare whether a navigable river which has fallen into disuse as a highway of commerce is to be abandoned as such a highway. (41 S. C. R. 409.)

Responsibility of Power Company for Low Wires Across Street.—The Alabama Power Company appealed from a verdict in a suit brought against it by one Fergusen, who was injured while driving on a street across which the company's wires were strung by the toppling over of crates with which his wagon was loaded because of these crates coming in contact with the wires. The company's plea that it was the duty of the plaintiff to look out for the wires was held by the Supreme Court of Alabama to be deficient in that it omitted any averment of fact which imposed on him such a duty, and the question asked a witness, "Whose duty was it at the time to maintain those wires?" though improper as calling for a mere opinion, was harmless to defendant, whose ownership and use of the wires had been clearly shown. (87 So. 796.)

Finding on Reasonable Inference of Compensable Injury Final.—The Supreme Court of Michigan has affirmed the award by the Industrial Accident Board of the state of damages for the death of a boilermaker found with life extinct under the boiler where he had been working (Paton vs. Port Huron Engine & Thresher Company). Although the testimony showed that the man had received an electric shock from a wet 110-volt lighting cord, the company maintained that the inference that this had caused his death was only conjectural and asked reversal of judgment under the legal rule that where two inferences equally consistent with the facts arise from the evidence one of which makes the employer liable and the other of which does not the application shall fail. This rule, the court held, does not apply where there exists a reasonable inference that the injury arose out of the employment. (182 N. W. 639.)

Los Angeles-Southern California Edison Contract Sustained.—In Miller vs. City of Los Angeles, a taxpayers' action to enjoin the city from carrying out a contract made two years ago with the Southern California Edison Company as the result of the indorsement by the voters of a bond issue to enable the municipality to purchase the company's distribution system within the city limits (see ELECTRICAL WORLD, May 31, 1919, page 1181), the Supreme Court of California has affirmed the judgment for the city rendered in the inferior court, holding (1) that under its charter empowering the city to purchase property necessary to furnish light, heat and power the city could purchase electrical energy for distribution; (2) that the city was authorized to contract for the sale of surplus electricity to corporations for distribution outside city, and (3) that a contract to purchase a distributing system without assuming indebtedness need not be submitted to the voters. (197 Pac. 347.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Compulsory Service.—The Wisconsin Railroad Commission has refused to allow a rolling-mill company operating an electric service for forty-four consumers to discontinue such service, although the owners asserted its unprofitable nature and their desire to withdraw from the business. The consumers protested against its abandonment and declared their willingness to pay fair rates.

Responsibility for Tampering with Meter.—While utilities have an undoubted right to cut off service to patrons who misuse or abuse it, the Pennsylvania Public Service Commission has declared, the charge of tampering with a meter is too serious to be sustained except upon clear and satisfactory proofs. In a case where such proofs were not sufficient to convince the commission gas service was ordered restored. The Utah Public Utilities Commission ordered a consumer whose electric meter had been tampered with, but not, according to the consumer, with his knowledge or approval, to install protective devices on penalty of discontinuance of service.

Rates Increased in Indiana. — Increased rates for the Indiana & Michigan Electric Company, affecting virtually all its Indiana consumers in the St. Joseph River valley, except the larger industrial consumers, have been authorized by the Indiana Public Service Commission. The advances granted, however, were not so much as requested by the company. The commission estimated that its order would add $142,000 annually to the company's revenues, thus giving it a return of 8 per cent on an investment of $10,000,000. Domestic lighting rates in South Bend, Mishawaka, Elkhart and Ligonier were increased approximately 7 per cent, and commercial rates were advanced 10 per cent. Power rates for all consumers having less than 500-hp. demand also were advanced approximately 10 per cent. No increase was made in the domestic and commercial rates affecting other cities, except that the minimum monthly charge was fixed at $1.25 in the towns, not including the four larger cities, and at $2 in rural districts. The minimum monthly bill for the domestic consumers in the four cities was raised from 85 cents to $1. Half of the $142,000 increase in revenue estimated to result from the advances is expected to be borne by the smaller consumers, including householders, and the other half by the smaller power consumers.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

E. J. Fowler, who was elected chairman of the Accounting Section of the National Electric Light Association at the convention in Chicago, has been statistician for the Commonwealth Edison Company and one of its predecessors in Chicago, the Chicago Edison Company, for twenty-three



E. J. FOWLER

years and has been with the company altogether twenty-five years. He was one of the pioneer substation operators in Chicago, his first position being that of operator of the old Adams Street distribution board. This position he held for a year and a half, being then transferred to the general office and assigned to statistical work, which has since developed into the present statistical department. In addition to this work Mr. Fowler developed the machine-billing and bookkeeping methods which are now in general use on the 500,000 accounts of the company. The only break in his service with the company occurred during the war, when he was commissioned a major in the Quartermaster's Corps, reporting for duty in April, 1918. He rendered valuable service at Washington in organizing and managing a statistical department in the Quartermaster General's office. Later, when the Quartermaster's Corps was reorganized, his work was classified as the statistical division of the office of the Director of Purchase and Storage. The most important part of this government work consisted of a monthly stock report showing goods at depots and in transit here and overseas. Such records had been very incomplete, but by means of his report Mr. Fowler largely prevented ordering on too great a scale, made it possible to give prompt attention to supplies which were running low and kept track of the location of available supplies, thus saving the government large sums. Mr. Fowler has been very active in the affairs of the Accounting National Section of the N. E. L. A. He organized and was chairman of the committee on customers' records and billing methods, and he was also chairman of the first committee on insurance. He organized and is now chairman of the committee on security holders' records. He is a member of the Western Society of Engineers. Mr. Fowler's education in electrical education was obtained at the University of Nebraska, Lincoln, Neb.

W. H. Harrington, formerly assistant chief engineer of the New Departure Manufacturing Company, Bristol, Conn., has been appointed electrical engineer of the Arrow Electric Company, Hartford, Conn.

Hartley Rowe, formerly manager of the Detroit office of Lockwood, Greene & Company, engineers, has been transferred to Boston as district manager, succeeding Kenneth Moller, who was recently made a member of the firm.

Ernest F. Learned has been appointed sales agent for the C. W. Hunt Engineering Corporation, with offices at 141 Milk Street, Boston. He will represent this organization in the marketing of coal and ash-handling machinery, industrial railways, industrial electric locomotives and other equipment for the conveying of bulk material as manufactured by the C. W. Hunt Company, Inc., of West New Brighton, N. Y.

J. R. Haskin has been appointed district manager of the Southern California Edison Company at Lancaster, to succeed H. A. Brody, who has been transferred to the new Lindsay district. Upon leaving college Mr. Haskin took up electrical work in the shops of the General Electric Company and Westinghouse Electric & Manufacturing Company, later going with the Niagara Falls Power Company. He resigned his position as assistant superintendent of the latter company during the Spanish-American War and saw active service in Porto Rico. On his discharge from the army he re-entered the Westinghouse organization and filled various positions in the engineering department until 1917, when he moved to Los Angeles and became power sales agent for the Los Angeles City Bureau of Power and Light. Early in 1920 he entered the commercial department of the Southern California Edison Company and received his appointment as district manager the first of this year.

Edgar Blessing of Danville, Ind., an attorney, has been appointed by Gov. Warren T. McCray as a member of the Indiana Public Service Commission to succeed E. I. Lewis, who resigned to become a member of the Interstate Commerce Commission. Mr. Blessing assumed his duties June 1.

E. J. Condon, Jr., has recently been elected assistant general manager of the Intermountain Railway, Light & Power Company, with headquarters in Colorado Springs, Col. Mr. Condon will be the active executive in charge of the operation and management of the eight central-station properties of the Intermountain company. He is also vice-president of the Condon Engineering Company of Chicago. During his



E. J. CONDON, JR.

past association with the operation of central stations Mr. Condon has been able to effect remarkable economies. He is a graduate of Armour Institute and gained wide electrical experience during war service in France. He has been superintendent of construction for the Indiana Utilities Company and manager of the Minnesota Electric Light & Power Company. He is an associate of the American Institute of Electrical Engineers and has served on the Indiana standardization committee.

Robert McF. Doble has been appointed on the engineering staff of the Metals Exploration Company as consulting engineer in charge of electric and hydro-electric power installations and operations. His headquarters will be at 201 Fourteenth Street, Denver, Col.

Major Harry B. Joyce, formerly of the Construction Division of the army, has resigned as a member of the firm of Johnson & Benham, Inc., consulting engineers, to assume charge of the engineering work of the Centrifugal Fan Company, Newark, N. J., engaged in the manufacture and installation of fans, blowers and ventilating systems. Major Joyce has had a broad experience in general engineering acquired in his consulting practice and as power engineer of the United Electric Light & Power Company, New York City.

W. E. Robertson, who at the Hot Springs meeting of the Electrical Supply Jobbers' Association last month was appointed a member of the executive committee of the National Electric Light Association, representing the electrical jobbers, is president of the Robertson-Cataract Company, Buffalo, N. Y. Mr. Robertson has been intimately associated with electrical work since 1898, when with his brother, James D. Robertson, he formed the Robertson Electric Construction Company. He has always been active in association work. He was one of the founders of the Society for Electrical Development and served as vice-president and director from its organization until Jan. 1, 1920. Mr. Robertson has also been one of the leaders in the Electrical Supply Jobbers' Association, having served for a number of years as a member of the executive committee and during the war as chairman of the war service committee. In 1917 he served as chairman of the Atlantic Division.



W. E. ROBERTSON

Edward Rahm, Jr., formerly Pittsburgh manager of the Underfeed Stoker Company, Detroit, Mich., has established an office in Pittsburgh, under the name of the Industrial Equipment Company, to handle power-plant equipment.

J. B. Crane, who has recently joined the sales and engineering staff of the George T. Ladd Company, manufacturer of the Ladd water-tube boiler, has had more than fifteen years' experience in the construction and operation of power houses and enjoys a wide acquaintance among public utilities, engineers and mining men in various parts of the country. Mr. Crane is a graduate of Trinity College of the class of 1902. After several years in the testing department of the General Electric Company at Schenectady, N. Y., he became associated with the Great Northern Power Company at Duluth, Minn., as commercial manager and superintendent of operation. In 1915 he joined the Electric Bond & Share Company of New York City and conducted a power survey for the Appalachain Power Company in West Virginia. Later he went to South America, where he made a complete investigation and report of the general power situation in Brazil, Argentina, Paraguay, Uruguay and Chile. In the last two years he has been engaged in efficiency studies and service for the W. S. Barstow Management Association and J. G. White Management Corporation of New York.

Richard Gregory, comptroller of the Western Electric Company, New York City, has been made a member of its board of directors.

S. Wallace Murkland, who has been assistant comptroller of the Western Electric Company since 1918, is now general contract sales manager.

M. W. Brown has been made manager of the Dallas office of the Power Specialty Company, New York City, manufacturer of Foster superheaters, economizers and oil stills, with offices in the Linz Building.

William F. Meyer has been placed in charge of the new Kansas City office of the Power Specialty Company, New York City, manufacturer of Foster superheaters, economizers and oil stills. This office will be in the Reliance Building.

E. E. Baker, for many years secretary of the Mount Whitney Power & Electric Company, Visalia, Cal., a subsidiary of the Southern California Edison Company, has been appointed traveling auditor for the San Joaquin Valley districts of the latter company.

Isaac Hardeman has been appointed sales agent for the American Engineering Company, Philadelphia. Mr. Hardeman will represent the Taylor stoker in the States of North Carolina, South Carolina and Georgia. His office is at 816 Realty Building, Charlotte, N. C.

T. M. Hardin has been placed in charge of the new branch office in New York City of the Ross Heater & Manufacturing Company, Buffalo, manufacturer of boiler-feed water heaters, surface condensers, evaporators, etc. The new office will be at 2 Rector Street.

H. M. Davidson, who from 1903 to 1919 was connected with the Hayward Company, manufacturer of buckets, cranes, derricks, etc., has again become associated with that company. Among other duties he will have the general management of sales. For the past two years Mr. Davidson has been with the Ohio Locomotive Crane Company as general sales manager.

Carl E. Johnson, who was made vice-president and secretary of the U. S. Electrical Manufacturing Company of Los Angeles at the time of its recent reorganization, has been in the electrical manufacturing business almost all of his life. Upon graduation from public school he entered the employ of a small manufacturing company which produced direct-current generators. This was in the days when metal brushes were used on direct-current machinery. Later he was employed by the Western Electric Company and the Cutler-Hammer Manufacturing Company in various capacities. Mr. Johnson was born in Chicago, but early removed to San Francisco and entered the employ of the Union Iron Works in the winding department, where he remained two years. In 1906 he organized the Dynamo Electric Company of Los Angeles and engaged in the manufacture of electric motors. In 1908 the U. S. Electrical Manufacturing Company was organized and took over the Dynamo Electric Machine Company. Mr. Johnson served in the capacity of general manager of the former company until the latter part of 1920, when H. G. Steele, formerly of the Pittsburgh Transformer Company, became associated with the U. S. Electrical Manufacturing Company, Mr. Johnson then becoming vice-president and secretary. He has taken a leading part in the affairs of the local technical societies, where his counsel has always proved of great usefulness.



C. E. JOHNSON

Obituary

W. F. O'Neill, treasurer and general manager of the Penn Electrical & Manufacturing Company, Irwin, Pa., died May 27.

William Chappell, president of the Rainier Heat & Power Company of Seattle, recently died in Baltimore, where he had gone for special treatment. Mr. Chappell located in Seattle in 1899, following successful operations in the Klondike district.

James Prentice Snedden, Bayonne, N. J., general superintendent in charge of manufacturing activities of the Babcock & Wilcox companies, died June 11 at Johns Hopkins Hospital. Mr. Snedden was born in Wishaw, Scotland, July 7, 1863, and came to the United States at the age of thirteen. In 1899 he became associated with the Stirling Boiler Company and remained with the organization when this company was amalgamated with the Babcock & Wilcox Company.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Heating Device Schedule to Be Lowered July 15

ANNOUNCEMENTS are being received this week by licensees under the Marsh patent stating that with the exception of ranges all electric heating devices will be placed on a lower schedule effective July 15. Electric irons under the new schodule will receive a cut of one dollar. The new listing will bring the standard 6-lb. irons to $6.75. All the other appliances will be placed on approximately a 10 per cent lower list. Electric ranges generally, except on the cheaper type of construction, remains unchanged owing, it is said, to the heavy overhead and the limited market of today.

As to schedule discounts, whereas the previous maximum discount to jobbers was 42-3-2, the new discounts will be 40 and 10; maximum dealer discounts, heretofore 30 and 7½, are changed to 30 and 10; maximum holding-company discounts, heretofore 42 off, are to be changed to 40 off.

Some Actions Jobbers Took at May Convention

WHILE the Electrical Supply Jobbers' Association was in convention at Hot Springs, Va., in the latter part of May, two reports were adopted which were outlined in these columns on May 28—the report of the committee on methods and forms employed in the purchasing, receiving, shipping and charging departments of an electrical supply jobbing house was adopted, and the association unanimously adopted a recommendation that manufacturers issue price information on sheets of a standard size, color and printing arrangement.

The size indorsed for this sheet was 8½ in. x 10 in., and the color scheme approved was goldenrod for cost to the distributer, russet for cost to jobber, light blue for cost to contractor-dealer and pink for cost to consumer. This list supersedes that reported in the May 28 issue of ELECTRICAL WORLD, wherein the colors for distributor and jobber were reversed. Where manufacturers do not differentiate between jobbers and distributers, the goldenrod sheet was recommended, and where manufacturers do not issue contractor-dealer discounts on consumers' prices the blue sheets or the pink sheets respectively will not be required.

Because many different styles of binders are coming into use it was unanimously voted that the association recommended to manufacturers that their price information sheets be issued unpunched. Furthermore, it was recommended that sheets as issued should have a binding margin of at least 1½ in., preferably 1¾ in., and that the margin on the other three edges of the sheet should be ¾ in.

Action was taken also on two other important matters. In regard to the establishment of net prices and the elimination of the list and discount method of quoting and selling the national representative states that on a standing vote being taken at the convention every member in attendance, except two who were partly engaged in the hardware business, voted in favor of requesting the manufacturers when quoting and selling to adopt net prices instead of list and discount.

The other question affecting manufacturers was that of prepayment of freight where freight is allowed by the manufacturers. This received further consideration, and the jobbers, it is stated, showed themselves unanimously in favor of having manufacturers adopt this policy.

Two Minor Changes in Recent Lamp Schedule Listings

TWO changes in lamp listings effected May 1 were concerned with diffusing-bulb lamps and candelabra decorative lamps. As to the former, in the new standard price schedules the diffusing-bulb, vacuum type, tungsten-filament lamps are collected and listed separately in order to make for convenience in ordering. The 15, 25 and 40-watt large lamps with diffusing bulbs are now found under that schedule listing and it is hoped that this may assist in drawing attention to these sizes when frosted lamps are desired and in the end work toward a standardization in these sizes, full-frosted, and the elimination of odd sizes and frostings.

Candelabra decorative lamps have been transferred to the large-lamp schedules from the miniature schedules, subject to the same conditions of sale and purchase as the other lamps on these large-lamp schedules. The slender and roundbulb types of candelabra frosted lamps are also listed in the diffusing-bulb schedules.

Recent French and Spanish Import Tariffs Higher

NEW Spanish import duties put into effect May 21, it is understood on advices from Madrid, are from three to four times what the old minimum rates were on electrical materials and manufactures and are given below in pesetas:

Article:	New Rate	Old Minimum Rate
	Per Kilo	
Telephone and telegraph apparatus	7.50	2.50
	per 100 Kilos	
Rails	18.06	4.20
Pig iron	8.12	1.40
Railway wheels	52.00	13.00
Wire of copper and copper alloys	85.50	28.50
Electric cable and wire, insulated, over 1 cm. diameter	180.00	45.00
Same, less than 1 cm. diameter	300.00	100.00
Dynamos, etc., up to 100 kilos	300.00	75.00
Dynamos, etc., from 101 to 400 kilos	284.00	71.00
Dynamos, etc., over 400 kilos	150.00	37.50
Switchboards, etc	300.00	75.00
Pumps	120.00	30.00
Cranes	80.00	20.00

At the same time comes a review of some of the more important articles to which the import tariff applies which has been lately imposed by France. These items are given below in francs:

	In 1914	April 1, 1921	May 1, 1921
Rails	9 to 15	9 to 15	24 to 40
Porcelain	12.50 to 30	12.50 to 30 × 1.5 to 2.2	40 to 400 × 1.5 to 2.2
Incandescent lamps	525 to 1,050	525 to 1,050 × 1.7 to 3	1,400 to 1,800 × 1.7 to 3
Dynamo-electric machines	30 to 150	30 to 150 × 2.9	80 to 420 × 2.9
Electrical apparatus	45 to 150	45 to 150 × 3	100 to 420 × 2
Electric wire and cable	60 to 150	60 to 150 × 3	160 to 400 × 3
Armatures for dynamo-electric machine	50 to 150	50 to 150 × 3	110 to 300 × 3
Arc lamps	150	150 × 2	320 × 2
Iron and steel tubes	13.50 to 6,000	13.50 to 6,000	36 to 16,000 × 3
Storage batteries	25	25 × 3	66 × 3

Schedule Material Prices Marked Lower Last Week

FROM about the ninth to the thirteenth of June the various manufacturers of schedule materials increased some of their discounts and lowered certain list prices so that the general result was a decrease in prices averaging around 10 per cent in standard-package quantities. With this general easier price, however, it can hardly be expected that any great amount of business will be stimulated, for the building construction outlet is not yet in a condition to absorb any large amount of schedule material and wiring devices.

It has been an incentive for jobbers in many cases to order various amounts, but just enough to bring their much-depleted stocks up to a present-demand working basis. These stocks had been allowed to dwindle to low levels because jobbers had been expecting lower prices for some months. In many cases, on the other hand, jobbers will not be in a position to add much stock at this time because they already have a fair working supply.

Although it is rather difficult to list all the drops on the different schedules put out by the various manufacturers, the general line of socket material, switches, receptacles, plates and all accessories except wall cases are about 8 per cent lower in standard packages; shade holders are 10.5 per cent lower; fuse plugs came down about 34 per cent and plug cut-outs about 14 per cent.

At the same time pull-chain sockets are 10 cents lower, listing at 50 cents, standard ¼, in standard packages; 9 cents has been taken off flush receptacles, bringing the list to 21 cents, and 12 cents off hinged plates, bringing list to 28 cents. Many other changes have brought new lists down in varying amounts up to 15 cents.

Insulation Manufacturers Optimistic Despite Light Buying

QUIETNESS is still the prevailing feature of the electrical insulation market. Repair shops are buying hand to mouth for most of them are not busy. Industrials are operating at reduced capacity, and furthermore they ordered ahead when deliveries were long, so that little buying is being done in that quarter. Electric railways are endeavoring to get along on such insulating material as they have and buy only for immediate needs, and as the appliance industry has been slack for a long time, small motor manufacturers are not active. One of the latter, for instance, recently bought 15 lb. of mica where a normal order formerly totaled 100 lb.

The general outlook in this field is held to be far from discouraging, however. The very fact that motor manufacturers, electric railways, etc., are not stocking insulation means all the more potential business yet to be placed, and as it seems there is not a great volume of repair work being done insulation needs along that line are piling up. Just when this business will break is, of course, a question, but the majority of producers are not expecting anything much to develop before the first of September.

Buyers apparently do not yet have confidence in present prices despite the radical reductions which the latter have undergone. Prices are still declining, it is true, but it is possible this is largely a result of conditions of keen competition. Since the first of this year, according to one of the large producers; cotton tapes, webbings and sleevings have declined 70 per cent, 25 per cent of this drop occuring just this week; varnished cloths have declined about 28 to 35 per cent, one-fourth of which decrease also was made this week; cotton armature twines, except linen, are down 33⅓ per cent and insulating varnish about 20 per cent. India mica up to the present is undiminished in cost as the price at the mines has not been reduced, but the South American product is now somewhat lower.

Conditions of stock vary considerably, though all producers are pursuing a policy of keeping down inventories and only producing on order. Deliveries of standard material for the most part are immediate, as in general stocks are too large rather than too small under present buying.

Electrical Manufactures for 1919 Shown in Census Report

THE value of the products of manufacture of electrical machinery, apparatus and supplies for the year 1919 was $884,343,000, according to the annual report of the Director of the Census for 1920, just made available. In the Jan. 17, 1920, issue of the ELECTRICAL WORLD, page 160, it was estimated that sales of electrical manufactures during 1919 would run between $800,000,000 and $1,000,000,000. This estimate was based on the reports received from manufacturers of the various lines of electrical apparatus and supplies as the year 1919 was coming to a close.

The census report shows the growth of this business from the year 1914 through 1919, giving the value of these manufactures in 1914 as $335,170,000. The number of electrical manufacturing establishments in 1919 was 1,403, while in 1914 it was 1,030. The estimate of the ELECTRICAL WORLD of the manufactured value of electrical apparatus and supplies for the year 1920 has been placed at a figure just in excess of $1,250,000,000.

Continuing, the census report gives the values of other equipment of interest to the electrical industry as follows, the first figure being for 1919 and the second figure for 1914: Leather belting, $40,939,000 and $23,036,000; gas and electric fixtures, $42,269,000 and $28,740,000; steam and other power pumps, $53,716,000; and $17,864,000; copper smelting and refining, $632,897,000 and $444,022,000. The number of leather-belting establishments was 172 in 1919 and 151 in 1914; gas and electric fixture manufacturing establishments numbered 342 in 1919 and 460 in 1914; steam and other power pump establishments numbered 112 in 1919 and 87 in 1914; copper smelting and refining establishments numbered 33 in 1919 and 37 in 1914.

The Metal Market Situation

THE copper market is in about the same position as reported last week. The low foreign-exchange level continues to be an important factor in the situation, for with sterling quoted at about $3.73, foreign buyers can purchase copper at London cheaper than they can have it shipped from New York. Domestic consumers are indifferent and there is little buying. Producers are not pressing to sell, but at the same time they are not holding to the top prices that have been quoted. There are few if any offerings of prompt and June shipment by producers under 13¾ cents, while July is quoted at 13¾ cents delivered. In the outside market offerings are both a little freer and slightly easier.

Demand for lead is flat and the "official" price has been reduced to 4.50 cents per pound, New York. This reduction is probably influenced by the decline in pounds sterling. Zinc has gone a fraction under 5 cents per pound, but even at this attractive price there is very little buying.

NEW YORK METAL MARKET PRICE

	June 7, 1921	June 14, 1921
	£ s d	£ s d
Copper		
London, standard spot	72 15 0	73 7 6
	Cents per Pound	Cents per Pound
Prime Lake	13.25	13.00—13.25
Electrolytic	13.12½—13.25	13.00—13.12½
Casting	12.37½	12.00—12.25
Wire bars	15.00—15.25	15.00—15.25
Lead, trust price	4.75	4.50
Antimony	5.20	5.12½
Nickel, Ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	10.00	10.00
Zinc, spot	5.00	4.95
Tin	29.50	29.37½
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.75—11.00	10.00—10.50
Brass, heavy	5.25—5.50	5.00—5.25
Brass, light	4.00—4.50	4.50—4.75
Lead, heavy	4.25—4.50	3.75—3.90
Zinc, old scrap	2.50—2.75	2.50—2.75

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

CERTAIN price changes have figured in the past week's transactions, although business activities seem to have settled down to a quiet summer trend. Manufacturers of schedule material have generally reduced some list prices and increased their discounts so that a general lower revision of about 10 per cent has resulted. Bells and buzzers are off about 20 per cent and non-renewable fuses are lower. The conduit and armored-conductor markets are soft. Licensees have been notified of a lower price on heating appliances effective July 15. The trade has been awaiting these reductions, and therefore they are not surprising.

Building of residences is progressing nicely in the New York, Atlanta, Intermountain and southern California territories. In New England it is not particularly active. The construction tie-up in Chicago appears to be broken up. Otherwise the demand for electrical materials is little better than a week ago. Manufacturers in St. Louis seem to be producing better, the agricultural outlook in the South and in California is favorable, and in the Northwest lumber is moving very satisfactorily.

NEW YORK

Prices are quite generally off this week but an increase in buying has not been reported. A general drop on the whole line of schedule material on June 11 is an important current feature of trade. Long-leaf yellow pine cross-arms are 10 per cent lower.

In addition to these two cuts bells and buzzers were reduced 20 per cent last week, and non-renewable fuses since the first of the month are down 11 to 16 per cent. Conduit is weak, an additional 5 per cent discount having been issued by manufacturers the first of this month, and the New York base price of armored cable, though nominally $55, is now $50 in reality. A slight break in washing-machine prices in one quarter is noted.

The fan-motor business in this section has been disappointing to date. Jobbers continue to buy conservatively in all lines, many holding not more than a thirty-day stock. The building outlook shows a great improvement in the period of May 21 to 27 inclusive over the previous week. According to the Dodge reports, plans for 832 new projects totaling $29,629,400 were reported in that period in New York State and northern New Jersey. New contracts awarded in that time, 451 operations valued at $13,529,600, also represent a big increase.

Conduit.—Good stocks are held, but demand is spotty. Prices are soft, an additional 5 per cent discount having been issued by manufacturers the first of the month without changing their card numbers. This is the second drop of this nature.

Condulets, V. V. Fittings, Etc.—Demand is slow and stocks fair. The general discount allowed on this class of goods is 15 per cent in standard package lots.

Bells and Buzzers.—Following a cut in price of 20 per cent last week, several manufacturers state that they are meeting this reduction, though one producer reports that no change in price has been made.

Schedule Material.—Following the general price reduction of all manufacturers announced elsewhere in this issue, some jobbers state that they will replenish stocks which ran low anticipating the drop. Others say that demand does not justify stocking.

Flexible Armored Conductor.—Though the nominal base price is still $55 New York, the actual base is now $50 for single and double strip material. The latter in 1,000-ft. quantities, No. 14, sells for $55 and slightly below, but demand is quiet.

Fans.—Some business was reported the first of this week as the result of warm weather, but it was not general and sales on the whole have been unsatisfactory thus far with no real life in the demand. Prices quoted to dealers by different jobbers on three well-known makes, 16-in. oscillator, lots of twelve, are $28.50, $31.60 and $32.40 each.

Household Appliances.—Demand for washing machines, vacuum cleaners, ironers, etc., is very slow, and stocks are held down in line with the market. The only price change reported is on some sizes of one popular make of washing machine, which was reduced 5 per cent the first of the month.

Rubber-Covered Wire.—Stocks are good, but not so demand. The market is highly competitive, and most jobbers are quoting within 25 cents either way of $6.75 per 1,000 ft. for No. 14 single-braid in 10,000-ft. lots.

CHICAGO

Following the acceptance of the post of labor arbitrator by Judge K. M. Landis, the six-weeks-long tie-up of the construction industry in Chicago is at an end. Arbitration has finally been agreed upon, the lockout to cease at once. All operations are to be resumed at the old wage scale pending the decision of Judge Landis, and his decision is to be absolutely binding to both sides.

General business conditions during the past week have shown practically no change. Lack of interest is evident on all sides. Only that portion of the electrical industry having to do with the supply of the routine requirements is keeping busy. Demand from industrial users is at a minimum, and price is virtually no factor in demand under present conditions.

Jobbers and manufacturers should feel an immediate benefit from the settlement of Chicago's labor troubles as contractors and dealers have all allowed their stocks to get very low. The revival in building which it is felt is bound to result should at once make a demand for all classes of material used in the construction industry. Full stocks are in the hand of jobbers.

Wire.—Small movement is reported in all classes of wire, with prices firmly held. No. 8 bare copper at 17 cents per pound in 1,000-lb. lots is being ordered only for necessary maintenance. Rubber-covered is still quoted at $7 per 1,000 ft. for No. 14 in 10,000-ft. lots and weatherproof at 18½ cents per pound, for No. 6 triple-braid in 1,000-lb. quantities.

Conduit.—Sale of conduit to fill country demand, while brisk, is not sufficient to make good business. One-half-inch black is $59 per 1,000 ft.

Flexible Armored Conductor.—Prices are unchanged, with No. 14, two-wire, double-strip at $57.50 per 1,000 ft.

Cross-Arms.—As mentioned last week, new prices are in effect on long-leaf yellow-pine cross-arms. The price to jobbers from Chicago warehouse is now, for the 75 per cent heart, unpainted, 5-ft., four-pin size, $56.53 per 100; for the 6-ft., six-pin size, $67.83 per 100. Demand is limited to maintenance requirements.

Insulators.—Demand is slight and prices seem reasonable. Porcelain insulators, 5,000-volt, are quoted by one jobber at $21.25 per 100 in barrel lots and $34 in less quantity. The 6,600-volt size are $30 and $48 in similar quantities. Glass insulators, of which plentiful supplies are now available, are quoted at $95 per 1,000 for the 5,000-volt size.

Fuses.—Trade requirements on domestic sizes remain normal, but industrial sizes are moving slowly. "Ecomy" fuses have recently been cut 26.8 per cent in price, the present list being only 20 per cent above that prevailing in pre-war days. List on the 3-amp. to 30-amp. sizes is 50 cents; on 31-amp. to 60-amp. $1.

BOSTON

Substantial reductions in the prices of wiring supplies featured the closing portion of last week's market in New England. Schedule material was chiefly affected, and the jobbers are busy putting new resale prices into their quotation books. Reductions of 15 to 20 per cent were announced on fast-moving items and about 8 per cent on slow-moving material. Business continues to reflect a slow but definite movement toward greater confidence and increased activity. One of the leading jobbers reports a larger number of orders last week than for many months, and inquiries are better as well. Collections, while slow, are no worse than for some time. Jobbers' stocks are still equal to the current demand. Improved conditions are evident in the textile and shoe-manufacturing fields. The metal trades are still quiet, and building operations do not indicate very active conditions, although some improvement is evident. The liquidation of retail stocks and labor continues slowly.

Wire.—Moderate quantities are moving and stocks are plentiful. No. 14 rubber-covered is selling down to $6.25 per 1,000 ft. in 25,000-ft. lots. Weatherproof base is 16.5 cents and bare base about 15.5 cents, with light demand.

Sockets.—Improved demand is expected following new prices anounced by leading jobbers. In a representative make, key sockets are selling for 25 cents each in standard packages, keyless at 23 cents and pulls at 37.5 cents.

Fuses.—Fuses are quoted about 20 per cent off last week's earlier prices. While the demand is moderate, buying is better in spots. From 60 amp. at 250 volts and smaller 50 per cent off list is given on standard packages. N. E. C. plug-fuse cases are now selling at doubled list prices, with a discount on standard packages of 57½ per cent.

Cut-outs.—List prices of code cut-outs, slate and porcelain, and of 2,500-volt cut-outs have been doubled, and the following discounts are in vogue: Porcelain, standard package, 60 per cent; slate, standard package, 65 per cent.

Flexible Armored Conductor.—Moderate sales are being handled, and local stocks are excellent. No. 14 two-wire sells for $57 per 1,000 ft. in 1,000-ft. to 2,500-ft. lots, and above this open prices prevail. Fittings and couplings sell for 33⅓ per cent off double-manufacturing lists in less than standard packages and connectors at $7.50 per 100 in these quantities.

Fans.—Notwithstanding continued seasonable weather, fan movement is very slow. Carry-over stocks have by no means been sold out as yet. The next two or three weeks should give a correct "line" upon the 1921 fan season.

Dry Cells.—Flash battery sales are picking up. The demand for dry cells for general service is fairly good. One jobber reports 300 per cent increase in business in the past two months. In barrel lots, No. 6 cells are moving at $30.35 per 100.

Lamps.—Manufacturing for stock continues, one large plant running four days per week. Sign lighting is more active than most lines. Replacement orders are, of course, a stabilizing influence in the lamp market regardless of outside conditions. Portables are in some favor this month for wedding presents.

ST. LOUIS

No striking developments occurred during the week, yet some progress is being made toward normal conditions. Demand is gradually increasing and prices are lowering. Most of the manufacturers are increasing their production, and the general basis of production is probably about 40 per cent as compared with about 5 or 10 per cent the first of the year. The iron and steel industries are apparently the hardest hit, most of the plants being entirely closed down. The recent announcement that the Illinois Central Railroad will expend the money saved from the reduced wages in deferred maintenance work is considered as indicative of improvement in demand from the railroads. Automobile production is on a basis of about 25 per cent, furniture factories 35 per cent, planing mills 35 per cent, brick plants 50 per cent, and shoe factories 80 per cent. About all of the industrials are either planning or making plant changes for improved efficiency.

The sale of new power shows slight improvement and the kilowatt-hour sales continue to be the same or slightly greater than a year ago. Retail sales of appliances continue on a good basis. Motors and industrial wiring devices show but small demand. Jobbers still report a steady and slowly increasing business. The heavy call for fans existing a week ago fell off somewhat during the past week because of cooler weather.

Credit conditions are possibly somewhat better, yet the average basis for collections remains at from forty-five to sixty days. Indications are that the agricultural results this year will be good and this will tend to improve credit conditions in the electrical industry.

Fans.—Jobbers report a decreased call last week due to the cool weather, but in anticipation of large retail buying shortly there was nevertheless a good quantity of attractive orders. Jobbers' stocks as a rule are in line for the demand so far developed.

Lamp Cord.—Demand on local jobbers shows no improvement and most jobbers have stocks that are still a trifle heavy. No. 18 twisted cotton cord sells at $16.50 per 1,000 ft. in 5,000-ft. lots and No. 18 twisted silk at $23.

Wire.—One jobber reports slightly improved demand, particularly in the smaller sizes of rubber-covered. No. 14 rubber-covered, in 5,000-ft. lots, is selling around $6.75 per 1,000 ft. The base on bare copper and weatherproof is between 15 and 16 cents.

Meters.—Several jobbers report a continued increase in demand, particularly from the smaller outlying utilities. Prices are firm and stocks in excellent condition.

Motors.—Slight improvement in demand is found, and yet it is very slow. The principal call is for motors of 5 hp. to 25 hp. Stocks of fractional-horsepower motors are still considered too large. However, one manufacturer of motors up to 2 hp. reports a good business.

Bake Ovens.—Considerable interest is being manifested by a number of the bakers, but no sales have been made for some time. The price of industrial gas has recently almost doubled, thus making electrical baking more interesting.

Vitreous Enamel Furnaces.—Unusual interest is found among the local enamel concerns because of the excellent results being obtained from one local installation. In fact, considerable attention is being given to all forms of industrial heating equipment owing to special efforts on the part of the principal central-station company. Several large jobs are pending at the present time.

ATLANTA

Jobbers report their business for the past week as having shown little change from that of previous weeks. Orders, however, continue to come in slightly increasing volume, though the size of orders remains below the average, purchases being made for current demand only. On a canvass of the trade the more optimistic seem to feel that the month of July will show considerable improvement in their line, but the consensus of opinion, however, is that conditions will continue as at present until early fall. Trade in the small towns and rural districts continues to be sluggish, though the outlook for fall business in the argircultural districts is very good. The Georgia State Agriculture Department statistician, in conjunction with the federal Bureau of Crops' estimates, reports that in a majority of instances, cotton excepted, the condition percentage of general crops in the State is much better than the past ten-year average. If anything like this condition is maintained until harvest, it is felt that business in the rural districts will show great improvement, despite the comparatively small price which will be obtained for the products. This is due largely to the low cost of production as compared with selling prices.

The demand for homes continues and construction of small residences and apartments still shows healthy activity.

Rigid Conduit.—Jobbers report a fair movement, particularly in sizes up to 2-inch, both galvanized and black. Stock is good to fair, and shipments are excellent. Prices, lots less than 2,500 ft. black, ½-in. $84; 1-in., $161.30; 1¼-in., $216, and 2-in., $351 per 1,000 ft.

Non-Metallic Flexible Conduit.—This market continues dull, orders being for very small amounts and for immediate demands only. All jobbers report heavy stock.

Flexible Armored Conductor.—A price reduction of 10 per cent is recently reported. Sales continue fairly good, though demand has slumped somewhat during the past several weeks. Jobbers expect a small price advance within the next ten days. Stocks vary from light to medium. Prices, two-wire, No. 14, lots of 1,000 ft. to 2,500 ft., $68 per 1,000 ft.

Safety Switches.—The market continues brisk, jobbers pushing safety switches in preference to the open type. In the case of the latter stocks are moving almost not at all.

Knobs, Tubes, Cleats.—With the exception of "Nail-it" knobs, the price of which is reduced 10 per cent, no reductions are expected before July 1. A slow but steady movement of the entire line is reported by jobbers who have heavy stocks on hand. Prices, standard packages, "Nail-it" knobs, $2.80 per 100; ⅝-in. x 4-in. tubes, unglazed, $1.23 per 100; combination one-piece rosettes, $8.50 per 100.

Lamp Cord.—The usual steady demand continues and stocks are reported in good shape.

Bell-Ringing Transformers.—Contractors are buying up to 50 per cent of their normal amount, but jobbers have allowed their stocks to sink to a low ebb.

Pole-Line Material.—Poles, cross-arms and hardware sales have not come up to early expectations. Little or no new construction is under way, purchases being confined largely to maintenance work, but the trade looks for better movement within the next sixty days. There is little activity in porcelain insulators, but the movement of glass telephone insulators is reported very good.

SAN FRANCISCO

On June 13, the builders' exchanges of San Francisco and the bay cities announced that they would open up building operations again on the American or open-shop plan, paying the wages recommended by the mutually selected board of arbitration, which are 7 per cent below the former schedule. Just prior to this date, the Building Trades Council announced that it had reconsidered its previous vote not to accept the above decrease and would return to work accordingly. However, the contractors of the builders' exchanges stand firm in their determination to employ labor irrespective of union affiliations. So far little building is reported.

The question of a bridge to connect San Francisco with Oakland, across the bay, is being vigorously advocated. No definite steps have yet been taken to start actual work, but there is no doubt that eventually the bridge will be built. The case is somewhat parallel to that of New York and New Jersey and presents similar problems, obstacles and benefits. All hope of the construction of the proposed thirty-million-dollar naval base at Alameda, on San Francisco Bay, has been abandoned, the measure having been killed primarily by the disarmament agitation.

Warm weather and almost ideal rainfall conditions are ripening the state crops and a big year is expected. Last year the action of the fruit associations in holding out for higher prices than the packers were willing to pay resulted in a very considerable loss to the growers, but this year amicable adjustments are expected.

Various conditions such as the building strike have interfered with the convention programs of the jobbers and contractors of the Pacific Coast and the state. The Pacific Coast Jobbers' Association has just met in San Francisco, but the California State Contractors' convention at Santa Cruz, originally set for the middle of June, has been indefinitely postponed.

Sales on electrical roughing-in material and other staples have fallen off tremendously in northern California, while in southern California such sales are very good. House-specialties such as washers and vacuum cleaners are in general slow throughout the state.

SEATTLE—PORTLAND

Electrical jobbers and dealers in the Northwest report little if any improvement in electrical trade over the past several weeks. The movement of domestic appliances and schedule materials, while below last year's levels, is fairly satisfactory, but sales of apparatus, including motors, generators, pole-line equipment, etc., are very much lighter than anticipated. Contractor-dealers are figuring on a considerable volume of work which is very slowly materializing. There are plenty of building plans under preparation, but contracts for building construction of consequence are not being awarded so rapidly as had been expected. Industrials generally are operating at low capacity, and proposed enlargements and extensions to existing plants are not being made.

No improvement is noted in collections, and very few new credits are being asked for or extended. Farmers in eastern Oregon and Washington are disposing of their wheat in considerable quantities, although the price they are receiving is less than the amounts which the banks have loaned upon the crops in general. Nevertheless, this should have a tendency to relieve the financial situation somewhat. The lumber industry appears more optimistic, mills are shipping more lumber than they are cutting, and new orders are in excess of shipments. Production in the Northwest mills is given as between 28 and 32 per cent below normal. Throughout certain parts of Washington and Oregon the fruit crop is reported rather unfavorable and the canning situation is very uncertain at the present time because of lack of orders for future delivery and difficulties confronting canners in financing their institutions.

Frozen credits in wool and farm crops are largely responsible for business inactivity. In Portland a reduction in price has been announced of about 10 per cent on ranges. Fans are beginning to show small movement in anticipation of summer weather.

Inside Wiring Material.—Business is a trifle better on account of numerous rewire and repair jobs which are under way. Prices are unchanged, although an early drop would not be unexpected. Stocks are good.

Flashlights.—The usual vacation run of sales is well started and jobbers anticipate a movement comparable to last year's. Stocks are in good shape and prices steady.

Washing Machines.—Dealers report a continued and steady interest in washing equipment, but owing to the general employment situation sales have not developed to the extent indicated by the inquiries. Stocks are in good shape and prices show no change.

SALT LAKE CITY—DENVER

Cooking schools at which electrical cooking appliances are demonstrated to thousands of women are being promoted during the month of June in several intermountain cities. Every electrical device for convenience and comfort in the home is shown in actual process of operation. The big response to these gatherings indicates wide interest among women in electrical appliances generally, and manufacturers and jobbers are using them as a means of popularizing their respective lines.

Home building in the city centers is proceeding on a rather satisfactory scale. There is little labor trouble to impede the progress of construction, and prices on building materials seem to have come down to a level that encourages more or less building activity. Big activity, however, is still waiting on the advent of better times. Slight improvement is noted in the matter of collections. Deliveries are good and electrical stocks in excellent shape generally.

Fans.—The fan market has experienced something of a flurry with the sudden advent of hot weather. With the mercury hovering around the 100-deg. point for the last week, a considerable demand has arisen. Stocks are reported sufficient to meet all requirements. The types most in demand are the 12-in. and the 16-in.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Kiln Capacity for Whitman Electric

The Whitman Electric Manufacturing Company, Whitman, Mass., has completed two new kilns of its own with large Sagar capacity. The company is getting out a line of porcelain specialties—rosettes, receptacles, etc.—and is in a position to make shipments on special porcelain material.

Big Increase in Space by Adapti Company

The Adapti Company, Cleveland, announces that it has purchased outright the property and buildings formerly occupied by the Cleveland Refrigerator Company at East Seventy-second Street and Oakwood Avenue, Cleveland, where operations will begin about July 15.

The new factory will give the company four times the manufacturing space it has at present, while the adjacent vacant ground included in the purchase will permit of liberal future expansion.

Household Electric Exposition for Chicago in October

The first annual Food and Household Appliance Exposition will be held at the Coliseum in Chicago, Oct. 1 to 10, according to an announcement of the Food and Household Appliance Exposition, Chicago *Herald and Examiner*, Hearst Building, Chicago. Every phase of home life will be covered, it is said, and 100 prominent women's organizations have already enlisted in the work of the show. Model kitchens, marketing booths, dining rooms, etc., will be shown with appliances and demonstrations, and it is understood that many manufacturers and jobbers have already signed up for space.

Diamond Electric's Two Plans for Increasing Sales

For building up sales of electrical appliances during 1921 the Diamond Electric Specialties Corporation, Newark, N. J., which believes that electrical appliances of every kind will be sold in greater quantities during 1921 than during any previous year, has formulated two plans which it is expected will help dealers increase their sales.

Plan number one is built on the sale of small specialties, such as flashlights, batteries, fans and socket heating devices. From recent investigations conducted by the Diamond company it was found that 74 per cent of the women had electric flatirons, 59 per cent had vacuum cleaners, 18 per cent washing machines, 4 per cent electric ironing machines, 22 per cent fans, 12 per cent electric percolators, 2 per cent electric stoves, 3 per cent vibrators and 30 per cent flashlights, etc. While these figures applied to a certain local market, they may not apply to another local market, so the company is urging its dealers to make a market analysis of their own trading communities as a basis for intensive sales work.

The second plan is built on the sale of washing machines, ironing machines, dish washers and vacuum cleaners. The basis of it is concentration upon tried and tested machines of the four lines with an appeal to the man of the family based on the saving and labor that will be effected in his household.

Increased Line for American Metal Molding Company

The American Metal Molding Company, Newark, N. J., is now producing a full line of conduit elbows in addition to its flexible armored conductor and metallic flexible conduit. Sufficient factory capacity also is available to turn out special press work for the commercial trade.

Reorganization of Kelvinator Corporation

Following the recent reorganization of the Kelvinator Corporation, 2051 Fort Street West, Detroit, manufacturer of iceless household refrigerators, announcement is made that there will be no change in the policy of the company and that it intends to continue the standard of its product. Service to its patrons will continue in the future as in the past—a matter of first consideration. The officers of the company are: A. H. Goss, president; U. R. Loranger, vice-president and general manager; H. W. Bailey, secretary; S. H. Todd, treasurer; C. A. Benford, sales director, and G. W. Dwelley, sales manager.

Successful Heat Show in New York Edison Rooms

During the week of June 6 to June 11 the New York Edison Company showrooms at Irving Place and Fifteenth Streets, New York City, were given over to an "electric heat show." Apparatus and appliances on exhibition and demonstration were for domestic use and industrial use, but at the same time there were interesting displays of materials and parts going into the make-up of this apparatus. The hours were from nine in the morning till six in the evening.

Thirty-eight manufacturers and representatives took part, and reports from the exhibitors showed the success of the undertaking. While many sales were recorded, it was the volume of inquiries received and leads obtained which satisfied the representatives. Far-distant points were represented in the inquiries noted. Furthermore, the degree of co-operation among the exhibitors was marked, and it is expected that the spirit that was manifested there will make itself felt in the upbuilding of this branch of the industry.

S. A. Woods Machine Company Extends Motor Line

The S. A. Woods Machine Company, Boston, has extended its line of motors to and including 25-hp. and 1,800 r.p.m. rating. This line of motors was recently brought out to introduce to the trade a class of equipment embodying interesting and advanced methods of ventilation and lubrication, the Woods company having organized a motor department at its South Boston shops and prepared to manufacture this product there. M. J. Fitch, sales manager, recently informed the ELECTRICAL WORLD that the company has already obtained orders for the complete equipment of several good-sized plants and that the indications are that business will soon increase still more rapidly.

McKenney & Waterbury Increase Distribution Activities

The McKenney & Waterbury Company, Inc., Boston, Mass., has been appointed distributers for the Phoenix Glass Company, Pittsburgh, and will market shades to dealers henceforth in barrel lots on application. This house has also become a distributer for the "Easy" washer. M. W. Vye, vice-president, reports a gradual improvement in jobbing sales within the past few weeks.

Freeman Electric Upheld in Socket Shell Decision

In the Supreme Court of the United States Justice Clarke on June 6 delivered the opinion of the court in a suit for infringement of patent No. 743,206, granted to August Weber, Sr., on writ of certiorari to the United States Circuit Court of Appeals for the third circuit—Weber Electric Company, petitioner, vs. E. H. Freeman Electric Company. The District Court held claims 1 and 4 valid and infringed, but the Circuit Court of Appeals, while affirming the validity of the claims, reversed the holding that they were infringed.

The opinion concludes that the socket of the respondent does not infringe the fourth claim of the patent in suit because there is no claim made therein of a lock against rotative movement of the cap and sleeve upon each other, etc., and the decree of the Circuit Court of Appeals as to claims 1 and 4 is affirmed.

Clark-Hunter Making Duwell Motor Grinders

The Clark-Hunter Company, Inc., 161 Summer Street, Boston, is now manufacturing the Duwell motor driven bench grinders at its Worcester factory. The company is also considering a few additions to its line which it hopes to put on the market soon.

Power Specialty Company Enlarging Its Works

The Power Specialty Company, manufacturer of Foster superheaters, economizers, oil stills, etc., 111 Broadway, New York, is just completing the expenditure of about half a million dollars in the enlarging of its works at Dansville, N. Y. This work includes a new steam-power plant and a new forge shop.

American Electric Fusion Plans Move to Larger Quarters

Preparations are being made by the American Electric Fusion Corporation, manufacturer of electrical apparatus for heating, welding and fusing, to move into more spacious quarters. The company has been manufacturing at 1906 North Halsted Street, Chicago, a temporary location, since last September.

Electrical Hotel Kitchen Products by L. Barth & Son

L. Barth & Son, 32 Cooper Square, New York City, has gone into the production of hotel and restaurant electrical kitchen equipment—bake ovens, ranges, broilers, hot plates, toasters, urns, plate warmers, etc.—and part of its factory at Kingston, N. Y., has been given over to this work. R. B. Basham, formerly of Duparquet, Huot & Moneuse, New York City, is manager of this electrical department.

Machinery Center Established in New York City

The Manufacturers' Exhibition Company, Inc., has been organized and has taken space in the old Greenhut Building on Sixth Avenue between Eighteenth and Nineteenth Streets, New York City. At present the entire second floor, containing about 85,000 sq.ft., is available for manufacturers who wish to make use of a central space for main offices, district offices, salesrooms or exhibition rooms for machinery and mechanical appliances. The third floor can be made immediately available for use, while the entire building is at the disposal of the company. In addition, there is about 47,000 sq.ft. of storage space at hand for keeping stocks, etc.

It is the purpose of the operating company to divide the exhibition space into sections, two of which are for power-plant equipment and for electrical apparatus. Already several manufacturers have taken space, and in the exhibits may be found lamps, gas-engine-driven generators and power-plant precision-measuring instruments. L. R. Duffield, formerly in charge of the machinery exhibit in the Grand Central Palace, New York, is in charge.

Service Department Opened in Detroit by Westinghouse

The Westinghouse Electric & Manufacturing Company has announced the opening of its service department and repair shop at 1535 Sixth Street, Detroit. It is a five-story building and similar to the sixteen buildings erected in the principal industrial centers of the United States for repair purposes.

The new repair shop is equipped to handle the designing and manufacture of all types of switchboards in the same way as they would be handled at the main works, and in addition dipping tanks and baking ovens are available. Stocks of repair parts are carried. The company's engineering organization, it is stated, is prepared to install or repair electrical or steam apparatus on the owner's premises.

John P. Morrissey, Inc., Formed in New York

A new company of contracting electrical engineers has been formed by John P. Morrissey in the National City Building, Forty-second Street and Madison Avenue, New York City, under the name John P. Morrissey, Inc. A request has been issued for catalogs covering electrical equipment for use in construction work.

Brinton-Hinley Electric Opens at Murray, Utah

A new electrical firm to be known as the Brinton-Hinley Electric Company has been organized by D. B. Brinton and George A. Hinley and will be established at Murray, Utah. This company will take over the electrical supply business of the Progress Company. Mr. Brinton has had wide association with the people of this locality and for twelve years has been closely affiliated with the Progress Company. Mr. Hinley, formerly of Ogden, has been engaged in electrical work for a great many years. Prior to his connection with the Progress Company he was employed by the Utah Power & Light Company. Besides electrical merchandising the company will make a specialty of electrical contracting, wiring and repairs.

Hotpoint-Hughes Ranges on Net Price Basis

In putting out its new line of Hotpoint-Hughes ranges with interchangeable sheath wire units and open coil units, the Edison Electric Appliance Company, Inc., 5600 West Taylor Street, Chicago, has just announced a new policy on prices. On electric ranges the company has discontinued quoting list prices and discounts and in place of this has adopted a principle of net prices to the trade. The percentage of margin of profit to its jobbers is stated to be the same as before. New lists are out showing jobbers' net prices and central station and dealer net prices, all effective June 15. As soon as the change can be effected the company announces that it will ship units separate from frames so that with a minimum number of frames and a complete stock of units customer requirements can be met by ready assembly.

Work Started Again on Johns-Manville Asbestos Plant

Johns-Manville, Inc., New York City, will proceed with the work of constructing and equipping its new plant at Waukegan, Ill., which was started more than a year ago. The total cost is estimated at $6,000,000 and about 360 acres are involved. Only certain buildings will be completed this year, however, such buildings as are necessary in the manufacture of asbestos products except textile.

The Emerson Electric Manufacturing Company, St. Louis, has reached an agreement with its employees whereby a wage reduction of 10 per cent will be effective from June 6. It is reported that this reduction is applicable to all classes of employees in the organization.

The General Electric Company is moving its production of certain schedule materials from Schenectady to its plant in Bridgeport, Conn. This will not be complete till next month.

The Crane Company, 636 South Michigan Avenue, Chicago, manufacturer of pipe, fittings, steam specialties, etc., has taken bids for its proposed new plant at Thirty-fourth Street and Allegheny Valley Railroad, Pittsburg. The cost with equipment is estimated at $800,000 and will include a six-story and basement pipe and pipe bending shop, 192 ft. x 292 ft.

The Pacent Electric Company, 150 Nassau Street, New York City, dealer in wireless instruments, has filed notice of increase in capital stock from $15,000 to $35,000.

The Power Specialty Company, 111 Broadway, New York City, manufacturer of superheaters, has filed notice of increase in capital stock from $270,000 to $950,000.

The Home Electric Appliance Company, 208 Stanwix Street, Pittsburg, has filed notice of increase in capital stock from $250,000 to $500,000.

The New Departure Manufacturing Company, Bristol, Conn., announces the removal of its Chicago sales office from 2721 South Michigan Avenue to the Peoples Gas Building, 122 South Michigan Avenue.

The Jeannin Electric Company, 110 Eleventh Avenue, Toledo, has purchased a site at Fassett Street and the New York Central tracks on which it proposes to erect a new factory. The capital stock of the company will be increased from $150,000 to $200,000 to provide for expansion of its business. The company manufacturers electric motors.

Foreign Trade Notes

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Philadelphia, and its Swedish associates have granted the exclusive rights and licenses for Brazil for the Gronwall type "Electrometall" electric shaft smelting furnace to the Companhia Electrometallurgica Brazillera and the Hatcheller-McConnel Company, New York City. Two large furnaces each of 3,000-kw. capacity are being installed by he Brazilian company and it is expected that others will follow.

THE GEORGE C. ROUGH SALES CORPORATION, 134 Coristine Building, Montreal, Canada, has been appointed Canadian representative for the Duncan Electric Manufacturing Company, Lafayette, Ind., manufacturer of the Duncan meters. The company is also sales representative for the Volta Manufacturing Company, Ltd., Welland, Ontario, for the Montreal district.

THE LACHAPPELLE ENGINEERING COMPANY, Regd., successor to J. D. Lachappelle, has removed from 223 Notre Dame Street West to 414 St. James Street, Montreal, where it has opened an office and factory. The company handles the products of the Erie Electrical Equipment Company, Johnstown, Pa.

DEMAND FOR GAS-FILLED LAMPS IN CHINA.—According to reports there is an active demand in China for gas-filled lamps, the present supply being mostly of American or Dutch manufacture. In view of the fact that in cities like Hongkong, Shanghai and Canton the shopkeepers are making great efforts in illumination there is an extensive range of action for enterprising salesmen.

ELECTRIFICATION OF PAULISTA (BRAZIL) RAILWAY.—The initial order, it is understood, has been placed in the United States by the American contractors for the electrification of the Paulista (Brazil) Railway from the Jundiahy to the Campinas section, a distance of 45 km. The equipment includes two passenger locomotives of 2,000 hp. each and two freight engines of 1,500 hp. each. An overhead trolley at 3,000 volts continuous current will supply the power. The entire electrification when completed will cover about 160 km.

ENGLISH ELECTRIC COMPANY'S PROGRESS IN 1920.—From the address of the chairman of the English Electric Company, Coventry, England, before the annual meeting of the company held April 27, it was brought out that during the last year the company's principal task was that of consolidating its organization. Satisfactory progress was made in the adaptation of its Coventry works and the restoration of the other factories to their normal activities, and the company has proceeded with the least possible delay in the application of its fixed policy of devoting each factory to the manufacture of that class of machinery for which, by reason of its layout and past history, it is best adapted. At Coventry the company is manufacturing turbine units of very large size, rolling-mill equipment and the larger classes of engineering products. The Preston works are specializing still more highly in the production of electric locomotives and all forms of electrical traction equipment. At Rugby and Stafford the manufacture respectively of the medium sizes of steam turbines and electrical generating and industrial machinery has been further developed. The Bradford works, which have been especially laid out for the smaller range of industrial motors, have now their own machine molding foundry in addition. The company has been able to enlarge and improve the foundry capacity of its own works and thus to become to a greater extent independent of outside suppliers. Business both at home and abroad was well maintained up to the latter months of the year. The company still had a considerable order book to be executed when the report was made and, except in the smaller classes of its manufacture, it expects that it will have some big orders to carry over until trade revives. The company's working agreement with Siemens Brothers & Company, Ltd., has been followed by the formation of the English Electric & Siemens Supplies, Ltd. This company will deal exclusively with marketing the minor products of the new concern and electrical supplies generally. It has taken over the former subsidiary company, the English Electric Supplies, Ltd., together with a section of the selling organization of Messrs. Siemens.

THE CANADIAN JOHNS-MANVILLE COMPANY, Ltd., with sales offices at Montreal and Toronto, and which for a number of years has been operating asbestos properties at Asbestos, Quebec, has awarded contracts for the construction of a plant in Asbestos. All classes of asbestos product formerly imported from United States will be manufactured in the new plant.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An inquiry has been received from a business man in England (No. 34,984) for an ice-making plant of a capacity of about 5 or 10 tons per day.

The representative of a group of manufacturers in China (No. 34,983) is in the United States and desires to form direct connections with manufacturers of machinery for electric power plants, transmission equipment, telephone equipment, etc. Catalogs, price lists and full information are requested.

A commercial agency in Spain (No. 34,994) desires to secure the representation of manufacturers for the sale of electric automobiles.

The industrial representative in the United States of a European country (No. 34,999) desires to secure catalogs and quotations from manufacturers of electrical machinery, apparatus, supplies and insulating materials, machine tools, transportation equipment and labor-saving devices.

LARGE HYDRO-ELECTRIC PROJECT FOR FORMOSA.—Consul Henry B. Hitchcock, Taihoku, Taiwan, Formosa, has forwarded to the Bureau of Foreign and Domestic Commerce, Department of Commerce, a copy of the specifications and drawings for the mechanical and electrical equipment of the Jitsugetsutan (Lake Candidius) hydro-electric project to be constructed by the Taiwan Electric Power Company, which has been forwarded to the bureau's New York Office, 734 Custom House. Reference should be made to file No. 29,632.

New Apparatus and Publications

ARC WELDING.—"Electric Arc Cutting and Welding by Alternating Current" is the title of a new fifty-two-page publication of the Electric Arc Cutting & Welding Company, Newark, N. J.

LABORATORY RESISTANCE BOXES.—The Ward Leonard Electric Company, Mount Vernon, N. Y., has developed a line of laboratory resistance boxes using "Vitrohm" tubes in sizes from 10 ohms to 1,000,000 ohms.

BELT CONVEYOR IDLER.—The C. W. Hunt Engineering Corporation, 143 Liberty Street, New York City, is distributing a folder describing its new all-steel self-aligning belt-conveyor idler.

ELECTRIC DRILL. — The Louisville Electric Manufacturing Company, Louisville, is distributing a circular covering its No. 3, two-speed, and No. 2, single-speed "Universal" electric drills.

BENCH GRINDER.—The Clark-Hunter Company, Inc., 161 Summer Street, Boston, is distributing a four-page leaflet describing the "Duwell" motor-driven bench grinder.

ELECTRIC WELDERS.—Bulletin No. 1 issued by the American Electric Fusion Corporation, 1906 North Halsted Street, Chicago, describes its type "VW" vertical welders.

AUTO-TRANSFORMER STARTERS. — The Cutler-Hammer Manufacturing Company, Milwaukee, is distributing an eight-page folder describing the C-H 9141 auto-transformer starter.

ELEVATOR CONTROLLER. — Publication 2035 issued by the Cutler-Hammer Manufacturing Company, Milwaukee, describes the C-H elevator controllers.

MAGNETIC CLUTCH.—Publication 2030 covers the Magnetic Clutches of the Cutler-Hammer Manufacturing Company, Milwaukee.

KVA. METER.—A graphic kva. meter has been developed by the Esterline-Angus Company, Indianapolis.

ALTERNATING CURRENT OHM-METER.—The Esterline-Angus Company, Indianapolis, has brought out a graphic alternating current ohm-meter for recording the resistance of liquids, the concentration of solutions, etc.

STEAM SEPARATORS.—The Griscom-Russell Company, 90 West Street, New York City, is distributing bulletin No. 1140, describing its Stratton receiver-type separator and other Stratton steam separators.

SMALL GENERATING SETS.—Bulletin No. 1117, recently issued by the Allis-Chalmers Manufacturing Company, Milwaukee, covers its small generating sets, which are suitable for isolated lighting and power plants, shipboard service, etc.

DAMPER REGULATOR. — The Atlas Valve Company, 282 South Street, Newark, N. J., has issued bulletin No. 5 describing its Victor damper regulator, No. 3, high-pressure.

New Incorporations

JOSEPH E. GREENE, INC., Boston, Mass., has been incorporated with a capital of $350,000 to manufacture electrical equipment and supplies. The directors of the company are Joseph E. Greene, 111 Federal Street, president and treasurer; L. A. Greene and D. F. Cunningham.

THE HAPPY HOME MANUFACTURING COMPANY, LTD., Toronto, Ont., has been incorporated with a capital stock of $40,000 to manufacture hand, gas, electric and water-power machines, wringers, etc. The incorporators are Daniel A. Lee, 32 Barrington Avenue; George S. Winder, 167 Kingswood Road; Frank F. Frendt and others.

THE BUFFALO SMOKE PREVENTION CORPORATION, Buffalo, N. Y., has been incorporated by C. E. Hock, W. A. Wilson and C. H. Cutting, 49 Niagara Street. The company is capitalized at $100,000 and proposes to manufacture fuel-saving and smoke prevention equipment for power-plant service.

THE WANAKENA LIGHT & POWER CORPORATION, Fine, N. Y., has been incorporated with a capital stock of $10,000 by J. F. Dubar, J. O. Hamele and F. M. Duryea.

THE ELECTRIC SUN COMPANY, Philadelphia, Pa., has been incorporated with a capital stock of $50,000 to manufacture electrically operated outdoor displays. A. V. R. Barringer, Jr., 1705 Mount Vernon Street, is treasurer.

THE W. H. HESS ELECTRIC COMPANY, Oneida, N. Y., has been organized by W. H. Hess and M. M. Dunn, Oneida, to manufacture electrical machinery and parts.

TINDALL & WHITE, INC., New York, N. Y., has been incorporated by C. A. White, 291 Broadway, and others. The company is capitalized at $100,000 and proposes to manufacture electrical appliances, lamps, etc.

THE ACME ELECTRIC COMPANY, INC., Baltimore, Md., has been incorporated with a capital stock of $10,000 to manufacture electrical specialties. The incorporators are Clarence D. Boyle, Louis Storm and L. Malloy, 223 North Calvert Street.

THE RIDGEFIELD (WASH.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $17,000. The incorporators are N. C. Hall, J. W. Blackburn, W. E. Lentz and W. S. Miller.

THE SHIRLEY (ILL.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by Charles W. Hutchinson, Charles Zeig, Deloss Funk, J. P. Walters and C. Welch.

THE SALEM (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,500 by T. M. George, J. V. Hayden and L. Hayden.

THE MOOSE RIVER POWER COMPANY, Lyons Falls, N. Y., has been incorporated with a capital stock of $10,000 to operate a local electric plant and system. The incorporators are F. DeP. Hone, C. W. Tillinghast and C. L. J. Ager. The company is represented by Porter & Taylor, 30 Broad Street, New York City.

(Issued May 17, 1921)

1,374,960. COLLAPSIBLE TOOL BAG FOR LINEMEN. Emanuel F. Shipman, Philadelphia, Pa. App. filed April 17, 1920. For hoisting tools, insulators, etc. No metal parts.

1,378,554. TROLLEY; George B. Nussbaum, New Philadelphia, Ohio. App. filed Dec. 1, 1920. Will follow curvatures.

1,378,557. ELECTRICAL SYSTEM; Ernest W. Pragst, Schenectady, N. Y. App. filed July 30, 1920. For suppressing grounds.

1,375,564. COLLECTOR-RING SUPPORT; Theodore Schou and Richard L. Behrens, Mansfield, Ohio. App. filed July 14, 1920. For rotary fields.

1,378,565. BRUSH HOLDER; Theodore Schou, Mansfield, Ohio. App. filed July 14, 1920. Tandem type.

1,378,566. ELECTRIC COOKER; Jacob L. Shroyer, Oak Park, Ill. App. filed Sept. 19, 1919. Vegetable cooker.

1,378,585. TELEPHONE SYSTEM; Elmer Curnutt, Garnett, Kan. App. filed Aug. 14, 1917. Rural party line.

1,378,589. ELECTRIC SADIRON; Leo B. Lincoln, Chicago, Ill. App. filed July 11, 1919. Easy access to heating element.

1,378,599. PROCESS AND APPARATUS FOR MAKING ELECTRODES; William G. Michel, Niagara Falls, N. Y. App. filed Dec. 17, 1919. By passing current.

1,378,604. CONDENSATION-PREVENTING DEVICE; John W. Murphy, Cambridge, Mass. App. filed June 17, 1920. For windows, windshields, etc.

1,378,684. ELECTRIC HEATING APPARATUS; Frank P. Kobert, Amityville, N. Y. App. filed June 5, 1920. For metal-working machines.

1,378,695. CONTACT SHOE; Henry G. Lewis and Walter S. Mayer, Philadelphia, Pa. App. filed Nov. 20, 1918. Rail contact.

1,378,708. MICROPHONE; Ray H. Manson, Rochester, N. Y. App. filed June 23, 1917.

1,378,712. AMPLIFIER; Joseph W. Milnor, New York, N. Y. App. filed Jan. 17, 1916. for telegraphic signals.

1,378,740. AUTOGUBERNATOR; Samuel T. Walkup, New York, N. Y. App. filed July 30, 1917. Self-guiding means for torpedoes, etc.

1,378,761. ELECTRICAL BOILER; Leonard R. Brunswick, Superior, Wis. App. filed Sept. 22, 1920. Heating plant for house.

1,378,801. ELECTRIC CABLE TAP; Homer M. Lamb, West Frankfort, Ill. App. filed Aug. 9, 1920. For "gathering motors" in mines.

1,378,829. APPARATUS FOR THE ELECTROLYSIS OF SOLUTIONS OF ALKALINE CHLORIDES; Claus N. Riiber, Trondhjem, Norway. App. filed Dec. 12, 1918. Has horizontal diaphragms.

(Issued May 24, 1921)

1,378,836. BALANCING EQUIPMENT FOR FOUR-WIRE CIRCUITS; Alva B. Clark, Brooklyn, N. Y. App. filed Jan. 29, 1919. Operator may monitor, talk and ring on circuits which include repeater circuit.

1,378,839. SIGNAL FOR DINING TABLES; Nathaniel B. Cregier, Los Angeles, Cal. App. filed July 11, 1916. Ornamental waiter signal.

1,378,850. ELECTRICALLY HEATED APPLIANCE; Lindol French, East Pepperell, Mass. App. filed July 18, 1919. To prevent overheating.

1,378,884. COINCIDENT MAXIMUM-DEMAND RELAY; Erving A. Lueky and Roy N. Houghton, Detroit, Mich. App. filed April 7, 1920. Automatically recording power supplied through a number of meters.

1,378,888. GALVANIZING MACHINE; Constantine G. Miller, Chicago, Ill. App. filed March 19, 1920. For galvanizing automobile rims, belly bands, tire carriers, etc.

1,378,919. PORTABLE REPEATER APPARATUS; John F. Toomey, New York, N. Y. App. filed March 22, 1919. Mounted in portable box.

1,378,923. SUPPORT FOR BRUSH HOLDERS; Walter J. Warder, Jr., Chicago, Ill. App. filed Jan. 17, 1918. Heavy-current generators.

1,378,938. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 25, 1916. Improved signaling.

1,378,940. AMPLIFIER FOR TELEPHONIC TRANSMITTERS; Harry T. Dale, New York, N. Y. App. filed March 31, 1919.

1,378,943. SELECTIVE SIGNALING SYSTEM; Joseph C. Field, Orange, N. J. App. filed April 24, 1917. Telephone.

Record of Electrical Patents

Notes on United States Patents

1,378,947. MACHINE-SWITCHING TELEPHONE SYSTEM; Charles L. Goodrun, New York, N. Y. App. filed July 14, 1917. Line-finder switches.

1,378,950. RECORDING KEY; Augustus D. Hargan, Bayonne, N. J. App. filed Dec. 4, 1918. Telephone.

1,378,952. ELECTRICAL CONNECTION; Ellsworth A. Hawthorne, Bridgeport, Conn. App. filed April 4, 1918. Dry-battery connector.

1,378,969. METHOD OF MANUFACTURING INDUCTANCE COILS; Ivan L. Milton, East Orange, N. J. App. filed March 22, 1920. Manufacturing cores.

1,378,971. ELECTRIC REGULATOR; William E. Moore, Pittsburgh, Pa. App. filed Nov. 16, 1918. For furnace, prime mover, etc.

1,378,972. ELECTRIC FURNACE; William E. Moore, Milwaukee, Wis. App. filed July 18, 1919. Non-ferrous.

1,378,978. TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed June 22, 1917. Printing telegraph.

1,378,982. SIGNALING SYSTEM; Herbert E. Shreeve, Millburn, N. J. App. filed Sept. 17, 1918. Combined wire and radio.

1,378,990. SIGNALING DEVICE; James A. Wotton, Montclair, N. J. App. filed June 13, 1918. Telephone plug.

1,378,991. TROLLEY-POLE HEAD; George T. Bell, Boston, Mass. App. filed Aug. 9, 1919. Easily replaced on wire.

1,379,017. SEMI-AUTOMATIC TELEPHONE SYSTEM; George A. Yanochowski, Chicago, Ill. App. filed Feb. 21, 1916. Busy call.

1,379,026. HAIR-WAVING HEATER; Frank and Gabriel Lantieri, Newark, N. J. App. filed Nov. 26, 1919.

1,379,037. TROLLEY-POLE HEAD; Howard F. Norman, Newtonville, Mass. App. filed April 16, 1920. Wheel automatically replaced.

1,379,068. MEASURED-SERVICE TELEPHONE SYSTEM; John Wicks, Chicago, Ill. App. filed Feb. 12, 1919.

1,379,088. STORAGE BATTERY; Thomas A. Edison, West Orange, N. J. App. filed Sept. 16, 1919. Alkaline.

1,379,089. PRODUCTION OF THIN METALLIC SHEETS OR FOILS; Thomas A. Edison, West Orange, N. J. App. filed Oct. 4, 1919. Nickel flakes for storage batteries.

1,379,144. CUT-IN SYSTEM OF RADIO-TELEGRAPHY; Paul Ware, New York, N. Y. App. filed Feb. 8, 1918. Enabling receiving station to cut in on sending station.

1,379,166. RADIANT-ENERGY SIGNALING SYSTEM; Theodore W. Case, Scipio, N. Y. App. filed Jan. 22, 1918. Transforms light rays into audible signals.

1,379,167. WIRELESS RECEIVER; Theodore W. Case, Scipio, N. Y. App. filed Feb. 20, 1918. For detecting feeble currents.

1,379,172. PHOTOMETRIC DEVICE; Virgil C. Crites, Chicago, Ill. App. filed Jan. 9, 1920. Photo-electric cell.

1,379,184. SHIELDING RADIO APPARATUS; Louis A. Hazeltine, Hoboken, N. J. App. filed Nov. 1, 1917. For eliminating disturbing effects caused by movements of the human body.

1,379,237. DETINNING OF TINNED IRON SCRAP; Matthew A. Adam, London, England. App. filed Aug. 31, 1920. Recovery of tin from tinned iron.

1,379,243. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Jan. 3, 1918. Submarine.

1,379,244. ELECTRICAL CONNECTOR DEVICE; Reuben B. Benjamin and Albert V. Boetter, Chicago, Ill. App. filed May 4, 1918. Plurality of receptacles supplied from a single outlet.

1,379,262. RADIO-RECEIVING ANTENNA; Stanton C. Hooper and George H. Clark Washington, D. C. App. filed Sept. 16, 1919. Multiple-antenna system.

1,379,266. COMPENSATION METHOD AND APPARATUS; Earl A. Keeler, Norristown, Pa. App. filed May 5, 1920. Measuring resistivity of materials.

1,379,279. LAMP; Ralph Osborn, Randolph, Neb. App. filed May 29, 1919. Small dry-battery lamp.

1,379,287. TELEPHONE INSTRUMENT; Frank J. Reichmann and John Press, Chicago, Ill. App. filed June 21, 1918. Loud-speaking receiver.

1,379,342. TIME-CONTROLLED DESK MEMORANDUM; Joseph A. Howell, Dover, Ohio. App. filed Dec. 13, 1920.

1,379,356. ELECTRICALLY HEATED COAT; Antonangelo Negromanti, Milan, Italy. App. filed April 4, 1919.

1,379,366. PROCESS OF PRODUCING ELECTRICAL CONDUCTORS; Ralph L. Seabury, Toledo, Ohio. App. filed March 17, 1919. Commutator brushes.

1,379,405. DYNAMO-ELECTRIC MACHINE AND SYSTEM OF CONTROL THEREFOR; Rudolf E. Hellmund and Laurence M. Perkins, Swissvale, Pa. App. filed Nov. 16, 1917. Single-phase commutator motor.

1,379,406. DYNAMO-ELECTRIC MACHINE AND SYSTEM OF CONTROL THEREFOR; Rudolf E. Hellmund, Swissvale, Pa. App. filed Nov. 19, 1917. Single-phase commutator motor.

1,379,413. MAGNETO; Edward A. New, Great Barrington, Mass. App. filed Nov. 28, 1919. For blasting.

1,379,467. ELECTROLYTIC CELL; Howard W. Matheson and Frederick T. Kaelin, Shawinigan Falls, Quebec, Can. App. filed April 15, 1918. For oxidizing mercury.

1,379,479. AUTOMATIC LIGHTING DEVICE FOR GAS STOVES; Walter E. Schneider, Pryor, Okla. App. filed July 6, 1920.

1,379,481. INCASED ELECTRICAL APPARATUS; Ivanhoe H. Sclater, Pittsfield, Mass. App. filed June 25, 1920. Transformer.

1,379,523. PROCESS OF REDUCING ALUMINUM OXIDE; L. Burgess, New York, N. Y. App. filed Aug. 15, 1919. Arc furnace.

1,379,541. ELECTROMAGNETIC-WAVE NAVIGATIONAL ARRANGEMENT; James Erskine Murray and James Robinson, Biggin Hill, England. App. filed Oct. 29, 1919. Directive propagation.

1,379,546. APPARATUS FOR RAISING OR LOWERING A LOAD; Rudolf Forster, Essen, Germany. App. filed Sept. 4, 1920. Motor compensates weight of load at all speeds.

1,379,557. RECEIVER-HOOK SWITCH FOR PORTABLE TELEPHONES; John T. Gray, Great Falls, Mont. App. filed Aug. 13, 1919.

1,379,560. PROTECTIVE DEVICE FOR INCANDESCENT LAMPS; Cromwell A. B. Halvorson, Jr., Lynn, Mass. App. filed Oct. 26, 1916. On direct-current series circuits.

1,379,582. PROCESS FOR PROTECTION AGAINST ELECTROLYTIC DESTRUCTION; Franz von Wurstemberger, Zurich, Switzerland. App. filed July 23, 1920. For condensers, etc.

1,379,589. WIRELESS APPARATUS; Henry H. Hyder, Hollywood, Cal. App. filed June 5, 1918. For exploding mines.

(Issued May 31, 1921)

1,379,614. OVERHEAD-CARRIER SYSTEM; Earl T. Bennington, Colonial Heights, Ohio. App. filed Oct. 11, 1920. Monorail.

1,379,637. CARTRIDGE EXPLOSIVE; Edward S. McKinlay, Denver, Col. App. filed Jan. 16, 1917. For blasting.

1,379,650. TESTING APPARATUS FOR MESSAGE REGISTERS; William A. Rhodes, New York, N. Y. App. filed June 27, 1919. For telephone switchboard.

1,379,671. PERCOLATOR; Theodore Abtmeyer, Pittsburgh, Pa. App. filed March 28, 1913, andd Nov. 10, 1917. Thin annular column of liquid is isolated for heating.

1,379,686. ELECTRICAL SYSTEM; Edward A. Hanff, Irwin, Pa. App. filed Nov. 22, 1916. Generator and motor permanently connected in closed circuit.

1,379,693. CONTROL SYSTEM; Amos A. Ponsonby, Scranton, Pa. App. filed Aug. 9, 1920. For governing dynamo.

1,379,698. STANDARD CELL; Clarence J. Rottmann, Wilkinsburg, Pa. App. filed Sept. 13, 1919. Long life.

1,379,706. VACUUM-VALVE DETECTOR; Roy A. Weagant, Roselle, N. J. App. filed March 10, 1917. Not subject to disturbances.

1,379,721. IRONING IMPLEMENT; Harry A. Rapelye, Edgewood Park, Pa. App. filed Oct. 1, 1919. Contains filling compound.

1,379,767. SWITCH MECHANISM; Hubert F. Krants, Brooklyn, N. Y. App. filed Feb. 11, 1919. Inclosed switch may be mounted with others on panel.

1,379,776. OZONIZER; Melvin J. Napier, Akron, Ohio. App. filed April 8, 1920.

1,379,795. SWIVEL CONNECTION FOR ELECTRICAL CONDUCTORS; Charles O. Allen, Shawnee, Okla. App. filed April 9, 1919. For telephones.

New England States

NORWAY, ME.—The Central Maine Power Company, Augusta, is considering changes to its local power house.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company is considering the extension of its lines for light and power service in Whitney Point and Maine, N. Y.

BRASHER FALLS, N. Y.—The Milling & Lighting Company, Inc., has applied to the Public Service Commission for authority to erect a transmission line from its power plant to Nicholville, Lawrence County.

BUFFALO, N. Y.—The City Council has approved a contract for improvements to the street-lighting system on Genesee Street from Bailey Avenue to Jefferson Street.

ENDICOTT, N. Y.—The Binghamton Street Railway Company is considering the construction of a new electric power house in Endicott.

GEORGETOWN, N. Y.—The Georgetown Electric Lighting Company has applied to the Public Service Commission for authority to build and operate an electric lighting system in Georgetown. It is proposed to locate the plant in the Andrus feed mill, which will supply power to operate the system.

HERKIMER, N. Y.—The Municipal Commission of Herkimer is considering extensions to the lighting system to East Herkimer.

NYACK, N. Y.—The Rockland Light & Power Company has applied to the Public Service Commission for permission to issue bonds, the proceeds to be used for the construction of an addition to its power plant, including new steam and electric equipment, estimated to cost about $435,000.

WATERVLIET, N. Y.—The installation of an ornamental lighting system in the business district is under consideration.

JERSEY CITY, N. J.—The Rogers-Pyatt Shellac Company, 39 Essex Street, is considering the construction of a new one-story power house at its plant.

BERLINSVILLE, PA.—The Genuine Washington Slate Company has closed down its boiler plant and is purchasing power from the Pennsylvania Light & Power Company. The former company contemplates the installation of additional equipment to double the size of its plant.

PITTSBURGH, PA.—Merger of light and power companies in Armstrong, Clarion and Butler Counties with the West Penn Power Company has been authorized by the Public Service Commission.

BALTIMORE, MD.—The Standard Oil Company has prepared plans for a new one-story power house, 93 ft. x 143 ft. at its plant on Third Avenue, to cost about $50,000.

OXFORD, MD.—Arrangements are being made by the Council for an issue of $15,000 in bonds for improvements and extensions to the electric system.

FAIRMONT, W. VA.—The Forest Coal Company is considering the installation of new machinery at its properties, including considerable electrical equipment, to cost about $150,000. H. W. Showalter is president.

RICHMOND, VA.—The Common Council has appropriated $10,000 for improvements to the lighting system on Hull Street.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following: Until June 21, Annapolis, Schedule 8,285—20,000 ft. two-conductor concentric cable; Portsmouth, Schedule 8,312—6,700 ft. electric cable and wire. Until June 24, Indian Head, Schedule 8,270—12,000 ft. electric cable; South Brooklyn, Schedule 8,272—miscellaneous quantity of switchboard panel material; Philadelphia, Schedule 8,307—three transformers, six fuse switches and one wattmeter.

North Central States

GRAND RAPIDS, MICH.—A movement has been started by the residents of Plainfield Avenue for the installation of an ornamental lighting system on that thoroughfare from Grove to Knapp Street, covering a distance of nine blocks. The cost is estimated at $15,000.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

CLEVELAND, OHIO.—The City Council has adopted resolutions providing for the installation of an ornamental lighting system on Superior Avenue from East Ninth Street to the boulevard, St. Clair Avenue from East Ninth Street to Gordon Park, Paine Avenue from the intersection of Superior Avenue to East Fifty-ninth Street, and on Euclid Avenue to University Circle.

HAMILTON, OHIO.—Plans and estimates will be prepared, it is understood, for the construction of a municipal electric light plant and remodeling the plant now in use.

CHICAGO, ILL.—The Old Ben Coal Company, 332 South Michigan Avenue, is considering the construction of a new power house, 50 ft. x 85 ft., at its No. 16 mine, to cost about $50,000.

QUINCY, ILL.—Extension to the street-lighting system on Sixth Street is under consideration. The cost is estimated at $20,000. L. L. Harper is engineer.

DES MOINES, IOWA.—Extensions to the lighting system from Fifth and Chestnut Streets to Thirteenth and Crocker Streets are under consideration. A. E. McGlothen is city clerk.

NEW VIRGINIA, IOWA.—The local electric light plant was recently destroyed by fire.

HOPE, N. D.—Bonds have been voted for improvements to the electric light plant.

KIOWA, KAN.—Plans are under consideration to erect a transmission line from Kiowa to Byron, Okla., also from here to Amorita, Okla. An election, it is understood, will be held to vote on the proposal to issue $30,000 in bonds for the project.

LAWRENCE, KAN.—Bids will be received by the State Board of Education, Topeka, until June 21 for a new two-story power plant at the University of Kansas, Lawrence. The cost is estimated at about $100,000.

HEBRON, NEB.—The construction of a hydro-electric plant on the Blue River near Hebron to cost about $25,000 is under consideration. W. Kassenbaurn is interested.

Southern States

MIAMI, FLA.—The Miami Light & Power Company is considering an expenditure of $275,000 for improvements, including the installation of machinery at its main plant to cost $200,000, additional boilers, $50,000; remodeling boiler house, $10,000; constructing meter repair shop, etc. H. H. Hyman is general manager.

NEW SMYRNA, FLA.—Business men of New Smyrna have started a movement for the installation of an ornamental lighting system on Canal Street, covering a distance of about a half-mile.

PLANT CITY, FLA.—The proposal to issue $150,000 in bonds to establish electric light and ice plants in Plant City is under consideration.

WAUCHULA, FLA.—J. G. Fancy and associates, Fort Mead, are considering the construction of an electric, ice and cold storage plant in Wauchula to cost about $50,000.

NEW ORLEANS, LA.—Preliminary plans are under way by the Consumers' Electric Light & Power Company for the construction of a new power plant.

COMANCHE, OKLA.—Bonds to the amount of $275,000 have been voted for improvements to the lighting, water and sewer system.

EL RENO, OKLA.—The Oklahoma Gas & Electric Company is considering rebuilding its lines at a cost of about $25,000.

TULSA, OKLA.—Cosden & Company are considering improvements and extensions to the power house at their local oil works to cost about $100,000. New equipment will be installed.

Pacific and Mountain States

OLYMPIA, WASH.—Estimates have been submitted by the Olympia Light & Power Company to the lighting committee of the Chamber of Commerce for lighting the main business district of the city with cluster lamps. The plans call for 310 standards, the cost not to exceed $50,000.

FULLERTON, CAL.—Property at Harvard and Walnut Streets, Fullerton, has been acquired by the Southern California Edison Company, Los Angeles, on which it will erect a new power house to cost about $50,000.

LOS ANGELES, CAL.—The Little Rock Power & Water Company has filed application with the State Water Commission for 50 cu.ft. per second direct diversion and 3,000 acre-ft. per annum, storage, from Little Rock Creek for power purposes. The total amount to be developed is estimated at 2,415.

OROVILLE, CAL.—L. O. Griffith has applied to the State Water Commission for 400 cu.ft. per second from the middle of Feather River and the south fork of Feather River, for power purposes. Diversion will be made by means of a conduit.

OROVILLE, CAL.—The Middle Feather River Development Company is having plans prepared and investigations made for the development of 185,000 hp. The plans provide for the construction of four power plants on the middle fork of the Feather River and a storage reservoir at Grizzly Valley to have a capacity of 90,000 acre-ft. Lars Jorgensen is engineer.

SAN FRANCISCO, CAL.—The United States Electric Steel Products Company, Inc., contemplates the construction of a new plant for the manufacture of steel products to cost more than $5,000,000. The plans provide for a power plant. The electric furnace installation will be made by the Electric Furnace Construction Company, 908 Chestnut Street, Philadelphia.

STOCKTON, CAL.—Application has been filed with the State Railroad Commission by the Western States Gas & Electric Company and its subsidiary, the El Dorado Power Company, for a certificate of convenience and necessity for construction work and extensions. The Western States Company proposes to enlarge its plant on the south fork of the American River, which, together with the proposed power plant of the El Dorado Power Company on the south fork of the Feather River, will give a total development of 156,000 hp. The latter company also plans to erect a transmission line to connect the two plants.

WILLOWS, CAL.—The Pacific Gas & Electric Company plans to install electroliers in Willows. The cost is estimated at about $8,000.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company, it is reported, has applied to the corporation commission for permission to sell $500,000 in bonds. The proceeds are to be used to take up outstanding indebtedness and for improvements to its electric and gas systems.

PHOENIX, ARIZ.—The Southern California Edison Company, Los Angeles, Cal., has filed application with the State Water Commission to develop the water power of the Colorado River at Glen Canyon and Diamond Creek. The cost of the project is estimated between $625,000,000 and $800,000,000.

BASIN, MONT.—The Jib Mining Company contemplates the erection of a 300-ton concentrating mill which will require an additional motor capacity of about 750 hp., also the installation of an additional bank of 600-kva., 62,500-volt to 2,200-volt transformers. The company supplies the town of Basin with light and water service.

Canada

BRIDGEBURG, ONT.—Plans are being prepared by the Hydro-Electric Commission of Ontario for the construction of another canal parallel with the one now under construction. The new canal when completed will develop about 100,000 hp and will cost about $10,000,000.

CHIPPAWA, ONT.—The Montrose substation on the end of the new canal of the Hydro-Electric Commission of Ontario was recently damaged by fire, causing a loss of about $100,000.

CEDAR, QUE.—The Montreal, Light, Heat & Power Company, 83 Craig Street, West, Montreal, has awarded the general contract for an addition to its power house at Cedar to cost about $80,000 to Anglin-Norcoss, Ltd., 65 Victoria Street, Montreal.

Electrical World

New York, Saturday, June 25, 1921

The Utilization of Our Many Convention Papers

ONE of America's greatest men attributed his success in large measure to a habit which he established early in his working life and pursued persistently throughout his long career. He set himself each year to learn one new thing thoroughly. It might be a different line of business which he investigated and studied. It might be a new subject to read and carefully digest. It might be simply another sport or hobby to practice and master. But each year saw this fresh objective. It brought a broadened interest and a bigger life.

There is a practical suggestion here for electrical men right at this time, for the National Electric Light Association has just presented to us something of great value which we are about to throw away. Men of the industry have just gathered and compiled a huge mass of priceless information and advice. The N. E. L. A. has published it and bestowed it upon us. But its value lies not in possession, but in utilization. It has enormous usefulness, tremendous power for production and for progress. Yet in the past the most of it has ever been in large part lost because there was so much of it. Men fail to read these papers with an eager and retentive mind and to apply constructively the parts they would like so to apply. The inclination is to pile these publications on a shelf, and then, with good intentions, leave them there neglected.

But each man among us could *at least* learn one thing thoroughly out of this treasure and apply it. If he would consider it an obligation to his industry that this great store of mental meat and bread be not entirely wasted *on him*—if he would but feel it the literal truth that this exhaustive work has all been done that *he*, and others, may gain a profit from it—could any man accept this gift and do less?

This is a point o' view toward the convention papers that electrical men should think about. For there is an economic loss involved in their neglect as well as a personal loss. There is an element of moral obligation that the individual should recognize. There is a proffered opportunity that cannot be ignored without offense. The gift is made in trust.

If you would do your part as an electrical man this year, read your own subject thoroughly in your convention papers. Study it. Apply it. Make good the work that has been done for you by a practical and profitable utilization.

Then read and learn at least one new thing also—one different subject. Broaden your interest and your knowledge in your industry. Follow this new subject week by week in the ELECTRICAL WORLD. Learn one new thing this year.



Charles Thomas Main

A consultant of national reputation in the industrial and power plant fields who has a fine conception of the broader rôle the engineer can play in public affairs

LARGE affairs are calling out the professional skill and public spirit of American engineers as never before in times of peace. The advice, the constructive insight and the untiring energy of such men are big factors in the nation's advance, factors not less potent because of their quiet application. A man of this type, eminent in the eyes of his confrères, is Charles T. Main, industrial engineer, of Boston. Born of colonial ancestry at Marblehead, Mass., in 1856, Mr. Main was graduated at the age of twenty from the Massachusetts Institute of Technology in the department of mechanical engineering. After three years as an assistant on the instructing staff, he entered the textile engineering field at Manchester, N. H., soon going to the Lower Pacific Mills at Lawrence, Mass., where in 1887 he was made superintendent. During a period of eleven years, which included the reorganization and rebuilding of the Pacific Mills plant, Mr. Main directed the work, never letting go his hold upon engineering in the press of administrative duties. Finally he entered the consulting field, forming a partnership in 1893 with F. W. Dean, under the firm name of Dean & Main, at Boston. This association continued until 1907, when Mr. Main established an independent office under his own name.

Many large industrial, steam and hydro-electric plants bear the impress of Mr. Main's engineering talents. Among these are the Wood Worsted and Ayer Mills in Lawrence, and in the water-power field four large developments for the Montana Power Company. Mr. Main has served as consulting engineer on many projects and as expert witness or referee in important legal actions.

Mr. Main is a past-president of the American Society of Mechanical Engineers and of the Boston Society of Civil Engineers. He is president of the Engineers' Club of Boston and a life member of the corporation of the Massachusetts Institute of Technology. Mr. Main's name is familiar to many readers of the technical press, and his contributions to professional gatherings have been numerous and useful. As a member of a special commission organized a few years ago to further water-power conservation in Massachusetts he performed distinguished service. In December, 1918, Mr. Main went to France as a member of a commission to confer with the French Society of Engineers upon reconstruction in the war zone. He sailed again on June 1 last to represent the American Society of Mechanical Engineers at the second World Cotton Conference, to be held in Liverpool, England, and he is also chairman of a delegation to represent the American Society of Civil Engineers at the engineering conference to be held in London, June 29 to July 1, and to participate in the presentation of the John Fritz medal to Sir Robert Hadfield.

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Committees on Public Information Should Be Supported

A GREAT service for public utilities of all classes is being rendered by the committees on public information now active in many states. Granting that the public is just if it is in possession of all the facts, the need of some central bureau for disseminating public utility information is apparent. The committee in Illinois, being longest in existence and therefore oldest in experience, has served as an example and inspiration to many others, and its work is indicative of what may be done in any other state where the committee is properly supported. The work is truly co-operative, and if it is to be at all effective, it must be supported by the electric light, railway, telephone, water, gas and other utility interests. The cost to the individual utility is nominal, and the benefit, though indirect, is none the less certain. In some states, notably Missouri, where enthusiasm was at first high interest is now beginning to wane through lack of funds. This is all wrong. The plan is certainly worthy of support, and those having the work in hand should not be handicapped. For the modest sum of from $15,000 to $25,000 a year it is possible to maintain a fairly respectable public information bureau, and when this cost is prorated among all the utilities of a state no single utility will find it burdensome. Possibly if the cost were higher the work would be appreciated more. Nevertheless, its cheapness is what commends it, and the work should not be considered any less desirable because it does not involve a great expenditure.

Fundamental Costs of Rural Service Must Be Studied

RURAL-SERVICE rate problems cannot be solved until the basic problems of financing, construction and operating have been solved. The present confusion in the rural-service situation is due almost entirely to a failure on the part of central-station executives to size up the fundamentals of the problem. In many cases the course of action has resembled a running jump to arrive at rates, with no attempt to find what these rates are being made to cover.

Fundamentally the problem is one of service. A certain amount of equipment must be employed and maintained. The conditions are such that previous experience is likely to be misleading. Investments and operating costs are radically greater than for any other class of service. Moreover, there will also be a variation between every two rural-service installations. The companies that are thinking most clearly are confining their rate-making efforts to the construction of a schedule under which each extension will receive individual treatment. As a general rule the energy charge is based on the schedules in use for the same class of service. In addition, the fixed and operating charges for each extension are carefully worked out and a fixed charge for service is applied. The charge will not be uniform over any system, and consequently the average cost per kilowatt-hour will vary as between extensions and also as between consumers on the same line in proportion to the energy used.

Mutual Confidence and Seeing the Other's Viewpoint

THE most hopeful sign yet apparent in the effort being made to solve the problem of inductive interference is the recognition by both power-distributing and communication companies that they must get together for the purpose of understanding each other's viewpoint and for discussing plans that may affect the service of either. Contests before the courts and regulatory bodies are due in no small part to a lack of understanding of each other's problems and a lack of consideration of each other's rights.

Perhaps the most disturbing element in the present situation is the establishment of so-called precedents through court or commission decisions. These precedents must be carefully studied; such precedents as are based on sound economic principles must stand; those based on partial facts presented before a judicial body must be discarded. In its final analysis, however, the problem is not one for legal treatment, nor is it one to which legalistic methods can rightfully be applied. The question at issue is the right of the public to have two essential services at a cost that will not prohibit rapid extension of either and at the greatest possible efficiency. Obviously a general solution cannot be reached by judicial consideration of the few facts that are present in any single case. Nor can any court or commission be expected to go into the technical and economic aspects of the matter and establish rules that will cover all phases of the problem. Without a thorough understanding of the technical problems no one can hope to determine the economic problems. It therefore follows that the men of the two industries involved must provide the ultimate solution.

At the present time there are all too many cases that have been carried before commissions or courts. It is not necessary to apportion the blame for such a situation. The quickest way of relief is to hasten the effective organization of state joint committees, take up pending cases, arrive at a settlement and ask for the dismissal of contests without letting them go to a formal decision.

The plan which was outlined before the N. E. L. A. at Chicago recently by the public policy sub-committee on inductive interference is workable. The organization proposed can function and eliminate any excuse for taking controversies to commissions or courts. The two industries need only to avail themselves of it. In the words of the doughboy, "Let's go!"

A Right Use of Authority by a Public Service Commission

HOW wise direction by a public service commission may work to the public benefit, even to the extent of affecting prices, was shown by the recent action of the California Railroad Commission in ordering an interconnection between the systems of two large central-station companies. In this instance the Great Western Power Company and the Pacific Gas & Electric Company were both asking the commission to continue a 15 per cent surcharge. The commission responded by bringing about an arrangement whereby one company, needing power, purchased of the other company, which needed a larger market. It was further stipulated that the most efficient steam plants of both companies should be operated on joint account. The commission held that the new arrangement would have a material bearing on the need for continuing the surcharge, which, in fact, it subsequently reduced more than half. This particular form of commission activity, which virtually directs companies to co-operate to the benefit of all concerned, is a step in the right direction. If all commissions will use wisely and fairly the best means at hand to help both companies and public to a more efficient supply of electric power, they will justify the laws that have intrusted to them such heavy responsibilities.

Problems of Transmission at 220,000 Volts Are Being Solved

OPINION among operating engineers appears to be crystallizing in favor of a national standard of 220,000 volts for extra-long bulk-supply transmission lines. For this service the value advocated is an excellent one because, as is made clear by F. G. Baum elsewhere in this number of the ELECTRICAL WORLD, it enables the economical transmission of large amounts of power over distances as great as 1,000 miles and, besides, is a simple multiple of voltages now firmly established. However, engineers should not confuse long lines in which power is transmitted the entire length with long lines having intermediate feed-in and feed-out taps, since the latter serve chiefly for interchange of power and seldom if ever have to transmit energy the entire length.

For the 220,000-volt insulator string three alternatives have been discussed—(1) the use of larger and heavier insulator units, (2) grading, or the use of units of high electrostatic capacity at the line end of the string to ease the electric stress on these units, and (3) the application of metal shields in such a way as to lower the voltage gradient at the units next the line. The second and third methods, and especially the last, appear to offer the best solution according to the classic studies carried out in the Stanford University laboratories by Professor Ryan, Mr. Baum and others. A combination of grading and shielding is also being considered. These tests have shown that even after the units next the line have been relieved there is great danger that flashovers will strike in at the upper units, themselves under low unit stresses, unless this contingency is carefully guarded against. Mr. Baum summarizes the whole situation by saying that the line insulators must be made as reliable as the transformers and other apparatus before the insulation problem can be considered fully solved.

The voltage control of long lines cannot be accomplished satisfactorily at the generator alone. The heavy and ever-changing charging current along the line, not to mention changing loads at various points in the line, call for remedies which Mr. Baum happily compares to the loading of telephone lines. Synchronous condensers distributed along the line give the obvious and apparently complete solution of this problem.

Are Gas-Filled Lamps Going to Supplant the Vacuum Type?

WHEN the metallic-filament lamp first appeared the very slender filaments of lamps rated below 40 or 50 watts possessed an undeniable fragility that operated against the popularity of these smaller sizes. However, the drawn-wire filament changed this situation very radically, and now there is no apparent reason why 15-watt and even smaller lamps cannot be freely used in suitable situations. At present the vital question is, how low can the candlepower of the gas-filled lamp be carried to advantage? Comparative figures for the 100-watt size indicate that so far as cost is concerned there is no excuse for the 100-watt vacuum lamp. None the less, this size is one which is used almost entirely for commercial and industrial lighting and the situation regarding the smaller sizes is still somewhat uncertain. Quite probably the gas-filled lamp could be furnished in all the usual sizes with a slight gain in efficiency, but its temperature and intense brilliancy co-operate to produce a lamp not altogether desirable for domestic service. In such service particular care must be taken on account of the heat, and the necessary shading may overbalance the increase in lumens per watt.

Inasmuch as the United States is about the only country in which 220-volt metallic-filament lamps are not used extensively, it would seem worth while to start a searching inquiry as to the real merits of the 220-volt lamp on the basis of actual practice in the countries where it is standardized.

Field of Motor Application Rapidly Extending in the South

WITHIN less than ten years the use of electric power in the growing industries of the South has increased to a very large extent. Today the connected load is fully two and a half times as great as at the beginning of the world war. Considered on the basis of actual energy consumption the load has increased more than fourfold. A summary of the facts which the ELECTRICAL WORLD has collected from this section of the country is given elsewhere in the current issue. Briefly, more than a thousand plants use electricity as their chief source of power. The energy generated locally is somewhat less than that purchased, in the ratio of about two to three. Perhaps this relatively small difference is partly due to the fact that a much greater proportion of the industries generating their own power than of those purchasing power replied to our questionnaire.

The great industries from the standpoint of electric service are the textile, the lumber, the chemical. The first named was the pioneer in electric drive on a considerable scale, and the total amount of energy taken by the Southern mills now certainly runs above 800,000,000 kw.-hr. There are more than 60,000 motors in these mills, more than three-quarters of them being under 5 hp. In the lumber industry the power consumption

is conspicuously less, below 200,000,000 kw.-hr., of which more than half is generated by private plants, as might be expected from the isolation of the industry and the waste available for fuel. Although only 7,000 motors are in service, their average rating is considerably larger than that of the textile motors, about 10 hp.

Looking at the rapid growth of the past few years and the possibilities springing up all over the great Southern territory, it is clear that there is a vast field yet untouched in the application of motors to manufacturing, a field certain to be opened up as the resources of the South begin to be better understood. Amplification of the existing electric service facilities will assist greatly in this development.

Need of Accurate Records on Cable Temperatures

THE ever-increasing desire for economical operation has brought those interested in underground lines face to face with several questions which demand an answer. Not only will it be necessary to know the maximum allowable temperature of all makes of cables in order to predetermine failures due to overloads, but it will also be necessary to know the effect on the length of life of the cable due to various temperatures and also the effect due to temperature changes. Briefly, all the effects of temperature on underground cables must be analyzed. It would seem at first that, considering the large investment represented by the duct line and the cables it carries, economy would dictate carrying currents as large as can be carried without failure of any one cable. However, it can be seen that, if the life of the cables is considerably reduced by high temperatures, it may prove too expensive to replace the cable at frequent intervals. The report of the underground systems committee of the National Electric Light Association brings out forcibly the importance of determining all such points.

Experience has indicated the need of means of determining accurately and easily the temperature of cables at all points of the duct lines. Considering the large amount of data compiled in the last few years regarding failures of cables, it is quite evident that if there were accurate records of the actual temperatures to which these cables were subjected very interesting conclusions could be drawn. With only a relatively small amount of further investigation the maximum allowable temperature of cables and the effect of high temperatures and variations in temperature on the life of the cable could be evaluated with such accuracy that the economies of operation attainable with underground cables could be definitely known.

Automatic Station Should Facilitate Small Power Development

FROM time to time we have described some of the automatic stations which have gradually been coming into use. Among others we gave some account of the 1,500-kva. plant at Cedar Rapids. After three and a half years of use there have been none but good reports from this equipment. The sum and substance of the story is that the expense of operation has been almost negligible. The plant generates about 7,500,000 kw.-hr. per year, and the average maintenance and operating charge thus far has been only $178 annually. The inspection given to the station consists in a daily cleaning of the racks by one of the boiler-room employees, which takes about thirty minutes, and an electrical and mechanical inspection weekly, requiring about two hours. Aside from the very low cost of operation, the abolition of labor is a particularly good thing on account of the difficulty in keeping operators at any price on an isolated and lonesome job like tending a small hydro-electric plant. The yearly fixed charges against the plant are $33,600, beside which the actual operating and maintenance cost is a very insignificant figure. The cost for delivered power on this basis is 0.45 cent per kilowatt-hour.

Several of these automatic plants are now in successful operation, some having gone into service during the current year. Others are on order, one of them to have 750 kva. in a single unit, and will presently be at work to keep down the cost of energy. In all the cases mentioned the generator is of the synchronous type, while the voltage varies all the way from 6,000 to 11,500 in the various instances. There is no doubt whatever that the automatic station has come to stay and will produce a very beneficial effect in certain situations. In particular it is likely to be of great importance in linking up small hydraulic powers situated on the same or near-by streams and which it would be quite impracticable to use if attendance should be required all or during any substantial part of the time at every station.

Spectacular Methods Not Necessary for Economical Plant Operation

A POOR workman supplied with the finest tools will still produce poor work, but when to a decent tool equipment is added the skill of interested and contented men who are competent to use the tools the best results may be expected. An example that should carry a forceful lesson to steam-plant operators is given in C. H. McClintock's discussion of the Denver Tramway Company's plant practice in this issue.

The foundation on which to build was not the best, the load curve, fuel and water conditions leaving something to be desired and the fuel conditions being such as to dismay those accustomed to the high-grade Eastern coal. By intelligent redesign of an old plant and intelligent and persistent training and supervision of the operating force, however, a kilowatt-hour is being produced on a basis of 23,750 B.t.u. Only a few of the larger steam stations are bettering this figure, and such a record for a plant carrying momentary peaks of 10,000 kw. and handling only street-railway load is a rather remarkable accomplishment. There is nothing spectacular in the equipment or methods and nothing that cannot be equally well accomplished in any plant of its size—or even in smaller plants if a fair degree of careful study and persistent reaching for results is employed.

The real difficulty at the root of much of the inefficiency of the small steam plants is the tendency to employ guesswork methods rather than devote energy to a careful analysis of conditions on which an intelligent elimination of wastes can be undertaken. Improper selection of equipment and wastes due to careless or unintelligent operation are the big factors in poor steam-plant results. There are many other companies that can accomplish what the Denver Tramway Company has already done, and a careful study of Mr. McClintock's article will benefit every operator of a small electric-generating plant.

Flashovers Can Be Directed Away from Insulator Disks



SOME important tests of 220,000-volt insulators have been conducted recently in the laboratory of Leland Stanford University, under the direction of Prof. Harris J. Ryan, with the co-operation of F. G. Baum and members of the N. E. L. A. sub-committee of which J. A. Kuntz is chairman. In the photograph is shown the high-frequency flashover of a string of insulators with which vertical shields are employed, the one on the left being capped by a pin-type insulator. The effectiveness of the insulator-capped shield is shown strikingly in this picture directing the arc away from the insulators and onto the tower structure. On the other side of the string the electric field is such that the arc strikes into the upper units, an action that must be effectively guarded against in actual operation. Results of some tests by Mr. Baum are given on page 1477 of this issue.

A. I. E. E. Convention
at Salt Lake City



Thirty-seventh Annual and Tenth Pacific Coast Convention Drew Large Audience from the East and Far West—Thirteen Technical Committees Submit Reports —Water-Power and Long-Distance Bulk-Power Transmission Were the Subjects of the Principal Papers—President Berresford Points Way for Proper Industrial Development

PERMITTING as it did the combination of business and a vacation trip through the scenic West, the Salt Lake City convention of the American Institute of Electrical Engineers drew an unusually large attendance this week from the East. The convention proper lasted from Tuesday morning to Friday noon, but entertainment, recreation and trips to various points of interest held many delegates the entire week. On the opening day Charles R. Mabey, Governor of Utah, delivered an address of welcome and Arthur W. Berresford made the annual presidential address. Following this thirteen technical committee reports and two papers on hydraulic subjects were presented. Abstracts of these, the president's address and a paper by F. G. Baum on voltage regulation of long lines are published in this issue, the latter beginning on page 1477. Next week there will be published abstracts and discussions of the remaining papers, which deal with long-distance bulk-power transmission lines and interconnections, insulator production and problems, harmonics and air strength, and miscellaneous subjects.

President's Address

For the proper development and economical operation of any industry, said Arthur W. Berresford, in his presidential address, the major interests in that industry must have the understanding, support and good will of those less important. This is true because the policies of a minor manufacturer may be directly contrary to the interests of the industry as a whole, not by intent, but by reason of a limited viewpoint. Such a manufacturer would be entirely willing to reverse these opinions if there were clearly set before him the certainty of ultimate unfortunate results to himself as well as to others. This process would be facilitated by the exchange of views made possible at association meetings.

From the industry's standpoint, therefore, the problem becomes the correlation of the necessary associations into a representative co-ordinating body and the direction of the combined effort in a manner that will insure such advantage to its members as is consistent with the rights of others and the best interest of the public. This correlation can be attained if the broad fundamental principles underlying the industry can be enunciated and if there can be developed therefrom the operating policies which the industry should follow. The execution of this task requires the best minds of the industry.

To show how such correlation would assist in the development of the industry, President Berresford considered one very important problem in the electrical industry, namely, the ultimate dependence of industry on science and the consequent vital importance of research. While the hope of commercial gain will impel the continuance of applied research where it is already established, the speaker declared, fundamental research must be stimulated. An incentive must be offered to induce temperamentally fitted men to undertake this career and to become largely qualified, or else industry will go begging for the men it will need in increasing quantity for its applied research.

In this connection the Bureau of Standards, as a center of research, deserves particular consideration, Mr. Berresford maintained. If that body is to function most effectively and satisfactorily, industry must first agree on what the scope of the bureau shall be; second, educate the bureau in industrial conditions, and, third, by demanding that the interests of industry be heeded, insure adequate financial support for the bureau. This can be accomplished only by a united industry—commercial and non-commercial. The electrical industry, by reason of its greater interests, should initiate this work and carry forward through its associations the necessary process of education. The leaders in this work, said the speaker in conclusion, are the most competent to determine the fundamentals and policies by which this industry should be guided.

Development at Niagara Falls

The progress of water-power development at Niagara Falls from its beginning to the present time was traced in a paper presented by John L. Harper and J. Allen Johnson of the Niagara Falls Power Company. Attention was directed chiefly to the recently completed development* known as Extension No. 3 and to the new work† undertaken by recent license from the Federal Power Commission. In brief this development involves running a 32-ft. (9.7-m.) U-shaped tunnel from above the falls to Extension No. 3, where additional generating capacity will be provided. To avoid exceeding the diversion allowed by treaty the least efficient equipment on the system—*i.e.*, at the Niagara plant—will be shut down. This development will utilize 220 ft. (67 m.) of the 314-ft. (95.7-m.) drop from the upper river to Lewiston and will ultimately add 187,000 hp. capacity to the system. The remaining 94 ft. (28.6 m.) can be developed in another plant farther down stream. A preliminary permit has been granted to the Lower Niagara River Power & Water Supply Company allowing two years for presenting plans to develop the lower river stage.

In the concluding portions of the paper by Messrs. Harper and Johnson emphasis was placed on the national benefits as distinguished from merely local benefits from developing Niagara power.

Advances in Hydraulic Design

The tendency in hydro-electric practice, said W. M. White, Allis-Chalmers Manufacturing Company, is to develop each power site completely and to use larger units which will permit the maximum utilization of water power available. Where system interconnections exist each hydro-electric station is as much a unit in the system as was a single generator in old plants. Hence more freedom is afforded in selecting size of units. Steady advances are being made in speed of units, and no doubt even higher speeds will be adopted. For high-speed service Nagler wheels are giving excellent results. Regulation of speed, Mr. White said, can best be accomplished by making use of the inertia of rotating parts. The governing apparatus alone should not be expected to perform this function when all it can do is to open and close the turbine gates after being actuated by a change in turbine speed. However, modern governors are so sensitive that they will respond to a speed change of less than one-quarter of 1 per cent. Integral governors constitute one of the latest advances, and there is a tendency to simplify them further so that they will be self-contained.

The speaker expressed the opinion that the ideal runner material is bronze without any zinc, although cast steel has been used with excellent results for both high-head and intermediate-head units. Plate-steel runners and guide vanes have been recent innovations. In the design of guide vanes the trend is toward cast-steel vanes with integral stems controlled by outside operating mechanisms. Both concrete and cast-iron spiral casings are being used for low-head plants, the tendency being toward a circular cross-section. Mr. White pointed out that conversion of the velocity head of discharge into useful power can be accomplished by properly designing the draft tube, reference being made to some tests conducted with various kinds of regainers, including the hydraucone type.

Among other subjects discussed in the paper were the fastening of runners on shafts, support and guide bearings, and formulas for determining maximum runner speed, runner diameter and pressure changes in the hydraulic system.

*See ELECTRICAL WORLD, Sept. 18, Oct. 2, 16, 23 and 30 and Nov. 13, 1920.

†See ELECTRICAL WORLD, June 11, 1921.

Technical Committee Reports

Electrical Machinery

For some time the electrical machinery committee, B. A. Behrend chairman, has had under consideration proposed changes in the standardization rules relating to high-potential testing. These have become necessary in order to overcome the failure of the present rules to impose any test (1) between adjacent coils in any circuit of any phase and (2) between phase windings where the highest potential difference exists when the machine is operating. In addition, it is hoped to overcome the unknown stresses imposed at certain points owing to capacity effects in large machines. Work will probably be continued along this line.

Lighting and Illumination

In continuing its work of obtaining papers to be presented before the society the committee on illumination and lighting, C. E. Clewell chairman, expects to be able to present data on the subject of production intensities in industrial lighting as well as on glassware for street and commercial lighting. Among developments which were emphasized were the increased use of incandescent lamps, increase in industrial lighting, lighting demonstrations, highway lighting and the increased use of the foot-candle meter.

Protective Devices

Among the subjects taken up by the various divisions of the protective devices committee, D. W. Roper chairman, were current limiting reactors, system troubles, lightning arresters, circuit breakers and switches, and schemes of relay protection. As in previous years, the sub-committees carry over into the next fiscal year, and therefore the reports are in the nature of indicators of progress.

System troubles due to failure of relays to function properly came in for considerable study. It is pointed out that where relays are set in increments to protect different sections of a system the increments between different relays are frequently so large that a fault occuring near the source of power may throw the generators out of step. On the other hand, if the increments of settings are too small, sections beyond the fault are sometimes cut out of service. Need is felt for current-limiting feeder reactors to avoid the heavy drag on generators due to a fault near the station and which would allow wider increments between relay settings.

One interesting point made by a sub-committee is that the use of low-voltage releases on power-house auxiliaries is of questionable value. In case of low voltage on the main bus the plant auxiliaries may drop off and cause a complete shutdown of the plant. Lightning arresters have also been reported as being the cause of system troubles.

Lightning arresters were studied carefully in order to obtain the present practice of operating companies. One of the questions asked was that relating to choice of an arrester for a feeder circuit of 1,000 kw. capacity

on 10, 33, 66 and 150-kv. lines. Out of thirty-four companies reporting sixteen recommended the oxide-film arrester and fifteen the aluminum-cell arrester for such a line at 10 kv. For 33, 66 and 150 kv. the opinions are also about equally divided between the oxide and aluminum-cell arresters. There are two or three companies that believe in the use of horn gaps with resistors or Bennett type arresters for voltages above 10 kv. In a study of the omission of arresters in special cases twelve companies were found to believe that there are no cases where arresters should be omitted, while several companies hold that at small substations or on short unimportant lines or at points not subject to lightning the arresters might be omitted.

The sub-committee on circuit breakers and switches worked with the electrical apparatus committee of the National Electric Light Association and the power-switchboard and oil-circuit-breaker section of the Power Club. An abstract of the analysis of questionnaires on this subject will be found in the ELECTRICAL WORLD of June 4 on page 1314.

It has been the aim of the relay protection sub-committee to act as a clearing house for all information on protective relay schemes and to present this information in such a form that it will be an authoritative record of the progress of the art. Records which have been compiled indicate that the general trend is toward the selection of defective lines by means of the fault or trouble current rather than by relying altogether on the use of progressive time settings and current settings on the basis of the total current.

ELECTROPHYSICS

One advance made in the electrophysics field during 1920 and 1921 was that by Rutherford on the atomic nucleus, the electrophysics committee, F. W. Peek, Jr. chairman, reported. Rutherford has bombarded the atoms of some of the lighter elements with alpha particles and has apparently succeeded in disintegrating them. Nitrogen was one of the elements thus disintegrated. Work and speculation on the arrangement of the electrons in atoms and molecules seem to be leading to something, and it is hoped that the results will be of great importance.

TRANSMISSION AND DISTRIBUTION

Some of the subjects given particular consideration by the transmission and distribution committee, E. B. Meyer chairman, were increased voltages in underground cable work and also in outside-line transmission, power-cable testing and protection of cable systems. The cable research sub-committee, which had continued its co-operative work with the underground systems committee of the National Electric Light Association, pointed out that there had been a definite tendency toward the use of higher-voltage underground cables. In Chicago there will be installed 30 miles (48-km.) of three-conductor cable intended for a normal working pressure of 33,000 volts. This cable will have sector-shaped conductors each of 350,000 circ.mil. with $\frac{3}{8}$ in. (7.6 mm.) insulation around each conductor and a $\frac{7}{64}$ in. (2.8 mm.) outer belt, and the thickness of the lead will be $\frac{9}{64}$ in. (3.6 mm.). The over-all diameter will be about 2.95 in. (7.5 cm.), so that it can be installed in a $3\frac{1}{2}$-in. (8.9-cm.) duct.

In regard to the crystallization of lead sheath it was declared that there is a direct relation between vibration and crystallization of the lead. Possibly crystallization has been caused by localized impurities or by lead becoming too cold in the die, although these points have not been definitely determined.

On standardization of cable ratings, some work has been done by the sub-committee and further investigations are in progress. There is a very evident lack of agreement as to the maximum permissible operating temperatures of paper-insulated cables, the committee reports. It may be possible, however, to prepare a tentative rating to show the permissible current for various maximum temperatures and then leave it to the user to determine the maximum temperature for his own cables.

INSTRUMENTS AND MEASUREMENTS

Makers of watt-hour meters and demand meters have expended most of their effort during the past year in restoring pre-war quality of output, so that there has not been much development in instruments, according to the report of F. V. Magalhaes, chairman of the instrument and measurement committee. In the development work that has been conducted the principal attention has been directed toward apparatus for measurement of either kilovolt-amperes or the inductive component to be used in connection with rates, including power-factor charges. Makers of precision and recording instruments report the continued development and application of electrical measuring methods and instruments for recording and for the quantitative control of industrial processes. The definition of power factor in polyphase circuits which was being actively considered last year is in the hands of the standards committee.

MARINE PRACTICE

Eight meetings of the marine committee, Arthur Parker, chairman, were held during the year, and sub-committees were appointed on American standards, appliances, editing, propulsion and auxiliaries. The final revision and passing of the recommended practice for electrical installations on shipboard has been completed and published by the Institute. A mass of information was collected dealing with the historical side of electric ship propulsion and electrical installations on shipboard.

MINES

Automatic substations for mine service constitute one of the most important developments during the past year, the mines committee, Graham Bright chairman, reported. One plant has been in successful operation for several months and several more are being built. In the future the automatic substation will play a very important part in mine installations. The committee asserted its belief that the synchronous converter is becoming more popular each year for mine service, owing largely to the improvement in converter design which makes this apparatus as strong and simple to operate as the motor-generator set.

The electric hoist is rapidly replacing the steam hoist, wound-rotor induction motors with the magnetic type of control being used extensively. Development and application of magnetic control to mine locomotives has continued because the control has greatly simplified the tandem operation.

In metal mining one of the recent improvements has been the application of motor-driven turbo-blowers to cupolas, converters and flotation cells. These blowers require high-speed synchronous motors. Electric power is also gradually replacing steam on shovels and drag

lines where it is available. Car dumpers are said to be increasing in size from year to year, the largest car dumper yet constructed having been placed in operation recently at Baltimore.

The latest type of locomotive for quenching service in by-product coke-oven plants is equipped with electro-pneumatic control having not only automatic acceleration but also the ability to operate on any notch. It is believed that there will be a considerable call for the remote control of locomotives and cars in the future, not only around coke plants, but also where large amounts of materials are to be handled over fairly great distances.

Iron and Steel

Much progress has been made in the most recent installations of reversing-mill drives and of adjustable-speed equipment for the lighter finishing mills. Control equipment of all kinds shows marked tendencies toward simplification, according to the committee on the iron and steel industry, of which W. F. James was chairman. In common with all industry, the iron and steel plants in many parts of the country will, on resumption of business, be confronted with the power problem, and much attention is being directed toward the development of dependable low-cost sources of electrical energy. Yard electrification is also being studied.

Power Stations

Considerable progress has been made in the designs of large power stations such as the Colfax power station in Pittsburgh, the Hell Gate station in New York City, the Delaware station in Philadelphia and the Calumet station in Chicago, according to the report of the power station committee, of which H. P. Liversidge is chairman. In the use of auxiliaries there is a decided trend toward electric drive. A number of improvements in design, construction and operation of turbines have been made, in which a more careful selection of material, closer inspection and improved testing facilities have been an important factor.

Operating reports during the year demonstrate the value and the greatly extended use of the oil conservator with large and high-voltage transformers, and there is a decided tendency toward simplification in station layout and details of design. Complicated switching connections to take care of possible contingencies have been replaced by simpler layouts, resulting in reduced costs and marked reduction in operating troubles. A radical departure in the arrangement of buses and switch-house connections is incorporated in the designs of the new Calumet station of the Commonwealth Edison Company, Chicago, and the Hell Gate station of the New York Edison Company. The principle is to separate the phases of each circuit, putting them into what are virtually separate rooms.

The most important development in oil circuit breakers has been in the extremely heavy-duty type. The latest designs are for units having a rupturing capacity approximately twice that of any previous breakers constructed, or 58,000 arc-amperes at 15,000 volts.

Changes in the design and application of reactors are said to have made these more satisfactory for present service conditions. Several companies have during the last few years prepared detailed operating instructions for their operating and maintenance attendants covering the operation of transmission and station equipment. Concluding the report there is a very complete bibliography of important articles on power-station design and operation which have appeared recently in American and foreign technical journals.

Industrial and Domestic Power

Considerable advance has been made by the incorporation of safety features in both motor and control appliances, especially the latter, A. G. Pierce, chairman of the industrial and domestic power committee, asserted in his report. The use of 50-deg. motors as compared with those of the older 40-deg. ratings has increased, and there is evidence of much more accurate study of the power required to drive machinery and a closer selection of the motors to do the work. During the past year a record was made in the number of electric main-roll drives put into service in steel mills, and improvement has been shown in the accuracy and speed of control provided and especially in the magnetic types.

An interesting development in the application of individual drive to a series of machines for starching and drying cloth in textile mills is reported. Three independent rolls, each driven by an individual motor, were tied together by automatic-control equipment that insures the same speed of the fabric throughout the three machines. A new form of sectionalized motor drive for paper machines has been developed, each section being driven by an independent motor, the speed of which with relation to the speed of the other sections may be regulated to suit the requirements and when once adjusted will retain this relationship as positively as though geared together. A unique installation in the lumbering industry consists of a combined outfit of electrically operated yard and loader hoists.

Telegraphy and Telephony

Important progress has been made within the past year in telegraph and telephone departments of railroads, Donald McNicol, chairman of the telegraphy and telephony committee, reported. Considerable advance has also been made in protecting against lightning disturbances, inductive interference and electrolysis. The application of automatic printing telegraph systems to commercial requirements is being extended, a noticeable tendency being the gradual standardization of apparatus and of methods. The problem of inductive-interference control and reduction is now recognized to be of mutual concern. The trend is clearly toward co-operative study and treatment. In radio communication there has been a reorganization of ownership and of the important patent rights which should relieve a very complicated situation and result in placing in use equipment superior to that heretofore employed. Trans-oceanic service has been further improved with a resulting increase in the volume of traffic handled and in the quality of service rendered.

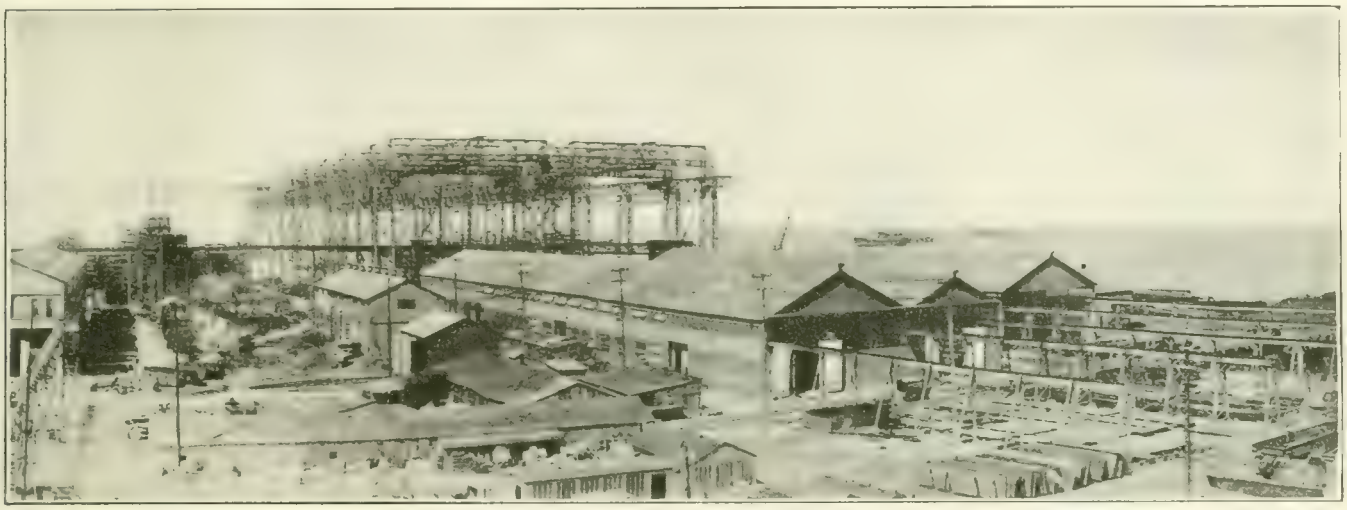
In radio telephony development has been in the direction of the application of the three-electrode tube to service as an amplifier delivering comparatively large power or to the problem of supplying radio service of a commercial character in connection with existing wire lines. Radio-telephone toll service is now in commercial operation, furnishing service between the island of Santa Catalina and the wire network of the mainland.

Technical Education

The most noteworthy movement in technical education is greatly to increase investigational and research work in the colleges, according to the report of Prof. C. E. Magnusson, chairman of the educational committee.

The Industrial Load in the Southern States

Industrial Plants of This Section of the Nation Have Adopted Electric Service to a Marked Extent During the Past Decade—Seventy-five per Cent of the Electrical Energy Consumed Is Purchased from Central Station Systems



A PORTION OF THE YARDS OF THE NEWPORT NEWS SHIPBUILDING & DRY DOCK COMPANY, WHERE ELECTRIC SERVICE FINDS A WIDE APPLICATION

DURING the past decade the Southern States have made rapid strides in the use of electric service in all industrial processes. In 1914 the connected industrial load of the central generating stations of the South Atlantic and South Central States, exclusive of the lighting load, was only 572,900 hp. In the five succeeding years this load increased 121 per cent, or to 1,264,700 hp. The increase in the electrical energy sold to power customers by the central generating stations during this period was even more marked, increasing from 644,900,000 kw.-hr. in 1914 to 2,840,900,000 kw.-hr. in 1919, or 341 per cent. No statistics are available as to the increase in the operation of private generating plants in the Southern States during the same period.

General data are limited in value and must be supplemented by detailed statistics on the subjects making up the total. With this end in view the ELECTRICAL WORLD initiated a detailed country-wide survey to ascertain the extent to which electrical energy is now being used by the various industries of the nation. The investigation of the industries of California was completed last summer, and a detailed analysis of the industrial load in California appeared in the Aug. 28, 1920, issue of the ELECTRICAL WORLD.

The survey of the industries of the South includes the States of Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Tennessee and Kentucky. About 8,500 questionnaires were sent out to the industrial plants in these states and 2,824 replies were received, of which 1,068 reported the use of electrical energy as the main source of power. The details of the results obtained from the survey are presented in Table I. Probably one of the most interesting portions of that tabulation is the section showing the source of electrical energy used by the companies reporting. The 1,068 plants using electrical energy reported private generators totaling 182,800 hp., which produced a total of 327,965,700 kw.-hr. during 1919. The electrical energy purchased by the plants reporting was only 478,450,627 kw.-hr. It should be pointed out in this connection that about 56 per cent of the industries generating all or a portion of their own electrical energy replied to the questionnaire sent out, while reports were received from only 32 per cent of the industries which purchased their electrical energy. On this basis the indications are that about one-fourth of the electrical energy used by the industrial plants of the South is still generated in private generating stations.

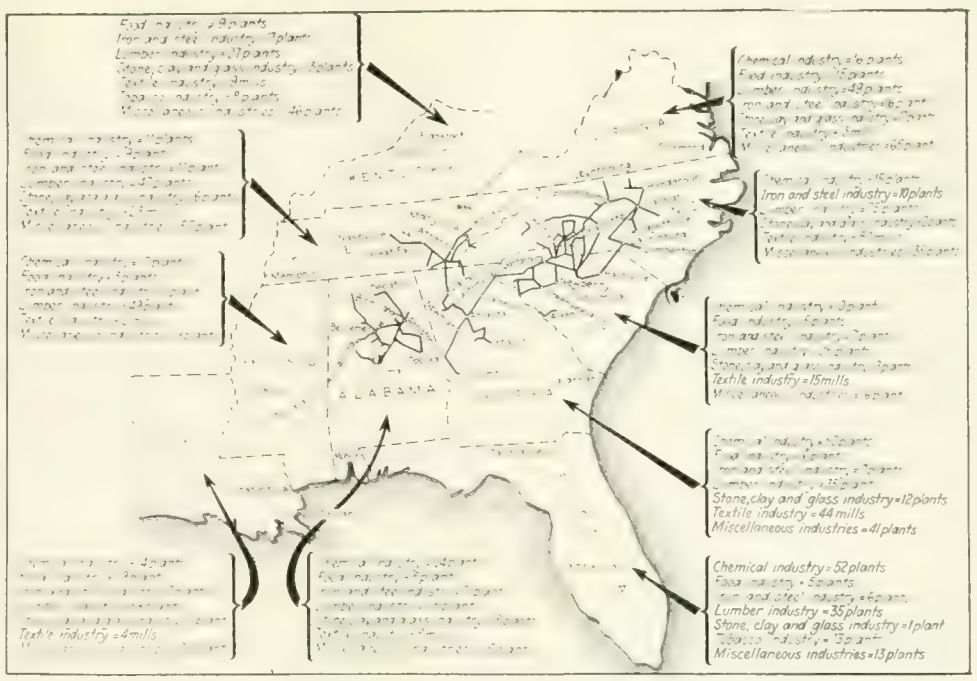
In the promotion of the electrical industry in the South certain of the electrical distributing companies offered special industrial power contracts in which the nature of the special service offered and the penalties for service interruptions were defined. Two classes of service were offered, namely, contracts for primary power and contracts for secondary power. One of the larger distributing companies defines "primary power" as meaning "such energy as the company agrees to furnish and supply every day in the year between the hours of 6 a.m. and 6 p.m., except when prevented by certain specified causes." "Secondary power" is defined as "such energy as the company agrees to furnish and supply eight months out of each consecutive twelve-month period of this agreement, and is such energy as the company reserves to itself the right to shut off and discontinue the supply thereof, by giving the customer twenty-four hours' notice of its intention to discontinue the supply, and being such energy as the customer agrees to resume the use of within twenty-four hours after the receipt by it of notice from the company that the company is ready to supply and furnish said energy to the customer, provided that the company shall not shut off and discontinue such supply during an agreement period of more than four months in each consecutive twelve-month period of this agree-

Table I — Segregation of the Industrial Load in the Southern States

These data are compiled from an industrial survey being conducted by the McGraw-Hill Company, Inc., under the supervision of the Editorial Departments of the ELECTRICAL WORLD and *Power*, and cover plants in all industries employing over fifty operatives.

State and Industry	Summary of Returns Received in Industrial Survey of the Use of Electrical Energy in Southern Industries													"Electrical World" Estimate of the Total Electrical Energy Used in Southern Industries (Based on Survey and Census Data)							
	Companies Reporting		Electric Generators				Electrical Energy		Motors Installed			Distribution of Drives			Electrical Energy		Motors Installed			Distribution of Drives		
			Direct-Current		Alternating-Current																	
	Total Number	Number Using Electrical Energy	Number	Total Rating, Hp.	Number	Total Rating, Hp.	Generated Kw.-Hr.	Purchased Kw.-Hr.	Number	Total Rating, Hp.	Number Under 5-Hp.	Belt	Chain	Direct or Geared	Generated Kw.-Hr.	Purchased Kw.-Hr.	Number	Total Rating, Hp.	Number Under 5-Hp.	Belt	Chain	Direct or Geared
Virginia and North Carolina:																						
Chemicals and allied products	67	38	12	1,387	1	550	1,546,300	6,476,265	413	8,807	163	280	8	125	2,543,000	22,300,000	1,200	27,590	473	812	16	372
Food and kindred product	128	64	3	33	3	78	164,207	2,899,605	241	4,136	142	146	20	75	740,000	19,730,000	1,610	27,670	948	975	134	501
Iron and steel, and their products	60	45	13	4,086	1	25	5,768,424	36,419,633	2,777	58,036	321	1,655	44	1,078	7,000,000	37,850,000	2,960	61,830	342	1,764	48	1,148
Lumber and its products	94	27	12	1,240	6	5,015	35,545,400	8,745,220	429	13,266	54	306	13	110	40,000,000	54,500,000	930	28,430	117	662	30	238
Metals and metal products other than iron and steel	17	10	2	350	1	750	3,050,000	30,112,900	543	50,271	66	142	7	394	3,675,000	45,700,000	810	75,000	99	212	11	587
Paper and printing	16	10	7	385	0	0	4,540	864,754	109	1,698	77	101	1	7	2,795,000	4,640,000	910	14,140	642	843	9	58
Stone, clay and glass	33	26	8	364	3	1,600	7,348,620	1,435,589	164	6,856	34	83	3	78	9,000,000	9,110,000	340	14,140	71	172	6	162
Textiles	231	141	20	3,083	50	14,797	31,808,773	64,831,879	17,259	90,451	14,985	4,690	1,569	11,000	40,000,000	234,000,000	49,100	256,600	42,600	13,320	4,480	31,300
Tobacco manufactures	11	6	3	230	5	950	1,977,000	747,000	154	1,663	16	84	31	39	7,750,000	3,160,000	620	6,660	65	338	125	157
Miscellaneous	200	30	7	1,259	4	900	1,582,500	1,468,969	280	3,473	124	226	3	51	25,100,000	31,950,000	5,230	64,890	2,315	4,225	52	953
Totals for Virginia and North Carolina	855	398	87	12,408	74	24,665	88,795,784	154,001,814	22,369	238,657	15,982	7,713	1,699	12,957	138,603,000	462,940,000	63,710	576,950	47,672	23,323	4,911	35,476
South Carolina and Georgia																						
Chemicals and allied products	204	51	13	201	7	1,800	5,276,000	20,180,740	638	22,354	137	499	16	123	5,500,000	36,400,000	1,040	36,480	223	812	28	200
Food and kindred product	140	31	4	455	0	0	1,697,700	5,884,800	241	1,521	110	188	12	41	1,750,000	17,430,000	1,300	8,210	592	1,012	77	211
Iron and steel, and their products	64	37	15	15,606	6	3,702	8,768,900	6,952,351	826	21,709	206	414	15	397	13,980,000	11,270,000	1,330	34,880	332	665	27	638
Lumber and its products	76	15	2	464	5	2,117	441,000	1,508,160	208	4,772	30	167	0	41	2,068,000	2,020,000	440	10,010	63	353	0	87
Metals and metal products other than iron and steel	7	5	0	0	1	168	1,834,000	946,000	44	1,035	8	41	2	1	2,000,000	19,220,000	180	4,170	33	168	8	4
Paper and printing	4	3	0	0	2	800	2,000,000	5,250,000	60	3,447	5	45	0	15	2,465,000	8,280,000	90	5,120	8	68	0	22
Stone, clay and glass	33	14	1	75	4	1,625	7,528,250	844,718	114	4,506	21	102	0	11	6,000,000	12,000,000	250	9,680	46	224		26
Textiles	202	110	27	1,753	41	24,190	69,319,817	109,776,169	4,551	76,454	1,492	2,234	963	1,354	89,800,000	231,000,000	8,350	140,530	2,736	4,100	1,768	2,482
Tobacco manufactures	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,800	1	5	0	1	0	0
Miscellaneous	218	5	1	75	2	150	46,000	269,820	55	857	18	47	5	4	1,634,000	4,310,000	1,030	16,130	336	879	80	71
Totals for South Carolina and Georgia	948	271	63	18,629	68	34,552	96,911,667	151,612,958	6,737	136,655	2,027	3,737	1,013	1,987	123,197,000	371,936,800	14,011	265,215	4,369	8,282	1,988	3,741
Florida and Alabama:																						
Chemicals and allied products	63	25	8	421	7	1,363	1,575,250	2,413,358	159	5,542	75	125	8	26	1,820,000	16,550,000	730	25,440	344	575	46	109
Food and kindred products	37	16	0	0	0	0	0	2,189,100	133	1,745	85	81	5	47	1,670,000	23,750,000	1,540	20,250	984	938	59	543
Iron and steel, and their products	46	27	11	3,950	2	185	10,193,000	25,840,468	876	29,740	248	370	13	493	20,500,000	88,750,000	2,350	80,010	667	996	24	1,330
Lumber and its products	82	14	6	250	3	2,155	931,000	406,530	143	2,790	23	71	3	69	2,053,000	5,670,000	830	16,110	133	412	17	401
Metals and metal products other than iron and steel	34	14	4	280	5	7,850	3,489,000	5,662,000	335	10,474	151	114	25	196	4,000,000	21,320,000	820	25,600	370	279	61	480
Paper and printing	4	2	0	0	0	0	0	63,000	12	25	10	9	0	3	4,000	9,280,000	650	16,490	314	488	0	162
Stone, clay and glass	17	9	1	7	0	0	6,000	1,583,500	38	1,425	0	28	0	10	4,800,000	32,100,000	880	33,030	132	648	0	232
Textiles	48	29	9	2,520	10	5,605	20,173,360	31,379,435	1,892	16,146	1,310	446	46	1,400	24,310,000	97,400,000	3,990	34,010	2,760	940	100	2,950
Tobacco manufactures	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	489,000	30	320	6	18	4	8
Miscellaneous	4	3	3	615	1	180	1,005,000	174,000	42	844	7	33	0	9	29,000,000	101,000,000	7,330	92,960	2,475	5,760	0	1,570
Totals for Florida and Alabama	335	139	42	8,043	28	17,338	37,372,610	69,711,391	3,630	68,731	1,909	1,277	100	2,253	88,157,000	396,309,000	19,150	344,220	8,185	11,054	311	7,785
Mississippi and Louisiana:																						
Chemicals and allied products	58	6	7	288	12	4,320	18,600,000	145,300	111	6,023	32	25	3	80	23,330,000	23,800,000	290	15,470	84	65	16	209
Food and kindred products	54	11	17	381	9	2,357	18,423,040	553,121	728	20,836	158	469	29	230	21,130,000	7,380,000	1,090	31,300	236	702	44	344
Iron and steel and their products	16	5	4	393	0	0	1,311,200	1,325,000	320	4,682	125	208	7	105	1,432,000	2,560,000	480	7,106	191	318	11	161
Lumber and its products	146	29	17	1,335	14	5,764	16,173,030	1,307,967	584	7,579	136	376	9	199	56,900,000	8,200,000	2,170	28,230	505	1,397	33	740
Metals and metal products other than iron and steel	5	2	3	375	0	0	216,000	18,000	75	541	3	74	0	1	221,000	268,000	160	1,129	6	158	0	2
Paper and printing	5	3	0	0	0	0	0	474,700	40	437	15	39	0	1	3,000	3,630,000	310	3,353	116	302		8
Stone, clay and glass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45,000	663,000	12	519	2	8	1	3
Textiles	26	9	0	0	3	500	3,200,000	8,769,000	148	3,548	35	106	4	38	6,180,000	9,220,000	191	4,578	45	137	5	49
Tobacco manufactures	2	2	1	76	0	0	3,300	10,400	11	37	8	4	3	4	3,300	10,400	11	37	8	4	3	4
Miscellaneous	18	0	0	0	0	0	0	0	0	0	0	0	0	0	8,930,000	10,720,000	1,630	20,605	550	1,204	188	238
Totals for Mississippi and Louisiana	330	67	49	2,848	38	12,941	57,926,570	12,603,488	2,017	43,683	512	1,301	55	658	118,174,300	66,451,400	6,354	112,327	1,743	4,295	301	1,758
Tennessee and Kentucky:																						
Chemicals and allied products	25	15	22	1,125	5	1,364	1,862,100	2,603,318	205	5,441	52	132	5	68	1,395,000	5,510,000	320	8,397	81	206	8	106
Food and kindred products	43	27	16	1,774	3	280	843,550	3,576,595	524	3,393	236	324	24	186	2,980,000	17,485,000	2,420	15,659	1,090	1,495	67	858

Iron and steel, and their products	65	411	36	7,010	9	18,251	10,313,973	22,150,006	1,982	25,444	406	870	37	1,075	20,250,000	30,400,000	3,090	39,748	633	1,355	60	1,675
Lumber and its products	65	12	4	600	3	155	265,200	416,585	277	1,653	73	228	15	34	2,525,000	4,620,000	2,920	17,414	770	2,400	102	358
Metals and metal products other than iron and steel	27	18	16	2,977	9	8,750	23,447,407	41,440,300	1,300	40,250	225	480	3	817	37,200,000	92,622,000	2,600	80,600	450	960	6	1,634
Paper and printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57,000	6,980,000	543	13,771	263	477	2	64
Stone, clay and glass	11	4	4	3,250	2	300	5,459,740	1,195,260	120	5,770	12	115	0	14	2,100,000	7,670,000	190	8,468	18	170	0	20
Textiles	73	59	10	801	15	2,050	1,512,652	17,281,305	1,772	14,428	353	720	402	150	2,940,000	33,600,000	2,483	28,180	688	1,401	787	292
Tobacco manufactures	7	3	0	0	1	150	364,100	120,150	51	438	16	38	0	13	632,000	923,000	160	1,408	50	119	0	41
Miscellaneous	40	14	13	2,150	5	400	2,892,367	1,757,387	382	4,441	107	255	80	47	23,450,000	49,000,000	6,000	69,751	1,682	4,000	1,262	738
Totals for Tennessee and Kentucky	356	193	121	19,687	52	31,689	46,959,069	90,520,976	6,122	101,258	1,480	3,162	566	2,404	93,529,000	248,810,000	20,723	283,396	5,725	12,583	2,354	5,786
Totals for the Ten Southern States:																						
Chemicals and allied products	417	135	62	3,422	32	9,397	28,859,650	31,818,981	1,526	48,167	459	1,061	40	422	34,588,000	104,560,000	3,580	113,377	1,205	2,470	114	996
Food and kindred products	402	149	40	2,643	15	2,715	21,128,497	15,103,221	1,867	31,631	731	1,208	90	579	28,270,000	85,275,000	2,190	103,089	3,850	5,122	381	2,457
Iron and steel, and their products	251	156	79	31,045	18	22,163	36,355,497	92,687,458	6,781	139,611	1,306	3,517	116	3,148	63,162,000	170,830,000	8,200	223,574	2,165	5,098	170	4,952
Lumber and its products	463	97	41	3,889	31	15,186	53,353,630	12,384,462	1,041	30,060	316	1,148	40	453	103,546,000	75,010,000	7,290	100,194	1,588	5,224	242	1,824
Metals and metal products other than iron and steel	90	49	25	3,982	16	17,518	32,036,407	78,179,200	2,297	102,571	453	851	37	1,409	37,200,000	179,130,000	4,570	186,499	958	1,777	86	2,707
Paper and printing	28	18	7	385	2	800	2,004,560	6,652,454	221	5,607	107	194	1	26	5,324,000	32,810,000	2,503	52,874	1,343	2,178	11	314
Stone, clay and glass	94	53	14	3,696	9	3,525	20,342,610	5,059,067	445	18,557	67	328	3	113	21,945,000	61,543,000	1,672	65,837	2,9	1,222	125	443
Textiles	580	348	66	8,157	119	47,151	126,014,582	232,038,078	25,122	201,027	18,175	8,196	2,984	13,942	161,230,000	635,220,000	64,111	463,898	48,829	19,898	7,140	37,073
Tobacco manufactures	19	11	4	306	6	1,100	2,344,400	877,530	216	2,138	40	126	34	56	8,385,300	45,892,000	822	8,430	129	480	132	210
Miscellaneous	480	52	24	4,090	12	1,630	5,525,867	3,650,176	759	9,615	256	561	88	111	88,114,000	196,980,000	21,220	264,336	7,358	16,068	1,582	3,570
TOTALS	2,824	1,068	362	61,615	260	121,185	327,965,700	478,450,627	40,875	588,984	21,910	17,190	3,433	20,259	561,660,300	1,546,447,200	123,948	1,582,108	67,694	59,537	9,865	54,546



DISTRIBUTION OF THE SOUTH'S INDUSTRIAL PLANTS EMPLOYING MORE THAN FIFTY OPERATIVES EACH, SHOWING THE LOCATION OF THE HIGH-TENSION TRANSMISSION LINES FROM WHICH THEY ARE SERVED

ment." The "secondary power contract" was especially adapted to plants requiring a certainty of uninterrupted twenty-four-hour service, and some of these contracts are still in force. The accompanying map, besides indicating the number of industrial plants employing more than fifty operatives each in each state, also shows the location of the high-tension transmission lines of the central generating stations of the Southern States. It is noticeable that only a small portion of the South is at present covered by these transmission systems, leaving wide areas which are not able to obtain central-station service unless in close proximity to a city or town having a local generating plant. The reason for the relatively large number of private electric generating plants still operated in the Southern States is, therefore, evident from this map. Table II gives data on the prime movers installed in the industrial plants of the companies reporting. It must not be assumed that all these prime movers are used in connection with electric generators in private power plants. Companies that are not using electrical energy for power purposes at all, and others using steam power as an auxiliary to electrical energy, made reports of prime movers installed, and these are included in this tabulation.

There are nine primary industries in the South as follows: Food and kindred products, this classification including beverages; textiles; iron and steel and their products, under which are also included railroad repair shops and steel shipbuilding; lumber and its manufactures; paper and printing; chemicals and allied products; stone, clay and glass; metals and metal products other than iron or steel, including mining, and tobacco manufactures. Other less important industries, such as leather and its finished products and vehicles for land transportation, have been included under miscellaneous industries.

Lumber Industry.—Probably the leader of the primary industries of the South is lumber production and the products of lumber. Every state reported extensive use of electrical service in the mills of this industry. The amount of electrical energy consumed annually by the lumber industry of the Southern States is estimated at almost 180,000,000 kw.-hr., of which about 58 per cent is generated in private generating plants. The generation of a large proportion of electrical energy by the private generating plants of the lumber companies is almost universal. This is to be expected on account of their isolation and the accumulation of waste that is used as fuel for boilers. Careful study has been given in recent years to the possible applications of electrical energy to virtually every branch of the lumber industry, and not only is almost every new mill now erected being electrified throughout, but also in many mills steam-driven line shafts are slowly giving way to electric drives for many operations. Both squirrel-cage and wound-rotor alternating-

current motors are used in the lumber industry, the voltage varying from 220 to 550, with a few 2,200-volt motor installations. It is estimated that 7,290 motors, with a total rating of 100,194 hp., are now in use by the lumber industry of the South; of which 1,588 are under five horsepower. About 72 per cent of the machines are belt-driven, 25 per cent are directly connected and only 3 per cent are chain-driven.

The principal machines in the lumber industry operated by electric motors are conveyors, planers, saws, molders, grinders, lathes, shapers, presses, drills, air compressors, cranes, pumps, dryers, fans, slashers, sizers, edgers, jointers and sorting tables.

Textile Industry.—The textile industry is by far the largest user of electrical service among the industries of the South. It is estimated that this industry consumed about 796,450,000 kw.-hr. of electrical energy in 1919, of which about one-fifth was generated in private plants. The large amount of energy generated in private plants appears to be the result of inability to obtain central-station energy owing to the isolation of the mill or the operation of an existing power plant for a part of the energy used and the purchase of the additional amount required. Very few textile mills are now installing their own generating plants if they are within reach of central generating-station service.

TABLE II—PRIME MOVERS IN THE INDUSTRIAL PLANTS OF THE SOUTHERN STATES

State and Industry	Companies Reporting		Waterwheels		Internal Combustion Engines		Steam Engines		Steam Turbines	
	Total Number	Number Using Electrical Energy	Number	Rating, Hp.	Number	Rating, Hp.	Number	Rating, Hp.	Number	Rating, Hp.
Virginia and North Carolina:										
Chemicals and allied products	67	38	1	600	1	70	23	4,045	0	0
Textiles	231	141	110	12,036	1	85	38	13,809	16	27,417
Iron and steel and products	60	46	1	250	0	0	13	1,807	1	260
Lumber and its products	94	27	0	0	0	0	34	8,130	2	2,500
Paper and printing	15	10	1	300	2	250	3	675	0	0
Food and kindred products	128	64	4	86	1	300	19	638	1	100
Stone, clay and glass	33	26	0	0	0	0	16	5,390	3	2,450
Tobacco manufactures	10	6	0	0	0	0	10	1,825	0	0
Metal and metal products other than iron and steel	17	10	0	0	8	893	5	450	1	600
Miscellaneous	200	30	0	0	0	0	25	4,260	1	167
Totals for Virginia and North Carolina	855	398	117	13,272	13	1,598	186	41,029	25	33,494
South Carolina and Georgia:										
Chemicals and allied products	204	51	2	250	0	0	17	3,145	7	3,000
Food and kindred products	140	31	0	0	3	23	19	2,200	0	0
Iron and steel and products	64	37	5	1,400	5	70	12	1,918	5	3,450
Lumber and its products	76	15	0	0	0	0	16	2,775	3	3,750
Metal and metal products other than iron and steel	7	5	0	0	0	0	1	225	0	0
Paper and printing	4	3	3	300	0	0	3	1,150	0	0
Stone, clay and glass	33	14	0	0	0	0	4	2,500	0	0
Textiles	202	110	56	26,629	0	0	65	39,245	19	11,340
Tobacco manufactures	0	0	0	0	0	0	0	0	0	0
Miscellaneous	218	5	0	0	2	150	1	100	0	0
Totals for South Carolina and Georgia	948	271	66	28,579	10	243	138	53,258	34	21,540
Florida and Alabama:										
Chemicals and allied products	63	25	0	0	2	200	17	3,100	0	0
Food and kindred products	37	13	0	0	0	0	5	441	0	0
Iron and steel and products	46	27	0	0	0	0	17	6,185	1	300
Lumber and its products	82	14	0	0	0	0	14	1,950	1	1,000
Metal and metal products other than iron and steel	34	14	0	0	0	0	5	830	3	500
Paper and printing	4	2	0	0	0	0	0	0	0	0
Stone, clay and glass	17	9	0	0	0	0	7	170	0	0
Textiles	48	29	20	7,350	0	0	13	12,415	8	7,466
Tobacco manufactures	0	0	0	0	0	0	0	0	0	0
Miscellaneous	4	3	0	0	0	0	0	0	4	972
Totals for Florida and Alabama	335	139	20	7,350	2	200	78	25,091	17	10,238
Mississippi and Louisiana:										
Chemicals and allied products	58	6	0	0	5	4,200	16	2,341	1	1,250
Food and kindred products	54	11	0	0	0	0	33	8,770	6	9,225
Iron and steel and products	16	5	0	0	0	0	6	540	0	0
Lumber and its products	146	29	0	0	12	84	81	14,588	6	5,700
Metal and metal products other than iron and steel	5	2	0	0	0	0	3	675	0	0
Paper and printing	5	3	0	0	0	0	2	125	0	0
Stone, clay and glass	0	0	0	0	0	0	0	0	0	0
Textiles	26	9	0	0	0	0	0	0	0	0
Tobacco manufactures	2	2	0	0	0	0	1	45	0	0
Miscellaneous	18	0	0	0	0	0	0	0	0	0
Totals for Mississippi and Louisiana	330	67	0	0	17	4,284	142	27,084	13	16,175
Tennessee and Kentucky:										
Chemicals and allied products	25	15	0	0	0	0	26	4,412	10	2,405
Food and kindred products	43	27	3	86	1	25	38	3,146	0	0
Iron and steel and products	65	41	0	0	0	0	73	11,885	6	5,093
Lumber and its products	65	12	0	0	0	0	9	1,478	0	0
Metal and metal products other than iron and steel	27	18	0	0	4	30	47	7,665	8	11,183
Paper and printing	0	0	0	0	0	0	0	0	0	0
Stone, clay and glass	11	4	0	0	4	250	4	1,650	3	2,802
Textiles	73	59	5	540	0	0	36	9,438	0	0
Tobacco manufactures	7	3	0	0	0	0	2	400	0	0
Miscellaneous	40	14	0	0	0	0	25	4,710	1	60
Totals for Tennessee and Kentucky	356	193	8	626	9	305	260	44,784	28	21,543
Totals for the ten Southern States:										
Chemicals and allied products	417	135	3	850	8	4,470	99	17,043	18	6,655
Food and kindred products	402	149	7	172	5	348	114	15,195	7	9,325
Iron and steel and products	251	155	6	1,650	5	70	121	22,335	13	9,103
Lumber and its products	463	97	0	0	12	84	154	28,921	12	12,950
Metal and metal products other than iron and steel	90	49	0	0	12	923	61	9,845	12	12,283
Paper and printing	28	18	4	600	2	250	8	1,950	0	0
Stone, clay and glass	94	53	0	0	4	250	31	9,710	6	5,252
Textiles	580	348	191	46,555	1	85	152	74,907	43	46,223
Tobacco manufactures	19	11	0	0	0	0	13	2,270	0	0
Miscellaneous	480	52	0	0	2	150	51	9,070	6	1,199
Totals	2,824	1,068	211	49,827	51	6,630	804	191,246	117	103,890

About 90 per cent of the motors now installed in this industry are of the squirrel-cage type. The voltage used varies over wide ranges, including 110, 220, 250, 440, 550, 600 and 2,200 volts. The size of the largest motors in textile mills varies from 1 hp. to 250 hp. with the smallest ranging from $\frac{1}{20}$ hp. to 3 hp. It is estimated that 64,111 motors are installed in the textile mills of the South, with a total rating of about 463,898 hp., and that 48,829, or more than three-fourths of these motors, are under 5 hp.

Chemical Industry.—Every Southern state reports extensive electrical operation in the chemical industry and its allied products. It is estimated that this industry consumed 139,148,000 kw.-hr. in 1919, of which 34,588,000 kw.-hr., or 24 per cent, was generated in private plants. This industry includes the making of dyes, potash, phosphates, gunpowder and all its derivitives, nitrates, chlorine, soda alkali products, acids and drugs and extracts of all kinds. The squirrel-cage motor is in general use in the chemical industry, with the wound-rotor motor used for variable-speed operations. The estimated number of motors in use in the chemical industry of the Southern States is 3,580, with a total rating of 113,377 hp. About 69 per cent of the machinery in use is belt-driven, 28 per cent is directly connected and only 3 per cent is chain-driven.

Metal Industry.—Metals and metal products other than iron and steel, which subdivision also includes mining of all kinds, are of large importance in certain of the Southern states, especially in Tennessee, Kentucky, Virginia and Florida. The motors used in the mining industry are as a rule of large rating, which accounts for the fact that the average rating of the motors reported by it is over 40 hp. and but one-fifth of the motors are under 5 hp.

Over 233,000,000 kw.-hr. of electrical energy is consumed annually by the iron and steel industries of the South. The motors, which are mostly belt-connected, are estimated to total 8,200, with an aggregate rating of 223,574 hp., and only about one-fourth are below 5 hp.

It would appear from a study both of the figures obtained from the survey and of the latest census figures available that the South is only in its infancy, electrically speaking. Great strides have been made during the past decade, but even a greater rate of growth may be expected as transmission systems are extended into the now insolated districts.

Factors Affecting Long-Distance Bulk-Power Transmission

Voltage Regulation of 220-Kv. Lines Can Be Insured by Proper Distribution of Synchronous Condensers—Several Promising Methods of Minimizing Insulator Destruction from Flashover—Necessity of Uniform Voltage Along the Line

SINCE a very large amount of power (100,000 kw. to 200,000 kw.) can be transmitted as far as 1,000 miles over one circuit at 220,000 volts, it is questionable whether any higher voltages will be required for national transmission systems, according to the paper which Frank G. Baum* presented this week at Salt Lake City before the American Institute of Electrical Engineers. This is particularly true because very large systems would demand at least two towers with four circuits to assure continuity of service. The speaker went on to say that so far as restrictions are concerned higher voltages might be adopted, but the economic limitations may be reached with 220,000 volts, when the value of standardization, the service insurance of multiple circuits, the amounts of power available at certain places and the demand of a given market are considered. If 220,000, 110,000 and 55,000 volts could be generally adopted, auto-transformation might be used economically. The frequency for such a standardized national electric power system should be 60 cycles, since this is generally advantageous for generation, transformation and distribution. Although it has generally been assumed that this frequency is disadvantageous for long transmission lines on account of voltage regulation, experience has shown that all requirements can be successfully met.

The insulation problem, Mr. Baum said, reduces itself to working to certain unit stresses, mechanical and electrical, and to the maintenance of certain factors of safety throughout the entire line structure, which includes insulators, towers, switches, transformers, etc. This factor of safety should be as permanent as possible, which means that the depreciation of the insulator should be virtually nil in service. This goal is being rapidly reached. While satisfactory potential distribution over insulator strings may be obtained at normal voltage by different methods of shielding or grading, further work along this line is desirable in order to crystallize the best methods into practical forms, so that the insulator manufacturers will be able to furnish the complete line-insulation equipment. Mr. Baum expressed the belief that 220,000-volt transmission is no more difficult than transmission at 110,000 volts or 175,000 volts, if due consideration be given to the unit air and leakage resistance stresses and if the insulation of the line is carried out sufficiently.

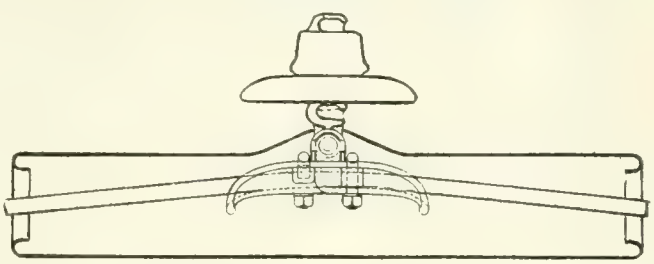


FIG. 1—AIR GRADIENT AT THE LINE END OF THE STRING IS IMPROVED BY A CYLINDRICAL SHIELD

For the successful operation of long transmission

*Consulting engineer, San Francisco.

lines it will be necessary to have virtually a uniform voltage along the line, not only for one load but for all loads. This voltage can be controlled within 3 per cent from no load to full load and with no greater variation for any points on the line. The standard transmission system must provide for power being supplied to the line and for loads to be taken off at certain points just as does a railway system. The system must be such that the power loads supplied to the line or taken from the line may vary, that the flow of power over sections may be actually reversed, or that the flow of power over the entire line may even be reversed without disturbing the voltage regulation necessary to give good service at all points.

By maintaining constant voltage along the line a number of troubles, such as voltage rise due to dropping loads, transformer variable ratios and voltage regulators, are abolished, and at the same time the insulation strain is reduced. Provision should be made for keeping the current and voltage virtually in phase at all points of the line. Mr. Baum pointed out that the 220,000-volt lines now being built are of extreme importance because of their effect on the transmission industry as a whole and on the practicable and is the only practical way of giving first-class service over long lines. Retransforming or regeneration schemes for long-distance transmission will not give such good service, and the shocks that come on the line are likely to be much greater than with the constant-potential system. Such a system of "loading" the transmission line to rotate the current through approximately the same angle as the pressure is rotated is comparable with the "loading" of long-distance telephones lines. This "loading" to maintain the current and voltage approximately in phase eliminates the question of the natural periodicity of the line, and hence the frequency may be selected independent of this point.

Such a system with say three or four circuits and synchronous condenser and switching stations every 100 miles to 150 miles (160 km. to 240 km.) may have automatic disconnection for any 100-mile section of each line without disturbing the service. Short circuits should be easily handled.

Since transformers can be designed so that increase of line voltage gives a very rapid increase of magnetizing current, they as well as the synchronous condensers will serve as auto-



FIG. 2—FLASHOVER TESTS SHOW THAT THE POTENTIAL OF THE UPPER THIRD OF INSULATOR STRINGS SHOULD BE INCREASED ABOVE THE AIR POTENTIAL TO PREVENT THE ARC FROM STRIKING IN AT THESE UNITS

A and *C*—Note the bowing-out of flux lines and breakdown to the upper units. *B*—Wet flashover of disk-insulator string with horn insulators having tinfoil caps. The combination effects a greatly improved electric field.

service that is given by the company erecting them.

A voltage regulation diagram for a 200-mile (320-km.), 220,000-volt line for 400 amp. was worked out in the paper. It was shown that without synchronous condensers the generator voltage would have to be 157 per cent of the receiver voltage for a load with a power factor of 0.95. At no load the generator voltage would be about 86 per cent if all charging current were carried by the generator. Even for non-inductive load the generator voltage at full load would have to be raised 36 per cent above the receiver voltage. Such a generator would be very expensive. Restricting the generator voltage increase to 10 per cent to make up the dissipated energy on the line requires synchronous condensers of about 80,000 kva. at full load, but about one-half this amount is required to correct the power factor of the load. It is thus shown that it is impossible to transmit power over long distances and give satisfactory service without synchronous condensers.

Such a system of constant-potential transmission is

matic magnetic brakes against increases in voltage. Corona loss, increasing with voltage if size of wire is chosen near the corona point, will also automatically act against increases of speed and voltage.

In dealing with the insulation of transmission lines the following points must have consideration:

1. The air insulation strength.
2. The porcelain insulation and mechanical strength.
3. The voltage distribution.
4. The leakage resistance gradient over the surface of the insulators.
5. Insulation of switches, transformers, etc.
6. Wet and dry arc-over of line insulation.

F. W. Peek, Jr., has shown that it requires only about 3 in. (7.6 cm.) of air between 10-in. (25.4-cm.) spheres to prevent breakdown for 130,000 volts to ground, it was pointed out, which is about the voltage to ground for a 220,000-volt line. More than 6 ft. (1.8 m.) from wire to ground at the towers, with 15 ft. (4.6 m.) between wires in the span, is being used, but without

getting the factor of safety commensurate with the distance. Regarding the line-clamp fittings and insulator pin of the first unit, the air gradient is very high owing to small diameters, angles of bolts, fittings, and also to the small pin of the bottom insulator. When excess voltages come on the line they pile up at the line-wire insulator units and break down the air at the metal fittings. This breaks down the air where it is highly stressed at the line fittings, and the air breaks down serially from one unit to another by transferring the high electric stress from one to another in the string. Corona also forms acids which attack the metal fittings. It is necessary to prevent incipient corona pluming or arcs at the insulators, said Mr. Baum, if the transmission line is to be fully successful—by which is meant that the insulation of the line must be such that the line should give as good operating results as the transformers or other transmission apparatus. Of course, the line is subject to damage maliciously done or due to accident, but, neglecting these, the line should be made as reliable as the remainder of the system.

Porcelain when well made is a good insulator, but the metal fastenings to the "cap-and-pin" disk types of insulators add a mechanical depreciation factor because expansion and contraction are not the same for porcelain and metal parts and for the cement used to fasten the parts together. By careful manufacture a tough porcelain can be made, in which depreciation from expansion and contraction can be much reduced. Careful selection and working of the clay and sufficient time in firing give a very high-class insulator product. In the link type of fastening the mechanical depreciation from expansion and contraction is very largely reduced, but in the types now made there is a restriction due to small diameters, and it is necessary on high-voltage lines to shield the links—at least those in the lower part of the string.

The prevention of depreciation due to expansion and contraction is largely a matter of cost, and as it is a slow process and since there is a factor of safety in the number of units in the string, the mechanical failure from the above causes may be dismissed as not affecting good service with good inspection.

From the voltage gradients for cap-and-pin insulators and also for the link type it may be seen that the total pressure is divided very unevenly among the units. In the cap-and-pin string of fourteen units the volts on the line unit are about 25,000, or about two and one-half times the average, but about six times the volts on the units near the ground end. In the link type there is even a worse case of distribution of pressure, the maximum being about 37,000, or four times the average and about ten times the stress on the units nearer the ground end of the string. This unequal stress on the units also causes unequal stress on the air, but, most important, it does not distribute the leakage stresses along the string uniformly. The maximum air and leakage stresses are from six to ten times the average. Reduction of the maximum stresses is therefore very important, and the result desired is that there will be more nearly average resistance stresses over the string.

Before a rational analysis of an insulator can be made the factors which limit the maximum stresses must be known. They are (1) the air stresses, (2) the leakage resistance stresses and (3) the insulator unit stresses.

The air stresses are known, and to control this factor the conductor must be enlarged at the insulator. The first controlling factor for satisfactory insulator characteristics, then, is that metal parts must be designed to give low air stresses at the line wire and also along the string of insulators, at least near the line-wire end.

The unit stress affects the leakage stress, and therefore it is very important also from this standpoint to reduce the maximum unit duties. The maximum leakage stress can be reduced (1) by reducing the unit voltage and (2) by enlarging the pin and by the design of the resistance path from metal to metal. The enlargement of the pin and the shield over the line wire also reduce the maximum voltage on units near the line. Taking care of these two points helps the grading of the units fairly well. The third factor, the grading of units, requires an understanding of the string gradient.

Satisfactory voltage distribution may be obtained (1) by use of ring shields, (2) by use of insulated horn shield, (3) by grading the lower one-third of the units and (4) by combining pin-type insulators at the line end with disk-type insulators at the upper end of string.

The first and second methods are very similar and accomplish the result by control of the field, by reducing

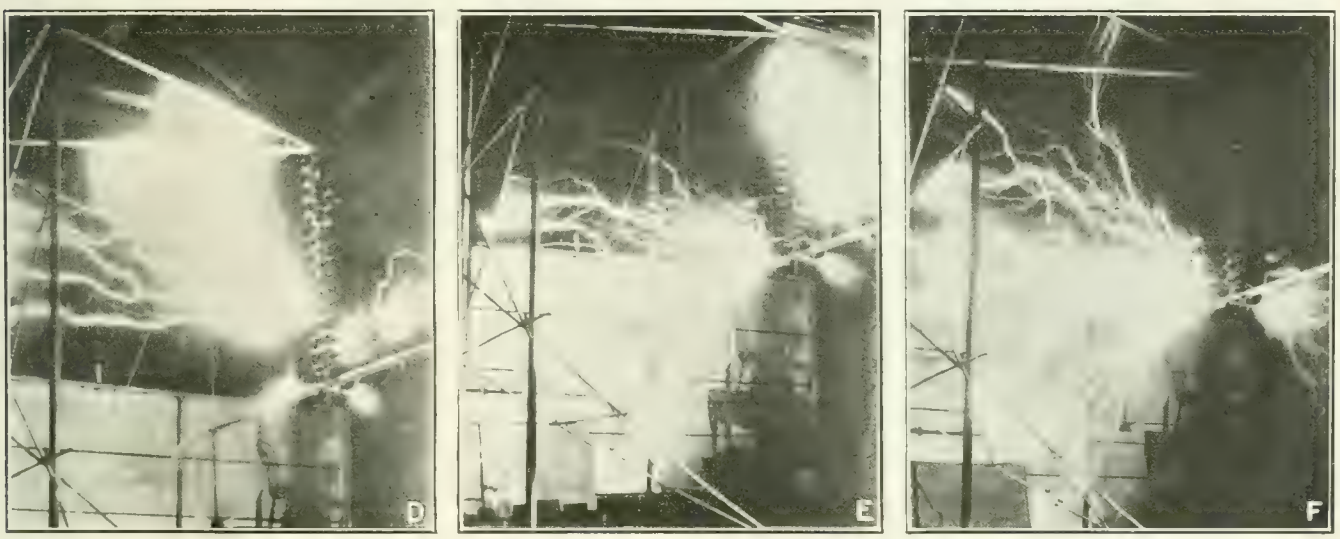


FIG. 3—HORIZONTAL SHIELDS AND VERTICAL SHIELDS CAPPED WITH INSULATORS IMPROVE THE FLUX DISTRIBUTION, CAUSING HIGH-FREQUENCY ARCS TO STRIKE TO THE TOWER

Where the insulator is omitted from a vertical shield (Fig. 3E) the arc strikes the upper insulators.

the current from metal parts of units to tower or ground and increasing the current from line wire to metal parts of the units. The disadvantage of raising the air potential above the units is that this also increases the currents from line wire to metal parts of insulator units and the dry arcs tend to break into the upper third of the string. By the use of the pin shields and line shields the height of the ring or horn shield may be reduced and part of the objection to the shields removed.

By the third method the potential of the string is kept as high as possible above the air potential, and hence it tends to prevent the arcs from breaking into the string. By using four large diameter units, with larger pins to increase the electrostatic capacity at the line-wire end, and by using the line shield, a very simple string is obtained. It is possible to use the four large units and a low ring or short insulated horn shield to grade the lower two units further, if desired. The air-potential gradient from line wire to tower should be made as flat as possible as a steep gradient invites arcs. This means a long string, and the air potential due to the line wire should be as low as possible. By the fourth method the string potential is brought close to the air potential. This method has not been worked out practically.

It is suggested that insulator men will undoubtedly work out a satisfactory solution for the insulators near the line wire and reduce the leakage resistance stresses and the air stresses to less than one-half of those now prevailing on 110,000-volt to 175,000-volt lines. This is held to be necessary to give satisfactory operation.

With the ungraded string the factor of safety is at the tower end instead of at the line-wire end of the string. Each insulator string should be treated like the end windings of transformers, not by adding more turns (or adding more units), but by increasing the insulation or decreasing the voltage stress on the units near the line wire so that these can absorb the excess voltages due to switching, etc., without undue stress.

Switching Apparatus Problems on 220-Kv. Lines

The very large amount of space required for the 220,000-volt substation switches, etc., makes it advisable to use outdoor apparatus so long as the total cost is less than where there is protection from the elements. Probably transformers and disconnecting switches can be more economically placed outdoors than in a building. But in the case of the oil switch a different conclusion may be reached on account of the fact that the enlargement of the bushings for outdoor use also enlarges the tanks more than is otherwise necessary, so that because of the increase in the bushing the cost of the switches for a given kva. capacity may vary somewhat as the square of the voltage, if all the elements of design are carried out consistently.

Thus, by keeping the 165,000-volt switch, when used on the 220,000 lines, dry and clean a greater factor of safety is attained than exists with the 220,000-volt switch when used outdoors. Since the 165,000-kva. switch will give all the rupturing capacity required, it will pay to use this type inclosed, if the cost of protecting it from the weather is less than the extra cost of the higher-voltage switches.

This factor does not arise in the case of transformers because the tanks are so large that the larger bushing cost is the only extra item to consider for the higher voltage. If the wet arc-over were increased by increasing the length and not the diameter, this would reduce the size of tanks.

The dry arc-over voltage of a fourteen-unit string insulator shielded with ring or insulated horn shields is about 700,000 volts, or 50,000 volts per unit. The arc clears the insulators fairly well but sometimes breaks into the upper third of the string. Under wet test the arc tends to follow along the string of insulators and the wet arc-over voltage is about 60 per cent of the dry arc-over value, or about 450,000 volts to 550,000 volts for fourteen units with precipitation of 0.2 in. (5 mm.) per minute.

Directing Flashover Away from Insulators

The control of the wet arc, to keep it away from the string of insulators, is important. Tests have indicated that the arc can be controlled in direction and kept away from the string, the accompanying illustrations showing that the arc-over can even be directed to the lower cross-arm. This may be accomplished by hanging two insulator units properly spaced below the line wire and then adjusting a pointer on the lower arm to direct the arc. The theory is that the units below the line will become dirty and wet and the insulation depreciate as do the line units. The adjustment for the wet and dry arc to travel to the lower arm can be very close to the arc-over for the string. Instead of hanging the extra units from the line wire, they may be hung from the lower arm, about 2 ft. (0.6 m.) toward the tower from the line insulators. The wet and dry arc can by proper adjustment be made to clear the string. Instead of the insulators hung from the arm, a porcelain tube may be used to direct the arc. The result here is even more satisfactory than in the other two cases.

While the wet and dry arcs may be controlled as above, it is believed that this control should be used only as a final protection in certain places. The effort should be to eliminate the arcs entirely, and it is believed that this can be accomplished, except in cases of accident.

Mr. Baum is confident, from all his observations and studies, that the final complete success of power transmission, at voltages higher than can be handled by pin-type insulators, must come from the design of the metal fixture (including the line wire) in contact with the air and porcelain, so that the air gradient and leakage gradient will be reduced to low values, in order that there shall be no tendency for arcs to start and that the maximum unit and leakage resistance can also be reduced to low values. Corona should also be prevented on account of the formation of acids

Double-string and dead-end insulator strings should be avoided wherever possible, and in place of these extra-strength units should be used to allow insulators to swing clear at angles as far as possible.

It is the peculiar characteristic of nearly all apparatus that it depreciates less when used in normal service than when taken out of service for part of each day. This is because the depreciation depends largely on the maximum range of temperature changes and the number of such changes or cycles in a given period. All electrical apparatus, including transmission lines, should be in constant service under conditions that will as nearly as possible cause the apparatus to remain in one condition.

A system of transmission controlled as to voltage and insulated consistently by one of the methods described to give low air and resistance leakage stresses at all voltages will give service not possible on lines where these conditions are not carried out.

Simple Methods of Economical Operation

By Redesign Denver Utility Company Cuts Down Fuel Requirements—Economy from Careful Inspection of Equipment —Bonuses and Schooling Assure Co-operation from Employees

By C. H. McCLINTOCK
Mechanical Engineer Denver Tramway Company

THE steam-power plant of the Denver Tramway Company is interesting not from the standpoint of originality of design, but from the standpoint of what may be accomplished in the rehabilitation of an old plant. By replacing old equipment with modern units, by careful education of employees in economical operation and by adopting a bonus scheme in which all station employees share alike it has been possible to raise the thermal efficiency of the station from 8 per cent to 14.4 per cent. A 9,500-B.t.u. (5,270 cal. per kg.) Colorado lignite is burned successfully.



THROUGH REHABILITATION OF EQUIPMENT AND OPERATING METHODS THERMAL EFFICIENCY WAS INCREASED 80 PER CENT

The plant, which was built in 1901, conformed to the standards considered as modern engineering practice at that time, and later two turbo-generator units with boilers were added, so that up to 1916 the following apparatus was installed:

Boiler Room:

Thirteen 415-hp. Stirling boilers equipped with superheaters and Babcock & Wilcox chain-grate stokers.

An elaborate system of economizers with induced-draft fans.

Steam driven, reciprocating boiler-feed pumps.

Six 705-hp. Stirling boilers equipped with superheaters.

Green chain grates and individual economizers with induced-draft fans.

Engine Room:

Three 800-kw. General Electric direct-current generators directly connected to Greene-Wheelock cross-compound engines running condensing and served by jet condensers.

One 1,600-kw. General Electric direct-current generator directly connected to an Allis-Chalmers Corliss-valve cross-compound engine running condensing and served by a jet condenser.

One 1,500-kw. General Electric alternating-current generator directly connected to an Allis-Chalmers Corliss-valve cross-compound engine running condensing and served by a jet condenser.

One 2,000-kva. Westinghouse turbo-alternator served by a 6,000-sq.ft. (560-sq.m.) surface condenser.

One 2,000-kva. Westinghouse turbo-alternator served by a Le Blanc-type jet condenser.

Upon investigation it was found that such economies would be realized that it would pay to install a modern turbo-alternator of sufficient capacity to carry the full load and a 3,000-kw. rotary converter to take care of that part of the load formerly carried by the direct-current machines; consequently the new turbo-alternator and rotary converters were installed late in the summer of 1917. This change, due to the better water rate of the new turbine, automatically decreased the required boiler capacity so that the load could be carried on three of the 705-hp. boilers, and the thirteen 415-hp. boilers were subsequently dismantled and sold. It was also necessary to dismantle and scrap one of the 800-kw. Greene-Wheelock direct-current units in order to find room for the installation of the rotary converter. Thus the power plant as it stands today contains the following apparatus:

Boiler Room:

Six 705-hp. Stirling boilers equipped with superheaters, chain-grate stokers, economizers and induced-draft fans.

Two open feed-water heaters.

Three boiler-feed pumps.

Engine Room:

Two 800-kw. direct-current cross-compound reciprocating-engine-driven units.

One 3,000-kw. rotary converter.

One 1,600-kw. direct-current cross-compound reciprocating-engine-driven unit.

One 1,500-kva. alternating-current cross-compound reciprocating-engine-driven unit.

Two 2,000-kva. alternating-current turbo-generator units.

One 9,375-kva. General Electric Company turbo-alternator served by a 7,500-sq.ft. surface condenser and steam-turbine-driven circulating, condensate and vacuum pumps.

IMPROVING FUEL AND WATER CONDITIONS

The fuel for the plant is purchased from the Leyden Coal Company and loaded at its mines, the Denver Tramway Company hauling it by means of electric locomotives to the plant. The coal is then unloaded into the track hopper, crushed and elevated by means of a continuous bucket conveyor to the bunkers overhead. Both slack and mine run are used. This coal is a Colorado lignite, high in moisture content and volatile matter, and has a heat content of 9,500 B.t.u. per pound

(5,270 cal. per kg.) as fired. It is burned well on the chain grate and has given very little trouble. However, the original Stirling arches have been replaced with flat arches over the stokers, this resulting in increased furnace efficiency and a decrease in maintenance cost.

The raw boiler-feed water is taken from an artesian well on the power-house property. This water is pumped into large storage tanks by means of an air lift, and from there it goes into the feed-water heaters. The water contains carbonate of magnesia, which separates out as a floury precipitate and, while not troublesome, requires the boilers to be "blown down" at least once a week, when the machines served by surface condensers are in operation and only 10 per cent raw

keeping the water at a proper level at the intake. The sheet-pile dam filled up virtually level-full with sand, and the sand coming down the river would fill up the intake and canals, necessitating continual removal by sand pumps. A gate was installed in the dam in such a position that when it was open the velocity of water past the intake was increased, and this cut the sand out. The situation has been so improved that the intake and canals do not now have to be cleaned out more than three or four times a year.

During the winter months, or low-water period, slush or "clinker ice" and slime float down the river. The ice stops up the intake screens and the slime coats the condenser tubes. In order to get rid of the ice on the screens the canal system has been so constructed that

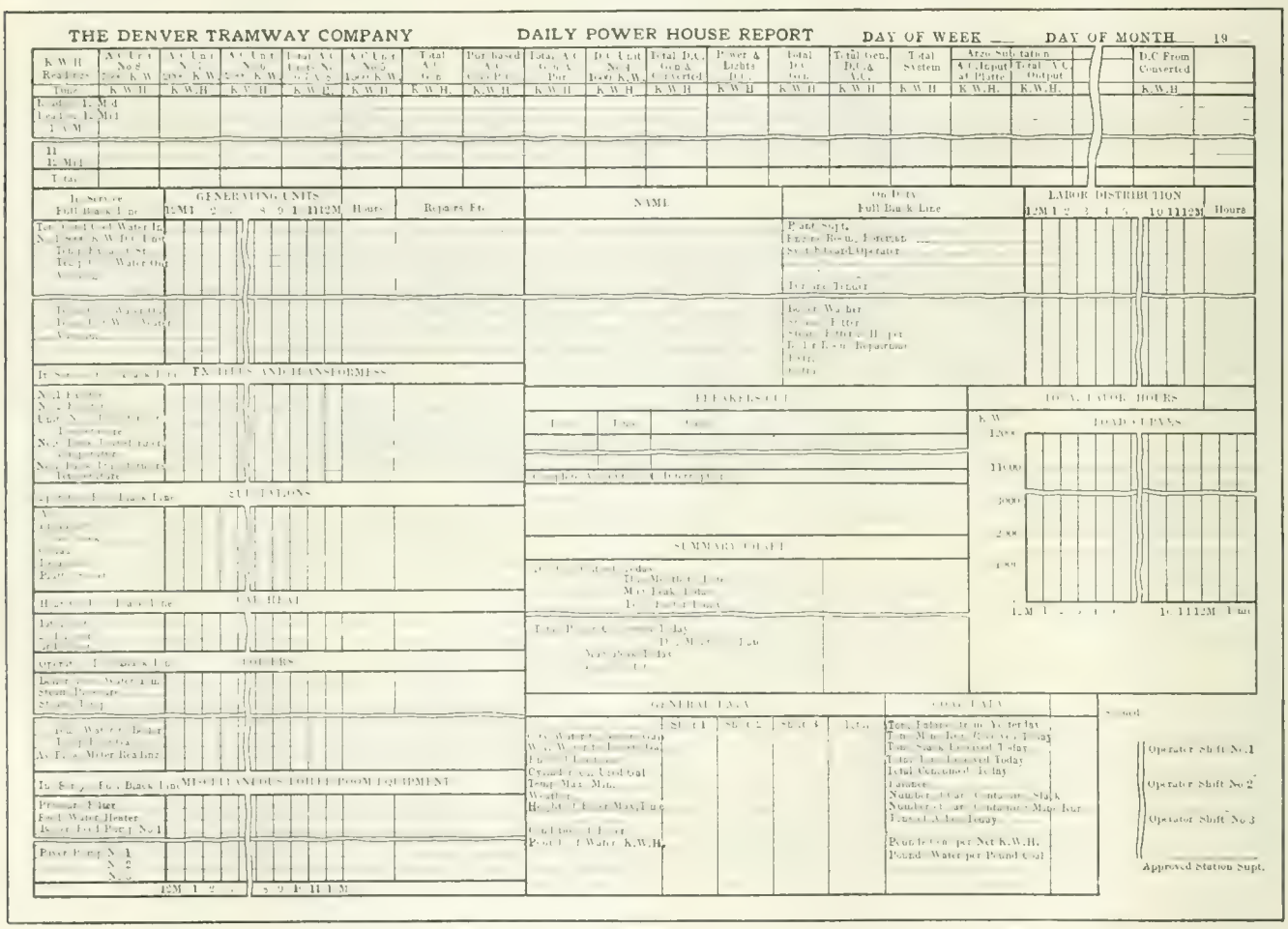


FIG. 1—THE MAIN POWER-HOUSE REPORT HAS BEEN CONDENSED INTO ONE SHEET THAT GIVES ALL THE OPERATING INFORMATION NEEDED

A record of meter readings is also kept, but the form is not reproduced here. The notable thing about the system is the total lack of complication. Complicated records do not spell economy, and the Denver Tramway Company has recognized this fact and depends upon its records to show results only. Those results are obtained by careful plant design and careful and intelligent daily operation, in which the full co-operation of the operating force is assured by careful training and recognition of efficiency.

make-up water is required. If the large turbo-generator is shut down for any length of time and all of the boiler-feed water is raw, the boilers are "blown down" once every twenty-four hours. If allowed to collect, the carbonate of magnesia will cause priming. The water does not coat the boiler tubes with any scale to speak of, and it is necessary to clean the boilers only once in six months.

The condensing water is taken from the Platte River and run into the power plant by means of a system of canals. An intake with screens was built on the side of the river, and a sheet-pile dam was "driven in" about 50 ft. (15 m.) downstream, for the purpose of warm condensing water may be diverted to the intake to melt off the ice. The slime is removed by putting 50 lb. (22.6 kg.) of chloride of lime into the condenser once every two weeks. The slime is an organic substance, and the chloride of lime has the desired effect. When the river is high considerable fine sand is held in suspension in the water and passes through the condensers. This sand, instead of being a nuisance, has turned out to be a help, as it scours the condenser tubes and keeps them bright and clean.

A system of records, samples of which are shown in Figs. 1, 2 and 3, is used to keep track of the operation of the plant. In addition, such instruments as

Form 850 THE DENVER TRAMWAY COMPANY

Date_____

Daily Report of { Steam turbine No 8 / Ruting

Report by_____ Unit started_____ Shut down_____

LOAD READINGS

Time_____

Pressure—degree superheat of steam
First stage
Absolute
Pump
Bearings
Hydraulic Gear
Temperature—Return Oil
Generator end
Middle
Generator end
Temperature Oil supply
Engine Room
Air to generator
Air out generator
Exhaust steam
Condensed steam
Cooling water inlet
Cooling water outlet
No. valves operating
Kilowatts
Volts
Amperes
Field excitation
Volts
Amperes
Power factor
Speed

INSPECTION

Condenser and Pump | Main Governor | Steam Seal | Oil Pumps | Bafflers | Strainers | Oil Filters

Oil Filters | Wheel Clearance | Brushes | Generator | Collector Rings | Emergency Governor | Cleanliness

REMARKS

FIG. 2—TURBO-GENERATORS HAVE AN INDIVIDUAL REPORT FOR EACH DAY

recording economy draft gages, recording and indicating thermometers, steam-flow meters, indicating and recording pressure gages, and a CO_2 recorder are in use. The CO_2 recorder, however, is used only as a checking device and is not in continuous service on any one boiler. When the instruments show anything wrong at any locality the trouble is remedied as soon as possible. In addition, all apparatus is thoroughly inspected at regular periods and is continually checked up.

Each employee on the power-house payroll who has been in the service of the company one month or longer receives a bonus, which is figured from the coal rate per gross kilowatt-hour. This bonus is divided equally among the employees, 90 per cent being paid monthly and 10 per cent being retained by the company to be paid semi-annually to all men who have been on the power-house payroll for the half year or longer just preceding the date at which this last amount is paid. A skeleton of the table used follows:

Coal per Kilowatt-Hour, Lb.	Total Bonus per Month	Coal per Kilowatt-Hour, Lb.	Total Bonus per Month
3.10 to 3.09	$2 00	2.71 to 2.69	422 00
3.01 to 2.99	32 00	2.61 to 2.59	652 0
2.91 to 2.89	112 00	2.51 to 2.49	932 00
2.81 to 2.79	242 00	2.41 to 2.39	1,262 00

From the complete table it is an easy matter for the office force as well as the men themselves to figure the bonuses. Another feature of the system is that all employees share alike in the bonus, thus eliminating the inclination of the men receiving the lowest pay to "lay down" on the job and throw all the responsibility of keeping up plant efficiency upon the shoulders of the chief operator and boiler-room foreman.

The bonus system has been in operation for more than three years now and has worked out satisfactorily to all concerned. Among many things it has promoted co-operation among the employees, as each one can see that individual negligence not only reflects unfavorably on the operating force as a whole but also tends to reduce the bonus.

In order that the men may feel that the company is as interested as they are in keeping the bonus large, a system of education was inaugurated. At first the men were brought together at regular intervals for the purpose of giving them lectures on the operation of a plant and methods for forestalling operating troubles. It was found that too much time was wasted by this method and too many imaginary troubles were cited. The method that is now used is to take up each trouble as it comes, correct it at the time and explain its cause, effect and method of correction to every man interested. Then if the same trouble comes up again every man knows how to remedy it.

The daily load curve of the plant is the typical and familiar street-railway curve—that is, two peaks, one in the morning and one in the evening, and a very light load from midnight till morning. Momentary peak loads of 10,000 kw. and hourly peak loads of 8,500 kw. are carried with an average yearly load factor of 45.9 per cent.

The over-all efficiency of boilers, superheaters, economizers and furnaces averages 71 per cent. Feed water consisting of 90 per cent condensate and 10 per cent raw "make-up" water is heated to a temperature of 150 deg. Fahr. (66 deg. C.) in the feed-water heaters before being pumped into the economizers. This is in order to keep the economizers warm enough to prevent hard soot deposits and corrosion due to condensation on the tubes of moisture in the flue gases.

Steam is delivered to the turbine and engine throttles at a gage pressure of 180 lb. per sq.in. (12.6 kg. per sq.cm.) and a total temperature of 450 deg. Fahr. (238 deg. C.). A back pressure of 1½ in. (3.8 cm.) of mercury is maintained in the turbine exhaust and 4 in. (10 cm.) in the exhaust of the engines.

Up to the summer of 1917 before the new 9,375-kva. turbo-generator was installed the coal rate of the plant was 4½ lb. (2 kg.) per gross kilowatt-hour, and since the installation the coal rate has been reduced to 2½ lb. (1.1 kg.), or 23,750 B.t.u. (6,000 cal.) per gross

Form 789

THE DENVER TRAMWAY COMPANY
CONDITION OF LOAD

Time_____ 11 _____ Date_____ 19_____

	Average Load	Maximum Peak	Machines in Service No	Kw	Capacity
A.C. generated at Platte					
D.C. generated at Platte					
D.C. converted at Delaware					
Total system load					

Hp. boilers in service
" " " "
" banked
" "

Remarks_____

FIG. 3—CONDITION OF LOAD IS SHOWN IN THIS SIMPLE FORM

kilowatt-hour. Although not so efficient as some of the more modern and larger steam-power plants, a thermal efficiency of 14.4 per cent as obtained at the present time against 8 per cent which was formerly obtained shows what may be accomplished by the rehabilitation of an old plant.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

How the Central Station Can Help to Popularize Radio and Promote Customers' Good Will

To the Editor of the ELECTRICAL WORLD:

SIR: Without a doubt there is no electrical apparatus that has received so little consideration in the past from the public utility as radio-telegraph and radio-telephone apparatus. When some irritated customer in the vicinity of a young amateur with a small spark coil complains about his lights flickering the service man usually goes through the routine of investigation and then the matter is dropped.

Today not a few utilities are taking advantage of the radio art and are experiencing gratifying results. For the central-station company serving a large territory radio sets are proving to be a wonderful aid in cases of telephone interruption. Moreover, when transmission lines are in trouble the telephone is found in the same condition. Not only from the operative standpoint but from a business viewpoint radio supplies are in such demand that the electrical utility handling up-to-the-minute merchandise cannot afford to stand by uninterested and allow the local sales end of this business to be mishandled by non-technical men. Here is not only a field of good business but one of co-operation with those who are now promoting the wider use of radio.

Since the inauguration of the daily market quotations and market news letters by the federal Department of Agriculture wireless has come to mean more to the agricultural community than ever before. Right here is the opportunity of a lifetime for a central-station company to promote good will. Any utility serving agricultural districts would be amply repaid many times for the few minutes a day required to copy this class of information. The blanks needed are supplied without cost by the Bureau of Markets of the Department of Agriculture.

Many utilities will be surprised to learn that they do need to go outside of their present organizations to find operators for these stations. The electrical engineer will in many cases be a man who has mastered the basic principles of radio telegraphy and telephony, and he can generally be relied upon to assemble and install apparatus that will meet conditions existing.

Some hesitancy has been evident, perhaps on account of the license question. This is one of the most important factors in the installation of a system of radio communication. Operators to obtain a second-grade amateur license must be capable of receiving at least ten five-letter words a minute, Continental Code. They must have a fair working knowledge of the apparatus and also of the laws governing radio communication.

The most feasible method of arranging for the licensing of stations which are being put into operation is to obtain amateur station licenses. These will serve until the system has been put into satisfactory operating condition. Owing to the nature of the work with which public utilities are confronted, it is often desirable to use longer wave lengths than the 200 m. allowed to amateur stations. For this class of work the Department of Commerce is authorized to issue limited commercial licenses. Operators of a higher grade will be necessary, but the central-station company will be able to furnish more accurate and dependable service. No charges are authorized as none are necessary. Of course, the station is prohibited from communicating with commercial and other stations except in case of emergency. Detailed information on license requirements and laws is available in the "Laws Governing Radio Communication," obtainable for 15 cents from the Superintendent of Documents, Government Printing Office.

ORVILLE R. TOMAN,
Bedford Light, Heat & Power Company, Manager.
Bedford, Iowa.

"Electric Power Industry" Favored as Properly Descriptive Name

To the Editor of the ELECTRICAL WORLD:

SIR: At a recent meeting of division managers and department heads of one of California's power companies it was suggested that the public service corporations of the state be no longer referred to individually by that name, but that collectively they be distinctively referred to as an industry. There is no doubt sound psychology in this suggestion, which upon a little study may become more apparent. The public mind is constantly subjected to varied influences which after a time create more or less definite impressions, finally consolidating into a general belief which may be termed public opinion. Frequently these influences are of a sinister character and assume far reaching proportions. The corporation plan began to find favor in America about 1850 and was considered a step forward in the conduct of expanding business. The branch of industry engaged in the business of generating, distributing and delivering electrical energy came in later years, as did others engaged in transportation, communication, etc., to be known as a group of public utility corporations.

Now let us consider the meaning of these words, their fitness, the changes later adopted, and why the most recent change in name may have been suggested. "Public," of course, means the people. "Utility" means "quality of being capable of bestowing benefits to the greatest number." "Corporation" means "combined into one body." A public utility corporation, then, is an institution fully capable of usefulness and of bestowing benefits on the people, with all the necessary agencies for such accomplishments combined into one body.

As these agencies became more efficient and the corporations realized that their obligation to the public was to give real service, as implied by the word "utility," rather than the sale of a commodity, the name "public service corporation" came into being. All during this time we saw certain influences depict the corporation

as an opulent and corpulent individual, heartlessly preying upon the helpless. This, largely owing to a lack of real understanding on the part of the public, has unquestionably engendered a feeling of mistrust and disfavor.

The word "industry" seems to be agreeably accepted today by the majority, although perhaps not any better understood. The following would seem to define it: "Any department or branch of art, occupation or business which employs capital and labor and is a distinct agency for economic development and human advancement."

It is therefore resolved by the California Electrical Co-operative Campaign that in the future we refer to that industry which has contributed by the supply of electricity to the upbuilding of the state and the general advancement, prosperity and happiness of its people as the electric power industry.

ROBERT L. ELTRINGHAM,
Manager.

California Electrical Co-operative Campaign,
San Francisco, Cal.

Need of Better Protection Against Improper Fusing of Circuits

To the Editor of the ELECTRICAL WORLD:

SIR: I was very much interested in reading the recent article by H. S. Rich regarding the refilling of fuses and a further discussion by Dana Pierce in the issue of April 30. I agree with Mr. Pierce in what he says relative to the misapprehension of what constitutes proper fusing. The fire hazard is greatly increased by the use of solder, plug fuses, iron wire, copper wire and copper pennies. I have seen cartridge fuses on 600-volt service that have been refilled with carriage bolts in place of proper fuse links. In my opinion more so-called electrical fires are due to improper fusing than to the use of the open knife switch. Several cases have come to my attention where fires have been directly due to this abuse, and an entrance cabinet which is not properly sealed and controlled by a person familiar with the dangers of improper fusing is not a "safe and sane" installation.

We have endeavored to convince city electrical departments of the desirability of sealing entrance switches and have been able to prove by reports of actual fires that few realize the hazard of not using proper fuses for the protection of electrical circuits. A person who willfully places anything other than the proper fuse in a cut-out is creating a condition that may mean a loss of property and possibly life. A glaring example of this practice came to the writer's attention when a fire in a local theater was reported as caused by defective wiring. An inspection revealed that twenty cut-outs were equipped with pennies as fuses. Here the improper fusing might have resulted in loss of life.

The use of the safety switch on meter services would seem to me undesirable, particularly on account of there being no convenient means for meter testing. Its application seems to be along industrial lines, its purpose being usually to open and close the circuit. Meters are rarely installed in connection with these switches, and arrangements do not have to be made for shunting the meter as in the case of meter-entrance switches. It is the writer's opinion that it is much more important to install inclosed-type switches in our industrial plants than on services, owing to the fact that they are handled very frequently and in a good many cases by persons unfamiliar with electricity. There is no question that this type of switch greatly reduces the accident hazard and prevents the operator from coming in contact with any live parts. In the case of an externally operated switch, which is sometimes misrepresented as a safety switch, being used, it would seem to me that to minimize the life hazard this switch should be sealed, in view of the fact that the operator is exposed to live parts when the cover of the switch is open. It has been the writer's experience that improper fusing is not so common in industrial applications as with meter-service installations. Undoubtedly this is due to the fact that in the former case responsible persons usually replace the fuses. The hazard is probably less on account of the main fuses furnishing additional protection, a condition which does not exist with many service installations.

I wish to quote from the National Electrical Safety Code with reference to the hazard of externally operated inclosed switches. Page 258, paragraph 324, reads:

> Where fuses are in locked cabinets (or otherwise made accessible only to qualified persons), sufficient protection is usually secured for all voltages if switches are provided to disconnect the fuses from all sources of electrical energy.
>
> When switches and fuses are inclosed in metal cabinets and live terminals are accessible, greater hazard exists than if they were not so inclosed, as the live terminals are adjacent to grounded metal.

The Travellers' Insurance Company, a noted authority on life hazards, advises that the safety switch should be so constructed that the door of the inclosed case cannot be opened unless the switch is in "off" position and the switch cannot be closed until the door has been shut. It is the belief of the writer that the various manufacturers could render valuable assistance to the electrical industry as a whole if they would advocate the sealing of entrance service cabinets and the installation of safety switches in connection with industrial applications. There is no question that the life and fire hazards are decreased by the use of inclosed, externally operated switches; but it is the writer's opinion that more "electrical" fires have been caused by improper fusing than in any other way. If we are to reduce to a minimum accident and fire losses from electricity, why not require the safest equipment and prevent unauthorized persons from tampering with the devices which are supposed to make it so?

J. C. LANGDELL.

Jackson, Mich.

Electric Heating System on Swiss Railroads

To the Editor of the ELECTRICAL WORLD:

SIR: For the last few months the passenger cars on the Berne-Thoune section of the Swiss Federal Railways have been supplied with steam for heating from electrical steam boilers. The heating unit of the boiler takes current directly from the overhead line without transformation and converts it into heat. This is the first electrical steam boiler installation working directly at 15,000 volts. The apparatus supplying the electrical steam was built by Brown, Boveri & Company and is installed in an ordinary railroad baggage car especially arranged for this purpose. The maximum capacity of the boiler is 1,200 kw. A regulating device up to the minimum of 300 kw. has been provided. It is intended to introduce these heating cars on a larger scale on several lines of the Federal Railways.

HENRY L. GEISSEL.

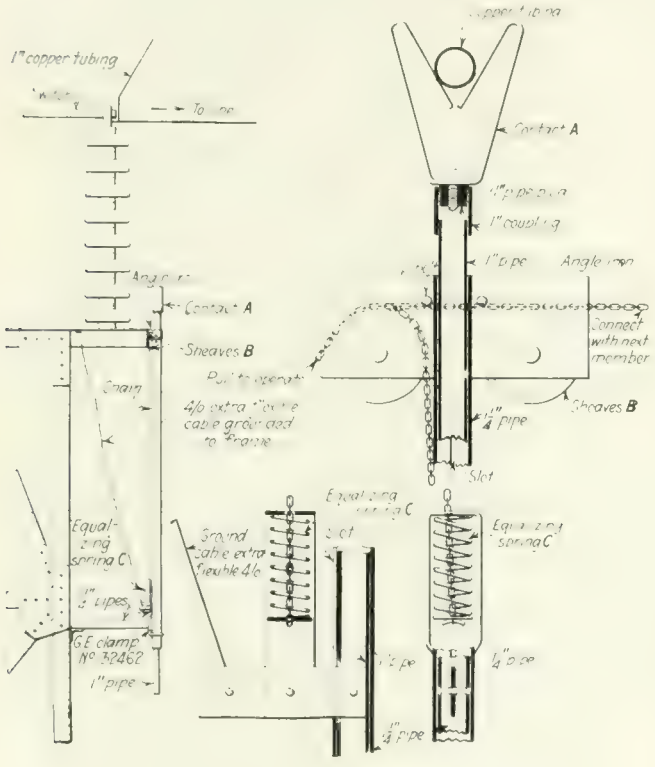
Beaurivage, Thoune, Switzerland.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Remote Hand-Operated Grounding Switch

AS THERE was insufficient room on the roof of a certain 60,000-kv., 100,000-volt substation to permit the use of standard grounding devices, the mechanism described in this article was designed and so



LINE IS GROUNDED BY PULLING CHAIN TO RAISE CONTACT *A* UP TO LINE

installed that every incoming high-tension line could be grounded from the main switching floor. No special material is used in making up these ground switches, and when they were installed in 1917 each one cost about $150 per line complete and ready for operation. In most indoor substations it is necessary to send a man out on the roof either to ground the line or to see that it has been properly grounded, but with this arrangement the action is so positive that any line can be grounded from inside the substation without fear of a mistake.

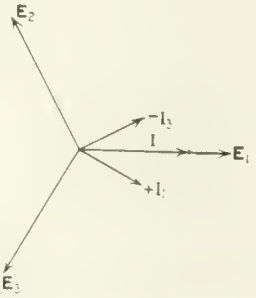
The grounding switch is constructed in the following manner: A 1-in. pipe 5 ft. long is made a sliding fit in a 1.5-in. pipe, both pipes being galvanized iron. The outer pipe, about 4 ft. long, is stationary and has a slot cut in its side. Connection is made to the inner pipe through this slot by means of No. 4/0 extra-flexible wire. The other end of the connection is grounded on the steel framework. At the top of the inner pipe is a copper contactor, *A*, which is pulled up against the incoming line by a chain and a steel wire which are connected to the inner pipe. The chain runs over a pulley and then passes through the floor to a small hand winch on the main switch floor of the substation. A second chain attached to the first passes to the next phase, which has a similar arrangement. From here a third chain passes to the next phase. Thus the grounding devices for the three phases of each line are operated from the one winch.

C. C. ROBINSON,
Superintendent of Electric Stations.
Union Electric Light & Power Company,
St. Louis, Mo.

Single-Phase Meters Used on Three-Phase Power Service

READERS of the ELECTRICAL WORLD may be led to use an incorrect meter constant by following the article on page 712 of the issue for March 26. In case I of this article the registration is 50 per cent instead of 57 per cent as stated. When using three-wire meters it is well to observe that the total number of turns in a series coil is the same as in a single-phase, two-wire meter of the same rating, the only difference being that the turns are divided in two sections. On a balanced three-phase, 110-volt circuit at unity power factor, as represented in the article, the phase relations are shown in the accompanying diagram. The effective current is readily seen to be the $\sqrt{3}I$ which is in phase with the voltage applied to the meter. The apparent watts, of course, are $3I \times 110$, but owing to the fact that the turns in each set of series coils are only one-half those of a single-phase, three-wire meter, the watts as registered by the meter would be only $(\sqrt{3}/2)EI$.

Now the true power is $\sqrt{3}EI$ under the condition stated so that the ratio of the true power to that shown by the meter is $\sqrt{3}EI \div (\sqrt{3}/2)EI = 2$. Therefore, if a single-phase, three-wire meter is used on balanced three-phase loads, the dial reading must be multiplied by the factor 2 in order to obtain the true energy delivered. It can readily be demonstrated that the meter registers correctly on any power factor if the load is balanced.

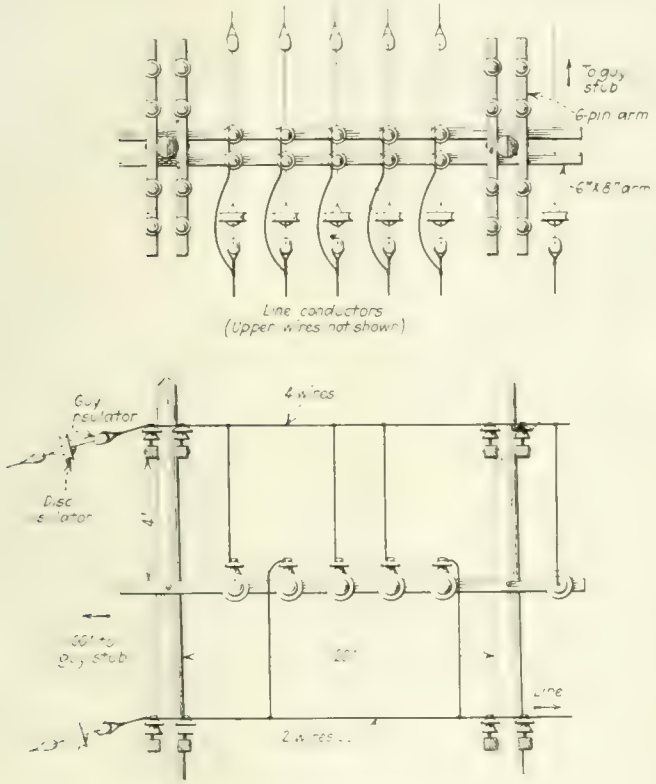


RELATIONS OF CURRENT AND VOLTAGE IN A WATT-HOUR METER

When such meters are supplied for operating on three-phase balanced loads, the register ratio is made just one-half that of a standard three-wire meter of the same rating and the use of a constant is thereby eliminated.

Double-Pole Corner for Heavy Lines

HEAVY cable corners that provide ample working space and safety for men whose duties require them to work on the pole line can be made by the method shown in the illustration, which is in use on the Denver Gas & Electric Company's distribution system in Denver. In the illustration a right-angle corner is shown. The strains are taken by guys run back to a guy pole. On the upper arm the method of taking the strains is clearly shown. A suspension-insulator unit is used as an insulator between the guy and the line conductor. The corner poles may be set in the parking space between the sidewalk and the curb where the space is wide enough, or the poles may straddle the sidewalk on narrow streets. The corner is also used a great deal in connection with bridge construction for alley distribution lines. It avoids the usual complication



CORNER CONSTRUCTION FOR HEAVY WORK

encountered where double buck-armed poles are used in combination with clamps and arm guys to carry heavy corners and affords ample working space.

Chicago, Ill. FIELD EDITOR ELECTRICAL WORLD.

Output of Twenty-seven Major Companies in Central States in 1920

THERE are a number of generating and distributing companies in the Central States which reported an output of 100,000,000 kw.-hr. in 1920 for the first time. The ELECTRICAL WORLD tabulation of all electric light and power companies with an output in 1920 over 100,000,000 kw.-hr., published in the issue of April 23, indicated that there were twenty-one companies of this class in the North Central States and three in the South Central States. Information has lately come to hand indicating that the number of these companies in the North Central States should be increased to twenty-three by the addition of the Northwest Utilities Company, with an output of 113,644,209 kw.-hr., and the Central Illinois Public Service Company, with an output of 106,974,419 kw.-hr. The Louisville Gas & Electric Company reports that its 1920 output was 108,118,350 kw.-hr., increasing the number of companies in the South Central States with an output over 100,000,000 kw.-hr. to four.

Repairing Mica-Insulated Coils

IT WAS originally the practice whenever a mica-insulated coil was punctured in the plant of the Shawinigan Water & Power Company to replace it with a new coil and send the old coil to the manufacturer for reinsulating, but now such coils are reinsulated in the plant and sometimes without removing entirely from the machine. Taking out a coil is comparatively simple in the case of a bar-wound machine, but with a coil winding the work of raising the overlapping coils, in order to release the lower side of the damaged coil, is considerable, and, moreover, the insulation on the good coils is apt to be cracked in the process. Consequently, when a machine broke down, it was difficult to predict how soon it could be put into service again.

Nearly all the breakdowns that occurred were in the top side of the coil. Some two years ago the practice was begun of cutting off the coil at the back end and replacing the damaged upper half by part of a new coil. The generators on which this was done were 14,000-kva., 6,600-volt, three-phase, 225-r.p.m., one a 60-cycle and the other a 30-cycle machine. They were wave-wound with one-turn coils. This practice was not considered safe by the manufacturer on account of the probable increase in eddy currents in the spliced coil. However, the splice was sectionalized to a certain extent, and these coils have shown no greater tendency to heat than the other coils as far as could be observed. A number of repairs have been made in this way in the last two years, and there has been but one failure of a splice. This was caused by the solder running out of the joint when the winding became very hot because of overload.

Recently a large number of the coils in one of these machines were damaged by a piece of iron being carried in the air gap. The damage in most cases consisted of a cut or nick on the side of the insulating cell next to the air gap. It was decided to repair these coils on the job in order to save time and expense. It was necessary to strip the upper half of the stator in order to restack the iron laminations which had been damaged to a certain extent, but in the lower half the coils were repaired by lifting only the upper half of each damaged coil out of the slot.

The actual repair to a damaged coil consisted first in cutting away the mica cell with a 3-in. taper on each side of the fracture. A longer taper would be better, but was difficult to obtain as the insulation was only 120 mils in thickness. A coating of insulating varnish was then put on the bare part of the coil, and on this two half-lapped layers of mica tape were wound. Each successive layer received a coat of varnish. Since the mica tape was not strong enough to permit drawing up very tight, the third wrapping consisted of cotton tape not lapped. This was followed by four more layers of mica tape half lapped, a second layer of cotton tape, and two layers of 7-mil paper.

A steel clamp was made up to compress the patch to correct size (see Fig. 2). When the clamp was in

place the insulation was baked by passing a heavy current through the coil. This was accomplished by joining the two ends of the coil by a 1,500,000-circ.mil cable on which one or more cable-type series transformers were strung with their secondaries paralleled on a 220-volt, 60-cycle circuit. On each end of the cable was a Dossert lug. The coil ends were clamped between a copper plate and the face of the lug. However, the series transformers available did not give sufficient potential on the short-circuited coil, and a special transformer was built for this purpose. Some 30-mil iron from an old transformer was cut into rectangles, 3 in. x 8 in., and laid up to form a core 18 in. long with an opening 5 in. x 5 in. square. A winding of sixty turns of two No. 10 double-cotton-covered wires in parallel was put on and taped over. The coil stuck through the opening acted as a one-turn secondary winding.

With 440 volts applied to this transformer a circulating current of 2,800 amp. was obtained in a coil removed from the generator. This was more than ample to heat the coil to a baking temperature. Owing to the magnetic losses in the steel clamp it would heat up considerably,

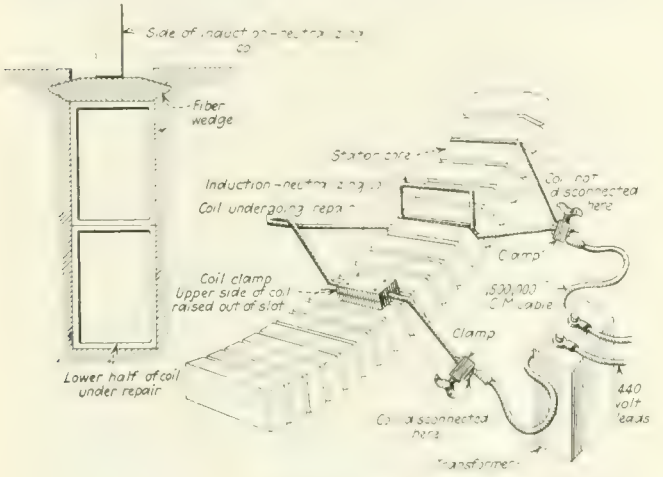


FIG. 1—BAKING A COIL WITHOUT REMOVING FROM GENERATOR

with the result that the patch was subjected to the highest temperature of any part of the coil. From four to five hours was required to bake the patch thoroughly, after which the coil was allowed to cool before the clamp was removed.

As previously stated, a number of the coils were repaired without removing them from the machine by raising the upper half only from the slot. When the heating transformer was applied to these coils a current of only 1,400 amp. was obtained. This reduced current was due to the lower half of the coil being embedded in the slot with a consequent considerable increase in reactance. Since 1,400 amp. did not give sufficient heating effect, an inductance-neutralizing device was made up in the form of a rectangular short-circuited coil of $\frac{1}{4}$-in. x $1\frac{3}{8}$-in. copper bar. This coil was set up as shown in Fig. 1, with one side resting on the wedge in the slot containing the lower half of the coil under repair. The result was to increase the circulating current from 1,400 amp. to 2,000 amp., which was sufficient to bake the insulation. It may be interesting to note that the rectangular coil was held in place so firmly by the magnetic attraction that it required the full strength of a man to pull it away from the slot.

One of the repaired coils successfully withstood a test potential of 22,000 volts applied for several minutes. The coils repaired out of the machine were tested regularly to 14,000 volts, and those repaired in the machine were tested to 10,000 volts. None of the patches broke down, though several of the coils punctured at other places, requiring a second repair. The generator has

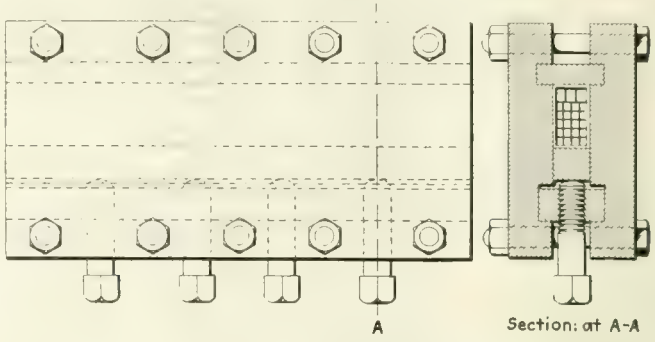


FIG. 2—IRON CLAMP FOR HOLDING MICA INSULATING PATCH ON COIL WHILE BAKING

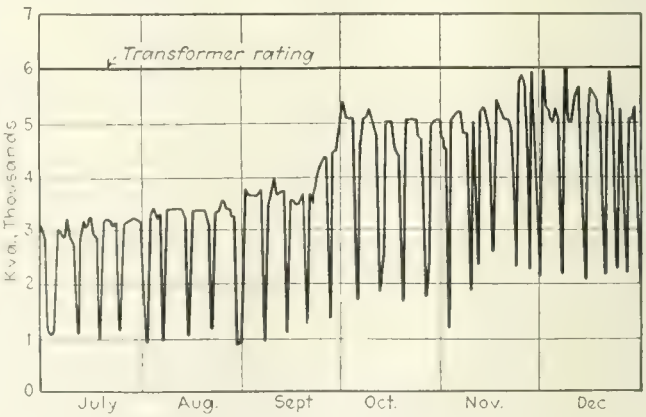
since been in service three months without any indication of breakdown. Later on a coil on the 60-cycle generator broke down on test and was repaired in this manner in considerably less time than was formerly required to insert a new half coil.

C. R. Reid,
Power-House Superintendent.
Shawinigan Water & Power Company,
Shawinigan Falls, Quebec.

Graphic Record Shows When Equipment Is Being Overloaded

In order to see quickly just what load is being carried by substations of the Worcester (Mass.) Electric Light Company, curves similar to the one in the accompanying diagram are plotted weekly from the daily log sheets. This curve shows the daily peaks on a substation serving an industrial district. It will be noted that the load has increased until some of the daily peaks are higher than the transformer rating of the substation. Should the load continue to increase, more transformer capacity must be placed in the substation. The trend of such a curve from year to year affords valuable indication of future requirements.

This is only one of a number of purposes for which



GRAPHIC RECORDS INDICATE THAT MORE TRANSFORMERS MUST BE INSTALLED IN THIS SUBSTATION IF LOAD GROWS

graphic records are kept by the distribution department of the Worcester Company. Several of these records have already been described in the Electrical World.

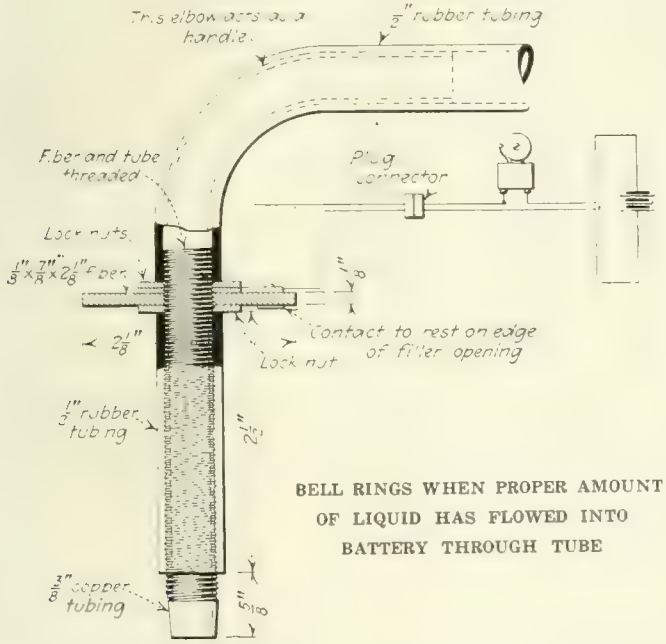
George M. Hardy,
Superintendent.
Worcester Electric Light Co.
Worcester, Mass.

Industrial Applications

The Economical Utilization of Electrical Energy
in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Arrangement for Quickly Filling Alkaline Storage Batteries

A BELL rings a signal when a cell has been filled to the proper height by means of the filler made in the vehicle-battery department of the American Railway Express Company, New York City. This prevents the cell from overflowing and allows the work to be done as quickly as possible. Either water or potash solution may be employed with this filler. The liquid to be used is held in a barrel which is supported upon a movable platform. This platform is a table about 4 ft. high mounted upon a four-wheel hand truck so that it may be moved from one location to another with ease. A faucet is screwed into the threaded opening of the barrel, and to this faucet is attached a rubber tube ½ in. in diameter. On the lower end of the tube the filling device is fastened. This is made by inserting a ⅜-in. copper tube bent as shown in the drawing into the end of the rubber tube. Just below the end of the rubber tube a lamp cord is fastened between two lock-nuts on the copper tube. The lower end of the tube is inserted into a hole in a fiber block, ⅛ in. x ⅞ in. x 2⅛ in. in size, and a lock-nut below holds it firm. Below this a 2½-in. length of ½-in. rubber tube is slipped on to the copper tube, leaving ⅝ in. bare on the lower end. In the end of the fiber block, as shown in the illustration, is set a binding post which extends through the block, forming a contact point below. To this post is attached another lamp cord. The section of the tube above the fiber is then taped up and both lamp cords are taped together to prevent them from being pulled off. To the other ends of these lamp cords a small plug connector is fastened. The receptacle for this is attached to two wires which lead respectively to a small low-voltage battery bell and to a clip which may be attached to a battery terminal post. The other wire from the bell also has a clip which may be attached to a battery terminal post.



BELL RINGS WHEN PROPER AMOUNT OF LIQUID HAS FLOWED INTO BATTERY THROUGH TUBE

In operation these clips are attached across three or four cells convenient to the battery being filled. The faucet is opened, allowing the liquid to flow into the rubber tube after the tube has been pinched shut by the finger. The end of the copper tube is inserted in the vent hole of a cell and the liquid is allowed to flow. When the liquid rises high enough to touch the brass tube, this completes the circuit from the brass tube through the solution in the battery to the metal case of the cell which is touching the contact screw on the fiber block. This causes the bell to ring, which is the signal that the tube should be pinched and the flow of liquid cut off.

The proper height of solution above the plates is about ½ in., and for different types of cells it may be necessary to adjust the length of the tube below the fiber block. Either water or potash solution may be used with this filler as there are no valves or small openings which would be clogged by the potash.

F. A. REIBERT,
Foreman Battery-Repair Department.
American Railway Express Company,
New York, N. Y.

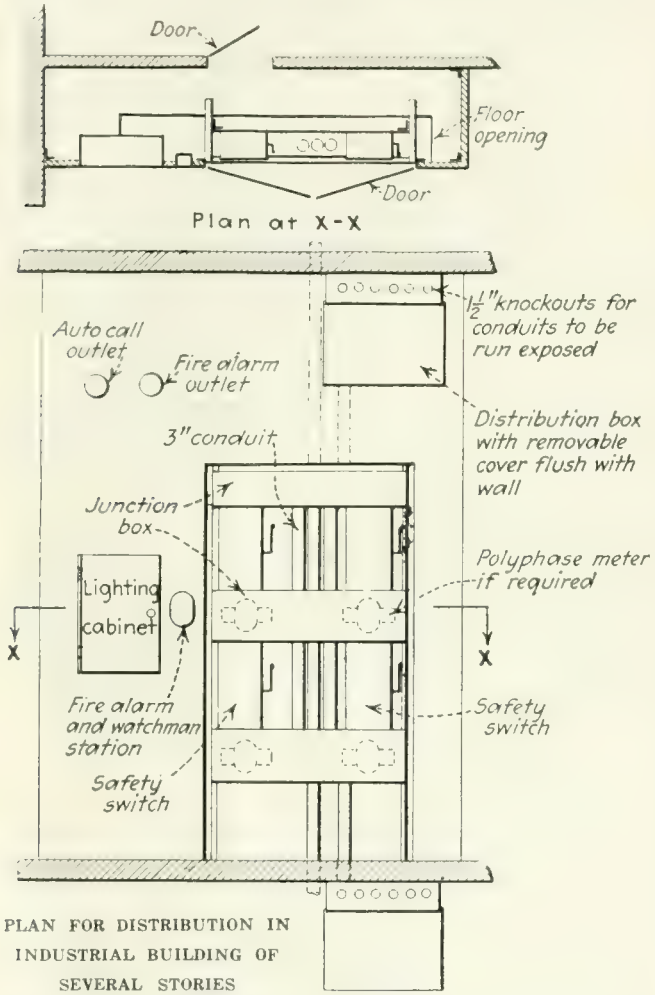
A Method of Distributing Power for Industrial Plants

FOR industrial plants where power is required throughout buildings of five or more stories distributing power can usually be simplified by the use of feeder "chases." Chases, which are nothing more than vertical runways for cables in conduits, are not new in their application, but the points of interest are the details employed in using the chases as control centers for each floor. In the past it has been customary to use slate panels with fused knife switches to control the various circuits on each floor, with sometimes a main switch for "killing" the whole floor, but today engineers are more inclined toward installing safety switches for performing this function, with the advantage of having a safer and more economical installation.

The accompanying drawing illustrates the general details of this type of construction. In this case there is provision for lighting cabinets, watchman, fire alarm and auto-call stations in the same chase at the side of the power section. The walls are of hard cement plaster on expanded metal supported by a steel framework. This steel framework is worked in with the supporting steel for switches, etc. Metal-clad doors are used, and thus a fireproof compartment is obtained.

For closing the openings in the floors inside the chases to conform to the regulations of the fire underwriters, a wire grill was placed over the holes at each floor and covered with mineral wool. This would prevent flue action in case fire succeeded in entering the chases.

There is a large rectangular steel box installed beneath each two switches and one of smaller dimensions above the top switches. The boxes underneath the switches may be used for the dual purpose of junction box and meter box. It may be necessary to meter each



PLAN FOR DISTRIBUTION IN INDUSTRIAL BUILDING OF SEVERAL STORIES

feeder in order to obtain accurate cost records, and this provides for mounting a polyphase meter in the box with a hole through the cover for reading dials, or the meter may be mounted directly on the cover of the box.

Three 3-in. conduits are run between boxes. The one in the center is to carry the main feeder from which the branch circuits are tapped, there being no main switch on each floor. The conduit on the right is intended to carry the branch feeders after they have left the switch. This conduit is terminated at the ceiling in a large pull box from which conduits are run exposed under the ceiling to the various points of usage. This conduit is also extended to the distribution box on the ceiling below, which facilitates running feeders under the floor and finally bringing them up through the floor at the point of usage. The conduit on the left is a spare to provide for contingencies.

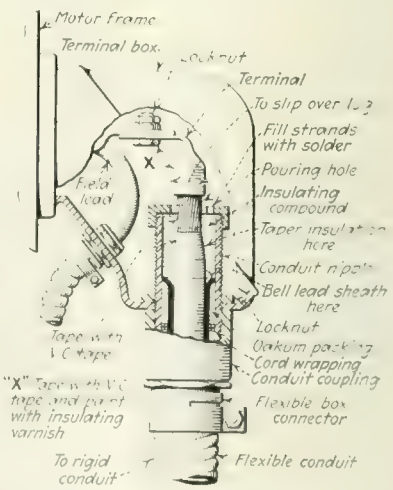
Switches were obtained with boxes deep enough to allow the switch cover to clear the junction boxes. A 5-in. switch box was required, as the junction boxes must be at least 4 in. deep to allow for 3-in. conduits in the side. The switches at the top are of 60-amp. capacity, and the bottom switches are of 100-amp. capacity. All switches are rated at 500 volts, as the system is 440 volts, three-phase, 60 cycles. Switches are installed only as required by the installation of distribution circuits.

Harry M. Hope Engineering Co., Boston, Mass. D. E. HAYNER, Electrical Engineer.

Sealing Cable in Terminal Box

IN A RECENT design of the electrical power layout of a large industrial plant using a 250-volt direct-current service, the choice of power conductors was limited to paper-insulated, lead-covered cable, because of the moisture present and certain other conditions. It therefore became necessary to seal these cables effectively at both the switchboard and the motor ends. This was accomplished in the former case by the use of standard single-conductor potheads, but as the motors were of large capacity and were relatively close to the floor, space would not permit similar construction at the motor end. Furthermore, the small space between the floor and the motor terminal box was utilized by flexible conduit in order to allow a certain amount of adjustment in the alignment of the motors.

Accordingly some means had to be devised of effectively sealing the cables within the terminal box itself, which resulted in the scheme shown in the accompanying sketch. Only common standard pieces were used in order to eliminate the extra expense which would result from the use of special fittings. The parts were assembled as follows: The flexible conduit, box connector, coupling and nipple were secured in place at the end of the rigid conduit protruding from the floor, and the cable was pulled in from the switchboard end, allowing about 6 in. to extend from the end of the nipple. The cable was then wrapped with cord and packing, the lead cut and partly belled out, and the terminal soldered in place. The whole was then carefully taped from the lead up to the terminal, after which the cable was pulled back into the position shown in the sketch. The lead was then belled out tightly against the nipple with a small stick and the nipple secured into the terminal box by the lock nut. After the fiber cap was screwed in place the nipple was filled with compound. The field conductor was brought into the rear of the terminal box and, being rubber-insulated and lead-covered, did not require sealing at the end. All lead sheath and conduit were effectively grounded at the switchboard with standard ground clamps to a copper ground bus.



END OF LEAD-COVERED CABLE SEALED WITHIN MOTOR TERMINAL BOX

With this arrangement the motor can easily be disconnected, either by removing the fiber cap and lock nut or by unbolting the box from the motor frame.

Boston, Mass. R. L. KIRK.

How to Measure Average Power Factor with Reactive-Component Meters

FOR the industrial electrical engineer the measurement of average power factor by the reactive component method is of growing importance, first, because there is an increasing tendency to include power-factor clauses in contracts for the sale of energy, based on this method, and, second, because it gives an accurate indication of average working conditions in an industrial plant. Even where energy is generated in the plant, the method is fully as valuable in establishing a method of checking the number of reactive kilovolt-ampere-hours against the kilowatt-hours used.

The method is comparatively simple and standard integrating meters can be used if desired, although apparatus is now available that eliminates the use of constants in arriving at the true value of the reactive hours. Many studies have been made of this method of power-factor measurement, although the two outstanding ones are one by the meter committee of the National Electric Light Association, W. L. Wadsworth chairman, and a paper presented by F. A. Coffin of the Milwaukee Electric Railway & Light Company at a recent convention of the Wisconsin Electrical Association. In this article both of these sources have been drawn from.

In the determination of average power factor by this method it is necessary to take readings with a kilowatt-hour meter and a reactive kilovolt-ampere-hour meter over a period of time for which the average power factor is desired. Where power factor at the time of maximum demand is required, it is necessary, however, to install printing devices of some kind so as periodically to record the meter reading. It is, however, the average power-factor method and the determination of the total reactive kva.-hours that are the purpose of this study.

The formula used in the determination of power factor by this method is as follows:

Power factor equals the cosine of the angle whose tangent equals total reactive kilovolt-ampere-hours divided by total kilowatt-hours or

$$\text{Power factor} = \frac{\text{Total kilowatt-hours}}{\sqrt{(\text{Total kilowatt hours})^2 + (\text{total reactive kva.-hours})^2}}$$

It is possible to reduce this formula by various ways, and in his paper Mr. Coffin has called the kilowatt-hours A, as the base of the right-angle triangle, and the reactive kva.-hours B, which, of course, is the vertical side of the right-angle triangle. By substitution in the formula and where C equals the hypotenuse of the right-angle triangle or kva.-hours, power factor equals A over C, and therefore:

$$\text{Power factor} = \frac{A}{\sqrt{A^2 + B^2}}, \text{ or}$$

$$= \frac{1}{\sqrt{1 + (B \div A)^2}}.$$

In both of these formulas the problem is to find the true values of the reactive kva.-hours before the power factor can be determined. In Fig. 1 are shown thirteen

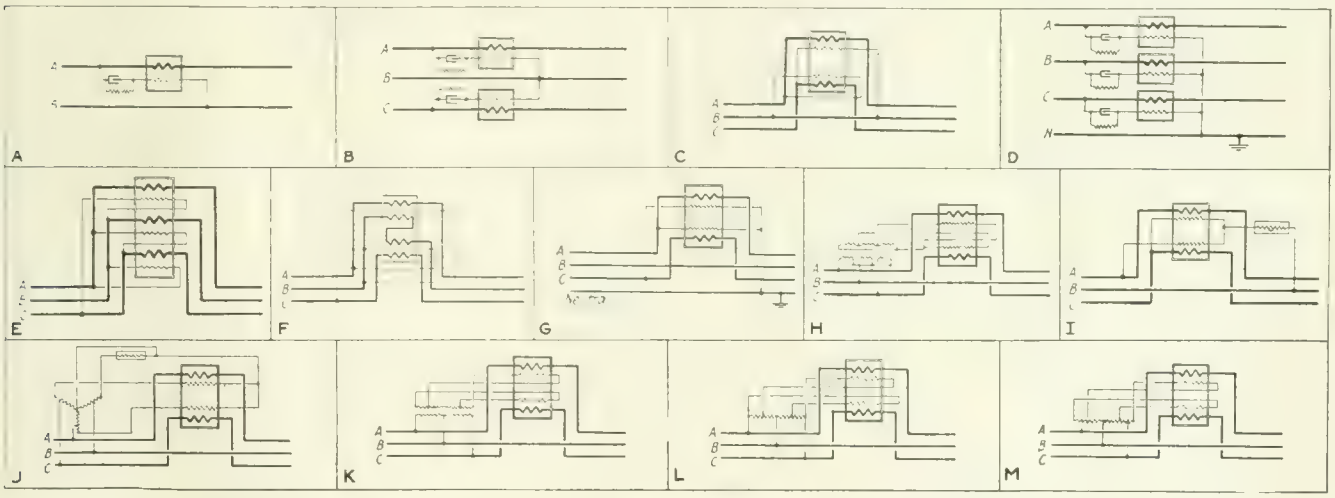


FIG. 1—METHODS OF CONNECTING INTEGRATING METERS FOR DETERMINING THE REACTIVE ENERGY COMPONENT

A—For single-phase measurement it is necessary to employ a special meter with an unlagged potential circuit. This meter has its potential circuit so adjusted as to bring its current in phase with the potential across it instead of 90 deg. out of phase, as in the case of the ordinary watt-hour meter. Standard watt-hour meters may be used for this purpose, provided that suitable means are employed for correcting the phase position of the potential current. A meter in use up to the present time has employed a combination of resistance and condensers for this purpose.

B—Two single-phase meters used on a two-phase circuit in the same general way as in *A*.

C—An ordinary two-element polyphase watt-hour meter with one potential reversed may be used for reactive component metering by connecting a current coil into each phase and impressing the potential of the other phase on the potential circuit.

D—Three single-phase reactive-component meters may be employed for measuring reactive kva. on circuits where a neutral point is available, so that individual phase voltages can be obtained, thus measuring each phase as a single-phase circuit. A three-element polyphase meter may be employed in the same manner.

E—Three-element polyphase watt-hour meter with potential cross-phase. With this connection a constant of 0.577 must be used or this constant must be introduced into the gear train or transformer ratio.

F—Standard four-wire two-element watt-hour meter such as is employed in metering three-phase four-wire circuits. The constant in this case is also 0.577 as in the *E* method, but has the advantage of allowing the use of a standard meter.

G—Two-element meter with a Y potential. The constant in this case is 1.732. Where a neutral is available, connections may be made directly to it, as shown.

H—This method is the same as in G, with the exception that an artificial neutral is established by the use of three potential transformers connected in Y-delta. Under this condition the ratio of transformers may be selected so as to eliminate the use of an odd constant.

I—An artificial neutral may be established by using a special reactor equivalent to the potential circuit of the meter connected from the junction point of two meter potentials to the third deg. For this purpose the potential circuit of another meter of the same type as the one used for measurement may be employed.

J—By the combination of a three-phase auto-transformer and a special reactor circuit the constant of 1.732 may be eliminated and the dial constant be made the same as for a watt-hour meter. In this case the line potential is connected on a tap of the three-phase auto-transformer having a ratio of 0.577 of the entire winding.

K—Two-element meter with open-delta connected potential transformer. This method makes use of a standard two-element polyphase meter and two potential transformers with the middle tap on their secondary winding. The potential coil of each element receives a voltage which is the result of one-half of that which would be impressed upon it if used for watt-hour measurement plus the full voltage for the other element of the watt-hour meter. The potential transformers may be the same as those employed for the watt-hour meters. This method requires that the dial readings be multiplied by a constant of 1.155 if a standard polyphase meter is employed.

L—This method is the same as in K, but is adaptable to low-voltage circuits not requiring potential transformers and makes use of two auto-transformers having center taps. The result is the same as if the middle points of the potential transformers were employed, and a constant of 1.155 is required for the dial reading.

M—A modification of the method shown in L, but so arranged as to give a step up ratio of 1.155 to 1, thus insuring normal voltage upon the meter potential circuit and eliminating the odd register constant.

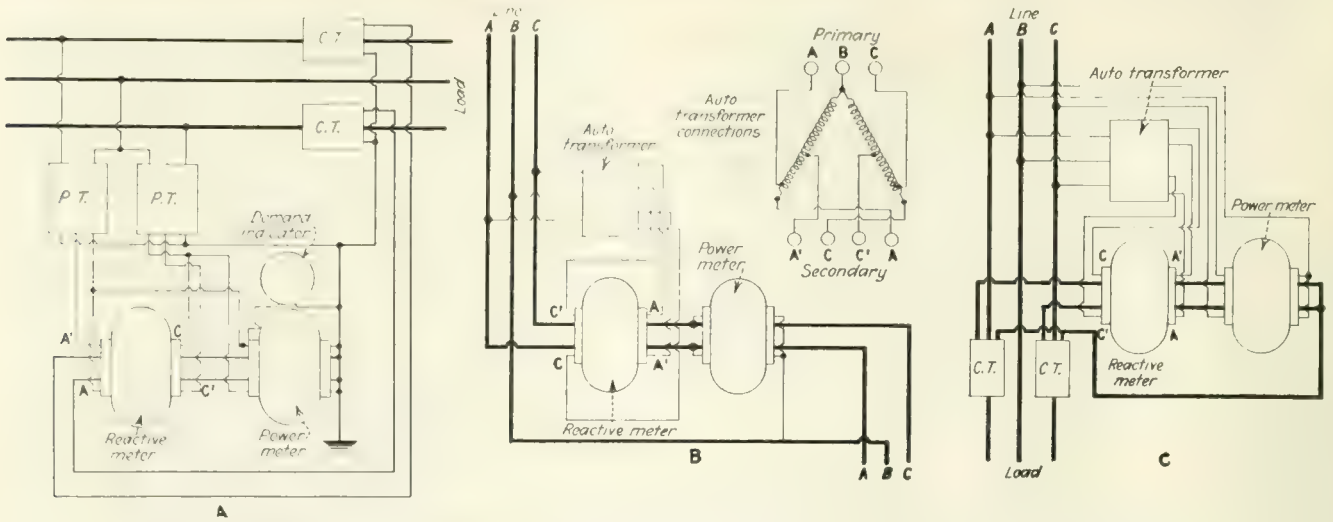


FIG. 2—CONNECTION OF TWO INTEGRATING METERS FOR THE PURPOSE OF MEASURING THE REACTIVE AND ENERGY COMPONENTS

A—While the special voltage is obtained from the mid taps of either potential metering transformers or balancing coils, it is necessary to use a constant of 1.155 in order to get the true reactive hours from the meter registration. In case the reactive meter rotates backward with a lagging load, interchange C with A' and A with C'.

B—Where a special auto transformer is used the connections are as shown. If the reactive meter rotates backward with a lagging load, interchange C with A' and A with C'.

C—Here the auto-transformer is used as in B, but current transformers are also used. In this case if the reactive meter rotates backward with a lagging load, interchange C with A' and C' with A.

wiring diagrams for the connection of integrating watt-meters for the purpose of measuring the reactive component meters. In any of these methods the principal feature is to get the meters connected so that the potential of the reactive component meter will be 90 deg. from the normal potential. In a two-phase system where there already exists a potential 90 deg. out of phase with the current this method can be easily applied in practice by using the potential from phase A with the current from phase B and the potential from phase B with the current from phase A.

In a three-phase circuit, however, a different problem exists. There being no voltage at right angles to the current, it is necessary to develop such a voltage by a combination of the existing voltages. The equipment required in this method, as previously stated, consists of two standard watt-hour meters, one of which may be the regular power service watt-hour meter. The current coils of the second meter, which is used for measuring the reactive component, are connected in series with the current coils of the power meter, but the potential coils are connected from some one phase to a point midway between the other two phases. In other words, if a voltage triangle is drawn, this voltage would be represented by a point midway on the side of the triangle.

In the case of primary service installations metering

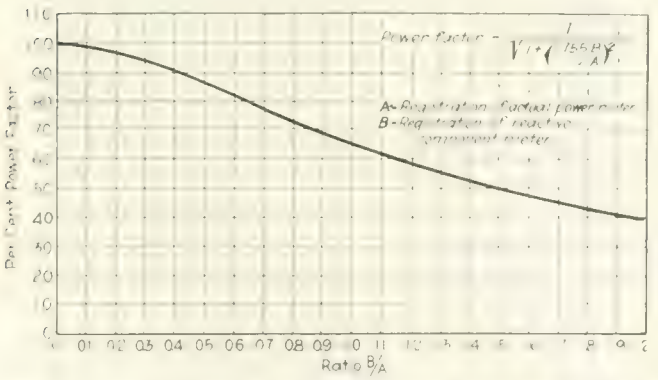


FIG. 3—POWER FACTOR MAY BE READ DIRECTLY WHEN THE RATIO B/A IS OBTAINED BY THE METHOD OF FIG. 2A

is done on the primary side of the service transformers and potential metering transformers are used. Mid taps are usually found on the secondaries of these transformers, and the desired voltage connections can be obtained without the use of additional equipment.

In the case of secondary service installations, however, where the metering is done on the low-voltage side of the service transformers and potential metering transformers are not used, it is necessary to use a special auto-transformer, or possibly two ordinary three-wire balancing coils, to get the necessary voltage connections. Fig 2 shows a diagram of typical metering connections where the special voltage is obtained from the mid taps of either potential metering transformers or balancing coils.

With connections made in this manner it must be remembered that the voltage impressed upon the reactive component meter is only 86.6 per cent of the voltage on the power meter, and consequently the registration of the reactive meter will be only 86.6 per cent of the actual reactive component, or the reactive component will be 1.155 times the reactive meter registration B, and the equation will become:

$$\text{Power factor} = \frac{1}{\sqrt{1 + (1.155\ B \div A)^2}}$$

In Fig. 3 a curve has been plotted by Mr. Coffin from which it is possible to arrive at the power factor by using the direct ratio of B/A. It is also possible, if desired, to calibrate the reactive component meter by adjusting the disk constant so that the registration will be the correct reactive component.

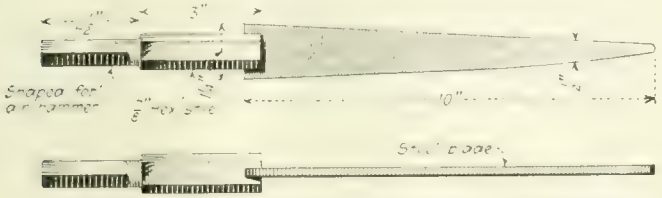
Manufacturers of metering equipment have developed a special auto-transformer for use in this form of metering which is relatively inexpensive and has the proper voltage taps to give correct registrations on the reactive component meter and require no correction in equation. Figs. 2B and 2C show diagrams of the connections of this transformer and typical metering connections where it is used. It may be considered a regular accessory to the reactive-component meter and used even where potential metering transformers are in service.

Air Hammer Forces Impregnated Coils from Slots

A QUICK method of removing impregnated coils from motors developed in an Eastern shop makes use of an air hammer which forces a steel chisel under the coils. The chisel should be almost as wide as the slot, shaped long and tapered somewhat as shown in the accompanying drawing. The large end is formed to fit in the air hammer. This air hammer is size No. 1, ⅞ in. x 3 in. Before the chisel is applied the wedges are first driven out with wedge drifts. In operation the small end of the tool is inserted under the coil at the end of the slot nearest the commutator and the air is turned on the hammer. The tool is then moved into the slot, forcing out the coil.

When removing coils from a closed or partly closed slot the ends of the coils at one end of the machine are first cut off flush with the laminations by means of a cold chisel with a flat, wide blade. Then the coils are pulled out at the other end by means of an iron bar. One end of the bar rests on a wood block placed on the end laminations to prevent damage by the bar. By prying up on the point of the coils they are pulled through the slots. Several coils may sometimes be pulled at once.

After the coils are removed a portion of the slot-cell insulation has a tendency to stick to the iron. This is removed very quickly by the application of a gas



CHISEL HELD IN AIR HAMMER FOR FORCING IMPREGNATED COILS OUT OF SLOTS

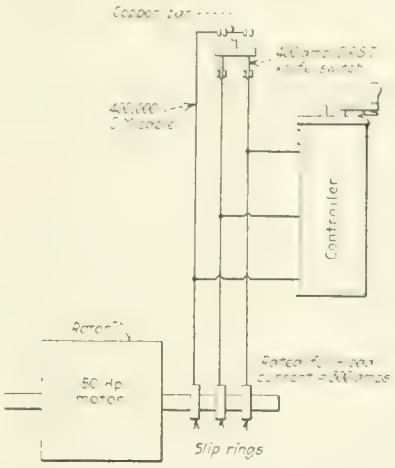
flame mixed with a slight air pressure directed into the slot, care being taken not to overheat the iron by holding the flame too long in one spot. This method has been found to be a great improvement over the old way, that of scraping, as it saves time besides leaving a smooth surface in the slots for the new cell insulation. After this operation the laminations must be examined and any sharp points must be filed off.

East Orange, N. J. E. R. DEBMAN.

Additional Switch Saves Contacts of Starting Controller

TO PREVENT burning of the "running" contacts of starting controllers which were evidently overloaded, a short-circuiting switch was employed by the writer with good results. The controllers were connected on the three-phase secondary side of two 150-hp. slip-ring induction motors. Owing to war conditions, the plant was forced to accept starting controllers of obscure manufacture, as none of the first-class companies could make delivery. Apparently these controllers were badly overrated, because after a few weeks of service both of them caused trouble by burning the running contacts so severely that the motors had to be shut down until the contacts could be replaced. This continued to happen at intervals of only two or three weeks until the knife switches were installed, as shown in the accompanying sketch. These two-pole, single-throw switches relieved the controller contacts of a great deal of the current and entirely eliminated the trouble, the present contacts having been in service more than three years.

The motor is started with the controller, as usual, and after the controller handle reaches the final position the switch is closed, providing a short circuit of low resistance in parallel with the controller. Incidentally, this gives the motor slightly better operating characteristics by reducing the resistance of the secondary circuit. It is of course understood that this expedient adds one more switch to be opened before the motor is started again. In stopping the motor it should always be slowed down by the starting controller before the line switch is opened. Before this can be done the short-circuiting switch must be opened, and therefore it adds no danger to the installation. It is, however, sometimes the practice to stop the motor by opening the line switch first, and sometimes this switch is opened by overload relays. The operator must then bring the controller to starting position before he throws in the line switch. In such a case there is a chance that he may forget to open the short circuiting switch. Such neglect will allow line voltage to be thrown on the motor while its secondary is short-circuited, which may cause serious damage.

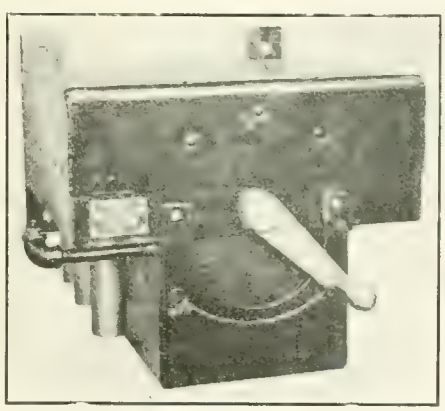


BURNING OF RUNNING CONTACTS PREVENTED BY SHUNTING WITH KNIFE SWITCH

Empire Tire & Rubber Corp., M. J. RICH,
Trenton, N. J. Experimental Engineer.

Inclosed Fused 2,500-Volt Switch

AN INCLOSED fused 2,500-volt entrance switch has been developed recently for application on high-voltage distribution where safety features are desired. This switch is rated at 100 amp. and 2,500 volts and is made with two and three poles, single-throw. These switches are principally for use by distributing companies at the end of 2,500-volt distributing lines and at the entrance of the line to the customer's plant. All live parts are completely inclosed in a pressed-steel case and tank. The leads enter through fiber bushings, and the cover cannot be opened when the switch is closed.



2,500-VOLT SWITCH COMPLETELY INCLOSED —STANDARD FUSES MOUNTED INSIDE

Central Station Service

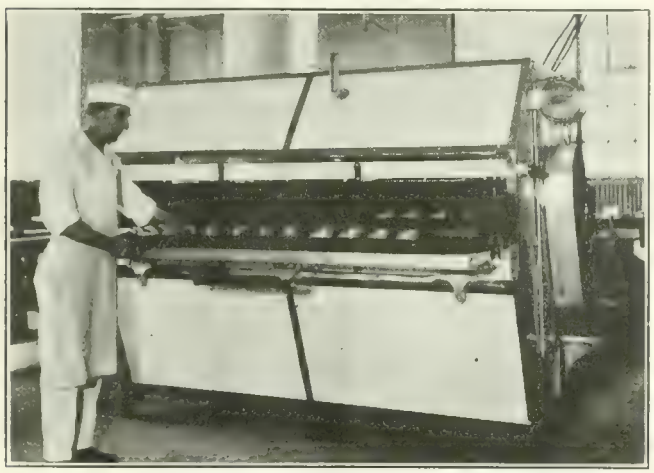
A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Commercial Baking by Wire

By John M. Strait

ONE of the comparatively new fields for increasing the central-station company's revenue is commercial heating, and the electric bake oven offers a steady, profitable load which comes for the most part at off-peak hours. The development of electric baking has reached a stage where absolute certainty as to the uniformity and quality of the baked product is assured, and it is being applied to many commercial bakeries with complete success. Uniformity of product, automatic temperature control, flexibility, economy and ease of operation are among the outstanding features of a recent type of electric oven shown here.

The oven is equipped with six standard oven heaters, each rated at 3.5 kw. at 220 volts, giving a maximum



FRONT VIEW OF ELECTRIC BAKE OVEN

capacity of 21 kw. These heaters may be operated continuously day after day without danger. The oven has a capacity of 112 1-lb. loaves, or 96 1½-lb. loaves, or 56 pies, and is capable of turning out 200 or 160 loaves and 100 pies respectively per hour.

There is a distinct saving in labor and time which is effected primarily by the ease and simplicity of control and operation of the oven. Owing to the fact that after the thermostat has once been set at a given value it requires no further attention, a baker can turn out considerably more bread, pies and cakes than with any other type of oven, and he has the further assurance of an absolutely uniform product. The operation is simplicity itself. If an operating temperature of 450 deg. Fahr is desired, the thermostat is set at 450 deg. The "on" button is then pushed, turning on the current, and the oven is allowed to attain the baking temperature, after which the automatic control automatically maintains the baking temperature. The raw products are then placed in the oven to its capacity and the motor drive started to operate at its rated speed of one revolution per minute. No further attention is required until the expiration of the baking period as given in the instructions. Baking temperature will be attained in one hour.

The superiority of bread, pies, cakes and pastries baked by electric heat over those baked in a coal, gas or oil-fired oven will convince even the most skeptical baker that the electric oven produces ideal results.

Commonwealth Edison's Method of Compensating Salesmen

THE Commonwealth Edison Company of Chicago has a very complete, carefully worked-out system of compensation of salesmen on either a split salary and commission basis or a straight commission basis. The system has been in practical operation for some time and was designed with the following objects in view: (1) To obtain business, especially of the classes known to be profitable; (2) to hold present customers, keep them satisfied and encourage them in the larger use of electricity; (3) to develop new avenues for the use of electricity and to educate the public to its wide use; (4) to put a premium on constructive business getting as against mere order taking; (5) to follow up business secured and have it connected without delay.

The schedule provides for the payment of commissions to lighting, power, heating, house-wiring, store-lighting, industrial-lighting and appliance salesmen. It provides that the total amount of commission paid to any one salesman shall not exceed $2,000 per year, and that salesmen working on a straight commission only shall be unlimited as to the amount each can earn in any one year.

The rules and regulations covering the payment of commissions on classified business are compiled with the sole purpose of paying commissions in accordance with the value of the respective classes of business to the company.

The schedule also provides for the payment of commissions based on horsepower, on 50-watt equivalents, on number of sockets, on number of receptacles, on specified units, 100-watt, 200-watt, etc., or on respective appliances, all in accordance with the classification of the various kinds of business and also the value of the sale to the company. It also provides for the payment of a smaller commission on "successor" contracts limited to one within a definite period.

It is interesting to note that in the case of house-wiring contracts a larger commission is paid on all floor or chair rail receptacles than on lighting outlets when they are in addition to the regular lighting outlets in the same room.

Ninety per cent of the commission is paid to the salesman and 10 per cent to the supervisor in charge. The schedule further provides for the imposing of penalties for discontinued business upon which commissions have been paid.

Apportioning Power Costs Among Various Classes of Consumers

By G. E. Quinan
Chief Engineer Puget Sound Traction, Light & Power Company

SO MUCH has been said on the subject of service cost that it will perhaps be well to dispel at the outset any apprehension there may be that a complete solution of the whole matter is about to be offered. The writer might have undertaken such a commission twenty years ago, and with a light heart, but at the present time will content himself with offering a method for apportioning against the various classes of service those costs which result from the common use of facilities by two or more classes but which cannot be easily and directly traced to any one class. These have been called fixed costs, but they are not fixed costs in the strict accounting sense, as the following tabulation will show:

Costs to Be Apportioned

A. Investment (annual charges). (Does not include investment made or reserved exclusively for the class under consideration.)

B. Operation and maintenance of above. (Does not include fuel, feed water or other items that vary with use.)

C. Proportion of general expense.

Costs Directly Assignable

A. Investment (annual charges). Includes all investment made or reserved exclusively for the class under consideration, embracing such items as meters, services, service transformers, distribution lines, etc.

B. Operating cost. Includes operation and maintenance of above. Includes also items which can be readily traced to the class or individual, such as fuel, feed water, utilization expenses, bookkeeping, billing, etc.

C. Proportion of general expense.

The above classifications are not intended as categories to be invariably followed, but are merely illustrative of the character of costs which in the one case must be apportioned and in the other may be directly assigned, partly on the basis of kilowatt-hours used and partly on basis of number of customers. General expense as carried on the utilities' books should be distributed as far as possible to the various operating accounts. The remainder may then very reasonably be split between the two above classifications in the proportion of the totals of all other costs.

This discussion will be confined to the first of the two general classes of costs, which for want of a better term will be called "fixed costs."

Cost Responsibility

Common fixed costs are by this method apportioned on the basis of the "cost responsibility" of each class of service, which is considered to arise out of the *use made,* and is completely determined when the relation of this use to the total use is known. It is not influenced in any way by the value of the service or kindred considerations which find their proper place not in costs but in rates.

The apportionment of cost against any class, depending as it does both on the use of the particular class and on the combined use of all other classes, will be called the "relative cost." This expression is appropriate also in that an apportioned cost attaches to a particular class not in an absolute sense but as its relative portion of a common burden.

Now we have a faithful picture of the use which each class makes of the company's facilities in its characteristics load curve, and we have in the system load curve a picture of the combined use of all classes. The part played by any one class in helping to produce the composite picture will now be analyzed.

As is well known, the combined demands of customers vary at different times of the day and year. Because of their habits and necessities they require, collectively, a much greater investment to serve them at 5 p.m. than at 3 a.m., a greater investment at 10 a.m. than at 10 p.m. Referring to accompanying chart, it is seen that the combined demands of all consumers around 4 p.m. require the installation of 5,000 kw. of capacity which is used less than two hours per day; to meet the demands at 10 o'clock in the morning requires 5,000 kw., which is used less than seven hours per day, while the total capacity of 30,000 kw. required at 3 o'clock a.m. has not an idle minute throughout the twenty-four hours.

We can, in fact, readily think of facilities as consisting of a number of individual plants, of equal capacity (for simplicity), operating for various durations each day.

In the chart below it is assumed that there are sixteen plants, of 5,000 kw. each, to carry the maximum point of the system load curve *A*. All but five of these are idle part of the day, the idle hours for each

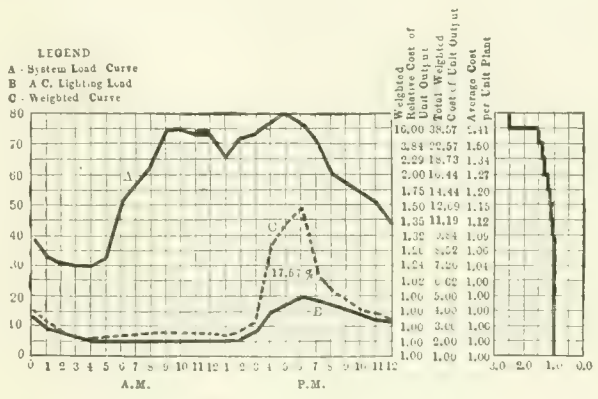


CHART FOR PRORATING POWER COSTS AMONG DIFFERENT CLASSES OF CONSUMERS

plant increasing progressively from the bottom to the top of the chart. The output of each of these partly idle plants is less than that of the first five, and the cost per unit is therefore greater.

The cost of one hour's use of each of the first five plants is evidently one-twenty-fourth of the day's fixed costs on each plant; the cost of one hour's use of a plant which operates only twelve hours a day is evidently twice as great, or one-twelfth of the day's fixed costs on that plant.

On the chart the cost of unit output of a continuously operating plant has been taken as unity, and the weights in the first column indicate the relative costs of unit outputs of each of the sixteen plants. It will be seen that the fourth plant from the top operates twelve hours a day and so has the weight 2, and the uppermost plant operates only one and one-half hours a day and has the weight 16.

Now, consider the system load curve during the hour from 9 a.m. to 10 a.m. Customers using power at that time require, collectively, fifteen of the sixteen plants to serve them, with weights ranging from 1 to 3.84. The total cost of serving them for this one hour is equal to the sum of the weights or 22.57 (see second column

2), while the average per plant for this hour is 22.57 divided by 15, or 1.5 (times the cost of one hour's use of a continuously operating plant, which we assume to be unity).

This figure 1.5 (see column 3) is the weight applying to the hour between 9 a.m. and 10 a.m. and to all other hours of the day when the system load curve lies between 70,000 kw. and 75,000 kw. Weights for each hour of the day, obtained in the same way, are given in column 3. To find the weight for any hour, as 6 a.m. to 7 a.m., note the value of the system load curve at that time. It lies between 50,000 kw. and 55,000 kw. and, following horizontally to the right, we find in column 3 the weight 1.15. This weight it will be seen applies also to the hour from 10 a.m. to 11 p.m. The weights in column 3 are plotted in the broken-line curve at the extreme right of the chart. They could obviously be plotted as a continuous curve under the system load curve.

Relative Cost for Given Class of Service

Having established a means for consistently relating costs at all hours of the day, we are now in position to ascertain the "relative cost" for a given class of customers. Curve *B* on the chart is the load curve of such a class. The area under curve *B* is proportional to the kilowatt-hours used by this class, and if the fixed cost of producing them were the same at all times of day, the area would also be proportional to the cost. Since the cost of serving varies, it is necessary to allow for this, which can readily be done by multiplying the hourly ordinates of curve *B* by the corresponding weights, thus obtaining curve *C*, whose area is directly proportional to cost. Obviously the area of the rectangle embraced between the base line and the dotted line at the top of the chart is proportional to total system cost, and the ratio of the area of curve *C* to the area of the rectangle gives directly the part of the system cost to be assigned to this class.

On the chart the ratio of curve *C* to the rectangle is about 17½ per cent, meaning that the *B* class of service has a relative cost equal to 17½ per cent of the system fixed costs. It is interesting to note that the maximum demand of the *B* curve is 25 per cent of the system demand and the demand at the time of system peak is 22½ per cent of the latter.

Having the relative cost for the class, this can be translated into cents per kilowatt-hour, or dollars per kilowatt per year.

Composite Curve of Seasonal Variations in Customer's Load

The above illustration has for convenience been based on the daily load curve. In order to obtain closely accurate results, the seasonal variations in load must be considered, which can be done with sufficient accuracy as follows:

For a class whose annual load parallels closely the system load curve it will be sufficient if a characteristic daily load curve taken at the peak-load season of the year is used together with the corresponding system curve. For other classes a composite daily load curve can be obtained for the class and for the system by taking a characteristic day for each of the four seasons of the year, and the analysis then can be carried through.

It will also be readily appreciated that on a large system it may be necessary to introduce several steps into the analysis. To illustrate this we will refer again to the chart. While it is clear that curve *B* must bear 17½ per cent of the generating cost, the percentage for transmission and substation cost will possibly be different. It can easily be obtained by using, instead of the system curve, the load curve of the line and substation of which curve *B* constitutes a part. This can be further extended to the distribution system when accuracy requires it.

Method Enables Segregation of Individual Class of Business

By means of the method described the relative cost can be obtained for any class or sub-class whose load curve can be drawn, and can even be found for the individual consumer whose load is of appreciable magnitude with respect to the system load. Further, it is evident that the method of apportionment is not concerned with the magnitude of total cost, but is applicable for the apportionment of any sum of money which it may be desired to set against a major division of the business as the cost to be collected in that division.

For instance, in case the public service commission has jurisdiction over lighting rates but not over power rates, it may be necessary to make a division of total cost between these two classes on some basis arising out of the regulatory situation. Having made the division, the apportionment within each class can be consistently carried through by the method here described. Or, if it is desired to consider that all costs are occasioned during sixteen hours of the day, the total cost can be apportioned on the basis of this part of the load curve with entire consistency.

The foregoing scheme of apportionment has been used by the writer in the Puget Sound district for several years past with generally satisfactory results. Cost schedules were prepared for different classes of power consumers with special attention to the hours of the day when power was used, and these have been used as a basis for comparing estimated revenue with the cost of prospective new business, and for reference in the preparation of rate schedules.

Boston Edison Curtails List of Free Renewal Lamps

EFFECTIVE June 1, the Edison Electric Illuminating Company of Boston announced a curtailment in the list of free-renewal lamps furnished customers in exchange for used lamps. Owing to the discontinuance by the manufacturers of the 100-watt vacuum lamp "B" class, it will become necessary to discontinue the supply of these to customers at an early date. The only vacuum lamp now renewed free is the 50-watt "Mazda" type in pear-shaped bulb, either plain or bowl-frosted, whereas in the former schedule the 50, 100, 150 and 250-watt "B" lamps were renewed free. The 75-watt gas-filled or type "C" lamp in a pear-shaped plain bulb is now listed by the company for the first time and exchanged at 30 cents, the 100-watt "C" lamp being exchanged at 40 cents. The company is calling its customers' attention to the 75-watt and 100-watt "C" lamps as logical substitutes for the 100-watt "B" lamp to be discontinued, and it points out that the increased efficiency of the "C" lamps is considered ample justification for the retirement of the "B" lamps in duplicate sizes.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Steel Works Motors.—W. W. WOOD.—Where three-phase current is generated and used for the main motors, the writer says, the modern three-phase live-roll motor can be used without the expense and losses of conversion necessary for direct-current machines and can be relied on to give as good service and greater reliability than a direct-current motor. No hard and fast rule can be laid down, however, as each case must be considered on its merits.—*Beama* (British Electrical and Allied Manufacturers' Association), May, 1921.

Some Recent Developments in Large Steam-Turbine Practice.—K. BAUMANN.—An abstract of an important contribution to the subject of development of large steam-turbine units of various types and makes. It is said that the chief factors governing turbine design are (1) reliability, (2) working conditions, (3) thermodynamic efficiency, and (4) over-all dimensions, weights and costs. These items are discussed in detail. An interesting cost analysis is given for a power station of a total installed capacity of 100,000 kw. and steam consumption of 10 lb. per kilowatt-hour, as follows:

TYPICAL BRITISH STEAM-ELECTRIC STATION COST

	Total Cost	Ratio of Total	Cost per Kw.
1 Land, buildings and foundation, roads and railway sidings	£850,000	0.303	£8 50
2 Boiler-house plant	480,000	0.171	4 08
3. Coal-conveying plant	140,000	0.050	1.40
4. Turbine	250,000	0.089	2 50
5. Condensing plant, house set and auxiliaries	220,000	0.078	2.20
6. River work, water culverts	150,000	0.054	1 50
7. Alternator	220,000	0.078	2 20
8. Transformers	100,000	0.035	1 00
9. Switchgear and instruments	200,000	0.071	2.00
10. Converting plant, wiring, cranes, miscellaneous	200,000	0.071	2 00
Total	£2,810,000	1.000	£28 10

Item 1 may be subdivided into: (*a*) For boiler plant, £3.5 per kilowatt capacity; (*b*) for condensing plant £1.5 per kilowatt capacity; (*c*) for electrical plant and turbine £3.5 per kilowatt capacity.

	Per Kw.
A. Cost of plant which depends on the kilowatt capacity of the station (1) + (7) + (8) + (9) + (10)	£10 7
B. Cost of plant which depends on the steaming capacity of the station (1*a*) + (2) + (3)	9.7
C. Cost of condensing plant which depends on the steaming capacity and on the thermodynamic efficiency of the turbine (1*b*) + (5) + (6)	5 2
D. Cost of turbine	2 5
Total	£28 1

The original paper contains a tabular résumé of turbine troubles from 1917 to 1920, with reference to the source of information in each case.—London *Electrician,* April 15, 1921.

Regulation of Synchronous Generators.—A. G. WARREN.—An analysis of some of the methods of predetermining regulation of synchronous generators of large size. In this issue the synchronous impedance and magnetomotive-force methods are discussed, other methods being reserved for succeeding numbers.—London *Electrician,* May 13, 1921.

The Importance of Efficiency in Electrical Machinery.—MILES WALKER.—A discussion of the problem of the saving effected by the use of more efficient machinery in comparison to the greater fixed charges due to higher first cost.—London *Electrician,* May 20, 1921.

Lamps and Lighting

Safety Features of Industrial Lighting.—SAMUEL G. HIBBEN.—The possibility of increasing production speed and the elimination of dangers to employees are the chief factors dealt with in this article. Results of unshielded lamps on eyesight are also considered.—*Electrical Review,* May 14, 1921.

Generation, Transmission and Distribution

Transmission System of the West Penn Power Company.—GEORGE S. HUMPHREY.—A discussion of transmission-line construction and operating problems in connection with this system.—*Electric Journal,* May, 1921.

On a Theory of Fluid Friction and Its Application to Hydraulics.—E. PARRY.—The paper calls attention to a modern theory of fluid friction which is more comprehensive than the older theory and is said to be so adequate for its purpose as to obviate any recourse to the empirical analysis which has so far dominated the subject. The theory as set forth is partly mathematical.—*English Electric Journal,* Vol. I, No. 4, page 146.

Standardization of High Voltage in Switzerland—I.—WYSSLING.—Low-voltage standards having been established, the Swiss government is now trying to determine certain normal high tensions for its power stations. Preliminary, 50-cycle, three-phase lines are considered. Single-phase railway systems with 15 cycles to 16⅔ cycles and high-voltage direct-current lines are for the present excluded from this standardization. After due consideration of the results of a vast amount of statistical work, the authorities concluded that there should be two main groups of voltages, *i.e.,* medium tension and highest tension. The lower limit of the first group should be not less than 2,000 volts, preferably higher, the upper limit not more than 16,000 volts. The latter value is to be such as to permit its direct generation by alternators and its direct use in large motors. Statistics showed that 8,000 volts is at present most used for this group, with 6,000 volts and 10,000 volts coming next. In the second group the voltage in the overwhelming majority of cases is 42,000. The question was brought up of what relation, if any, there should be between adjacent voltages, if more than one were used in each group. The logical assumption was the ratio of one to the square root of three, but much thought has been given to Rüdenberg's suggestion of one to the fourth root of ten. The association of Swiss manufacturers has finally submitted two alternatives: (1) 3,300-6,000-10,000-18,000-33,000-60,000-100,000-180,000 volts and (2) 4,800-8,500-15,000-27,000-48,000-85,000-150,000-270,000 volts. Preference is given to the first of these alternatives, with the further suggestion to interpolate a voltage of 8,000. One of the main reasons for this preference is that these

figures conform to most of the foreign voltages. But the Swiss National Federation prefers the second series both for medium and high values. Six main questions have finally been formulated in reference to the two series of voltages, and these have been sent out to all Swiss power plants, manufacturers and public service companies for further comment and discussion. The outcome of this questionnaire will decide the final adoption of standard voltages.—*Bulletin of Swiss Electrotechnical Society*, Vol. IV, No. 12.

The Modern Steam Condenser.—E. R. Briggs.—Tendencies in the design of modern steam condensers of large capacity are dealt with.—*English Electric Journal*, April, 1921.

Water Power Developments.—Daniel W. Mead.—A discussion of the question of the amount of total developed and undeveloped horsepower of water-power developments in the country.—*Electric Journal*, May, 1921.

Boiler Tests with Pulverized Illinois Coal.—Henry Kreisinger and John Blizard.—The authors present a summary of the results obtained in an extended series of tests of a 468-hp. water-tube boiler fired with pulverized Illinois coal. The results show that, contrary to the customary specification, it is not necessary to pulverize the coal to the extreme fineness of 85 per cent through a 200-mesh screen in order to get good combustion and good efficiency. This ability to burn coarser coal means increased capacity of the pulverizing mills and decreased cost of coal preparation. The results also show that it is not necessary to dry coal to about 1 per cent moisture in order to burn it successfully in pulverized form, and it is stated that with most Eastern coals drying is not at all necessary. Good results can be obtained when the coal is burned at rates varying from 0.5 lb. to 2 lb. per cu.ft. (8 kg. to 32 kg. per cu.m.) of combustion space per hour, and the best results at a rate of 1 lb. to 1.5 lb.—*Mechanical Engineering*, May, 1921.

Progress in Transmission at 220,000 Volts.—John A. Koontz.—The writer deals particularly with research work in insulation for extra-high-voltage lines.—*Journal of Electricity and Western Industry*, May 15, 1921.

Observation of Temperatures in Power Stations.—G. Kleinath.—Although it is essential for the most economic and safe operation of power stations to be able to know constantly the exact temperature of such vital elements as boiler fires, steam, feed water, generators, bearings, transformers, switches, etc., only a very sporadic use of proper instruments is being found even in modern European power plants. Mercury thermometers, while useful up to about 500 deg. C., are not reliable, because they will frequently give errors as high as 30 deg. Thermometers of the resistance type and thermocouples are most reliable. The former may be used up to 800 deg. C., the latter up to 1,600 deg. C. Higher temperatures may be measured accurately only with optical pyrometers. Full value of the temperature control can be achieved only with self-registering instruments. The author gives a detailed description of a great variety of methods and instruments and mentions the fact that temperature control of electric machines is being used extensively in American plants. —*Elektrotechnische Zeitschrift*, May 5, 1921.

Transmission of Electric Waves Along Wires.—A. G. Warren.—The first part of the paper embodies a determination, using elementary mathematics only, of the fundamental equations of a long transmission line. The interpretation of the equations is also discussed.—*Journal of Institution of Electrical Engineers*, Vol. 59, page 330.

Recent Improvements in Steam-Turbine Design.—During the past few years manufacturers have had to concentrate on the construction of accepted designs rather than experiment with new ideas, but since factories have returned to peaceful production a number of new inventions have been put into practical use. It is proposed to discuss these improvements in this and succeeding articles of the series. In this article a type of unit specially designed for shipboard use is described. —London *Engineer*, May 6, 1921.

Traction

Motion Phenomena on Catenary Suspension Systems for Electric Railways.—E. Zeulmann.—For the safe collection of current from overhead lines it is of greatest importance to maintain as perfectly as possible the horizontal location of the trolley wires. During the past twenty years a great many systems of catenary suspension have been developed with more or less successful take-up devices for any slack of the wire. The author compares the main groups of these systems and arrives at the conclusion that an arrangement with free side-swinging supports and both messenger and conductor take-up gives best results. He asserts that only this system permits of the use of different metals for messenger and conductor—for example, aluminum cables as messenger and a steel wire as conductor.—*Elektrische Kraftbeitriebe und Bahnen*, April 24, 1921.

Electric Locomotives of the Gotthard Railway.—W. Heyden.—A detailed description of the alternating-current types used on this tunnel line, comprising the 1B + B1 express locomotive (107 metric tons weight, 2,000 hp., built by Brown, Boveri) and the 1C + C1 freight locomotive (128 metric tons weight, 1,700 hp., built by the Oerlikon works). An overhead line operating at 15,000 volts is used.—*Elektrische Kraftbetriebe und Bahnen*, April 10, 1921.

A Review of Recent Large Electric Locomotives.—A. Laternser.—A comparison between recent American and European locomotives for electric service. Tabular data are given showing the physical characteristics of the various locomotives.—*London Electrician*, May 13, 1921.

Installations, Systems and Appliances

Electric Winders.—J. Kirkwood.—Control of winding machinery for electric hoisting is dealt with by the author in this article.—*English Electric Journal*, April, 1921.

Using Accumulated Heat.—R. Wolff.—It is suggested that water can be heated electrically in heat-insulated containers and used in hot-water-heating systems. The heating would take place during the off-peak periods, when advantage could be taken of a low tariff for energy. It is proposed to actuate the heater by an automatic time switch. Two types of heaters are described.—*L'Electricien*, May 1, 1921.

Relay Protective Features of the Toronto Power Company's Transmission and Distribution System.—P. Ackerman.—A discussion of the problem of protecting the Toronto-Niagara system, giving results with time-limit protection, parallel-feeder protection, double-line protection and the ground selector. The paper concludes with details of design for the various methods of protection

mentioned.—*Journal Engineering Institute of Canada,* Montreal, April, 1921.

Review of Cost of Rolling Steel in Various Mills.—G. E. STOLTZ.—The author urges the adoption of electric drive in place of existing steam drive for the main units of rolling mills and presents data to show the saving possible with the electrical system.—Paper presented before the Association of Iron and Steel Electrical Engineers, May, 1921.

High-Frequency Absorbers.—I.—G. FACCIOLI and H. G. BRINTON.—This article deals with the effect of resistance in series with a capacitance used as a "high-frequency absorber." It is said that such an absorber is a valuable adjunct to a lightning arrester in protecting against those transient disturbances which are of too low voltage to spark over the arrester but which may still be dangerous because of steep wave front and because under certain conditions they result in the building up of local oscillations.—*General Electric Review,* May, 1921.

Electrochemistry and Batteries

Control of Corrosion in Iron and Steel Pipes.—F. N. SPELLER.—The causes of corrosion, external and internal, in iron and steel pipe mains, with a summary of control methods.—*Journal of Engineering Institute of Canada,* Montreal, April, 1921.

Study of the Photo-Active Electrolytic Cell, Platinum-Rhodamine-B-Platinum.—CARLETON C. MURDOCK.—The range of the current-time equations is investigated in this article; also the polarization capacity of the cell and some other cases, as, for instance, there is a flow of current without any light on the electrodes.—*Physical Review,* May 1921.

Units, Measurements and Instruments

Measurement of Power at Low Power Factors.—H. COTTON.—A mathematical treatment of the effect of the lag of current in the potential coil of a wattmeter applied to the measurement of power at low power factor.—London *Electrician,* May 6, 1921.

Pyrometric Practice.—PAUL D. FOOTE, C. O. FAIRCHILD and T. R. HARRISON.—A very comprehensive report, of more than 300 pages, profusely illustrated and describing practical methods in use in the industries in the year 1920. The treatise contains nothing of historical development, and purely scientific aspects of pyrometry have been subordinated to practical methods and devices.—*Technologic Paper No. 170, U. S. Bureau of Standards.*

Testing of Electrical Machinery.—H. E. MELLOR.—The writer deals with the testing of electrical machinery before acceptance by the purchaser and calls attention to advantages of making these tests in the plant of the manufacturer before shipment.—London *Electrician,* May 20, 1921.

Telegraphy, Telephony and Signals

Equivalent Circuit of the Vacuum Tube Modulator.—JOHN R. CARSON.—The author starts from the consideration of the equivalent circuit to a three-electrode vacuum-tube amplifier. He then derives mathematically the equivalent circuit of a three-electrode vacuum-tube modulator. The resulting theory is applied to a practical example in modulator design and its usefulness demonstrated.—*Proceedings Institute of Radio Engineers,* June, 1921.

On the Poulsen Arc in Coupled Circuits.—P. O. PEDERSEN.—A bibliography of oscillating arc investigations with coupled circuits is given. A special form of circuit, wherein the arc and the antenna circuit are coupled electrostatically through an arc "series condenser" and a "shunt condenser," is studied analytically. Experimental results on the same circuit are given, and the practical usefulness of the circuit is discussed.—*Proceedings Institute of Radio Engineers,* June, 1921.

Tapping of Telephone Circuits During the War.—A. CARLETTI.—The difficulties commonly met in telephone transmission were utilized by the Italian armies in detecting the plans and movements of the enemy. In a grounded telephone circuit the distribution of the return current through the ground varies with the conditions and formation of the soil, and sometimes it is possible to detect the current flowing through the ground at a considerable distance from the transmitting point. If a metallic conductor connects two grounded points in the zone traversed by the telephone return currents, it is possible to detect these currents by means of a simple receiver at any point along the metallic conductor. At the beginning such detecting stations were placed only in proximity to the enemy lines, but soon the technical staff developed suitable and more sensitive apparatus to be used at any distance. A condenser is used to prevent continuous current from flowing through the receiver and also to reduce to a minimum the impedance of the apparatus, obtaining the conditions of resonance at the average frequency of the telephone currents. In another apparatus a telephone transformer with adjustable ratio was used instead of the condenser. When the ground return system was superseded by the full metallic circuit the solution was given by the poor or defective insulation of the lines. Then the apparatus had to be made more sensitive, amplifiers of different kinds were used, and it was found not only that the leakage current could be utilized but also that the unbalanced conditions of the lines produced an excessive self-inductance and that this phenomenon could be advantageously used to detect messages at considerable distance from the telephone lines.—*Telegraphie Telephoni,* Vol. II, No. 1, page 16.

Vacuum Tube Amplifiers in Parallel.—R. V. L. HARTLEY.—The general theory of the power output of a number of dissimilar vacuum tubes operated in parallel is given. The equations obtained are applied to the case where all the tubes have the same amplification constant and also to the case where the tubes all have the same internal resistance. Practical examples are given.—*Proceedings Institute of Radio Engineers,*—June, 1921.

Automatic Signaling Over Superposed Relayed and Loaded Long-Distance Cables.—R. T. KING and E. J. BARNES.—In connection with the introduction of long-distance cables the need of providing suitable automatic signaling, giving a service with no delay, has arisen. Experiments have been carried out by the authors, using standard multiplex distributers, to enable each speaking circuit in a group to signal independently over a separate common line.—*Post Office Electrical Engineers' Journal,* April, 1921.

Determination of the Direction of Atmosperic Disturbances or Static in Radio Telegraphy.—L. W. AUSTIN.—Observations on the character of static disturbances in various parts of the country, with particular reference to directional effects and frequencies.—*Journal Franklin Institute,* May, 1921.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Illinois Commission Bill Passes

JUST before adjournment last Saturday the Illinois State Legislature passed the pending utilities bill. It has not yet been signed by Governor Small. A superficial study of the bill as passed disclosed no objectionable changes made in the present utility commission situation. The commission under the act will become the Illinois Commerce Commission, with seven commissioners in place of the present five and eight assistant commissioners corresponding to the present examiners. Any municipality desiring home rule can call an election on petition of 25 per cent of the legally registered voters, but this petition must not be initiated by city authorities. Even after home rule is thus assumed utilities have the right of appeal to the Illinois Commerce Commission and from there to the state courts.

Although the full effect of the bill will not be known until the amendments passed in the last-minute rush are analyzed, the general feeling is that the only changes made from the present law are needed improvements. Among the amendments passed is one providing for the holding of commission hearings in the county in which the complaint originates.

New York Water-Power Board Organized

IN ACCORDANCE with the water-power law passed this year by the New York Legislature, a State Water-Power Commission, composed of the chairman of the House and the President of the Senate, has been General, the State Engineer and Surveyor, the Speaker of the House and the President of the Senate, has been organized and is holding meetings. F. P. Williams, a consulting engineer, has been engaged as secretary.

The commission has issued a book of rules to guide those filing applications for permits, and up to the first of the week had received twenty-two applications.

The commission is proposing to make a study of the way in which it shall derive revenue from future water powers. Just at present it remains to be decided by the Supreme Court whether the state or the federal government shall exercise jurisdiction over the St. Lawrence and Niagara rivers. In the meantime those who have filed on New York waters in Washington are also filing in Albany.

American Standards Committee Designates Sponsors

ANNOUNCEMENT is made this week by the American Engineering Standards Committee of the appointment of sponsors for the formation of sectional committees on a number of electrical standards. They are as follows:

American Institute of Electrical Engineers for "standard of aluminum for conducting purposes."

American Institute of Architects, American Institute of Electrical Engineers and the National Association of Electrical Contractors and Dealers jointly for "symbols for electrical equipment of buildings and ships."

United States Bureau of Mines for "safety rules for installing and using electrical equipment in bituminous-coal mines," "portable electric mine lamps" and "storage-battery locomotives for use in gaseous mines."

Long Distance Transmission Gets Special Attention at A. I. E. E. Convention

ON TUESDAY of this week the thirty-seventh annual and tenth Pacific Coast convention of the American Institute of Electrical Engineers opened in Salt Lake City with the address of President A. W. Berresford. Besides touching on the essentials of research which must always form the basis of engineering development, he discussed with broad vision the commercial engineering responsibilities which engineers are now realizing they must assume. In considerable detail he outlined his conception of the proper sphere of activities of such bodies as the United States Bureau of Standards in order to eliminate misunderstandings and correlate in an effective way all the work of such bodies with that of corporate and university laboratories in the public interest. (An abstract of his address will be found on page 1469 of this issue.)

In the two days before this issue of the ELECTRICAL WORLD went to press the discussion dealt with phases of hydro-electric generation and high-tension transmission. Eminent engineers from the West and East showed great interest in papers covering the development at Niagara Falls as brought out by J. L. Harper and J. A. Johnson of Niagara Falls, N. Y., and the progress in waterwheel engineering summarized by W. M. White of the Allis-Chalmers company as typified by such installations as those at Pit River, Caribou and the Canadian and American Niagaras.

The discussion of long-distance transmission lines by F. G. Baum, consulting engineer of the Pacific Gas & Electric Company, added an exhaustive treatise to his many original contributions to the Institute during the past twenty years on voltage regulation and insulation of high-voltage transmission lines. This paper was one of three of a symposium on long-distance transmission systems. Another, by W. W. Lewis of the general Electric Company, dealt with line tests, and the third, by L. L. Elden of the Edison Electric Illuminating Company of Boston, took up the operation of interconnected systems. The discussion of these papers was largely on details of the theoretical fundamentals presented and emphasized the need of constant-voltage transmission and flat regulation on long lines, together with accurate information on the operating characteristics of grounded and isolated circuits.

Three remaining papers, by L. E. Imlay of the Superpower Survey, Raymond Bailey of the Philadel-

phia Electric Company and E. H. Fritz of the Pittsburgh High-Voltage Insulator Company and G. I. Gilchrest of the Westinghouse Electric Company, dealt with transmission from the standpoint of the Eastern superpower system, connections between generating systems and the design and production of suspension insulators.

H. T. Plumb, engineer General Electric Company, as chairman showed marked ability in conceiving and executing an entertainment program especially fitting to the engineering interest of the delegates as well as in acquainting them with the majestic setting of the convention city and its place in the industrial empire of the West. Features of this program were special excursions by automobile and train to substations of the Utah Power & Light Company, over drives in the Wasatch Mountains and to the mines and smelter of the Utah Copper Company, which operates the largest surface copper mines in the world. Visiting ladies were elaborately entertained. In addition to several auto tours there were dancing and musicals in the Utah Hotel and luncheons at prominent clubs.

To Lay Plans for New N. E. L. A. Year Next Week

MEMBERS of the new executive committee of the National Electric Light Association and of the executive committees of all the national sections except the Commercial Section are scheduled to meet in New York next week to lay plans for the new administrative year. The Commercial Section executive committee will meet at Association Island July 22 and 23.

On June 28 the executive committee of the association will meet with the American Gas Association to consider those parts of the uniform classification of accounts that touch both kinds of service.

The following day President-elect Milan R. Bump will meet his executive committee to consider plans, scope of activities of association and at headquarters development of departmental activities, recommendations made at the Chicago convention, consolidation of work of some committees and selection of individuals for the general and special national committees.

The executive committees of the Technical and Public Relations Sections have been called for June 30 to consider similar section matters.

Electrical Safety Conference Continues Work on Standards

AT A MEETING of the Electrical Safety Conference in New York on June 17 the various joint committees which have been working on safety standards for switchboards, rotating electrical machines and oil circuit breakers presented progress reports.

Tentative plans for the oil-circuit-breaker standards were discussed at the meeting. Recommendations on guarding line and current-carrying parts and on protection from fire and safety hazards and definitions of types, such as those for indoor and those for outdoor location, will probably be part of the final draft.

The safety standards for industrial control equipment are now available in published form and may be procured from the Underwriters' Laboratories in New York. The report on rotating electrical machines will soon be ready for ratification and the work on switchboards is well advanced.

Public Relations Emphasized at North Central Meeting

APPOINTMENT of a joint committee to further co-operation with the telephone interests, of a committee to study the rural-service problem and co-operate with the Wisconsin Electrical Association committee and of a committee to study the California co-operative movement and the subject of joint pole construction was recommended by President T. D. Crocker in his address to the North Central Geographic Division of the National Electric Light Association at Duluth, Minn., on Wednesday of this week. The need of furthering good public relations in such a way as to prevent political attacks on utilities was also emphasized, and the importance of the companies gaining the confidence of their own employees as a basis for successful public relations work was urged.

Increased thrift and decreased production and transportation costs were given by J. H. Ingwerson of Duluth as the basis for a return of prosperity in discussing business conditions in the Northwest. Mr. Ingwerson made a strong plea against any modification of the federal reserve act that would materially change its present character. Improvement of conditions as fall advances, if crops are good, was looked for by the speaker, but he expressed the view that conditions in 1922 would be better than those this year.

R. A. Gantt, chief engineer of the Northwestern Bell Telephone Company, and C. B. Randall, counsel and secretary of the Tristate Telephone & Telegraph Company, in treating of the relations between power and telephone companies, emphasized the need of co-operative work and the importance of keeping out of court.

The convention was addressed by Martin J. Insull, retiring president of the National Electric Light Association. Tuesday was devoted to registration and a trip to the hydro-electric plant of the Great Northern Power Company on the St. Louis River.

State Information Committee Movement Spreads to the South

ORGANIZATION of state public utility information committees has spread to the South. George F. Oxley, director of publicity of the National Electric Light Association, who was engaged last week in helping the organization of these committees, reports the Georgia organization completed and the expectation that the Alabama committee will open headquarters in Montgomery not later than Aug. 1. All of the larger Georgia utilities have shown an active interest and have pledged support.

The Georgia committee has appointed L. K. Starr, until recently city editor of the Atlanta *Journal*, executive secretary. The executive committee, which will direct the work, is composed of George T. Smith, Augusta-Aiken Railway & Electric Corporation, chairman; P. S. Arkwright, Georgia Railway & Power Company, vice-chairman; C. D. Flanigen, Athens Railway & Electric Company; F. L. Marshall, Gas Light Company of Augusta; H. C. Foss, Savannah Electric Company; P. R. Bomeisler, Ware County Light & Power Company; L. A. Magraw, Macon Railway & Light Company, and L. K. Starr.

S. B. Irelan, vice-president and manager of the Montgomery Light & Water Power Company, will have charge of the organization of the Alabama committee.

State Water-Power Conferences to Be Held in Pennsylvania

ARRANGEMENTS for a series of conferences on ways and means to develop and conserve Pennsylvania's water-power resources were made at Harrisburg recently at a meeting of men interested in such projects. Gifford Pinchot, Commissioner of Forestry for Pennsylvania, outlined a state policy embracing fifty-year grants and renewals, the state water-supply commission to act with the commissioner. Mr. Pinchot was authorized to communicate with the Secretaries of State of various states to compile laws on the subject.

New Officers of Canadian Electrical Association

AT THE closing session of the convention of the Canadian Electrical Association held in the city of Quebec last week the following officers were elected: President, Julian C. Smith, Shawinigan Water & Power Company, Montreal; first vice-president, P. T. Davies, Southern Canada Power Company, Montreal; second vice-president, A. P. Doddridge, Quebec Railway, Light, Heat & Power Company; third vice-president, L. W. Pratt, Hamilton-Cataract Light & Traction Company; secretary-treasurer, Eugene Vinet, Shawinigan Water & Power Company. The executive committee is composed of the officers and the following members: A. Monro Grier, Canadian Niagara Power Company; C. T. Barnes, Toronto & Niagara Power Company; R. J. Beaumont, Shawinigan Water & Power Company; A. A. Dion, Ottawa Electric Company; D. H. McDougall, Toronto Power Company; J. S. Norris, Montreal Light, Heat & Power, Cons.; J. B. Woodyatt, Southern Canada Power Company; W. L. Weston, Nova Scotia Tramways & Power Company, and representatives chosen by the Canadian General Electric Company, the Canadian Westinghouse Company, the Sangamo Electric Company and the Northern Electric Company.

Script Dividends Bring Big Drop in Cities Service Stock

ONE of the biggest smashes in security prices came last week in Cities Service stock as a result of the decision of its board of directors to issue scrip dividends on all classes of stocks to conserve cash resources in order to meet abnormal conditions in the oil industry. Prior to the meeting of the board on June 10 the common was selling around 215. The following day it broke to around 140 and on Monday it sold down to 110. It was recognized, however, that the drop had been too precipitous and on advice of reassuring news from the office of Henry L. Doherty & Company the stock went up to over 130 by the close of the week. This week, however, saw fresh selling spurts and as the paper goes to press the common is selling down to around 120.

The preferred, which is 6 per cent cumulative, also broke. It had been selling around 63½. The news caused it to go down below 40. It recovered to almost 50 and during this week was off again about 5 points from its high of the previous week.

Mr. Doherty pointed out that the net earnings of the public utility subsidiaries are at the highest point in their history. Net earnings for the twelve months ended May 31, 1921, were $20,577,867 as compared with $20,735,416 for the similar period a year previous.

Cities Service Company controls through stock ownership twenty-six oil subsidiaries and seventy-nine public utility subsidiaries. Its oil production in 1920 was in excess of 13,600,000 barrels. Its utility subsidiaries supply electric light and power, natural and artificial gas, street railway and other service to more than 350 communities in twenty-one states and Canada.

A. I. E. E. Standards Submitted for Approval

THE American Institute of Electrical Engineers has submitted its "Standards" (1921 edition) to the American Engineering Standards Committee for approval as American standard practice. The standards are submitted in accordance with the special provision in the procedure of the committee under which important standards adopted or in process prior to 1920 may be approved without going through the regular process followed in new work.

Standards recently approved by the committee include four copper specifications submitted by the American Society for Testing Materials as "tentative American standard," as follows: "Soft or annealed copper wire"; "Lake copper wire, bars, cakes, slabs, billets, ingots and ingot bars"; "electrolytic copper wire, bars, cakes, slabs, billets, ingots and ingot bars," and "battery assay of copper."

Exhaustive Inquiry into Boston Edison Rates Expected

THE most comprehensive inquiry thus far made into the rate structure of the Edison Electric Illuminating Company of Boston appears in prospect from announcements made by counsel for the city of Boston at a resumed hearing June 15 before the Massachusetts Department of Public Utilities. The city has appropriated $50,000 to support the extra expenses of the inquiry. The city proposes to ascertain first whether the company's present income is too large, having in view a fair return of the property and allowance for proper operating costs, depreciation, etc., and, second, the effect of any apparent discrimination or inequalities in the functioning of the rate schedule.

Patent Office Bill Reported Out Favorably

THE bill providing for an increase of force and salaries in the Patent Office, introduced by Representative Lampert, has been reported out by the House committee on patents with the recommendation that it be passed at the earliest possible date. The bill increases the salaries of the principal examiners in the Patent Office from $2,700 to $3,900 per year. Assistant examiners are allowed increases ranging from $150 per year to $900 per year.

The bill also increases the commissioner's salary from $5,000 to $6,000, that of the first assistant commissioner from $4,500 to $5,500, that of the second assistant commissioner from $3,500 to $5,000, that of chief clerk from $3,000 to $4,000, that of one solicitor from $2,750 to $5,000, that of five law examiners from $2,750 to $4,000, and that of two examiners of interferences from $2,700 to $5,000. Five members of the board of examiners in chief who are appointed by the President and who under the statute must have both scientific and legal training will be allowed an increase by this bill from $3,500 to $5,000.

Federal Commission to Study Waste Elimination Proposed

A FEDERAL commission to study waste elimination in industry is proposed in a bill which has been introduced by Senator Calder. The bill is intended to continue and to amplify the survey made by the Federated American Engineering Societies at the instigation of Herbert Hoover, who until recently was president of that organization.

Senator Calder's bill provides that the commission is to be known as the United States Industrial Waste Commission and to have the Secretary of Commerce as chairman.

The commission is directed by the bill to make a final report on or before September, 1922, the report to cover waste in timber, power, transportation, oil, coal, essential minerals and other basic raw materials. There is reason to believe that the committee on commerce, to which the bill has been referred, will take prompt and favorable action on it. It is emphasized that no regulation is contemplated in this legislation and that there is not to be a suggestion of interference with private initiative.

The Superpower Survey is cited as an effort to eliminate waste. In the Boston-Washington industrial area some 17,000,000 hp. is being produced. Of this only 10,000,000 hp. is actually productive. The remaining 7,000,000 hp. either is wasted or is used to transport the fuel for the 10,000,000 hp. actually effective. The Superpower Survey is expected to show that the gradual development of an interlocking system of electrical transmission between superpower plants, to which coal could be transported economically, and a gradual development of hydro-electric plants would result in saving most of this 7,000,000 hp. In addition, byproducts could be saved and the transportation system correspondingly relieved.

Public Relations the Dominant Topic of Northwest Convention

THE urgent need of better public relations, gained partly through improvement in the service rendered, partly by more carefully planned contact with the public and partly as the result of widespread accurate information as to the problems and needs of the electric utilities, was the keynote dominating the fourteenth annual convention of the Northwest Electric Light and Power Association (geographical division of the N. E. L. A.), held in Portland, Ore., June 15 to 18. This subject was dealt with in one form or another almost to the entire exclusion of others. In discussing this point E. V. Kuykendall, director of the Washington Department of Public Works, said that the average consumer attaches more value to the quality than to the cost of service, but that courteous treatment is prized above price and quality. In his opinion discourteous treatment of the public by company employees and lack of diplomacy should be classed with incompetency as cause for dismissal. He expressed the opinion that good-will advertising was largely valueless unless it explained the fundamentals of rate-making valuation and accounting.

In one of the most appreciated addresses of the convention M. H. Aylesworth, executive manager of the National Electric Light Association, emphasized the point that it is of the greatest immediate importance to hold all of the four branches of the industry together and bring them into harmonious working relations.

Outlining the plans of the newly formed Northwest Electrical Service League, S. I. Miller, its secretary-manager, made it clear that it was not intended to conduct merely a campaign but that a long period of steady growth was desired. Other speakers were G. L. Myers, who spoke on "Winning Public Support and Confidence"; Robert Sibley, whose subject was "Western Industrial Development"; C. E. Driver, who dealt with "Public Utility Securities," and L. T. Merwin, who talked on "The Essentials of Power Development."

Officers elected were: President, W. R. Putnam, vice-president and general manager Idaho Power Company; vice-presidents: For Washington, J. M. Kincaid; for Idaho, I. E. Rockwell; for Utah, P. M. Parry; for Oregon, G. L. Myers. C. M. Brewer, L. A. McArthur and L. B. Faulkner were elected members of the executive committee. The attendance approximated 150.

Chicago Vehicle Men Plan Co-operative Association

AT A MEETING held June 10 in the offices of the Commonwealth Edison Company, Chicago, representatives of the electric vehicle industry formed a tentative organization for the purpose of pushing the sale in that city of electric trucks, passengers cars, tractors and batteries. E. W. Lloyd of the Commonwealth Edison Company, who presided, said after the meeting that the conference was the first step toward a permanent, stable association of vehicle men, an organization which can co-ordinate the present dissociated activities of the local dealers and manufacturers and by uniting their effort aid in putting the electric vehicle locally on its proper plane.

Mr. Lloyd offered the co-operation of the various Commonwealth Edison employees interested in electric transportation. He also stated that the Commonwealth Edison Company had in preparation an advertising campaign on electric trucks and transportation and would gladly help in a newspaper advertising campaign, standing its share of the expense.

A number of suggestions were made, including the need for a central bureau to supply reliable statistics relative to electric truck performance and maintenance, the desirability of a slogan such as "Electrics for economy!" a newspaper advertising campaign, a large loop garage to encourage the use of passenger cars, the concentration of the efforts of all dealers on a certain line of business for a certain period and the classification of users as well as prospective users. A number of other suggestions were made, and it was decided that all these questions would be taken up at the time the organization was perfected.

Twelve dealers and manufacturers were represented as follows: Mercury Manufacturing Company, Detroit Electric Car Company, Commercial Truck Company, Walker Vehicle Company, Ehrlich Electric Truck Company, Electric Tractor Company, Electric Storage Battery Company, Northwestern Electric Company, Automatic Transportation Company, Edison Storage Battery Company, Harry Salvat, Milburn and Ward electric vehicle distributer, and Schaefer Brothers. Meetings of a sub-committee appointed to determine the form of the organization were scheduled for a later date. It has been suggested that the association be called the Electric Automotive Trade Association.

Tentative Draft of Water-Power Licensees' System of Accounts Issued

THE tentative draft of rules and regulations for the establishment and maintenance of a system of accounts for licensees under the federal water-power act has been printed by the federal power commission for purposes of discussion only. O. C. Merrill, executive secretary of the commission, says in his explanation of these rules that they are based on those proposed by the committee on statistics and accounts of public utilities of the National Association of Railway and Utilities Commissioners, many of its recommendations having been adopted as they stood, others slightly modified and a few materially changed. Modifications were necessary in order to bring the accounting requirements into conformity with the provisions of the act or the commission's regulations, particularly the regulation relating to depreciation reserves. Comment, suggestions and criticisms may be filed with the commission up to Aug. 15, and a hearing will be had by the commission subsequent to that date.

Utilities Entitled to Fair Return Even in Periods of Depression

A PUBLIC utility is entitled to earn a fair rate of return in bad times as well as good. This was the gist of a very interesting decision recently handed down by the Public Service Commission of Indiana. In granting higher rates to the Illinois Bell Telephone Company the commission said:

"Although the commission hesitates to increase rates at a time when business generally is depressed and prices show a tendency to decrease, it cannot deny an increase in rates to a utility which has not earned a reasonable return in recent years; which furnished service throughout the war period at less than cost, while unregulated private corporations were making large profits; whose reasonable requirements for an estimated year are $215,660 in excess of its estimated revenues under present rates, and which is efficiently and economically managed, since the utility must continue to give service, extend its lines and improve its equipment, and the only source of revenue and credit is derived from the subscribers and patrons who pay the rates.

"It is contended that in times of business depression a public utility should be required to forego its profits and take its losses like any private corporation. This might be all right if during hard times a public utility were permitted to close its doors and suspend operation until business conditions became promising. It might be still more logical if a utility were permitted during boom times to enjoy large earnings and pay out its profits in dividends.

"Regardless of the state of business generally, a utility must continue to operate at maximum speed. It must continue to give service, for its service has become one of the necessaries of life. It must constantly extend its lines and add to and improve its equipment in order to keep up with the growth of its community and the developments of the art. The public demands these things.

Their cost is great and will probably never again be at the pre-war level. As time passes and improvements are developed the service demands become more complex and insistent. There is but one source of revenue and credit, and that is from the subscriber and patrons who pay the rates. Like most public utilities, the petitioner is a large borrower of money for its improvement program. In order to borrow money at all it must have credit. Regardless of its credit, the cost of borrowed money today unfortunately is extremely high.

"A utility is entitled under the law to earn sufficient revenue to meet its necessary operating expense and pay a reasonable return on the value of its property. This the petitioning utility has not been able to do for several years with the rates it has had in effect. Under the circumstances the commission has no choice under the law but to increase the rates."

Arrange for International Co-operation on Standardization

THE secretary of the American Engineering Standards Committee, Dr. P. G. Agnew, has just returned from a short trip to Europe, where he went to attend a conference in London of the secretaries of the national standardizing bodies. After the conference he visited France, Switzerland and Germany for a more detailed study of the standardization work in those countries.

The conference had for its object an interchange of experience and the furtherance of co-operation between the various national bodies in their work of industrial and engineering standardization. The secretaries will submit the suggestions of the conference to their respective organizations for approval. These have to do with the interchange of publications, a reciprocal arrangement for making foreign standards available to the industries of each country through their sale by the offices of the national bodies, the exchange of information as to the status of work in progress, and other methods of furthering co-operation between the national bodies.

It was the view of the conference that international co-operation in industrial standardization work should proceed along such informal lines being based primarily upon the interchange of information on active subjects of mutual interest, rather than by any attempt at the present time to form a general international standardizing body; that in cases in which formal organization should be found necessary the organization should preferably be by subject or industry, somewhat along the lines of the International Electrotechnical Commission; but that in all cases efforts should first be made to gain results by less formal methods, and to this end it would often be desirable that in a given subject the office of one of the national bodies most interested should, by informal agreement, perform such secretarial functions as would further international agreement in the particular subject.

Arrangements are being made for close co-operation between the national standardizing bodies and the International Chamber of Commerce, which will give special consideration to the subject of standardization at its convention which is to be held in London the week of June 27.

The secretaries present and the countries they represented were: Belgium, G. Gerard; Canada, R. J. Durley; Great Britain, C. le Maistre; Holland, E. Hijmans; Norway, A. Eriksen; Switzerland, M. Zollinger; United States, P. G. Agnew.

Bill to Exempt Leased Electric Devices from Execution for Rent Vetoed

AN ACT passed by the Pennsylvania Legislature to exempt electric household equipment, including washing machines, vacuum cleaners, ironing machines, dish-washing machines, sewing machines, portable lamps, refrigerating machines, flatirons, vibrators, heaters, ranges or water heaters, which have been leased or hired from sale on execution for rent has been vetoed by the Governor. The strongest opposition came from the department-store interests.

In 1909 the Pennsylvania State Association of Electrical Contractors and Dealers was responsible for a similar act being approved applying to electric motors, dynamos and fans. The act just vetoed simply kept step with the development of electrical appliances, which have been sold on the time or deferred-payment plan of merchandising in large degree.

Company Finds It Cannot Dispose of 5 per Cent Bonds

THE Indiana General Service Company and the American Gas & Electric Company have jointly petitioned the Indiana Public Service Commission for authority to issue $2,368,500 worth of 7½ per cent bonds. The American Gas & Electric Company owns nearly all of the common stock of the Indiana company and a considerable part of its preferred stock and now has $2,368,500 worth of 5 per cent bonds of that company.

The American company says in its petition that it cannot dispose of these bonds because of the low interest rate. The two companies petitioned the commission for authority to issue the same amount of bonds at 7½ per cent interest, which the American Gas & Electric Company is to take over and sell for the Indiana General Service Company.

"Better Illumination" Exhibition Makes Good Start at Boston

UNDER the auspices of the Massachusetts Institute of Technology, the New England Division of the National Electric Light Association, New England Electrical Supply Jobbers' Club, New England Section of the Illuminating Engineering Society, New England Electrical Sales Associates, Massachusetts State Branch of the National Association of Electrical Contractors and Dealers, and other manufacturers, engineers and architects interested in lighting practice, a "Better Illumination Bureau" was opened June 15 at the Rogers Building, Boston, to continue at least one year. A number of leading electrical men assembled the previous day for a private view of the display.

In the Boston display forty-nine circuits and ninety outlets with varied fixtures have been installed in a room, 49 ft. 7 in. long by 28 ft. wide, on the first floor of one of the principal buildings in the old home of the Massachusetts Institute of Technology. The exhibit is within about ten minutes' walk of the downtown district and, like its predecessors at other large cities, is designed to show flexibility for demonstration examples of good and bad lighting, with opportunities for illumination measurement and regular lectures by experts upon various phases of industrial and commercial lighting.

A. L. Powell, illuminating engineer Edison Lamp Works of the General Electric Company, Harrison, N. J., gave the first lecture, and Prof. W. J. Drisko of the Massachusetts Institute of Technology touched upon the significance of this and other forms of co-operation between that institute and industry.

It is estimated that the cost of maintaining this exhibit, including the installation expense, will be about $5,000 for the first year and $2,500 for each succeeding year in case sustained interest warrants its continuance.

The various interests that were mentioned above have subscribed funds to establish and carry on the work for at least a year, and a careful system of following up the "prospects" developed by visits of interested persons will be put into effect at once. This includes memoranda from the bureau to the sources of information regarding actual visitors and periodical "check-ups" of better lighting installations resulting from the display, along with estimates of the new business derived, energy sales, etc.



ELECTRICAL MEN VIEW EXHIBIT BEFORE PUBLIC OPENING

Back row, standing left to right—Julius Daniels, illuminating engineer; A. L. Powell, illuminating engineer, Harrison, N. J.; Howard S. Knowlton, New England editor ELECTRICAL WORLD and *Electrical Merchandising*; Prof. George P. Bacon, Tufts College.

Middle row, standing left to right—J. J. Caddigan, E. C. Kimball, L. L. Edgar, L. D. Gibbs, Boston Edison Company; Donald W. McIntosh, Union Electric Supply Company, Providence, R. I.; N. J. Campbell, Edison Electric Illuminating Company of Boston; Frank J. Allen, Westinghouse Electric & Manufacturing Company; H. Cairnie, J. F. Davis, Western Electric Company; J. C. D. Clark, Boston Consolidated Gas Company; C. S. Davis, Westinghouse Lamp Company; William Coale, National Lamp Works; H. G. McConnaghy, Boston Edison Company; D. C. Gidley, Crouse-Hinds Company.

Seated, left to right—R. S. Hale, Edison Electric Illuminating Company of Boston; Merle R. Griffeth, General Electric Company; S. E. Doane, National Lamp Works; Prof. W. J. Drisko, Massachusetts Institute of Technology; J. C. Norcross, Edison Electric Illuminating Company of Boston; E. M. Coffin, Associated Industries of Massachusetts; W. H. Atkins, general superintendent Edison Electric Illuminating Company of Boston; J. E. Wilson, secretary Bureau for Better Illumination; H. F. Wallace, president Bureau for Better Illumination; J. S. Patrick, Benjamin Electric Manufacturing Company; C. A. Strong, Westinghouse Lamp Company; C. H. Parker, Edison Electric Illuminating Company of Boston.

Indiana Company Would Increase Capital by Two Classes of Preferred Stock

THE Southern Indiana Gas & Electric Company has filed with the Secretary of State a notice of increase of its capital stock from $6,000,000 to $10,000,000. The company wishes to issue its increase of $4,000,000 in two classes, the first $2,000,000 to be 6 per cent preferred stock and the second $2,000,000 to be 7 per cent preferred stock.

American Electrochemical Society Plans Electrodeposition Division

THE American Electrochemical Society recently appointed a committee to investigate the possibility of forming a division upon electrodeposition. The purpose of such a division will be to hold meetings in connection with the semi-annual meetings of the society and thereby to encourage the presentation and discussion of papers upon the electroplating, electrotyping, electrorefining and electro-analysis of metals, and the electrodeposition of metals for any other purposes. If a sufficient number of members express their desire to join such a division, its formation will be authorized by the board of directors, and temporary officers will be appointed by it pending an election to be held at the next general meeting.

Radio Station in China Rated at 1,000 Kw. to Be Started at Once

DIRECT radio communication between Shanghai, China, and San Francisco—a distance of 5,360 nautical miles—is to be made possible by a 1,000-kw. arc station at Shanghai, construction of which is to start at once and which is to be completed within nineteen to twenty-four months. Contract for the construction of the plant, which will be similar to the station at Bordeaux, France, has been signed with the Federal Telegraph Company. A similar station is to be erected at San Francisco, and when both are completed they will, together with the Bordeaux station, constitute a chain by means of which messages can be transmitted entirely around the world. The separation of the three stations is almost exactly 120 deg. of longitude.

Although the power of the Shanghai unit will not be greater than that of the station at Bordeaux, several improvements, it is announced, will be incorporated in it. Among these are the "uni-wave" signaling system, which is expected to afford a distinct advantage for long-distance communication by improving the clarity of the signals.

Questionnaire on Taxation Submitted to 1,400 Business Organizations

A SERIES of questions on taxation has just been submitted to a referendum vote of the 1,400 business organizations within the membership of the Chamber of Commerce of the United States. The vote is on proposed forms of taxation and does not deal with amounts of revenue to be raised. The purpose of the referendum is to fix the national chamber's position on the forms of levy which might be used if needed to replace revenue lost through the proposed repeal of the excess profits tax, to determine an attitude with respect to the continuance of war excise taxes, and to get opinion as to the form of taxes that might be substituted for excise taxes if the revenues now derived from them have to be replaced.

One probable result of the vote will be to determine the chamber's position as to a sales tax, on three forms of which members are asked to vote. The referendum is supplemental to one taken last winter, which did not result in a decision respecting all questions asked. The first referendum brought a decision as to treatment of increments to capital income, questions of net and inventory losses, administration, etc. The present referendum is confined to forms of taxation which had prominence at the chamber's last annual meeting, held at the end of April in Atlantic City.

Los Angeles Gas & Electric in $3,500,000 Financing

A NEW issue of $3,500,000 of general and refunding mortgage 7 per cent gold bonds, series B, due 1931, of the Los Angeles Gas & Electric Corporation came on the market this week at 97½, to yield over 7.35 per cent. The new issue is marketed callable for five years. The proceeds are to provide for betterment and additions.

Northern States Sales Manager Reports Large Power Business

ASSERTING that negotiations for new electric power business at profitable rates have never been carried on on such a large scale as at the present moment, H. E. Young, sales manager of the Northern States Power Company continues:

"Changes in operating costs have affected small isolated plants much more seriously than large plants like ours and consequently a large number of municipally operated as well as privately operated small electric plants, in the smaller towns, find their operating expenses prohibitive, and the number of negotiations now being carried on for serving this kind of business by a single town or group of towns getting together and building transmission lines to our lines is much greater than was ever known before. The effect of present conditions applies similarly to industrial plants now generating their own power, and many of these with which we could not formerly compete satisfactorily are now good 'prospects' for the sale of large amounts of central-station power."

Extensive Additions to Louisville Generating Station Planned

AMONG the features of an enlarged construction program announced by the Standard Gas & Electric Company are extensive additions to the Louisville (Ky.) Gas & Electric Company's Waterside generating station to be made next year. These additions will cost between $2,500,000 and $3,000,000. The necessity for this enlargement of the power plant is clearly shown by the fact that its annual output in 1920 was 108,118,000 kw.-hr., as compared with 85,783,000 kw.-hr. in 1919. Since 1916 the output has increased about 100 per cent.

Utility Taxes in Indiana to Be Less

INDIANA utilities, including street railway, interurban, gas and power companies, will pay less taxes next year, generally speaking, than they have paid for some years back. Recent rulings of the Indiana state tax board have cut down the assessed valuations of the utilities generally. Only in one or two instances has an increase been made. The valuation of the Interstate Public Service Company has been increased from approximately $3,500,000 to more than $5,000,000, but this was because of a recent merger of the company, which took into one corporation about eight smaller utility companies.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest

British Electrical Engineers Return to Own Building.—The Institution of Electrical Engineers has removed its offices, returning to its own building on Savoy Place, Victoria Embankment, London.

Newark Revises Its Electrical Safety Rules.—A booklet has just been issued by the electrical bureau of the division of buildings of the Newark (N. J.) Department of Public Safety containing the city's revised rules for the installation of interior wires, fixtures and apparatus.

Intercollegiate Radio Service. — The University of Texas at Austin and the Texas Agricultural and Mechanical College at College Station now exchange college news by wireless, and it is planned to extend the interchange of information to take in colleges in other states, including Harvard and Yale.

Hydro-electric Power in Argentina.—Recently published details on the Argentine government's scheme for utilizing the Iguazu Falls and the Salto Grande for the generation of hydro-electricity represent the available head of water as varying from 154 ft. to 280 ft. and the flow as ranging from 12,000 cu.ft. to 250,000 cu.ft. a second. The average flow is put at 50,000 cu.ft., and it is estimated that the development would mean a fairly constant output of 370,000 hp., most of which would be taken by Buenos Aires.

Wireless in Latin America.—Announcement has been made that one of the most powerful wireless stations in the world is soon to be erected at Buenos Aires to operate between Argentina and Europe. There will be six 689-ft. towers, and the station is to be erected under contract with the Telefunken Radiographic Company of Germany. In Mexico the government has approved of the erection of thirty additional wireless stations and has besides overhauled and put in good condition the twenty-seven stations now in operation in that country.

East Indian Student of Shakespeare Turns His Attention to Street Lighting.—Neglect on the part of the municipal authorities of Madras, India, to fit a new ornamental post with an electric lamp very properly brought down upon them the following rebuke from a native of a literary turn of mind who none the less has an eye for practical affairs: "Last night Vinayaga Maistry Street was enveloped, as it were, in total darkness, when the iron tongue of time told two in the drowsy ear of night, in spite of the existence of a lamp post in fairly good working order. The needful must be done at once. If it were done when it is done, then it were done quickly. We cannot but look up with an air of resignation, characteristic of an Oriental, to the corporation to do the needful in this behalf before the dark fortnight dies into the shade, ushering in the bright daughter of the month to dance into light."

Wireless from Flanders.—A site has been selected in the province of Flanders, Belgium, on which it is planned to erect one of the most powerful wireless station in the world. This station will be capable of communicating with North America during the whole of the twenty-four hours, with the Argentine Republic during twelve hours and with the Congo, where the unfavorable atmospheric conditions of the equatorial regions prevail, eight hours. It is estimated that 60,000 words will be transmitted each day.

Secretary Hoover Approves School of Pan-American and Foreign Commerce.—Secretary of Commerce Hoover has expressed approval of the efforts at instruction in the fundamentals of foreign trade that are being made by the School of Pan-American and Foreign Commerce, with headquarters in New York City. This school, of whose advisory board Dr. Leo S. Rowe, director-general of the Pan-American Union, is chairman, is holding a "Plattsburg for Business" in Washington from June 20 to July 10 along the same lines as the one held last year.

Oklahoma Utilities Use More Gas than Any Other State.—Oklahoma utilities consumed more natural gas in the production of electricity during January and February, 1921, than was used by utilities in any other state in the Union. As shown by a recent report of the United States Geological Survey Oklahoma consumed 408,287,000 cu.ft. in January and 399,520,000 cu.ft. in February. West Virginia stood next to Oklahoma with a natural-gas consumption for manufacture of electricity of 278,447,000 cu.ft. in January and 263,988,000 cu.ft. in February. Ohio held third place.

War Work of the Bureau of Standards.—From the Department of Commerce comes a 300-page publication containing brief descriptions of the investigations and tests conducted by the Bureau of Standards during the war which were of service to the military departments. Photographs illustrating the apparatus used are given in some cases. Among the investigations described are those on aerouautic instruments and power plants, calibration of testing machines, coke ovens, electric batteries, electric blasting apparatus, electric tractors and trucks, electrical inductance for location of metal bodies, illuminating engineering, magnetic and metallurgical researches, radio communication and radiometry, searchlights, telephone problems and X-rays.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

American Electric Railway Association.—The annual convention of this association will be held at Atlantic City, N. J., during the week beginning Oct. 3. On account of the business depression the exhibits this year will be abandoned.

Electrical Association of Nova Scotia.—The newly formed Electrical Association of Nova Scotia has elected these officers: President, W. Murdoch, manager Northern Electric Company; vice-president, P. R. Colpitt, city electrician of Halifax; honorary secretary-treasurer, J. T. Dorey, president Dorey Electrics, Ltd.

Salt Lake City Named for 1922 Convention of American Association of Engineers.—The 1922 convention of the American Association of Engineers will be held in Salt Lake City. In the selection of the place for this meeting three cities were voted upon, and Salt Lake was first choice, Norfolk, Va., second, and Philadelphia third. The convention will take place in May of next year, and it is expected that more than 500 delegates will attend.

Engineering Society of Akron.—Officers elected for the ensuing year by the Engineering Society of Akron, Ohio, are as follows: President, J. H. Vance, superintendent of power for the B. F. Goodrich Company; vice-president, L. G. Tighe, superintendent of power production and distribution for the Northern Ohio Traction & Light Company; directors (to serve two years), R. R. Metheany and H. G. McGee. The board of directors includes in addition Burt Waltz and Benton Dales, whose terms expire next year, and Past-presidents Fred Ayes and Gale Dixon.

Coming Meetings of Electrical and Other Technical Societies

Associated Manufacturers of Electrical Supplies — New London, Conn., June 27-30.

Society for the Promotion of Engineering Education — New Haven, Conn., June 28-July 1.

Ohio Electric Light Association — Cedar Point, Ohio, July 12-15.

National Association of Electrical Contractors and Dealers—Buffalo, July 18-22. (For program see issue of April 30, page 1010.)

American Physical Society, Pacific Coast Section—Berkely, Cal., Aug. 4 and 5.

N. E. L. A., New England Division—New London, Conn., Sept. 6-9.

N. E. L. A., Great Lakes Division—French Lick Springs, Ind., Sept. 14-16.

Association of Iron and Steel Electrical Engineers—Chicago, Sept. 19-24.

Illuminating Engineering Society—Rochester, N. Y., Sept. 26-30.

American Electrochemical Society — Lake Placid Club, N. Y., Sept. 29-Oct. 1.

American Electric Railway Association—Atlantic City, N. J., Oct. 3-7.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Status of Public Utility Leased to Private Company by Municipality.—The Illinois Public Service Commission, which has no jurisdiction over rates for electric service furnished by a municipal plant, has determined that a public utility leased by a municipality to a private company is none the less municipally owned and therefore not under the commission's jurisdiction.

Effective Date of Rate Changes.—The New York Public Service Commission recently adopted the following ruling: "A bill for gas or electricity or service covering a period during which a change in rate has become effective shall be based on the later rate only from and after the next meter reading subsequent to its effective date. A monthly service charge shall be deemed to cover a period of not less than thirty days after effective date and shall not be billed in advance."

New York Commission Criticises Salaries.—Granting to the Hammondsport Electric Light Company a rate of 11 cents per kilowatt-hour instead of the 15-cent rate requested by the company, the New York Public Service Commission held that $4,700 was too great a charge for salaries and that the item should be reduced to $2,400. The company in 1920 had an output of 131,500 kw.-hr., with 373 meters in use. Its capital investment, the commission held, could fairly be put at $20,000.

Rates Ordered to be Lowered at Galena, Ill.—The Illinois Public Utilities Commission has ordered the Interstate Light & Power Company, which serves Galena and vicinity, to make a reduction in its power rates pending a final determination of a proper schedule. The commission based this order, it was announced, upon a reduction in the price of coal and imposed a scale ranging from 6½ cents per kilowatt-hour for the first 1,000 kw.-hr. a month down to 2½ cents for consumption in excess of 20,000 kw.-hr.

Hawaii Commission's Attitude on Proper Rate Basis.—In a recent gas rate decision the Hawaii Public Utilities Commission thus reiterated its view on what constitutes a fair rate: "This commission has uniformly held that a public utility adequately serving the public is entitled to charge such rates as will yield over and above operating expenses, including a depreciation reserve, a fair return upon the property actually devoted to the public service, subject to the limitation that such rates must not be more than the service is worth."

Cost Plus 20 per cent to Be Rate for Energy Paid by Railways to Supply Company.—The Illinois Public Utilities Commission has ruled that the rate to be paid the East St. Louis Electric Light & Power Company by three railway companies which purchase electrical energy from it shall be the actual cost of the power purchased plus 20 per cent.

Regulation of Dual Utility Where Virtually All Customers Consume Both Commodities. — Stability of operating costs during temporary fluctuations in one department of a combined gas and electric utility supplying service in a community where the consumers of one commodity were to a large extent consumers of the other was advanced as the reason for not segregating these departments in a rate proceeding before the Arizona Corporation Commission affecting the Central Arizona Light & Power Company. In the special case of the city of Phoenix, the commission held, a considerable benefit would result for the consumers if the commission regulated the gas and electric businesses as one utility instead of separately as two utilities. As a result of combined regulation the temporary fluctuations in operating costs of one utility would be stabilized so that the rates of one commodity would not have to be advanced until the return on the property employed in both utilities became less than the minimum allowable return. Such a procedure, however, the commission granted, would not be equitable where the two commodities were not so generally used by the same persons.

Vermont Commission Orders Fuel Charge Eliminated.—In refusing, on the protest of the granite manufacturers and quarriers of the Barre district, to sanction the addition of a fuel surcharge to the rates of the Montpelier & Barre Light & Power Company, the Vermont Public Service Commission said: "A schedule of rates which leaves to the company power to increase or diminish its charges according to some variable circumstances in its discretion does not furnish to the customer that information which the law contemplates. Rates established by such a method are not fixed by law, but by the will of the company. The proposed fuel charge, if in operation, would place the matter of determining the times when and conditions under which its steam generating plant should be used entirely in the hands of the defendant corporation and in effect render the defendant instead of the authority constituted by the Legislature the rate-making power. To state the effect of the operation of the said fuel charge in another manner, it would amount to a delegation of the rate-making power from the authority constituted by the Legislature to the corporation." The commission also held that expenses incurred by the company in upholding before the commission its rate increase of 1919 were an improper charge to the operating expenses of 1920.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Condemning Property Beyond State Limits.—A decision of the Wisconsin Supreme Court in Superior Water, Light & Power Company vs. City of Superior permits Wisconsin municipalities to condemn the property of Wisconsin corporations in adjoining states, provided that there is nothing in the laws of the invaded state to prevent their doing so. By this decision Superior acquires the right to condemn property situated in Duluth, across the Minnesota line.

Company Held Not "Willfully" to Have Failed to Make Report.—The Danville Light, Power & Traction Company recently appealed to the Court of Appeals of Kentucky against a verdict against it and in favor of the commonwealth imposing upon it a fine for "willful" neglect to file a report with the State Auditor as required by law. The Court of Appeals reversed the verdict, finiding that the non-filing of the report was due to misinformation furnished to the responsible agent of the company from a subordinate to the effect that the report was duly filed, and that as soon as the mistake was discovered the report was at once prepared and filed, and that therefore the failure to file it within the date set by law was not willful neglect. (230 S. W. 38.)*

Duty of Utility to Extend Service.—In State ex rel. Ozark Power & Water Company vs. Public Service Commission of Missouri an appeal against an order of the commission requiring the company to furnish electric service to the inhabitants of Diamond, Newton County, was under review. The Supreme Court of the state found for the commission, declaring (1) that although a power company is not required to serve a community it has not undertaken to serve it can be required to serve a city within the territory it has undertaken to serve; (2) that where a company built a transmission line through a certain county, erected a substation a mile from a certain town and built distribution lines from this substation it could be required to serve the town in question and that the commission's order in the case was reasonable; (3) that the evidence showed the extension of service was warranted by the test of the existence of demand reasonably certain to justify commercially the preliminary expenditure entailed. (229 S. W. 786.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

J. D. Kuster, who was recently appointed manager of the San José division of the Pacific Gas & Electric Company of California, as announced in the ELECTRICAL WORLD, has been in the commercial organization of that company since 1902. Mr. Kuster was born in California in 1872 and attended



J. D. KUSTER

Washington College. He became assistant manager of the Marysville district of the California Central Gas & Electric Company, which later became part of the Pacific Gas & Electric Company system. In November, 1902, he was made manager of the Colusa district of the same company, succeeding P. M. Downing. In 1906 he was appointed manager of the Fresno district of the Pacific Gas & Electric Company and in 1909 was transferred to San José, where he became manager of that district. When the commercial organization of that company was recently changed Mr. Kuster was promoted to his new position.

T. B. Patton has been elected vice-president of the Northern Virginia Power Company, Winchester, Va., to succeed the late Col. R. P. Chew.

Fred S. Baldwin, formerly general sales manager of Pass & Seymour, Inc., Solvay, N. Y., has become president of the Baldwin-Hall Company, Syracuse, N. Y., which has recently been incorporated to do a wholesale business in electrical supplies and machinery. Mr. Baldwin started the electrical department of the Syracuse Supply Company, which he operated for four years, after which he managed the New York office of Pass & Seymour, later becoming general sales manager.

W. T. Neill, formerly with the Public Service Commission of Oregon and recently in consulting engineering practice in Seattle, Wash., has accepted the position of rate engineer of the Pacific Power & Light Company of Portland, Ore.

L. A. Bell has been appointed local manager of the St. Johnsbury (Vt.) division of the Twin State Gas & Electric Company, and John Ordway has been appointed manager of the Berlin (N. H.) division of the same company, whose headquarters are at Boston.

David F. Houston, Secretary of the Treasury in the Wilson administration, has become associated with the American Telephone & Telegraph Company. While his title has not been decided, his chief work with the company will be of a financial character. He took up his new duties June 1.

William H. Hall, Jr., formerly district manager of the Chicago territory for Pass & Seymour, Inc., Solvay, N. Y., has become secretary and treasurer of the Baldwin-Hall Company, Syracuse, N. Y., which has been incorporated to do a wholesale business in electrical supplies and machinery.

Ira Cushing, formerly sales representative of the Electrical Engineers' Equipment Company at Boston and for eighteen years attached to the Boston office of the General Electric Company, has joined the staff of the Condit Electrical Manufacturing Company, 838 Summer Street, Boston, as sales engineer. Mr. Cushing is a past-chairman of the Boston Section of the A. I. E. E. and is widely known in the New England electrical field.

T. Julian McGill has resigned as manager of the Chicago office of the Westinghouse Electric & Manufacturing Company to become vice-president of the Twin City Rapid Transit Company of Minneapolis and St. Paul, in charge of operation and public policy. Mr. McGill was with the Westinghouse company since 1898, the preceding four years being spent with Augustine W. Wright, at that time vice-president and later president of the Siemens & Halske Company of America. In 1903 he was made the manager of the Minneapolis office. With Prof. C. F. Scott of Yale, Mr. McGill installed the Canyon Ferry-Butte transmission line, operating at 70,000 volts, which in those days was the highest transmission voltage in use in the United States. In 1909 he became manager of the Atlanta office, where he remained until 1914, when he was appointed to the managership of the Chicago office.

Julian C. Smith, vice-president of the Shawinigan Water & Power Company, was elected president of the Canadian Electrical Association at its annual convention last week. Mr. Smith was born in Elmira, N. Y., in 1878 and in 1900 was graduated from Cornell University with the degree of mechanical engineer. He began work with Wallace C. Johnson, consulting engineer at Niagara Falls, N. Y. Two years later he became assistant engineer to Mr. Johnson at Shawinigan Falls, Quebec. The following year he was made superintendent of the Shawinigan Water & Power Company, and in 1906 advanced to general superintendent, becoming in addition chief engineer in 1909. He also exercised supervision over the Cedars Rapids Manufacturing & Power Com-



J. C. SMITH

pany, which is operated by the same interests, and the Laurentide Power Company, which sells its output to the Shawinigan company. Mr. Smith has made many important contributions to technical literature and for two of his papers the Gzowski medal of the Canadian Society of Civil Engineers has been awarded to him—in 1913 for his paper on "Design of High-Voltage Transmission Lines," covering the new Shawinigan-Montreal lines, and again in 1917 for his part of a paper on the Cedars Rapids Manufacturing & Power Company's development. Mr. Smith is a fellow of the American Institute of Electrical Engineers and one of the small number of Canadians who are members of the British Institution of Electrical Engineers.

R. W. Stanley, who has been general manager in charge of production and engineering for Rauch & Lang, manufacturers of electric cars, Chicopee Falls, Mass., has been elected first vice-president.

Frederic D. Brown, for eight years manager of the Huron (S. D.) Light & Power Company, has resigned that position and will open an engineering office in Huron. He will undertake general engineering work, including consultation, estimates and appraisals.

William H. Meadowcroft, who recently celebrated forty years of association with Thomas A. Edison, was born in Manchester, England, May 29, 1853 and came to America in August, 1875. His first employment was as assistant chief clerk in the law office of Carter & Eaton. In the early part of 1881, when Major Eaton accepted an invitation from Mr. Edison to become vice-president and general manager of the Edison Electric Light Company, Mr. Meadowcroft entered the service of that company as Mr. Eaton's assistant. In the early eighties he wrote the first commercial paper ever published on the



W. H. MEADOWCROFT

incandescent electric light. During the years when he was connected with the Edison Electric Light Company he came into close association with many men now prominent in the electrical and business world. Among these were Samuel Insull, John W. Lieb, George F. Morrison, Charles L. Edgar, Schuyler S. Wheeler, Dr. Edward G. Acheson, H. M. Byllesby, John W. Howell, Wilson S. Howell, Frank J. Sprague, T. C. Martin, Frederick A. Scheffler, Miller F. Moore, Alfred O. Tate, William E. Gilmore, Rorbert T. Lozier and William J. Hammer. All of these men were pioneers in electrical work, and their names are indelibly engraved in the history of electric lighting. In 1885 Mr. Meadowcroft resigned from the company and with two friends formed a small organization to produce miniature incandescent lamps. This organization acted as authorized agents of the Edison Lamp Company. Two years later he rejoined the Edison company and subsequently became assistant to Francis R. Upton, manager of the Edison Lamp Works, Harrison, N. J. Some time later, owing to ill health, Mr. Meadowcroft took a leave of absence, returning as assistant to Major Eaton, general counsel of the Edison General Electric Company. A few years afterward he went back to the Edison Lamp Works at Harrison as secretary of the Edison miniature and decorative lamp department. This position he held for about seven years. On the discovery of X-rays by Roentgen, Mr. Meadowcroft induced the company to manufacture the Crookes X-ray tubes and apparatus and took charge of the X-ray department. Since then Mr. Meadowcroft has been interested in developments and experiments with liquid air. For two years he assisted Messrs. Dyer and Martin in the preparation of their biography of Mr. Edison. He is author of "The Boy's Life of Edison" and also of a primer entitled "A B C of Electricity," which has had a sale of more than 100,000 copies. In 1910 Mr. Meadowcroft was appointed assistant and confidential secretary to Mr. Edison, a position which he still holds. He is a founder member and the historian of the Edison Pioneers, an organization of men who were at one time associated with Thomas A. Edison.

W. L. Goodwin, assistant to the president of the Society for Electrical Development, was the guest of honor at a dinner given by the H. I. Sackett Electric Company at the Lafayette Hotel, Buffalo, on the evening of June 13.

Herbert I. Markham, who has been general manager of the Federal Sign System (Electric) and the Federal Electric Company, has resigned and has associated himself with Paul H. Davis & Company, investment bankers, and the Quaker Manufacturing Company, manufacturer of furnaces and ironing machines.

Hoyt Catlin, who since 1919 has been developing and selling heater switches and other specialties for the Bryant Electric Company, Bridgeport, Conn., has been appointed advertising manager of the company. For ten years Mr. Catlin was identified with the central-station branch of the electrical industry as assistant to the manager in the erection and operation of the gas-electric plant of the Ware County Light & Power Company at Waycross, Ga., and later as specialist on electric ranges for the Pacific Power & Light Company of Portland, Ore. In 1917 Landers, Frary & Clark of New Britain, Conn., engaged him to develop a line of electric ranges, but this work was necessarily delayed by the war. At the beginning of 1919 he became connected with the Bryant company.

N. G. Symonds, manager of the industrial division of the Chicago office of the Westinghouse Electric & Manufacturing Company, has been appointed manager of the Chicago office, succeeding T. Julian McGill, Mr. Symonds will have completed twenty years of service with the Westinghouse interests on Jan. 1, 1922. After his graduation from the Leland Stanford, Jr., University of California in 1901 as an electrical engineer, his first position was with a mining company in the Northwest. A short time later he joined the organization of the Westinghouse, Church, Kerr Company of New York in the stoker-erecting



N. G. SYMONDS

department. In January, 1903, he was made district superintendent of stoker erection, a position he held for two years. When the Westinghouse Machine Company became engaged in the manufacture of stokers Mr. Symonds went to East Pittsburgh as assistant engineer of that company's stoker department. In May, 1905, he was made stoker salesman for the Chicago office of the Westinghouse company. About 1915, when the Westinghouse Machine Company was absorbed by the Electric & Manufacturing company, he was made manager of the power department. In 1918 he was appointed manager of the industrial division of the Chicago office.

Obituary

Richard Hutchison, formerly district sales manager of the Babcock & Wilcox Boiler Company, with offices at Boston, died recently at New Castle, N. B. He was born at New Castle in 1872 and was well known in New England engineering circles.

Adolph Sorge, Jr., Western representative of the Harrison Safety Boiler Works-Cochrane Corporation, died on May 3. Mr. Sorge's work was confined largely to mechanical engineering. The Sorge-Cochrane hot-process water softener is a development of ideas originally patented by him. He was graduated from the Stevens Institute of Technology in 1875, and after various activities entered the steam engineering field in Chicago in the early nineties as superintendent of the foundry of the Fraser-Chalmers Company, builder of mining machinery and steam engines. In 1895 he became Western representative of the Harrison Safety Boiler Works, and he continued with that organization during its years of development and expansion into the present company.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

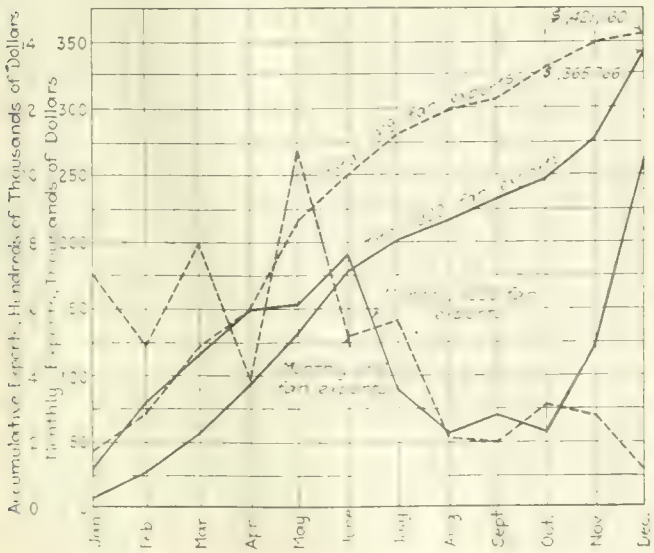
Two Underlying Features for Better Business Conditions

THE second reduction in its discount rate, from 6½ to 6 per cent, has just been announced by the Federal Reserve Bank of New York, acting with the approval of the Federal Reserve Board at Washington. This rate of 6 per cent existed during the early months of 1920. This lowered rate does not directly create easy credit conditions but reflects such a condition and is a consequence of it.

Thomas W. Lamont, of J. P. Morgan & Company, has just returned from Paris, where he was financial and economic adviser to the American peace delegation. "Germany's acceptance of the reparation terms marked a pivotal point in the economic status of Europe," said Mr. Lamont, "and it is my belief that improvement will before long become manifest in the world's economic condition. For America there can be only one result of Germany's acceptance. It will mean in the long run stimulus to manufacture, better markets for our farm products and sound and increasing prosperity in both foreign and domestic trade."

Analysis of Fan Exports for the Years 1920 and 1919

AN ANALYSIS of fan-motor export figures for the years 1920 and 1919 shows that while these exports in 1920 came to a total of $1,365,766, in 1919 they reached $1,421,160. There was no uniformity in the monthly reports during these two years. In 1920 the greatest value was exported in December, $257,432, followed by June and May, with January turning in the lowest amount, $29,587. In



EXPORTS BY MONTHS VERY IRREGULAR EACH YEAR

1919, however, May was the highest month, at $269,934, followed by March and January, December being lowest with $32,648.

British India took the greatest value in fans in both 1920 and 1919, but the other countries do not hold anything like the same sequence during those years. There were eleven countries importing American fans in 1920 in amounts over $25,000, while in 1919 there were ten countries. The Philippine Islands' total for 1919 was $43,418, but in 1920 its receipts of fans from the States amounted to only $6,787. The accompanying table shows clearly the relation of buying during the past two years.

Eleven countries in 1920, importing over $25,000 worth of American fans each, took $1,169,973 worth; these same countries imported $1,211,741 in 1919. Fifty-five countries in 1920, importing less than $25,000 worth of American fans, took $195,793 worth; the same countries in 1919 took $209,411 worth. The Eastern Hemisphere took the greater

1920 AND 1919 FAN EXPORTS

	Value of 1920 Exports	Value of 1919 Exports
British India	$344,162	$321,901
Cuba	192,292	49,064
Argentina	141,582	90,941
Canada	117,257	289,319
China	82,838	277,965
Mexico	68,808	51,466
Spain	68,246	11,638
Hongkong	55,001	77,949
Japan	47,852	22,661
Uruguay	26,105	4,982
Brazil	25,830	13,855
Australia	21,262	31,748
England	19,189	39,271
Straits Settlements	17,009	7,392
Dutch East Indies	14,623	14,319
Panama	13,213	8,931
Philippine Islands	6,787	43,418
Forty-nine other countries importing fans	103,710	64,340
	$1,365,766	$1,421,160

quantity of fans in both years, the figures of the seventeen countries tabulated for 1920 and 1919 being respectively $676,969 and $848,262. The corresponding figures for the Western Hemisphere are $585,087 and $508,588. Data have been compiled by the ELECTRICAL WORLD from figures given by the Bureau of Foreign and Domestic Commerce.

Excellent Deliveries on Malleables

UNDER present conditions of demand delivery of malleable-iron products is only limited by the time required in manufacture. For standard-pattern items this would probably range in the neighborhood of one month. In view of the situation prevailing in the malleable market just one year ago it seems almost incredible that conditions could have exactly reversed in so short a time. Twelve months ago deliveries were anywhere up to a year behind, while at present operation in this field is only about 25 per cent of capacity and new business is very scarce. The automobile trade, one of the large consumers of malleables, has long been flat, but it shows some improvement now.

Prices have followed the pig-iron market down, but not nearly to so great an extent because of the labor factor. Valley furnace malleable pig, Pittsburgh, is worth $25 per ton delivered, a drop of more than 50 per cent from the peak. Prices on heavy malleables are estimated to be down from 20 to 25 per cent and more, but on light castings the drop has not been great, being only about 5 to 10 per cent. The reason for this difference is the increased unit cost on the small items due to handling, labor and other charges. Wages are down about 20 per cent, it is stated.

At the present time word has already gone out in the trade of a further reduction in the price of malleables to be made on July 1 amounting to 10 per cent. There seems little hope of this bringing about a stronger volume of buying, however, as the general expectation is that this year will remain quiet, with a gradually increasing demand toward the end of 1921.

Bill Introduced Would Repeal Portable Lamp and Fan Tax

FOUR bills which amend the revenue law so as to relieve industry of $1,730,000,000 annually in taxation and transfer this to the owners of unused land and the inheritors of vast fortunes were introduced in Congress last week by Representative Oscar E. Keller of Minnesota. The bills are sponsored by the committee of manufacturers and merchants on federal taxation, of which Otto Cullman of Chicago is chairman, and which is said to have a membership of more than 31,000 substantial business firms in all parts of the United States.

The first bill repeals all existing transportation, stamp and sales taxes, with certain exceptions, and also repeals the excess profits tax and the 10 per cent tax on the income of corporations. The interesting feature of this projected measure for the electrical industry is that portable lamps and fan motors have been and still are included in "sales taxes."

The second bill amends the income tax so as to distinguish between earned and unearned income. The third bill amends the inheritance tax and the fourth bill provides for a land-value tax.

A. M. E. S. Outlet Box Section Extends Its Scope

AT A MEETING of the Outlet Box Section of the Associated Manufacturers of Electrical Supplies held on June 7 at the Edgewater Beach Hotel, Chicago, it was voted, for the purpose of facilitating action of the various interested representatives in the Outlet Box Section, to enlarge its scope to embrace manufacturers of switch boxes, outlet-box fittings and cast boxes, the original sections to be divided into four sections by the addition of the new ones named. Only actual manufacturers of products involved will be eligible to the Outlet Box Section, it is understood, the term "manufacturers" to mean only companies who have invested in plant tools and machinery to produce the said products.

The officers of the Outlet Box Section are: G. H. Sicard, chairman, Pratt-Chuck Company, and H. G. Knoderer, secretary, Sprague Electric Works. R. P. Harrison, Thomas & Betts Company, was elected chairman of the Cast Box Section and H. G. Knoderer, secretary. Of the Outlet Box Fittings Section R. P. Harrison is chairman and C. Renshaw, National Metal Molding Company, is secretary. Of the Switch Box Section F. H. Merrill, Appleton Electric Company, is chairman and C. Renshaw is secretary.

Increased Buying of Cross-Arms

WHETHER it is due to recent price decreases or not is uncertain, but producers report that buying of crossarms shows quite an increase of late. This increase in demand, it is stated, centers around central-station buying, the electric railway market being quiet. Demand is still far from normal, but producers are encouraged because it shows up as well as it does.

There may be some connection between current buying and the price situation, for on the first of this month a general cut on long-leaf yellow-pine cross-arms was made amounting to about 10 per cent. Fir cross-arms were not affected by the drop. This is not the first price decrease on cross-arms this year, as a cut amounting to 15 per cent was made on Feb. 1 and another varying from 9 to 15 per cent on March 1. These covered both fir and pine arms, and in addition fir arms went down about 10 per cent the middle of April.

Stocks are reported to be good with immediate shipments prevailing. Producers are optimistic that the market will open up considerably more during the latter months of the year.

Current prices on 75-per-cent-heart, long-leaf yellow-pine arms, quoted by a representative producer, are given below. The quotations include the recent cut above mentioned and are made f.o.b. Hattiesburg, Miss. Electric light arms, two-pin, 3 ft. x 3¼ in. x 4¼ in., less than 1,000 lineal ft., $28.61 per 100 net, over 1,000 lineal ft., $25.43; 6 ft. x 3¼ in. x 4¼ in., six-pin, less than 1,000 lineal ft., $57.23, over 1,000 lineal ft., $50.87; N. E. L. A. arms, 5 ft. 7 in. x 3½ in. x 4½ in., four-pin, less than 1,000 lineal ft., $64.72, over 1,000 lineal ft., $57.52; New England arms, 5 ft. 6 in. x 3¼ in. x 4¼ in., four-pin, less than 1,000 lineal ft., $57.23, over 1,000 lineal ft., $50.87. Quotations on the same size arms as above, in the same quantities f.o.b. cars Rutherford, N. J., on McCormick fir are as follows: $51.09, $45.41; $102.18, $90.83; $115.56, $102.72; $102.18, $90.83.

Chicago Contractor-Dealers' Need for Building Up Stocks

THE announcement that Federal Judge Landis has consented to act as arbitrator in the dispute between the building trades and the contractors' association of Chicago and his action in insisting that building be resumed immediately pending a final settlement find Chicago contractor-dealers in a more favorable position than dealers in other building materials. While the local lumber, steel, brick and other building-material interests have been forced to keep their stocks close to normal on the chance that construction would be resumed at any moment, electrical contractor-dealers have been able to liquidate and cut down their supplies of various items and can now start to restock at the present favorable prices.

In general contractor-dealers have considerably reduced their supplies of such items as conduit, rubber-covered wire, sockets, fuses, knobs and tubes, plugs, switches, boxes, etc., while jobbers have plenty of this material on hand. This is an added instance of the fact that more often than not the jobber saves the dealer from some precarious situations and is an essential in any distribution system. Under present conditions local dealers can obtain almost any amount of supplies from jobbers within forty-eight hours.

Chicago building experts estimate the construction under way and planned for this season to be $100,000,000. Of this amount from $4,000,000 to $5,000,000 should go into wiring, fixtures, engines and generators. This schedule does not include the preliminary work being done on the Illinois Central Railroad electrification project.

The Metal Market Situation

WITH continued lack of demand in the copper industry, prices have again weakened and are about ¼ cent lower on all positions compared with a fortnight ago. Some consumers have been induced by the low prices to purchase some copper for June, July and August and domestic demand is increasing. Foreign buying is very light and exchange rates continue in their recent decline. Large producers have quoted 13 cents per pound delivered for as far ahead as July, and small selling interests are reported to have accepted orders at 12.62½ cents delivered for prompt and June copper. The third-quarter position is held at 13 cents to 13.25 cents.

NEW YORK METAL MARKET PRICE

	June 14, 1921	June 21, 1921
Copper	£ s d	£ s d
London, standard spot	73 7 6	70 7 6
	Cents per Pound	Cents per Pound
Prime Lake	13 00—13.25	12 75—13 00
Electrolytic	13 00—13.12½	12 62½—13 00
Casting	12 00—12.25	11.75—12 00
Wire base	15 00—15 25	15.00—15 25
Lead, trust price	4 50	4 50
Antimony	5 12½	5 12½
Nickel, Ingot	41 00	41 00
Sheet zinc, f.o.b. smelter	10 00	10 00
Zinc, spot	4 95	4 95
Tin	29.37½	29.00
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	10.00—10 50	10.00—10.25
Brass, heavy	5 00 - 5 25	4 75— 5 00
Brass, light	4 50— 4 75	4 00— 4.50
Lead, heavy	3 75— 3 90	3.50— 3.75
Zinc, old scrap	2 50— 2 75	2 50— 2.62½

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

TRADE in electrical materials continues to hold a quiet course, with little hope advanced of real activity before the fall months. Building of residences is keeping up at a fair rate in nearly all sections of the country. The Chicago deadlock has been broken and building has been resumed. Northern California, however, has not got back its activity in this line. Commercial and industrial construction is quiet.

Although general supply business is on a low level, heating devices are moving well in Chicago and hollow ware in the Intermountain and San Francisco districts. Washing machines keep up in Chicago, while in California ironers and dishwashers are moving well. Fan-motor sales have picked up all over. From the Southeast the reports of good crop yields, except cotton, open the way for better fall business, and in the Intermountain regions the crop outlook is better than for several years.

Though Boston reports New England collections a little easier to make, the other parts of the country hold that it is no easier to get in the money. Movement of wool in the Mountain States is providing a little relief there.

NEW YORK

There is not a great deal of consistency to reports on trade this week; in several quarters a slight improvement is noted, but in others business shows no change. A large jobbing house finds that wire and motors from 5 hp. down are moving better. The general market is quiet, however. Plans filed for building work and contracts let recently show quite an increase, but there is apparently not much activity of this nature at a stage which aids the electrical market.

Armored cable boxes are down 15 per cent, the second reduction this year. Prices on conduit are being shaded, and in fact there is very little material on which prices are not lowered on occasion to meet competition. Fan buying has shown its first signs of life but is not generally good. Vacation sales of flashlights have been disappointing. Schedule material is moving a little better, but rather because the trade is again replacing stock following the recent price decrease. Thirty days' supply of goods is about the most that any jobber is carrying, while the stocks of a good many are considerably under this.

Armored Cable Boxes.—Effective June 20, manufacturers of armored cable ceiling boxes reduced prices 2½ cents per box in standard-package quantities to jobber. This amounts to about 15 per cent and follows a cut of 25 per cent made earlier this year.

Conduit.—Fairly good stocks are held, but very little is moving. In 2,500-ft. lots ½-in. black is quoted at $62 to $65.28; galvanized, $66.86 to $70.38; 1-in. black, $116 to $123.75; galvanized, $125.65 to $134. These prices are being shaded at present.

Non-Metallic Flexible Conduit.—Little or none of this material is moving and stocks are spotty. In 1,000-ft. lots ⅜-in. brings $22 to $23.10 and ½-in. from $24 to $25.15.

Lamp Cord.—Good stocks are held, but these are not moving. No. 18 cotton-twisted in 1,000-ft. lots sells for $13.75 to $17.70 and parallel from $16.50 to $18.75.

Tape.—Demand is spotty and on the whole is far from good. The supply is plentiful and in 100-lb. lots brings all the way from 38 and 37 cents per pound on friction and rubber tape respectively to a high range of 52 cents on both. The average price, however, varies from 40 to 45 cents.

Fuses.—Price reductions have not helped stimulate the present fair demand much. In standard-package quantities jobbers quote N. E. C. standard non-renewable 30-amp. fuses at $7.50 to $11 per 100, and 30-amp. renewable fuses listing at 50 cents each, 40 to 42 per cent off list.

Safety Switches.—Several jobbers say demand has picked up materially and is fairly good at present but others do not confirm this, especially on switches for industrial use. The growing favor of the meter switch used extensively in New Jersey has undoubtedly helped sales of this type. Prices are steady for the time being.

Flashlights.—There has been a small vacation demand but nothing great as yet. Renewal business is only average. In standard packages 40 and 10 per cent is allowed.

Fans.—Within the last week or two fans have started to move and a number of jobbers report good sales, but the general situation is not what it should be as several houses have not yet really begun to sell. The most popular size is the 16-in. oscillator.

CHICAGO

In the construction labor controversy both sides presented arguments to the arbitrator, Federal Judge Landis, this week. Work has been resumed on all jobs which were under way when the shutdown came, probably 20,000 men returning to work. This has put some life into sales of construction supplies, but no new work is being initiated pending the arbitrator's decision, which, it is stated, will probably not be made until the end of this week. A disturbing feature is the failure of the carpenters' unions to agree to abide by the result of the arbitration. Many of them have refused to return to work and as a result the progress of work under way is being seriously retarded.

Trade conditions remain quiet, prices in most lines remaining unchanged and orders being limited to actual requirements.

Ninety days remain the average for collections in the jobbing trade, no real improvement having been noted. Money stringency continues, both in the farming districts and in the manufacturing towns, particularly in such cities as devote most of their activity to one particular line. Collections in the city of Chicago still remain better than in the country.

Heating Appliances.—Former prices still prevail and the usual rush of wedding trade has caused a real flurry in demand. Some jobbers report stocks, not large to begin with, as exhausted. The demand is not playing any favorite, everything from a flatiron at $7.75 up to nine-cup percolator at $25 moving with equal celerity. The advent of extreme hot weather is helping the market.

Fans.—Midsummer temperature prevailing in June has helped distribution of fans, particularly for household use. Normal demand is sufficient to keep stock moving without any special price inducement. A peculiarity of the trade is that while marked economy is noted on the part of the retail buyer in practically all lines, the better types of fans are having first call.

Washing Machines.—This line continues to be the backbone of the retail business and seems in better shape than any other all along the line from the manufacturer down to the retailer. Factory activity is remaining about constant at the pace set in April, and sales effort backed by the proper financial arrangement meets unfailing response.

Line Hardware.—A reduction of 5 per cent on all line hardware has just gone into effect. Business is quiet, being limited to maintenance requirements almost exclusively. The apparent probability of a cut in steel prices in the near future discourages any heavy buying.

Wire.—All quotations are unchanged. Market for outside wire is very limited, greatest activity being noted in bare copper for replacement. A slight increase in demand for inside wire is noted in the city, due to resumption of building work, but buying is very cautious.

BOSTON

No marked change is apparent in trade this week, although the general trend is upward in volume. Jobbers' stocks in many lines are now considerably reduced, and on some makes of domestic labor-saving equipment deliveries are running up to three or four weeks. Collections are a trifle better, and one large house reports that its leading accounts are being liquidated to better advantage. Seasonal appliances are rather dull and power equipment is moving very slowly. Building and engineering contracts for the week ended June 14 totaled in New England $3,329,300, according to the published Dodge reports. This represents a low volume compared with corresponding weeks of war-time years except 1918, which it exceeds by half a million dollars. Labor conditions in the electrical field are relatively quiet this week. Central-station output is very well maintained considering the general business situation.

Motors.—Light buying of small motors in single lots is reported, with increased sales to diversified industries. This business is far below normal, but appears to have turned the corner toward better demand.

Flatirons.—Vigorous sales campaigns are moving flatirons fairly well. On some lines deliveries are being met by subdividing shipments. Prices are unsteady on the older designs, which are being offered at mark-down sales in retail circles. In a three weeks' campaign just closed the Central Maine Power Company sold 1,641 irons against a quota of 1,505, yielding about $8,000. The latter designs are firmer in price.

Rubber-Covered Wire.—A moderate demand is reported, with good stocks. Single-braid No. 14 is moving at $7.50 per 1,000 ft. net in lots of 1,000 ft., $6.50 in 5,000-ft. lots, and on application above this. Central-station expansion is slow and new house wiring is not normally active. One suburban central station near Boston will obtain, however, about $30,000 worth of house-wiring contracts in a six weeks' campaign now concluding.

Flexible Armored Conductor.—Prices are weak in quantity sales. This material is moving fairly well at present, and in lots of 1,000 ft. $55 per 1,000 ft. is being obtained on single-strip or double-strip No. 14.

Non-Metallic Flexible Conduit.—Small quantities are being handled in this territory with no complaint as to supply. The demand is somewhat spotty. Prices are softer, ½-in. selling at $22.50 per 1,000 ft. in 1,000-ft. lots and at $30 per 1,000 ft. in lots of 250 ft. The ⅜-in. size sells respectively as to quantity at $20 and $25 per 1,000 ft.

Ironers.—Considerable interest is developing in this equipment. An active retailer complained Monday that stocks are too low in some cases to enable him to close immediate sales.

"Nail-it" Knobs.—Although the demand is not heavy, some sales are going through from existing stocks. Present prices in barrel lots and three-barrel lots are $21 and $18 per 1,000 respectively.

Iron Conduit.—The market is not very active, but some pipe is moving into the hands of contractors doing construction work. Typical net prices per 1,000 ft. are as follows in less than 2,500-lb. lots; ½-in., black $62.18, galvanized $67.28; ¾-in., black $80.67, galvanized $87.57.

Push Switches and Plates.—The latest prices on this equipment are given below, current demand being moderate only, standard packages: single-pole, 27 cents; three-way, 38 cents; one gang, 11 cents; two gang, 22 cents; three-gang, 33 cents.

ATLANTA

This week gives indication that business so far for the month of June in the electrical jobbing trade is considerably improved over the May average, one or two of the firms reporting an increase of as much as 30 per cent in the volume of business done. Conditions in the rural districts continue slow, though Florida activities continue to hold up unusually well. This in a measure is a reflection from an excellent citrus crop and tourist patronage. Crop reports from various Southern states indicate excellent conditions in agricultural lines, virtually all crops being in very good shape for this time of the year, with the exception of cotton. Among these is the report from Louisiana that the rice sales are already 2,500,000 pockets ahead of last year, with the European demand very firm. These conditions will not serve to assist business in general until early fall, when the farming population is able to market its products and thus liquidate outstanding obligations.

Porcelain.—A general price reduction in all lines of porcelain, ranging from 5 per cent to 8 per cent, became effective this week, but has not served as yet to cause any activity above that of the past few weeks. Stocks are dull and heavy.

Fans.—The continued hot spell is assisting in a brisk movement of fans, though the volume of business this year will not equal that of last. Ceiling fans are moving very satisfactorily. In the case of desk fans it is to be noted that purchasers are buying smaller-size fans this year than heretofore.

Ventilating Equipment.—Hand-to-mouth purchases are still the rule as jobbers and dealers could not anticipate what this specialty would do. Orders are coming in very satisfactorily, however, in spite of the necessity for a large proportion of factory shipments because of spotty stocks. The demand seems to be strongest for the 24-in. size.

Twin Plugs.—Jobbers and retailers report rapid sales. An 8 per cent price reduction was offered last week.

Sewing Machines.—In the territory as a whole these are moving very slowly, but special campaigns have served to sell a very fair quantity in Atlanta and vicinity. All jobbers report heavy stocks.

Interphones.—The demand can be reported as only fair, the tendency of builders being to eliminate all items of expense, with the result that this specialty has not kept pace with other lines of building material. Local stocks are reported as quite heavy.

Wire.—Rubber-covered continues on a 15-cent base in the face of a very weak market. The price is not stabilized on sizes up to No. 14, there being a variation of around 50 cents per 1,000 ft. Weatherproof continues to hold up fairly well in the more popular sizes of No. 6 to No. 12 and is steady on a 16-cent base.

Flexible Armored Conductor.—This occupies a rather peculiar position at the present time, the quotations being offered showing little or no stability owing to a very spotty demand and heavy stocks. The average quotation is on the basis of $69 per 1,000 ft., though recent quotations show a variation of as much as $10 per 1,000 ft. from that figure.

ST. LOUIS

Business conditions in this territory seem to be approaching a certain level where but little weekly change can be noted in demand or production. This level, while materially higher than that prevailing at the first of the year, is nevertheless in most lines far from normal. No appreciable betterment in business conditions is now expected before fall, and some express the possibility that it may not come until spring. However, it cannot be denied that the foundations of the business structure in this locality are becoming stronger; credit is more substantial, stocks are everywhere reduced to the minimum, giving higher turnover; demand for essential commodities is increasing, and conservatism marks all business developments. The same conditions are found in the electrical jobbing and merchandising lines. A good volume of business is found, but it is reported that the profits therefrom are meager owing to the continued necessity of revising inventory valuations downward.

Schedule Materials.—A reduction of six points in the discounts on all schedule materials is announced. Stocks are rather heavy in all items and the demand is considered slow.

Knobs and Tubes.—Very light movement is encountered because of the small amount of new construction work. Some increase is noted as residential building increases. Stocks are about in line with the demand. "Nail-it" knobs are quoted by a large jobber at $19.80 per 1,000 in barrel lots. Three-inch tubes are quoted at $8.30 per 1,000.

Fuses.—Steady demand in almost all sizes and kinds is experienced. Stocks are maintained on a conservative basis. In standard package lots the prices on N. E. C. 220-volt cartridge fuses are quoted by a representative jobber as: 10 amp., 13½ cents each; 30 amp., 13½ cents; 60 amp., 17½ cents. Other quotations run lower; for example, one quotation of 10 cents is found on the 30-amp. size. The 30-amp. renewables are quoted at about 29 cents each in standard packages.

Conduit.—A representative price for ½-in. black is $66.10 per 1,000 ft. and for 1-in. black $123.70 per 1,000 ft., both in 5,000-ft. lots. These prices are about 5 per cent lower than those quoted a few weeks ago by the same jobber. In the expectancy of lower prices stocks have been kept at a minimum by most jobbers for some time. A small increase in demand is reported.

Wire.—A fairly good demand for the smaller sizes of rubber-covered held throughout the week, and there is a slight tendency toward increased demand on weatherproof. Some purchasing by the jobbers from manufacturers is found, but as a rule just enough to maintain satisfactory stocks. The price on No. 14 rubber-covered remains around $6.75 per 1,000 ft.

Safety Switches.—One line of switches has been reduced about 5 per cent in price in certain kinds. Other reductions would not be unexpected. The volume of sales is rather low. Stocks appear to be everywhere in line, and consequently jobbers have been firm in their prices.

Fans.—Continued warm weather has maintained good wholesale and retail movement the past week. The indications are that the year will be a very successful one in this line. Replacements in stocks are being closely watched to avoid the possibility of carrying over any large amount of stock until next year.

SAN FRANCISCO

The builders' strike, from which the present electricians' lockout is an outgrowth, seems to be progressing toward an eventual settlement. A comparatively few of the electrical contractors are operating full staffs on the open-shop plan; there is plenty of work in sight for them. The larger jobs are still held in abeyance, although union leaders instructed the men that, beginning June 20, there would be no objection to their signing for work on jobs where the open shop prevailed. It is felt that the situation is now reaching its crux and that next week's developments will prove a determining factor.

The contracting business of northern California is virtually at a standstill, and the appliance business has slackened noticeably, but the power companies are still providing excellent business in pole-line materials. Another source of good business is the government, all of whose yards are operating at top speed. The extensive military plant of the government at the Presidio, San Francisco, is congested not only because of the removal thither of the Western Corps' headquarters staff but also because of the constantly increasing military and naval activity along the Pacific Coast.

Credits and collections are below normal and some jobbers report a very lax interpretation by their customers of the cash discount.

Household Appliances.—The customary June wedding sales were reflected in a better movement of household appliances, particularly of the percolators and smaller hol low ware. Most dealers, in expecting the drop in list prices of flatirons and small heating devices, have been buying in negligible quantities. Of the larger appliances for household service ironers and dishwashers are showing a movement beyond all proportion to the better-known clothes washers and vacuum cleaners. They are being displayed well and in nearly every case are being demonstrated in the stores. Sewing machines have picked up.

Marine Material.—The seamen's strike, which has filled Pacific Coast harbors with idle ships, has dropped marine wiring to a small fraction of its normal volume.

Radio Material.—Probably the best-selling retail line at the present time is that of wireless material. More and more dealers are carrying complete stocks and are improving their sales facilities by the installation of wireless departments and wireless demonstrating and sample rooms where amateur operators, who furnish the bulk of the present business, may drop in for information and practical suggestions. Daily wireless demonstrations are made in the larger stores.

SALT LAKE CITY—DENVER

The outlook for big crop yields in the Intermountain region has not been brighter in a number of years. Though farmers are hard put to it for additional labor during the period of planting, there has been little reduction of acreages of the various kinds of crops. The recent disposal of wool has brought some money into the banks but not in sufficient amounts to relieve entirely the tense credit situation. Collections are reported to be about as slow as ever. The building of homes is proceeding at a fairly good rate in the larger cities. Jobbers are plentifully stocked with all electrical materials called for by contractors and can make deliveries on demand. Labor conditions are good.

Motors.—Dealers, especially those maintaining service stations, report a large demand for motors of the size that are used principally for replacement on washing machines and sewing machines.

Hollow Ware.—With the advent of hotter weather and the consequent increased use of chafing dishes, toasters and percolators, trade in hollow ware is showing a marked improvement.

Flashlamps.—Business in this line is particularly good at present, the impetus in demand coming from their increased use during the touring season. The price is stable.

Flatirons.—Some dealers are stimulating business by offering a trade-in proposition on used irons. The regular demand, however, is small, and the price is regarded as the biggest bar to general buying.

SEATTLE—PORTLAND

Neither jobbers nor dealers in Seattle and the Puget Sound district report any change over several weeks past, and they assert that June business will be as light as or lighter than that of the preceding month. In spite of increased efforts to increase sales volume, sales of house-wiring devices, schedule material and domestic appliances, while not dropping off, are far below original expectations. There are frequent drops in prices on certain lines, particularly cord, switches, schedule materials, etc. These decreases, while not large, have an effect on jobbers with large stocks. Domestic appliance prices are holding up and are not expected to drop until fall, if then. Collections are no better and no worse. It is believed there will be a considerable number of failures of small-appliance dealers and contracting firms in this district before and during fall months unless conditions change radically.

Residential construction is still showing improvement. The larger class of construction, however, is being held up more or less because of improper financing and in many cases the lack of any. In western Oregon and Washington 114 lumber mills report last week's production at 57,700,000 ft., which is 30 per cent below normal. The mills and camps are expected to close down for a week or two early in July, and during this time many will make repairs and betterments. The non-employment situation is still far from a solution as there are about 6,000 idle men in Seattle alone.

Portland jobbers report business improving somewhat, but the change is very slight. There is some activity, however, in line construction material. There has been no warm weather in this section of sufficient duration to develop any activity in fan sales. The credit situation is in very poor shape; collections are not materially better than they have been, the average for Portland being about forty-six days outstanding. The average is kept down as low as this primarily by the promptness of large accounts as the majority of the smaller accounts, particularly contractors', dealers' and lumber companies', are on a very much longer time basis. Portland contractors report considerable activity in residence wiring and general remodeling work. Fixtures are active, owing largely to activity in residence building.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

Revised Schedule of A. M. E. S. Meetings and Events

In the final revised schedule of meetings of the summer sessions of the Associated Manufacturers of Electrical Supplies, June 27-30, at the Hotel Griswold, New London, Conn., a few changes are noted from the schedule published on page 1385 of the Electrical World for June 11. Of the four meetings formerly set down for Thursday, June 30, the Fuse Section will meet on Tuesday and the Knife Switch, Molded or Formed Insulation and Line Material Sections will meet on Wednesday. Thursday is open for matters demanding further consideration.

The dinner-dance, entertainment and radio demonstration will take place Tuesday evening. Three handicap golf matches are scheduled for Monday and Tuesday.

From the returns received up to the middle of this week the summer meetings will establish a record for attendance and interest. The interest in the association has increased greatly this spring, for whereas at the first of the year the company membership totaled 190, the present company membership is 225. The association started in 1915 with eighty-three members. Former members who have withdrawn are coming back in considerable numbers.

A. H. Petersen Company Discontinues Tool and Die Department

The A. H. Petersen Manfacturing Company, Milwaukee, manufacturer of tools and dies, etc., announces that it has discontinued this department and will turn over its entire plant to the manufacture of "Hole Shooter" portable electric drills and other automotive devices.

Frigidaire Consolidated with Delco Light Company

Announcement was made on June 18 by the General Motors Corporation, Detroit, Mich., that the Frigidaire Corporation has been consolidated with the Delco Light Company, the two latter companies being subsidiaries of the former. No information has yet been received as to whether or not the manufacturing of Frigidaire equipment will be moved from Detroit to Dayton.

For some time sales of Frigidaire machines have been conducted through the sales organization of the Delco company, but now there is a physical merger of the two companies. R. H. Grant, general manager of the Delco Light Company, will be general manager of the consolidated companies, while J. Parker Fiske has resigned as president and general manager of the Frigidaire Corporation.

Better Business in Wire Reported by Belden

The Belden Manufacturing Company, Chicago, Ill., according to C. P. Belden, is finding that the demand for rubber-covered wire and for lamp cord has picked up within the last forty-five days. Mr. Belden states that orders for rubber-covered wire have been slightly ahead of production, while appliance manufacturers are placing orders for lamp cord that are generous under existing conditions. The market for magnet wire has fallen off. Most of the larger users of this product are still heavily stocked up. Considerable business is being placed for repair purposes.

Western Electric Dedicates Athletic Field to Veterans

To honor the memory of the forty-nine Western Electric men who died in the war the company has just presented to its employees a completely equipped 10-acre athletic field at Hawthorne, near Chicago, between Twenty-second and Twenty-third Streets and Forty-ninth and Fiftieth Avenues. H. F. Albright, vice-president of the Western Electric Company and superintendent of the Hawthorne Works, in making the presentation, explained the part athletics play in supplying a big industry's people with the chance to get acquainted and to develop group spirit. He attributed the splendid spirit existing in the ranks of the company to the great share outdoor exercises have had in its welfare programs.

The grounds include an eight-lap track, space for basketball, baseball, soccer, lacrosse, etc., twenty-two tennis courts and provision for flooding fields to make ice for winter sports.

J. F. Davis Enters Boiler Manufacturing Field

After thirty years of experience in manufacturing, engineering, dealing and selling in connection with every phase of the power boiler industry, J. F. Davis has organized the J. F. Davis & Sons Company, with a capitalization of $500,000, and articles of incorporation have been issued. J. F. Davis is president and treasurer and his son, J. E. Davis, is secretary. General offices will be established in the Harris Building, Chicago.

The company has purchased the entire plant site, machinery and equipment of the De Pere Manufacturing Company, West De Pere, Wis., where facilities are adequate for both rail and water shipment. Boilers, tanks and special steel-plate construction and fabrication will be a part of the work. In addition the company plans to continue reconditioning used boilers. Mr. Davis has been especially active in salvaging and marketing power plants of various war industries, and in both this country and in Europe these boilers have again been put in operation.

A water-tube boiler of special design is contemplated with a view to obtaining better efficiency of operation, but until present tests are completed it is being withheld from the market.

Olson-Boettger Electric Reorganizes and Undertakes Jobbing

The Olson-Boettger Electric Manufacturing Company, St. Paul, Minn., announces its entrance into the electrical jobbing field and its reorganization under the name Olson-Boettger Electric Company, with an increase in capital stock of $75,000 to $250,000. H. S. Olson is the president and treasurer, J. O. Nelson secretary, and R. P. Young vice-president and manager.

The corporation will conduct its jobbing business from its modern five-story building at 108 East Third Street, St. Paul, while its old location at 413 North Franklin Street will be used for a repair shop for rebuilding motors and generators. Seven men will cover Minnesota, North and South Dakota and part of Iowa and Wisconsin.

Increase in Representation by E. O. McDonald

E. O. McDonald, manufacturers' representative in wiring devices at 30 Church Street, New York City, has taken on the line of sectional switch boxes manufactured by the Mansfield (Ohio) Electric Hardware Company for the metropolitan district and New England.

Triumph Electric Announces the Removal of Three Offices

The triumph Electric Company, Cincinnati, manufacturer of motors and generators, announces the removal of its Chicago office from 628 West Lake Street to 2814-16 Wentworth Avenue, where it has more spacious quarters. W. R. Bonham is manager of this office. The company has also moved its New York office, of which T. W. Kloman is manager, from 80 Cortlandt Street to the Knickerbocker Building, Forty-second Street and Broadway. The Wood & Lane Company, St. Louis representative of the company, is now established at 1016 Market Street, St. Louis, where it has large warehouse facilities and carries ample stocks of the various lines.

New Officers for Stoker Manufacturers' Association

At the annual meeting of the Stoker Manufacturers' Association, held in Stockbridge, Mass., June 14 to 16, the following officers were elected: President, Maxwell Alpern, vice-president American Engineering Company, Philadelphia; vice-president, S. A. Armstrong, vice-president Underfeed Stoker Company of America, Detroit; treasurer, Richard D. Hatton, vice-president Laclede-Christy Co., St. Louis; secretary, J. G. Worker, vice-president Phoenix Manufacturing Company, Eau Claire, Wis. These officers, with the addition of R. Sanford Riley, retiring president, and A. G. Pratt of Babcock & Wilcox Company, make up the executive committee.

In discussing the advertising and publicity requirements of a typical stoker company, H. E. Cleland pointed out the necessity of selecting mediums with special care and then advertising consistently. It was decided not to extend the scope of the association at this time to include membership of semi-automatic shaking-grate manufacturers.

Golf matches took up the attention of the attending members every afternoon, and the award of prizes was made a special feature at the banquet on Wednesday evening.

Laundryette's Plan to Get Consumers' Viewpoint

Believing that a satisfied customer is the best advertisement, the Laundryette Manufacturing Company, 1190 East 152d Street, Cleveland, is in the midst of a six weeks' drive called a "User's Book Contest." The competition is taking place among Laundryette distributers and dealers and their salesmen, and it is the idea to see who can build the best scrapbook containing from ten to fifteen original letters from users of the company's washer and dryer. Prizes, of course, will be awarded to the winner and for certain runners up.

National Metal Molding's Plan to Extend Existing Wiring

Under the slogan, "Brings Electricity Where Needed," the National Metal Molding Company, Pittsburgh, is putting on an extensive advertising campaign to extend existing wiring by putting in more outlets while keeping the conductors concealed.

The objects in view are to create a desire for making the fullest use of electric service, to point out the advantages of adequate wiring and to educate and interest the public in the company's product. If the plan is successful in one of its chief objects, namely, to assist the company's distributers and electrical contractors in making sales and installations of National metal molding, it must be conceded that it will bring with it the market for other electrical wiring devices and appliances.

Through the use of the *Saturday Evening Post* as a national medium to reach a consumer market the company is tying in its trade paper advertising and local advertising with dealer and sales help. Without aggressive sales work, however, it is felt that the plan will lack success.

New Recreation Grounds for Electric Storage Battery

The Electric Storage Battery Company, Philadelphia, is about ready to turn over to its employees a modern and completely equipped club house and recreation ground, including baseball field, tennis courts, bowling alley, shooting gallery, pool and billiard tables, gymnasium apparatus, shower rooms and dining room, etc. An interesting provision in this turnover is that the employees themselves assume entire charge and responsibility for the clubhouse and grounds, including the cost of maintenance. To date the enrollment takes in more than 1,500 of the members.

Electric Hoist Manufacturers in Publicity Field

Two recent bits of publication from the Electric Hoist Manufacturers' Association, 165 Broadway, New York City, embody the slogan—"The Strong Arm of Industry." One of these bulletins, "Approved Applications," pictures and describes under 133 headings partial uses to which electric hoists have been applied, while the other one, "Monorail Runway Construction," gives specifications covering standard practice in monorail runway construction, including curves and tables.

American Di-Electrics Sees Big Market for Insulation Ahead

American Di-Electrics, Ltd., 71 West Broadway, New York City, which has been in the field of electrical insulation as manufacturer and engineer for about a year, reports that business, though small individually, is constantly on the increase. John H. Barker, president and general manager of the company, attributes this to the natural growth of a newcomer in a large field. He is extremely optimistic over the business outlook in this line, because with everything electrical in the country gradually wearing out and comparatively little repair work being done, there should be an enormous potential market. This, he thinks, will make itself felt by fall.

Risler & Hornung, Inc., Jobbers, Formed in New York

Risler & Hornung, Inc., a new addition to the electrical jobbing trade in New York City, has opened offices on the ground floor of 132 West Thirtieth street. The company will handle the usual line of electrical supply items and appliances, selling goods at wholesale only. Among the manufacturers whose goods are carried in stock at present are the "Apex" cleaner, "Locomotive" washing machine, the "Star" and the "Peerless" motors and the "Monarch" renewable fuse. E. A. Risler, Jr., formerly owner of the Fullerton Electric Corporation, supply jobbers at Scranton, Pa., is president. Mr. Risler for the past two years has been sales manager and secretary of the F. W. L. Fullerton Company, supply jobber, New York City. H. J. Hornung, secretary and treasurer of the new company, was until April 1 of this year manager of the Western Electric Company's Fortieth street branch office, New York City.

Indemnity Company Handles Motor Insurance

The Royal Indemnity Company, 84 William Street, New York City, after having worked for some months on a form of policy for the insurance of electric motors, etc., early this year received approval from the insurance authorities in New York State of the form of a policy which would indemnify for the electrical and mechanical breakdown of motors, generators, transformers, regulators and other electrical apparatus. The company guarantees the repair bills directly incidental to such troubles.

In the opinion of the Indemnity company manufacturers will probably find a reduction in numbers of complaints from alleged defects in workmanship and material, since actual causes of breakdown will be determined by the guarantor's field force and the findings will usually fail to show defects traceable to the manufacturer. Up to date most of the insurance written seems to be in Canada and in the Western and Far Western States, and a good part of it is applied on electrically driven pumps for irrigation purposes.

Greenfield Tap & Die Absorbs Two Grinder Companies

At a meeting of the board of directors of the Greenfield Tap & Die Corporation held Thursday, June 9, it was voted to purchase the entire capital stock of the Greenfield Machine Company of Greenfield, Mass., manufacturers of cylindrical and universal grinders, and the Morgan Grinder Company of Worcester, Mass., manufacturers of internal grinders.

The combination of the Morgan Grinder Company and the Greenfield Machine Company, together with the machine business now conducted by the Greenfield Tap & Die Corporation, will constitute the machine division of the Greenfield Tap & Die Corporation.

The Greenfield Tap & Die Corporation will operate both plants in their present location, although eventually the Worcester plant will be moved to Greenfield. The organization of both plants will remain the same.

The Banks Supply Company, Huntington, W. Va., electrical supplies, has taken on the line of "Denzar" fixtures of the Beardslee Chandelier Manufacturing Company, Chicago. A complete stock is on hand.

Foreign Trade Notes

PROPOSED ELECTRIC PLANT FOR CHINESE RAILWAY.—The Tientsin-Pukow Railway Company, according to *Electrical Industries*, has decided to build an electric plant at Pukow, to cost about $900,000.

THE ONWARD MANUFACTURING COMPANY, Kitchener, Ontario, has made arrangements with Blackadar & Stevens, Roy Building, Halifax, N. S., to act as its wholesale distributer for the Eureka vacuum cleaner for the Maritime Provinces, which include New Brunswick, Novo Scotia and Prince Edward Island. The company has also engaged the Weber Sales Company, 862 Cambie Street, Vancouver, to act as its distributer for the Province of British Columbia.

NAMES OF AMERICAN BUSINESS REPRESENTATIVES IN EGYPT DESIRED.—Julian E. Gillespie, assistant trade commissioner, writes from Constantinople that the American Chamber of Commerce of Egypt, at Alexandria, desires to obtain the names and addresses of all agents of American manufacturers and exporters in Egypt. This information should be sent to the secretary of the above-named institution.

FRENCH SENATE HAS VOTED CREDITS FOR THE PROPOSED RHONE POWER SCHEME.—The French Senate, according to *Electrical Industries*, has voted the necessary credits for the proposed scheme for developing the water power of the Rhone and has approved the details of the plan for making the river a navigable waterway, a source of great hydraulic power and a means of irrigation. The plans provide for not less than eighteen power stations to be erected along the course of the river, the largest of which will be at Genissat, near Belegar, which will have a generating capacity of 200,000 kw. The total output of all the stations is estimated at about 1,100,000 hp. The two most important consumers of this energy will be the P. L. M. Railway Company and the city of Paris. The railway company plans to equip all of its lines included in the quadrilateral bounded by Belegar, Lyons, Marseilles and Vintimille for electrical operation. The distance between Paris and Genissat, the station which is to supply electricity in Paris, is 280 miles. Energy will be transmitted to Paris by two great feeders, one passing through Dijon and the other through Nevers, the two being linked up just before they reach Paris. Each of these feeders will consist of six cables, which will transmit 150,000 volts. The cost of this installation is estimated at about 60,000,000 francs.

SURVEYS FOR HYDRO-ELECTRIC PROJECTS IN INDIA. — Several surveys have been undertaken by the Assam government, according to *Electrical Industries*, for a hydro-electric development. The Hukong Valley scheme seems to be the most promising.

BRUSH ELECTRICAL CLOSED SUCCESSFUL YEAR.—From the report of manufacturing operations for the year 1920 submitted at the thirty second general meeting of the Brush Electrical Engineering Company, Ltd., London, held May 9, it appears that the company had a prosperous year. After providing for all general charges, maintenance of plant and buildings and interest on the company's debenture stock and loan, there is a balance of profit of £191,096. After writing off depreciation, expenses in connection with the issue of capital last year, and other certain expenses there is carried forward an amount of £143,268, as a result of the year's operation. The gross profit on trading was £285,328 as compared with £223,000 in the preceding year. Expenses, of course, were higher. The report states that the company's order books are well filled and there has been a gratifying increase in the demand for its Brush-Ljungstrom turbo-generator plant. Orders on hand at the time of the meeting represented in horsepower more than the total the company supplied in the whole period from the commencement of the manufacture of this generator in 1914 to the end of 1920. A new factory now under construction at the Falcon Works is to be devoted to the manufacture of this turbo-generator. The position of the company has improved with regard to the giving of quotations on long-time contract, and the company is now able, the report states, to make contracts at firm prices. The export trade situation is reported far from satisfactory with the result that the nation is already suffering heavily by loss of much of its foreign business.

THE DEVOE ELECTRIC SWITCH COMPANY, 414 Notre Dame West, Montreal, has established an office and showroom at 105 Victoria Street, Toronto, in charge of W. R. S. Careless.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of electrical merchants in Spain (No. 35,049) desires to obtain the representation of manufacturers of miscellaneous electrical appliances and household conveniences such as fans, flatirons, warming pads, sweepers, toasters, grills, percolators and heaters.

A manufacturer in Italy (No. 35,052) desires to purchase machinery for the manufacture of 30,000 glass bulbs per day for making incandescent lamps.

A merchant in India (No. 35,025) desires to purchase electrical goods and appliances such as bulbs, shades, lamps and fans.

New Apparatus and Publications

GAS-PURIFYING EQUIPMENT.—Chas. Eisler Engineering Company, 15 Kirk Place, Newark, N. J., is now marketing electric high-pressure nitrogen and argon gas-purifying equipment which is adaptable for filling type "C" lamps and for laboratory purposes.

ELECTRIC VEHICLE. — The Walter Motor Truck Company, 227 West Sixty-first Street, New York City, has developed a new line of electric road truck of from 1500-lb. to 7-ton capacity.

LIGHTNING ARRESTERS. — The Hi-Voltage Equipment Company, Cleveland, has developed a new type of lighting arrestor for outdoor mounting.

FLATIRON.—A new 3-lb. electric flatiron with curling-iron attachment has been placed on the market by Manning, Bowman & Company, Meriden, Conn.

LIGHTING FIXTURES. — The Polly Manufacturing Company, Polacheck Building, Milwaukee, Wis., has issued a forty-eight-page catalog covering its residence lighting fixtures.

PORTABLE ELECTRIC GRINDER. — The Black & Decker Manufacturing Company, Towson Heights, Baltimore, has recently placed on the market a portable electric grinder.

UNAFLOW ENGINES.—Bulletin No. 29 recently issued by the Ridgway Dynamo & Engine Company, Ridgway, Pa., describes its unaflow engines.

STAMP VULCANIZER.—The Automatic Electric Heater Company, Warren, Pa., is distributing a leaflet describing its new "Sepco" automatic electric stamp vulcanizer.

STEAM TABLES.—The Wheeler Condenser & Engineering Company, Carteret, N. J., has published the sixth edition of "Steam Tables for Condenser Work."

TRANSFORMERS. — The Enterprise Electric Company, Warren, Ohio, is distributing a four-page pamphlet covering its "Peerless" transformers.

CENTRIFUGAL PUMPS. — "Centrifugal Pumps for Ice and Refrigerating Plants" is the title of leaflet No. 2056 distributed by the Allis-Chalmers Manufacturing Company, Milwaukee, in which it describes its centrifugal pumping units for refrigerating plants.

IRONER.—"A perfect Ironer for One Hundred Dollars" is the title of a descriptive circular issued by the William G. Yates Company, Cleveland, manufacturer of the cottage ironer.

WATER HEATER.—The Aqua Electric Heater Company, 250 West Fifty-fourth Street, New York City, is marketing a new instantaneous automatic electric water heater, 22 x 12 in. x 8 in. for domestic use.

BREAD OVEN.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, has placed on the market a continuous conveyor bread-baking oven in five sizes, baking from 400 to 1,200 1½-lb. loaves per hour.

New Incorporations

THE S-T ELECTRIC EQUIPMENT CORPORATION, Dover, Del., has been incorporated by B. B. Smith, Thomas J. Turner and Joseph Harris, New York City. The company is capitalized at $500,000 and proposes to manufacture electrical equipment. It is represented by Truston P. Causey, Milford, Del.

THE EASTERN PENNSYLVANIA LIGHT, HEAT & POWER COMPANY, Potter Township, Pa., has been incorporated with a nominal capital stock of $5,000 to install and operate an electric light and power system in this section. L. A. Reinhart, Schuylkill Haven, is treasurer.

THE GAINADAY ELECTRIC COMPANY, Jersey City, N. J., has been incorporated by H. A. Black, John R. Turner and Alfred F. McCable, 15 Exchange Place. The company is capitalized at $200,000 to manufacture electrically operated washing machines.

THE APEX ELECTRIC COMPANY, 1379 Springfield Avenue, Newark, N. J., has filed notice of organization to manufacture electrical apparatus. M. Freund, 946 South Grove Street, Irvington, is interested in the company.

THE KNOWLTON ELECTRIC COMPANY, Framingham, Mass., has been incorporated with a capital of $5,000 to manufacture electrical specialties. Fred W. Spaulding is president and treasurer and Frederick H. Knowlton, Framingham, is secretary.

THE TAYLOR-MALCOLM COMPANY, Albany, N. Y., has ben incorporated by S. and G. B. Taylor and I. Malcolm, Albany. The company is capitalized at $15,000 and proposes to manufacture and deal in storage batteries.

THE TOWNSHEND (VT.) ELECTRIC COMPANY has been incorporated by J. H. Warren, C. H. Willard, C. W. Cutler, W. A. F. Wheeler and F. A. Blood. The company is capitalized at $10,000 and proposes to furnish electricity for lights and power in the towns of Brookline, Newfane and Townshend.

THE MacDOUGALL PROCESS COMPANY, INC., Niagara Falls, N. Y., has been incorporated with a capital stock of $200,000 to manufacture electric products. The directors of the company are A. J. MacDougall, Toronto, Ont.; James G. Rowe and Ray H. Bennett, North Tonawanda.

THE VENICE (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by John F. Stradtman, B. K. Sessler, Paul R. Grahl, Joseph A. Brunner and Charles C. Trike.

THE ELECTRIC MACHINERY MANUFACTURING COMPANY, Minneapolis, Minn., has been incorporated with a capital stock of $1,000,000 by C. T. Jaffray, E. W. Decker, E. W. Backus, N. V. Wood and Silas McClure.

THE SERVICE ELECTRIC COMPANY, 328 South Seventh Street, Newark, N. J., has filed notice of organization to manufacture and deal in electrical specialties. M. Kern is interested in the company.

THE COLBY LIGHT & POWER COMPANY, Woodland, Me., has been organized with a capital stock of $10,000 to generate and distribute electricity for lighting and power purposes in Woodland. The directors of the company are Frank A. Anderson, president; C. Albion Johnson, treasurer and Frank P. Thomas, clerk.

THE BURNS-POLLOCK ELECTRIC MANUFACTURING COMPANY, Indiana Harbor, Ind., has been incorporated by Anthony J. Burns, Thomas Pollock and J. G. R. O'Hara. The company is capitalized at $1,000,000 and proposes to manufacture electrical appliances.

THE LAGRANGE ELECTRIC COMPANY, Milo, Me., has been organized with a capital stock of $50,000, to generate and distribute electricity for light and power purposes in the town of Lagrange. The directors of the company are Julian d'Este, president; John N. d'Este, treasurer and Cecil D. Towne, clerk, all of Milo.

THE UNION-FORT SPRING POWER COMPANY, Union, W. Va., has been incorporated with a capital of $30,000 by C. W. Boon, Union, and W. H. Garnet, Fort Spring.

Record of Electrical Patents

Notes on United States Patents

(Issued May 31, 1921)

1,379,854. LIQUID-TIGHT JOINT FOR PREVENTING LEAKAGE BETWEEN THE TERMINAL RODS AND COVERS OF ELECTRIC ACCUMULATORS; Alfred Dinin, Nanterre, France. App. filed Sept. 4, 1918. Liquid-tight joint.

1,379,881. ARC STRIKING AND EXTINGUISHING APPARATUS; Elmer A. Sperry, Brooklyn, N. Y. App. filed July 22, 1916. Contact bridge gap.

1,379,900. STORAGE-BATTERY PLATE AND PROCESS OF MAKING SAME; Rufus N. Chamberlain, Chicago, Ill. App. filed Sept. 12, 1918. Active material mixed with finely divided wood particles.

1,379,919. MAGNETIC-WAVE THERAPEUTIC APPARATUS; Thomas H. Herndon, Washington, D. C. App. filed Aug. 2, 1920.

1,379,942. ELECTRIC FURNACE AND METHOD OF OPERATING SAME; Frederick T. Snyder, Oak Park, Ill. App. filed Oct. 23, 1913. Automatically regulated.

1,379,971. CIRCUIT CONTROLLER; Clarence T. Evans and Richard B. Hunter, Milwaukee, Wis. App. filed Aug. 27, 1915. For overload and no voltage.

1,379,998. PREPARING FERRIC ARTICLES FOR METALLIC BATHS; James H. Maddy, New York, N. Y. App. filed Nov. 11, 1920. Protecting iron or steel from corrosion.

1,380,034. DRY CELL; William Balderston, Madison, Wis. App. filed Dec. 3, 1919. For use in flashlights.

1,380,039. AUTOMATIC TELEPHONE SYSTEM; W. A. Chapin, Chicago, Ill. App. filed Oct. 28, 1916.

1,380,061. SEAL FOR STORAGE-BATTERY TERMINALS; Clarence W. Hazelett, Lakewood, Ohio. App. filed Aug. 19, 1918. Seals cover and terminal.

1,380,063. ELECTRIC LAMP SOCKET; Harry F. Hitner, Wilkinsburg, Pa. App. filed Dec. 1, 1919. Cheap simple socket.

1,380,091. ELECTRIC LANTERN; Leigh D. Brainerd, Chicago, Ill. App. filed Dec. 31, 1919. May be used in developing films.

1,380,123. PORTABLE LIGHTING PLANT; William E. Sullivan, Roodhouse, Ill. App. filed Aug. 2, 1918. Light weight.

1,380,131. CEILING LIGHT; Lauritz W. Anderson, Waterbury, Conn. App. filed Aug. 10, 1916. For porches, corridors and the like.

1,380,142. PLATING BATH; Hugo H. Hanson and Albert C. Walker, Bangor, Me. App. filed Nov. 17, 1919. Deposition of zinc.

1,380,143. PORTABLE ELECTRIC LAMP; William A. Harvey, Scranton, Pa. App. filed March 18, 1920. Means for varying degree of illumination.

1,380,144. ELECTRIC CHANDELIER FIXTURE; William A. Harvey, Scranton, Pa. App. filed April 24, 1920. Means for varying the luminosity.

1,380,168. THERMOSTATIC SWITCH; George H. Whittingham, Bancroft Park, Md. App. filed Dec. 20, 1917. Used in operating refrigerating apparatus.

1,380,180. MAGNETO POCKET LAMP; Georges M. Beaudot, Paris, France. App. filed Dec. 9, 1920. No batteries.

1,380,206. VACUUM-VALVE DETECTOR; Roy A. Weagant, Roselle Township, N. J. App. filed March 10, 1917. Not affected by static and high potential.

1,380,248. ELECTRIC FURNACE; Charles H. Priestley, Elizabeth, N. J. App. filed April 24, 1919. Able to withstand increasing gas pressure.

1,380,250. PROCESS OF MOLDING OR SHAPING PARTS IN MOLDS OR DIES; Martin H. Reymond, Anderson, Ind. App. filed Oct. 22, 1919. Electromagnetic induction used as heating agency.

1,380,291. TEMPERATURE REGULATOR; John J. Danylchuk, Saskatoon, Saskatchewan, Can. App. filed March 30, 1920. For electric flat-irons.

1,380,311. AUTOMATIC-CALL CLOCK; Charles R. Bacon, Los Angeles, Cal. App. filed April 21, 1919. For call bells, lamps and the like.

(Issued June 7, 1921)

1,380,353. METHOD FOR TREATING STORAGE-BATTERY SEPARATORS; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Aug. 26, 1918. For storage.

1,380,354. STORAGE-BATTERY SEPARATOR; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed July 19, 1919. Methods of treating wood.

1,380,357. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Dec. 28, 1918. Means for selecting operator's position.

1,380,374. SIGNALING SYSTEM; Fred G. Gardner, New York, N. Y. App. filed Nov. 21, 1919. Composite telegraph and telephone.

1,380,419. ELECTRIC MEASURING INSTRUMENT; Frank W. Roller, East Orange, N. J. App. filed Aug. 5, 1916. Hot-wire meter.

1,380,451. TELEPHONE-EXCHANGE SYSTEM; Ray S. Wilbur, Lyndhurst, N. J. App. filed May 13, 1918. Inter-office trunk circuits.

1,380,544. SLEET HAMMER; John N. Duncan, Boone, Iowa. App. filed Oct. 14, 1920. Carried by trolley.

1,380,550. BUSBAR CLAMP; Frank E. Getts, Chicago, Ill. App. filed Sept. 21, 1918. Adjustable to size of bar.

1,380,579. ELECTRIC POPCORN POPPER; Abner R. Neff, Long Beach, Cal. App. filed May 31, 1919.

1,380,656. ELECTRIC OVEN FOR COOKING PURPOSES; Clarence H. Lauth, Islington, London, England. App. filed June 16, 1920.

1,380,663. WIRELESS CONTROL DEVICE; John Lindgren, Lemont, Ill. App. filed May 16, 1918. For synchronizing movement of armature located at a distance.

1,380,679. PRINTING-TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed May 8, 1918. Ready intercommunication established.

1,380,684. TROLLEY HARP; Roy C. Showalter, Altoona, Pa. App. filed March 15, 1921. Novel contact spring.

1,380,696. MOTOR CONTROLLER; Charles W. Yerger, Milwaukee, Wis. App. filed June 23, 1919. Resistance control.

1,380,711. ELECTROLYTIC PRODUCTION OF ZINC; Arthur E. Hall, Omaha, Neb. App. filed July 15, 1915. From oxidized zinc ores, etc.

1,380,712. PURIFICATION OF ZINC-BEARING SOLUTIONS; Arthur E. Hall, Omaha, Neb. App. filed Jan. 7, 1916.

1,380,751. REPEATER-NETWORK-SELECTING APPARATUS; John F. Toomey, New York, N. Y. App. filed July 9, 1919. Telephone repeaters.

1,380,753. ELECTRIC STOVE; Leo Trouilhet and Gaston Duveau, Lyons, France. App. filed Nov. 19, 1919.

1,380,764. SYSTEM OF ELECTRICAL REGULATION; Ernst Bauer, Niagara Falls, N. Y. App. filed Jan. 25, 1918. For electric lighting of railway cars.

1,380,767. PROCESS FOR MELTING METAL TURNINGS, METAL BORINGS, ETC.; William K. Booth, Chicago, Ill. App. filed Dec. 3, 1919. Electric furnace.

1,380,770. STORAGE-BATTERY CONSTRUCTION; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed Sept. 20, 1919. Several cells in one jar.

1,380,809. ELECTRICAL BATTERY AND BULB TESTER; William B. Kouwenhoven, Baltimore, Md. App. filed July 10, 1920. For use in stores.

1,380,852. ELECTROLYTIC APPARATUS; Henri Tobler, Hackensack, N. J. App. filed June 19, 1918. For production of hypochlorites.

1,380,853. ELECTROLYTIC APPARATUS; Henri Tobler, Hackensack, N. J. App. filed Nov. 8, 1920. For production of hypochlorites.

1,380,857. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Dec. 31, 1919. Automatic.

1,380,871. APPARATUS FOR MAGNETIC SIZING AND GRADING OF ORE; Walter G. Swart, Duluth, Minn. App. filed Sept. 11, 1917. Magnetic sizing and grading.

1,380,872. RADIO-COMMUNICATION TRANSMITTER; Roy E. Thompson, New York, N. Y. App. filed Sept. 24, 1917.

1,380,885. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Jan. 15, 1921. To regulate a dynamo automatically.

1,380,880. LIGHT SUPPORT; Charles S. Farriss, De Land, Fla. App. filed March 24, 1919. Possible to tilt at various angles.

1,380,941. ELECTRICAL SYSTEM OF POWER TRANSMISSION AND REGENERATIVE BRAKING; Clinton J. Axtell, Schenectady, N. Y. App. filed Feb. 4, 1918.

1,380,943. SUBMERSIBLE MOTOR; William Baum, Milwaukee, Wis. App. filed Sept. 27, 1917. For pumping in ships, etc.

1,380,947. SPARK INTENSIFIER; Arthur B. Christopher, St. Louis, Mo. App. filed Oct. 11, 1920. For internal-combustion engines.

1,380,959. TROLLEY-WHEEL ATTACHMENT; William T. Hill, Baltimore Md. App. filed June 28, 1919. To prevent wheel from becoming separated from wire.

1,380,961. ELECTRICITY TRANSFORMING AND CONVERTING APPARATUS; Henry M. Hobart, Schenectady, N. Y. App. filed Sept. 4, 1917. High-tension alternating current into low-tension direct current.

1,380,962. STORAGE-BATTERY GRID; Walter E. Holland, Philadelphia, Pa. App. filed July 8, 1918. Increased strength and durability.

1,380,963. STORAGE-BATTERY GRID; Walter E. Holland, Philadelphia, Pa. App. filed Nov. 22, 1919. Cored type.

1,380,975. POWER PLANT; Charles E. Kettering and William A. Chryst, Dayton, Ohio. App. filed Dec. 8, 1919. Farm lighting.

1,380,978. CONVERTER; Willem C. Korthals-Altes, Schenectady, N. Y. App. filed Dec. 22, 1917. Variable voltage.

1,380,981. TELEPHONE; Irving Langmuir, Schenectady, N. Y. App. filed April 21, 1917. Loud-speaking.

1,380,983. CORE FOR ELECTRICAL APPARATUS; Corliss E. Lee, Pittsfield, Mass. App. filed Oct. 18, 1920. Transformer core.

1,381,008. BATTERY GRID; William R. Polk, Atlanta, Ga. App. filed June 16, 1920. Double-lattice grids.

1,381,044. SHORT-CIRCUITING DEVICE; Alfred F. Welch, Fort Wayne, Ind. App. filed Sept. 10, 1917. For starting single-phase motors.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS. — Property on Pine Street has been recently acquired by the Edison Electric Illuminating Company, to be used in connection with operations in the Broadway extension district.

READING, MASS.—The Commonwealth of Massachusetts, Metropolitan District Commission, 18 Tremont Street, Boston, is considering the construction of a new electrically operated pumping plant at Reading, to cost about $40,000.

WALTHAM, MASS.—The Edison Electric Illuminating Company has filed petition with the City Council for the construction of a conduit from the Watertown line through River, Newton and Pine Streets to the electric power station for the purpose of providing another source of power supply.

Middle Atlantic States

BINGHAMTON, N. Y.—The Council has authorized the installation of ornamental lamps on Water Street between Court Street and the north line of the waterworks property.

CORINTH, N. Y.—Application has been made to the Public Service Commission by the Corinth Electric Light & Power Company for approval of a franchise to install and operate an electric system in the eastern district of Corinth Township for a period of ten years.

CORTLAND, N. Y.—Bids will be received by Dr. Frank B. Gilbert, acting commissioner of Education, Education Building, Albany, until July 7 for the construction,

heating, sanitary and electric work. State Normal and Training School, Cortland. L. E. Pilcher, Capitol, Albany, is state architect.

ITHACA, N. Y.—The Tompkins County Power Corporation, a new subsidiary of the Associated Gas & Electric Company, has purchased the power plant of the Ithaca Traction Corporation. Contracts have already been let for an additional 1,500-kw. steam turbine and one 500-hp. boiler, etc. Present plans call for an expenditure of about $150,000 at the present time, with an ultimate total expenditure of $500,000.

LANCASTER, N. Y.—Plans are under way by the Depew & Lancaster Light, Power & Conduit Company for the construction of a new electric power plant.

LONG ISLAND CITY, N. Y.—The Loft Candy Company, Broome and Center Streets, New York City, is considering the construction of a new one-story power house at its plant on Hamilton Street, Long Island City. Tenney & Ohmes, 101 Park Avenue, New York City, are engineers.

NORTH TONAWANDA, N. Y.—The installation of an ornamental lighting system in the residential section is under consideration.

PASSAIC, N. J.—Arrangements are being made by the Eastside Business Men's Association for the installation of an ornamental lighting system on Second Street.

PRINCETON, N. J.—Arrangements are being made by the Borough Council for improvements to the street lighting in certain sections of Princeton.

NORTHAMPTON, PA.—Property of the Northampton Traction Company, including traction line, power plant, etc., has been acquired for operation by a bondholders' protective committee, of which C. S. Newhall is chairman. Extension to the property are under consideration.

PHILADELPHIA, PA.—Fels & Company, Seventy-third Street and Woodland Avenue, manufacturers of soap, contemplate the installation of additional electrical equipment, including a 1,000-kw. turbo-generator set and a 1,000-kw. motor generator set.

PITTSBURGH, PA. — Plans are under way for the installation of a new street-lighting system on Bigelow Boulevard, East Ohio and Ferry Streets and Second Avenue. Cluster lamps will be used. Arrangements have also been made with the Duquesne Light Company for the removal of a number of wooden poles now in use in the city and substituting iron service standards and also for placing wires underground wherever it is possible.

READING, PA.—The City Council has plans under way for the construction of a new electric power plant on Madden Creek. E. B. Ulrich, city hall, is engineer and Louis T. Klauder, Pennsylvania Building, Philadelphia, is consulting engineer.

WILKES-BARRE, PA. — The question of placing underground the wires on South Main Street is under consideration.

ANNAPOLIS, MD.—The Harper's Ferry Electric Light & Power Company has been granted permission by the Public Service Commission to extend its transmission lines to Frederick County.

LAUREL, MD.—The old mill property of the Mount Vernon-Woodberry Mills, Inc., comprising about 216 acres of land, with water-power rights, has been acquired by the Industrial Power Corporation, recently organized. The new company, it is reported, is considering the use of the property for power development. Robert J. and Albert S. Gill, 224 St. Paul Street, Baltimore, are interested in the organization.

BOYDTON, VA.—The Roanoke River Development Company, Mutual Building, has been granted a preliminary permit by the Federal Power Commission for a 50,000-hp. water-power development on the Roanoke River in Mecklenburg County.

RICHMOND, VA. — The Old Dominion Beverage Corporation, 202 Lyric Building, plans to build a new plant, 82 ft. x 125 ft., to cost about $175,000. Electric motors, conveyor systems, transmission equipment, etc., will be required. W. C. Saunders is president.

WASHINGTON, D. C.—A bill has been passed by the Senate appropriating the sum of $200,000 to start work on the construction of a hydro-electric plant at Great Falls. The ultimate cost of the project is estimated between $44,000,000 and $60,000,000.

North Central States

ESCANABA, MICH.—Tentative plans for the installation of an ornamental lighting system on the part of Ludington Street are under consideration. The Rotary Club is interested.

LANSING, MICH.—Plans have been prepared by the Michigan Agricultural College for the construction of a one-story and basement power plant, 50 ft. x 136 ft., to cost about $150,000. E. A. Dowd, 127 Allegan Street, is architect.

MONROE, MICH.—Plans are being prepared by the Detroit Edison Company for extensions to its transmission lines in the vicinity of Monroe.

BEDFORD, OHIO.—The B. L. Marble Chair Company has entered into contract with the H. K. Ferguson Company, Cleveland, for the construction of a three-story-and-basement building, 80 ft. x 300 ft., for the manufacture of hardwood office chairs. The company is also considering the construction of a new power plant. The cost of the building and equipment is estimated at $400,000.

CLEVELAND, OHIO.—The City Council has adopted resolutions providing for the installation of an ornamental lighting system on Hough Avenue from East Seventy-ninth Street to East 105th Street, Superior Avenue from East Fifty-fifth Street to the boulevard and Woodland Avenue from East Fifty-fifth Street to East Seventy-ninth Street.

LEIPSIC, OHIO. — The North Western Ohio Light Company has been authorized by the Commissioners to erect a high-tension transmission line from its power plant at Leipsic to Ottawa.

SPRINGFIELD, OHIO.—The installation of electric lighting in the Melrose district is under consideration.

LEXINGTON, KY.—Improvements at the University of Kentucky, including the construction of a central power and heating plant, to cost about $400,000, are under consideration.

BRAZIL, IND. — Crawford & McCrimmin contemplate the installation of a turbine-generator set with accessories in connection with changes to be made at its foundry. F. H. Reynolds is vice-president and general manager.

NEW CASTLE, IND.—An appropriation of $30,000 has been made by the City Council for the installation of a new street-lighting system and rebuilding the fire-alarm system. Plans submitted to the Council by Luther Younce, superintendent of the waterworks, provide for the installation of a three-phase, 60-cycle, 2,300-volt, alternating-current generator and a new main switchboard with constant-current regulating transformers.

ATWOOD, ILL. — The Atwood Electric Light & Power Company, recently incorporated, has been granted a charter to generate and distribute electricity. The plans provide for operation of the lighting plant in Hammond, formerly run by Elmer B. Levitt, and the erection of a high-tension transmission line connecting with the Illinois Traction System at Bement and extending same to the towns of Hammond, Pierson, Atwood and Garrett. J. H. McKinney and others are incorporators.

CHICAGO, ILL. — The Illinois Supply Company, importers, 225 North Michigan, is having estimates prepared for a warehouse and factory, each 200 ft. x 1,250 ft. and a power house, to be built at Sixty-fifth Street and Grand Avenue.

ELGIN, ILL.—Plans are being prepared by Victor H. Kassen of the city engineering department for the installation of a new lighting system on two streets, to cost about $5,000.

MARION, ILL.—A petition will be presented to the City Commissioners by J. W. Williams of East Main Street requesting that the ornamental lighting system be extended from its present terminus on East Main Street to the fair grounds.

BRANDON, MINN.—A proposal to issue $15,000 of electric light bonds will be submitted to the voters.

ELSWORTH, MINN.—The question of rebuilding the municipal lighting plant is under consideration.

ST. PAUL, MINN. — Bids will be received by H. W. Austin, purchasing agent, until June 27 for furnishing material and labor for the complete installation of 401 standards mounted with single lamps of 400 cp. on Summit Avenue form Wabasha Street to the Mississippi River boulevard. Plans and specifications are on file in the office of the purchasing agent.

WADENA, MINN.—Plans have been approved for the installation of an ornamental lighting system covering about six blocks. The plans provide for one-lamp standards, two circuits and underground cable. Nels Peterson is village clerk.

DAVENPORT, IOWA. — Work has been started by the Western States Portland Cement Company, Independence, Kan., on the construction of its new plant at Davenport, Iowa, to cost, including machinery, about $2,000,000. The plans provide for a power house, machine shop and other mechanical departments.

CHILLICOTHE, MO.—Plans are under consideration for improvements to the municipal electric light plant. C. F. Adams is president of the Board of Public Works.

INDEPENDENCE, MO. — Bonds to the amount of $35,000 have been voted for improvements to the municipal electric light plant.

SELIGMAN, MO.—The Silver Lake Mining Company is considering plans for the construction of a new power house at its properties. Considerable new mining machinery will also be installed. T. R. Gilliam is vice-president.

Southern States

GREENWOOD, S. C.—Improvements to the municipal water and electric light plant, including the installation of transformers and regulators, are under consideration. It is also proposed to replace 200-cp. lamps now in use with lamps of 400 cp. A. J. Sproles is superintendent.

THOMASTON, GA.—The construction of a power plant at the Thomaston Cotton Mills is under consideration.

PARIS, TENN.—The proposal to issue $250,000 in bonds for extensions to the street-lighting system, rebuilding streets, etc., is under consideration.

GUION, ARK.—Plans are being prepared by the Silica Products Company for the construction of new works for the production of glass sand, with an initial daily capacity of 200 tons. The plans provide for a power plant, elevating and conveying equipment, etc.

CROWLEY, LA.—Bonds to the amount of $100,000 have been voted to rewire the city, install a 500-hp. engine in the power plant, etc.

CASTROVILLE, TEX.—The Gulf Portland Cement Company, 812 Gibbs Building, San Antonio, recently organized with a capital of $3,000,000 contemplates building a cement mill in Castroville. The plans include an electric power plant. W. S. Campbell is president and general manager.

LLANO, TEX.—The J. B. Nelson Quarry Company, Houston, plans to install quarrying works at its granite and marble properties at Llano. The cost of the machinery, with power house, is estimated at more than $200,000.

WEATHERFORD, TEX.—The Weatherford Water, Light & Ice Company is considering extensions to its electric power plant.

Pacific and Mountain States

TACOMA, WASH.—An ordinance was recently passed by the City Council providing for the installation of a street-lighting system on J Street, from Division Avenue to Center Street, to cost about $16,630.

COLORADO SPRINGS, COL.—Bids will be received by the City of Colorado Springs until June 29 for the installation of an ornamental lighting system on Colorado Avenue from Rio Grande viaduct to Thirty-first Street. The plans provide for 198 single-lamp standards, current regulators, poles, cables, lamps and accessories. The cost is estimated at $30,000. W. D. Hoffeditz, Colorado Springs, is engineer.

COLORADO SPRINGS, COL.—The City Council has authorized the city electrician to prepare specifications and estimates of cost for the installation of an ornamental lighting system on South Tejon Street and new lamps on South Nevada Avenue from Vermijo Avenue to the southern end of the city limits.

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